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Proceedings of International Conference on Recent Trends in Science, Engineering and Technology

ICRTSET - 2024

Date: May, 10-11, 2024

(Hybrid Mode)

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International Conference on "Recent Trends in Science Engineering and Technology"

(ICRTSET-2024)

May 10th-11th, 2024

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(ICRTSET-2024)

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- Network Communication
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- Wireless & Mobile Computing
- Radar & Satellite Communication
- Network and Service Management
- Security and Privacy
- Cyber Crime & Ethics
- Block Chain
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- 5G Network
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- Microwave Tomography
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Track 2: Cloud Computing

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- Computer Communications
- Dependable Computing & Fault Tolerance
- Distributed Processing
- Scalable Computing
- Green Cloud Computing
- Cloud Scalability & Analytics
- Computational Biology and Bioinformatics
- Fog Computing
- Big Data & Data Science
- Artificial Intelligence & Deep Learning
- Pattern Analysis & Machine Intelligence
- Behavioural and Social Computing

Track 3: Sustainable Engineering

- Sustainable Materials and Manufacturing
- Thermal and Fluid Engineering
- Smart Manufacturing
- Industry 4.0
- Modelling, Simulation & Optimization Techniques
- Waste and Water Management plans for Sustainable
- Environment
- Smart Cities and Construction Technologies
- Alternative Structural Engineering

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- Material Science
- Bio-Chemistry and Chemical Biology
- Mathematical Physics
- Natural Product Chemistry
- Special Functions, Differential Equations
- Computational Physics
- Green Chemistry
- Non Linear Physics
- Number theory & Cryptography
- Laser Physic
- Organic Synthesis
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- Applied Statistics
- Semi Conductor Physics
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About the University

Jagan Nath University, Jaipur has been established by an Act of the Rajasthan State Legislature Act No. 19 of 2008 on April 16, 2008, approved under section 2(f) by the UGC Act, 1956, accredited by NAAC (2nd Cycle) with "A" grade in 2022 and is member of the Association of Indian Universities (AIU). The University has also acquired a distinctive status in agriculture education of having been accredited by ICAR for its B.Sc. (Hons.) Agriculture program.

The University is offering UG and PG programs in the areas of Engineering & Technology, Architecture, Management, Law, Agriculture Science, Pharmacy, Physiotherapy, Paramedical Sciences, Education and Allied Health, Naturopathy and Yogic Sciences.

The University has evolved a comprehensive academic system which incorporates the latest guidelines of NEP-2020 including CBCS, outcome-based assessments, skill development, industry partnerships, holistic eco-system, research, extension activities with focus on promoting quality higher education and employability among students.

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Established in 2008, Faculty of Engineering and Technology offers intensive programs covering modern engineering, technical courses and a whole spectrum of engineering and architecture. It offers a range of programs from Undergraduate to Doctoral level.

The aim of Faculty of Engineering and Technology through its various programs is to educate well-integrated individuals who possess technical and social competence to succeed in professional arenas and design solutions for global problems. Our dynamic hands-on experiential learning-based engineering education and flexible academic model, which nurtures imagination & innovation, has enabled us to create engineers who are able to meet the real-world demands of their profession and provide best solutions for the betterment of the society.

Modern technology transforms the way of living via creating the building bridges among people, bringing citizens from different cultures and backgrounds close to each other. Technology speeds up our lives to make our surroundings comfortable and more valuable. It provides the capability of doing what even could not be thought of a few years ago, and it is possible due to continuous efforts of technocrats who nurtured an environment conducive to learning and living with modern technologies.

About the Conference

The International Conference on Recent Trends in Science Engineering and Technology" (ICRTSET-24) on May 10th-11th 2024. With cloud computing, focusing on all of cognition, computation, and business to understand and engineer effective value-creation in the field of Science Engineering and Technology.

ICRTSET-2024 aims to cover all acts or processes of knowing, perceiving, judging, reasoning, and associating based on computing platforms and algorithms. The conference objective is to provide an opportunity for academic and industry professionals to discuss the research issues and progress in the areas of Big data, IOT, Cloud computing and Cognitive sciences. Also, the conference served as a technical forum to present high – quality papers which were closely related to the various Track 1 to 4.

Preface

It is a matter of great pride and pleasure to present the **Proceedings of the International Conference on "Recent Trends in Science, Engineering and Technology (ICRTSET-24)"**, held in **Hybrid Mode on May 10–11, 2024**. The conference provided a vibrant global platform for academicians, researchers, scientists, industry professionals, and students to exchange ideas, share research findings, and deliberate on emerging trends and innovations shaping the future of science and engineering.

ICRTSET-24 was conceived with the objective of fostering interdisciplinary research and encouraging meaningful interaction among participants from diverse domains. The overwhelming response to the conference reflects the growing importance of collaborative research and innovation in addressing contemporary technological and societal challenges. The hybrid mode of the conference ensured wider participation, enabling contributors from across the globe to engage effectively in technical sessions, discussions, and knowledge-sharing activities.

The present proceedings comprise **peer-reviewed research papers** that were presented during the conference and selected based on their originality, technical quality, relevance, and clarity. The papers are organized into **four major tracks**, covering a broad spectrum of current research areas:

- **Track 1: Network & Communication** – addressing advancements in communication systems, network security, wireless technologies, and emerging networking paradigms.
- **Track 2: Cloud Computing** – focusing on cloud architectures, virtualization, distributed systems, data analytics, and related technologies.
- **Track 3: Sustainable Engineering** – highlighting innovative approaches, green technologies, renewable energy solutions, and sustainable development practices.
- **Track 4: Science** – encompassing contemporary research and applications across fundamental and applied sciences.

We sincerely believe that the research contributions compiled in these proceedings will serve as a valuable reference for researchers, practitioners, and students, and will stimulate further research and innovation in the respective domains.

On behalf of the organizing committee, I extend my heartfelt gratitude to all the authors for their valuable contributions, the reviewers for their meticulous evaluation and constructive suggestions, and the session chairs and committee members for their dedicated efforts in making ICRTSET-24 a successful academic event. I also express my sincere appreciation to all participants for their enthusiastic involvement and cooperation.

I am confident that the outcomes of ICRTSET-24 will contribute meaningfully to the advancement of knowledge and inspire future research collaborations.

Dr. Om Prakash Sharma
Program Chair, ICRTSET-24
Chief Editor, Conference Proceedings

The Following committees are constituted for preparations and smooth conduction of the International Conference on Recent Trends in Science, Engineering & Technology **(ICRTSET-2024)** that is going to be organized on **May 10-11, 2024.**

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5	Finance Committee	Mr. Rakesh Kumar Mr. Pankaj Sharma Mr. Krishna Agarwal Mr. Dharmraj Sharma Mr. Arjun Sharma	including arranging for sponsorships and coordination with vendors for services such as catering and audio visual equipment, kit purchase. All Account details maintaining
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May 10-11, 2024

International Conference on Recent Trends in Science Engineering and Technology

(ICRTSET-24) Hybrid Mode

May 10th -11th, 2024

Program Schedule

Venue: Auditorium, Block – C, Sitapura Campus, Jaipur

Detailed Programme Schedule

Day 1: 10th May 2024

Sr. No.	Particulars	Time
1	Registration	9.00AM to 10.00AM
2	Welcome note and Introduction of ICRTSET-24	10.00AM to 10.05AM
3.	Green Welcome of 1. Chief Guest 2. Guest of Honor	10.06AM to 10.08AM
4.	Lamp lighting followed by Maa Saraswati Vandana	10.09AM to 10.12AM
5.	Welcome Address by Pro-President and Dean_FET	10.13AM to 10.15AM
6.	About the Conference By Dean Research	10.16AM to 10.18AM
7.	Words of Blessings by Registrar	10.19AM to 10.22AM
8.	Technical Address by Guest of Honor Prof. K K Sharma, Prof. MNIT Jaipur	10.23AM to 10.33AM
9.	Inaugural Address by Chief Guest Sh. Sanjay Kumar, Chief General Manager, BSNL	10.34AM to 10.50AM
10.	Words of Wisdom by Hon'ble President	10.51AM to 11.00AM
11.	Presentation of Memento to the Chief Guest and Guest of Honor	11.05AM to 11.10AM
12.	Vote of Thanks	11.11AM to 11.15AM
Tea Break		
Key Note Address by Prof K K Sharma		

Parallel Proceeding of Track **10th and 11th May 2024**			
Track 1	Track 2	Track 3	Track 4
Dr. Ramesh Bharti	Dr. Renu Bagoria	Dr. Amit Saraf	Dr. Anil Kumar Sharma
10th May 2024	11th May 2024	10th May 2024	11th May 2024

Day 2: 11th May 2024

Valedictory Session after Close of All the presentations in All the 4 Tracks

Track – 1 : Paper
Dr. Ramesh Bharti

A Review: Propagation Standards, Design, Obstacles, and Advancements in 5G Massive MIMO Antenna

Sakshi Sharma, Assistant Professor, Jagannath University
Chetan Swami, Jagannath University

ABSTRACT— A wireless access approach known as massive multiple-input multiple-output (mMIMO) has been researched and examined in light of the high need for bandwidth in the wireless communication industry throughout the globe (MIMO). One of the key enabling technologies for the next generation of networks is massively multiplexed antenna systems (MIMO), which combine antennas at the transmitter and receiver to achieve remarkable energy and spectrum efficiency with relatively simple processing. Understanding the huge MIMO system and fixing its fundamental issues is crucial for the effective deployment of 5G networks and beyond if the intelligent sensing system is to realize its many potential uses. This article examines the key enabling technologies required for sub-6 GHz 5G networks in detail, with a focus on the current large MIMO systems. Gain, isolation, ECC, efficiency, and bandwidth—the five most important aspects of multiplexed multiple-input multiple-output antenna systems—are discussed in this article. Two distinct kinds of large-scale 5G MIMO antennas are detailed here. At sub-6 GHz bands, these kinds are used according to the applications. While 5G base station antennas with the latest architectures for massive MIMO have been presented, the original kind of massive MIMO antennas were developed for use in base stations. The second kind is built for use in smartphones, and it summarizes research on several small antennas that have been proposed in the literature and shown to be capable of supporting massive MIMO technology. This leads many to believe that mMIMO antennas will work well in 5G networks.

KEYWORDS- 5G systems; massive MIMO; base station; smartphone; 5G antennas; 5G applications;

INTRODUCTION:

Fifth Generation (5G) is going to be the next big thing in wireless communications since people demand higher and faster data rates all the time. The main goals of 5G communication networks include higher capacity and data throughput (up to 20 Gbit/s), excellent dependability, low latency (1 ms), better device-to-device connection, and more flexibility [1]. In response to the worldwide shortage of bandwidth in the wireless communications industry, massive multiple-input multiple-output (mMIMO) was developed. This technology is crucial for next-generation and beyond networks. With mMIMO, arrays of antennas are used at both the transmitter and receiver, which allows for great spectrum with relatively simple processing, as well as power efficiency [2].

By decreasing transmission power and bandwidth, mMIMO technology has made great strides in satisfying the need for high-quality mobile communication services that provide improved coverage while using less power. Without adding more, it can significantly boost data throughput [3].

As shown in Figure 1, many assessments have summed up the aforementioned 5G criteria as satisfying the advantages and characteristics of mMIMO [2,4,5].

The 5G communication system relies on the huge MIMO antenna, which is an integral part of its architecture. By using a large number of active communication antennas, Massive MIMO improves spectral efficiency and throughput, marking an advancement in the MIMO technology [5].

The 5G mMIMO system design process begins with identifying the element type (antenna) and its intended purpose. The 5G mMIMO design is therefore characterized as 5G antennas plus the application.

Antennas designed for 5G networks enable MIMO, or multiple-input, multiple-output. In order to transmit and receive massive amounts of data all at once, they are constructed from a plethora of antenna components. 5G base stations and mobile app antennas need to be multi-frequency capable. This makes it feasible to get download speeds that are much quicker. In addition, it expands the capabilities and connections of many gadgets. An increase in bandwidth allows for the transmission of more data. Antennas like these are essential for beamforming, steering, and reception in mobile devices such base stations, cellphones, linked automobiles, health monitoring equipment, and even industrial machinery [1,6].

Base station (BS) antennas are the building blocks of a wireless communication network. One or more directional RF antennas, capable of transmitting and receiving radio signals, could compose it. Customers get cellular service from these antennas, which are base stations installed atop towers. Many times, a single radome may house many multi-band base station mMIMO antennas. Each antenna in this case has its own unique connector that may be connected to several base stations or even individual components of a single base station [7].

This is the primary point of communication for either single- or multi-user devices. Antennas that produce a beam are used by 5G base stations. On top of that, several ground targets may be focused and directed by an array of antennas all at once [3].

Whether inside or out, the base station antenna is a signal transmitter that may reach a greater number of receivers. This antenna type can receive and broadcast signals and is utilized in satellite, GPS, GSM, WIMAX, WAN, LAN, and other communications systems [8,9,10,11,12].

Antennas that can be moved about are ideal for devices that need to be able to communicate while in motion, and they provide a number of benefits. In order to enable beamforming, these phones will need multiple-input multiple-output (MIMO) antennas placed on the phone's outside edges and corners. Around six high- and low-frequency antennas make up a standard smartphone. In contrast, multiple-input multiple-output (MIMO) is essential for 5G, which necessitates two bands for the lower band and one band for the upper band, with a popular combination being 4 × 2 (or 4T2R). What this means is that four antennas are standard on most, if not all, of the latest 5G phones. It is quite probable that these antennas will come equipped with the ability to automatically modify the antenna [13].

Separating a mobile phone's antennae from one another is the best approach to keep them from interfering with one another. This is very challenging on a little phone. Thankfully, all three parameters—operating frequency, wavelength, and antenna length—are rather high. For this reason, more antennas will need to be included into phones in the future, particularly since most of these standards allow for massively multiple-input multiple-output (MIMO) antennas [14].

5G networks that operate below 6 GHz need data speeds of 20 Gbps or greater and a broad bandwidth. Boosting the bandwidth to 100 MHz, the 5G bands that were issued include 3.3-4.2 GHz and 4.4-5 GHz. The base station also features a 3D layout, which includes both the azimuth and vertical planes, allowing it to cover wide regions. Phones and base stations alike need to beef up their antennas for frequencies lower than 6 GHz. With more radiating antenna components in a mMIMO array, 5G networks will have much less congestion and much greater capacity and throughput at higher frequencies [15].

The mid-band of the sub-6 GHz (FR1) spectrum, which includes the following bands: LTE n71 (470-698 MHz), n81-n83, n91-n94 (698-960 MHz), n74-n76 (1.427-1.518 GHz), n65, n66 (2.11-2.2 GHz), n30, n40, n38, n41, n 90 (2.3-2.69 GHz), n 77, n78, n79 (3.3-5 GHz), and LTE42/43/46/47 (3.3-5.925 GHz). The 5G communications will be deployed in this region. In the future, FR1 bands will likely carry the vast majority of traditional cellular mobile communication data. One of the plans for the future is to use the radiation aperture of the original 3G, 2G, and 4G antennas to deploy a large-scale sub-6 GHz MIMO array [15,16]. An uplink data rate that is twice as fast as the downlink data rate is enabled by the 5G standard in the stated usage cases. In the present stages of deployment below 2.6 GHz, 5G is advised to use a minimum of a 2 x 2 uplink MIMO and a minimum of a 4×4 downlink MIMO [17,18].

Phase 2: 5G Massive MIMO under 6 GHz
5G mobile networks are expected to improve power efficiency and wireless communication systems' spectrum while simultaneously delivering high data throughput with low latency. Many technologies are now under investigation for potential use in 5G networks. A key technology that is expected to steer 5G development is the mMIMO system. Mobile multiple-input multiple-output (mMIMO) is one of the technologies that will underpin 5G wireless networks [19].

When both the base station and the terminal make use of several antenna components, the resulting configuration is called a huge MIMO system. Antennas provide for more efficient use of both spectrum and power, allowing for simultaneous communication amongst several users using the same resource. It is feasible to interact with a user endpoint (UE) using the same time-frequency resource using spatial multiplexing when the base station has several active antennas [20]. Also, instead of building a new base station site, the beamforming improvement technology that was made for these mMIMO systems may be used to upgrade the base station equipment with a large number of antennas, thereby reducing the transmit energy need [19,21].

One cutting-edge antenna technique that 5G NR networks are using, massive MIMO, boosts spectral efficiency, network capacity, coverage, and practical data speeds (sub-6 GHz). Multiple users may be supported concurrently using Massive MIMO, which employs multi-antenna components [22,23].

The main characteristics of multiplexed multiple-input multiple-output antennas are the following: gain, isolation, radiation pattern, phase, and beamwidth. Increasing the bandwidth might be a solution to the problem of slow data transfer rates and low throughput in wireless and mobile devices, both in the present and in the future [24]. Several strategies that are appropriate for such a dense capacity of antenna components without increasing the distance between antennas are required to reduce the mutual coupling effects in large-scale arrays with limited space. The system's performance will not be hindered by the low mutual coupling, which provides high isolation and low correlations. Inserting a metamaterial wall to provide a spatial band-stop filter or a spatial polarization-rotated wall is one of many proposed decoupling strategies; another is to use metal structures between the antenna's components to provide an extra coupling channel [25]. Because they all need to be very considerable in size, such decoupling structures are difficult to construct in a large-scale MIMO antenna. It is optimal for a mMIMO array's mutual coupling to be less than -25 dB or even lower for BSs and smartphone applications, with a value of less than -10 dB or lower. An mMIMO system's gain and efficiency might be enhanced by using beamforming techniques. Beamforming is a signal processing technique that boosts system performance and capacity by transmitting or receiving numerous signals from many desired terminals simultaneously using multiple antenna arrays on the reception side and/or transmitter side [26].

Figure 2. Techniques of applications for 5G massive MIMO at sub 6 GHz.

Two-Dimensional Massive MIMO

One of the simplest planar mMIMO configurations is a rectangular planar lattice array. One example is a planar array configuration with dimensions N×M [27]. One of the most common components used in mMIMO design is the 2D model element. 5G base stations may now make advantage of newly developed dual-band antenna arrays that share an aperture and both polarizations.

A (4 × 4) planar MIMO array that functions in the 3.3-5 GHz band (upper band-UB) and one antenna element that operates in the 0.69-0.96 GHz band (lower band-LB) are both components of the antenna array that was constructed. A big rectangular grid array with sixteen antenna components, the UB antenna array is purpose-built for real-world MIMO applications. Three decoupling techniques—a ferrite chock ring, a rectangular ring resonator, and a one-of-a-kind baffle design—are shown in Figure 3a as ways to minimize in-band and cross-band mutual coupling between the UB and LB antennas. Using decoupling technology, the UB and LB antenna arrays are compactly combined, measuring just 0.93 × 0.93 × 0.17 λL. A dual-band antenna array may attain a bandwidth of 41% in HB antennas and 32.7% in LB antennas. More than 30 dB of high-quality cross-band port isolation is offered. The UB antenna generates consistent radiation patterns, whereas the LB antenna achieves an average gain of 8.6 dBi. The radiation efficiency is more than 90% over all operating ranges. By integrating a magneto electric (M.E.) dipole antenna with a dual-polarized differential feeding system, the antenna may achieve low cross-polarization (X pol), high gain, and isolation features. In order to take use of these array features, a modified H-shaped (1-16) differential feed network was designed to feed the 16-antenna array, as shown in Figure 3b. Here, the array isolation is further enhanced by positioning the vertical cross-sections with dotted slots between neighboring dipole units. By dismantling an H-shaped differential power feeding network and its supporting substrate, a system of multi-input multiple-output (MIMO) antennas with large capacity might be assembled. The results of the measurements reveal that within the 5G frequency range, an antenna element may reach a low X-pol of -35.7 dB and a high gain of more than 8.1 dBi (i.e., from 3.3 to 5.1 GHz). The antenna array's low envelope correlation coefficient (ECC) value of 0.004 and high gain of 17.3 dBi make it suitable for usage in 32-channel capacity MIMO antenna technologies [30,31].

Antenna arrays with dual polarization (D.P.) mMIMO (32T/32R) and densely spaced, large antennas for 5G base stations have a unique design and study of their interconnections (mutual coupling). Two chamfered aerial bowtie dipole antennas fed by two coaxial wires may achieve dual polarization when arranged in opposite orientations. Included in the model are two arms of the bowtie aerials and chamfering, which enhances the isolation to port. The positioning of a metal ground plate at a λ/4 distance results in the production of radiation that is unidirectional. The anticipated frequency range of operation for the radiating component is 3.5 to 4.0 GHz. According to the results of the simulations, the expected 2-chamfered aerial bowtie dipole antenna with dual polarizations would have a signal-to-noise ratio (SWR) of 1.5, bandwidths ranging from 2.8 to 4.0 GHz, an isolation of -27 dB between the two ports, a gain of 9.1 dBi for both polarizations, and a mutual coupling of around -25 dB. With an overall height of

0.25λ0, the antenna has a straightforward and easily-manufacturable design [32,33].

n mMIMO antenna system architecture based on patch antennas is detailed. To change the direction of the beam and generate lower correlation coefficient values, each port in the array has a (2 × 2) patch antenna sub-array with separate phase excitation at each element. A total of sixteen ports, or 64 elements, make up the array. It has been built to supply the beam-tilts using a fixed progressive phase feed network [34]. Antenna system specifications include a three-layer FR-4 substrate of 33.33 cm × 33.33 cm × 0.16 cm, operating at 3.6 GHz with a bandwidth of 230 MHz, achieving gains of 5.4 dB for each port, and strong isolation between surrounding ports at least 25 dB [34]. A portable ultra-wideband MEA was considered for a large indoor MIMO base station. The design of the antenna relies on the fact that each MEA element may activate many characteristic modes at the same time. Thus, a 484-port antenna might be built using a (11 × 11) mMIMO array of 70 cm × 70 cm and 121 physical antenna components, as seen in Figure 4. This led to a 54% reduction in size when compared to the conventional cross-dipole MEA. The antenna functions throughout a wide frequency range of 6 to 8.5 GHz, has an intra-element and inter-element connectivity of ≤−20 at the antenna port, and a reflection coefficient of less than or equal to 10. The entire antenna efficiency, which is around 70% for all four ports, is calculated using the 3D radiation patterns [35,36].

Massive 3D OFM The overall system performance is greatly affected by the different channel characteristics (circular, planar, and cylindrical) that arise from different antenna array configurations. The beam is often only adjustable horizontally in arrays with circular or flat dimensions, which exhibit a significant decrease. Even with these setups, the ever-increasing capacity requirements aren't met. Hexagons, cylinders, triangles, and other three-dimensional large array designs are proposed as a solution to this deficiency [39].

There are two categories of 3D methods discussed. The three-dimensional array's element configurations determine the first kind. Several array topologies, as well as cubic and stacked polyhedral arrays (rectangular, triangular, and hexagonal) were used to design a compact mMIMO antenna system with 1 × 4 (sector) sub-array configurations that operates in the sub-6 GHz band for 5G base stations, as illustrated in Figure 5. With a multi-multiple-input multiple-output (mMIMO) technique, a system's limit may be improved by more than ten times while its energy efficiency is increased by one hundred. There may be a maximum of five sectors per sector, and each sector includes components for a 1 × 4 sub-array. The top layer of the one sector includes patches that measure 1 × 4, whereas the bottom and middle layers, which are responsible for organization, comprise a distinct ground plane. Either a single port mode or a huge MIMO display mode with beam directing capabilities might be used by the whole system. The sub-6 GHz spectrum, spanning frequencies between 3.36 GHz and 3.50 GHz, is traversed by the 140 MHz deliberate data transmission of the frame. A unit sub-array measured 280.5 mm in length, 56.1 mm in width, and 2 mm in height. There was a 12.95 dBi gain for a single port, and a 19.73 dBi gain for a single panel with five sectors organized in a rectangular layout. A mutual coupling of around -16 dB was observed in all of the ports. The radio antenna array system was configured to operate within the frequency range of 3.3 GHz to 3.8 GHz. Reason being, in order to accommodate 5G, the sub-6 GHz spectrum was reserved and focused on a global scale [40].

Enhanced mobile broadband (eMBB) is one of three possible 5G implementations. Multi-antenna maximum-in-space (mMIMO) is used by eMBB. Frequencies below 6 GHz and 28 GHz are potential 5G usage. Simulating massively multiple-input multiple-output (MIMO) antenna systems at 26 GHz and 3.5 GHz is the main goal. There were a total of 108 patches on the antenna described in reference [49]; 12 patches operated at 3.5 GHz and 96 patches at 26 GHz made up the array. An internal transmit antenna is what the built antenna will be used for. A proximity-coupled feed with a dielectric constant of 2.2 and a connection are features of this antenna. A gain of 7.3 dB, an s-parameter result of <−10.8199 dB, and a mutual coupling of <−32.6201 dB are all characteristics of the engineered antenna [49].

As the number of components in the mMIMO system rises, the channel capacity also increases. Many studies have looked at how many antennas are needed to get a certain gain, with the assumption that all of the antennas in a very large array have the same gain. These studies have mostly used channel properties to study how edge effects and mutual coupling affect the gain variation in a large-scale MIMO array with 32 elements. Patch and dipole antennas, used in modern high-volume MIMO experiments, were the primary objects of the effect investigation. The finite patch array's gain pattern fluctuation is smaller than that of a dipole array. Not all antennas contribute equally to all users in the huge MIMO system, and the number of effective antennas observed for a single user decreases because to the significant gain pattern variance. Consequently, the zero-force MIMO detector for all users experiences a 20% decrease in speed for patch arrays and a 35% decrease for dipole arrays, as seen at the system level. However, user unfairness and inequity are created by mixing maximal ratios. Accurate antenna measurements are dependent on taking readings from all 32 array active components, which may be accomplished in an anechoic room with the use of a large MIMO test bench. Patch arrays are the most effective solution for system throughput. The microstrip model's 31 mm square patch included two 1.4 mm wide U-slots that were merged. After that, we moved on to the 3.4–3.6 GHz and 2.4–2.62 GHz bands of frequencies. The primary comparison was carried out at 2.6 GHz. A limited array of antenna components showed substantial variance in their gain patterns, as shown experimentally. This beamforming, which is angle-dependent, is caused by mutual coupling and the edge effect. Due to the stronger mutual coupling in a dipole array, the gain fluctuation is larger. This means that an omni-directional array will be more angle-sensitive than a directional patch array [50].

The eigenvalue distribution and two-user MU-MIMO (multi-user MIMO) capacity in a practical urban macro (UMa) setting at 3.5 GHz were investigated using a zero-forcing block diagonalized (ZFBD) method. Extending the number of Tx elements from eight to twenty-four was discussed in it. There was only a little improvement when the numbers climbed rapidly, but ratios of over 63% and 73% were achieved for Tx numbers up to 64 and 128 respectively, compared to independent channels with the same distribution (i. i. d). A small but noticeable trend toward eigenvalue uniformity emerged as the number of Tx increased.

There are still (i. i. d.) channel gaps in the measured environment, even if mMIMO creates more ordered sub-channels and de-correlated user channels than classic MIMO. Antenna arrangement affects performance on both the receive and transmit sides, and capacity increases as the number of antennas deployed per user increases. This means that orthogonal user channel representation isn't employed while measuring [51,52].

Due to its ability to make full use of preexisting space resources, greatly improve spectrum efficiency, and alleviate the present spectrum resource problem, massive MIMO is a prominent candidate among 5G mobile communication system technologies. Researching mMIMO technology necessitates documenting several radio channel properties from the existing MIMO system. A large virtual antenna array consisting of 64 components was used to conduct an outside 3.33 GHz measuring experiment. From what we can tell from the measurements, the most common channel characteristics, such as the power delay profile (PDP), azimuth spread (AS), and delay spread (OS), all responded as predicted. Data gathered in the latency and spatial domains show that channels are not static for big arrays. The results may be used to build 5G communication systems and mMIMO channel models [53,54].

A 16-port, inexpensive MIMO non-planar antenna system was built on a 3D octagonal polystyrene block for future 5G applications. Because the MIMO parts were arranged on all eight sides of the octagonal polystyrene block, the bottom and top of the block could be seen. A slotted microstrip patch, broken ground plane, and step-biased feed line were all parts of the antenna. For 5G applications, a FR4 substrate measuring 22 mm x 20 mm was used to produce each MIMO element within the frequency band of 3.35-3.65 GHz. The isolation between the members of the array was enhanced using a metamaterial decoupling structure that is based on meander lines and is exponential with a near-zero negative sign (NZI-ENG). Array pieces were placed on top of the bottom layer, which had ground planes and isolation structures for common connections [55].

In side-by-side arrangements, the antenna components were separated by >28 dB owing to the decoupling structure based on metamaterials.

All the parameters were within acceptable ranges: the envelope correlation coefficient (ECC) was less than 0.10, the total active reflection coefficient (TARC) was less than -18 dB, and the channel capacity loss (CCL) was less than 0.30. When various 5G devices are wirelessly linked to a central server, the proposed non-planar 3D-MIMO antenna system might be used for wireless personal area network applications and indoor positioning systems [56]. The use of numerous antennas at both the transmitter and receiver allowed for the spatial multiplexing characteristic of most 5G MIMO systems. This proposed 16-element indoor BS antenna array is capable of operating in the 3.3-6.0 GHz range and was specifically designed for 5G applications.

The bottom and upper bands, which are LTE bands 42/43/46-N77-N78-N79, were covered by a monopole antenna in the form of a. Nearby on a substrate was a printed hexa-kaidecagon polygon that served as the antenna element. After positioning the antenna components to provide excellent polarization diversity and isolation, the projected BS array was developed, built, and evaluated by looking at radiation patterns, S-parameters, overall results, antenna performance.

It also managed to obtain an extremely low I (envelope correlation coefficient) of less than and a high antenna efficiency of around 82- percent during MIMO performance tes According to reference [57], the anticipated erg channel capacity of the (16 × 16) MIMO system 85 bps/Hz. Fabrications according to all designs employed in this investigation, and all values were measured. Base station applications of mMIMO methods are enhanced and supported, as shown in Table 1.
The application's selection type is, in the end, contextualized by the app's surroundings and its use. In order for mMIMO systems to work well, the environment has to provide the best propagation circumstances. Future work should focus on improving overall performance with metamaterials and implementing a three-dimensional massive MIMO array of the base station for maximum coverage and low SAR for smartphones with a flexible spectrum band. This will allow for good implementation of mixture (5G/6G) and 6G networks.

5. Conclusions

The 5G infrastructure relies heavily on massive MIMO. A plethora of antennas, on the part of both base stations and mobile devices, are used by 5G massive MIMO. A huge MIMO system's performance is improved by increasing the number of base station antennas in accordance to the number of users and devices. Antennas' spatial correlation and mutual coupling are both important factors. 5G antennas will need special properties for massive MIMO to function in both cases. Consequently, the growth characteristics of massive MIMO systems that are applicable to both ways may be satisfied by a large number of 5G antennas. While smartphones are limited to 20 antenna elements, 5G mid-band base stations with large MIMO antenna systems may accommodate up to 256 elements for sub-6 GHz frequencies.

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Design of Voltage Sag Compensation Using Improved Fuzzy Logic Bases Shunt Active Power Filter

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Abstract— These structures and devices are particularly vulnerable to wave power and various disorders due to the widespread use of frequency and variable speed drives, robot systems, automated production lines, precise digital control systems, programmable logic control systems, computer data management systems, and so on. Many of these gadgets are non-linear loads and harmonic sources. Any issues with power quality might lower product quality or cause management uncertainty. This study proposes the use of a fuzzy logic-based shunt active power filter algorithm for systems. It consists of a special-purpose voltage source converter (VSC), a three-phase grid, and nonlinear linear/nonlinear loads. This system combines a system with a converter that functions as both a three-phase active and a static power source. A compensator is used to regulate reactive power. It also respects the regulations by improving the quality of an IEEE-519 harmonics standard in the three-phase distribution network. As a result, harmonics, load balance, and power consumption are reduced by this technology. At the point of failure coupling, factor correction and terminal voltage regulation are common. In these scenarios, where fuzzy based control technology is used, a single-stage system is used in conjunction with perturbation. To model and simulate the system, the proposed MATLAB/Simulink is utilised. Simpower system toolboxes, as well as the system's behaviour, are available. Based on a laboratory-developed system, experimental verification is carried out under varied loads and climatic circumstances. Design of a shunt active power filter employing a fuzzy logic-based controller is part of the proposed study. To evaluate the performance of the suggested model under unbalanced load conditions, the proposed shunt active power filter was compared to a typical shunt active power filter.

Index term: DVR. PI Controller, Voltage Sag, Swell, Transmission Line, Faults, Power System, Protection, Harmonics.

I. INTRODUCTION

According to the power quality concept, "any electrical fault manifested through voltage, current, or recurrence deviations that result in end-use hardware damage, upset, or unhappiness." Power electronics is typically related with first PQ difficulties in both local and modern applications (PE). Private machines, such as TVs, PCs, loaders, inverters (low power), and office devices, such as copiers, printers, and so on, employ PE devices, as do mechanical equipment, such as programmable logical controllers, customizable drives, rectifiers, inverters (high power), and distributed generations (solar, wind, etc.). Depending on the type of problem, divided proof of a PQ problem should be possible from side effects.

Electronic Gadgets of High Strength The most comprehensive explanation of tones, steps, songs, and unwelcome non-partisan patterns (nonlinear gadgets). Power devices, converters, starters, music generation devices, electronic counterweighs for release lights, SMPS for PCs, and HVAC/DC for Power Electronics are all represented by these models. Because the voltage or harmonics produce heat in the torsion field, motors, transformers, switches, connectors, and condenser banks are among the most affected components (reverberation). Bidirectional converters are instruments that create scores and influence electronic control devices. The SMPS is in charge of generating neutral currents. Computers, copiers, printers, and other devices with SMPS capabilities are often utilised. Unbiased currents are significantly influenced by the neutral conductor. As the temperature rises, the transformer's operational capacity decreases. The arcing gadgets on fan controllers, engines, and cycloconverters make bury sounds.

IEEE Standard 1159-1995 defines a Voltage Sag as a reduction in RMS voltage from the 0,5 cycle to 1 moment at the repeated power level, announced as the rest of the voltage. On utility networks, voltage drops may occur at transmission and delivery voltages. Voltage slope, which is most common at high voltages, usually extends over the utility system and is transmitted to lower voltage systems via transformers. The voltage slopes can be formed without affecting the utility grid in a mechanical system. These are frequently caused by huge office motors or electrical issues. Various flaws, abrupt energy consumption, powerful acceptance engines, and high inrush current through the empowerment of gigantic transformers are some of the key reasons for the device's Voltage Sagges. With its fast-reacting, unshakeable quality and apparent prices, the Dynamic Voltage Restorer (DVR) is a fantastic power gadget approach for better power quality and ensuring sensitive loads, while remunerating deep voltage slits and voltage unbalances and sounds effectively. DVR is a restricted switched voltage source converter that infuses the suitably voltage regulated voltage using an infusion transformer or three single stage transformers. The simulation data from Matlab/Simulink was used to create a fuzzy process control scheme that represents a scaled blunder between the source side and the sag remedy relationship, indicating that the SAPFhas been run in uneven voltages and lacking situations in the system.

II. RELATED WORKS

Anantha et al. [2014] A simplified method for optimum layout DG distribution system, the method determined by the TENVDI (tail node voltage deviation index), for improving the tail node voltage, optimal size to reduce power consumption in DG the best location. This study shows the effect of the best layout of DG on improving the voltage distribution, especially for consumers connected to the tail end node and minimum power loss [14].

Murthy et. al. [2013] More than four optimal allocation methods DG to reduce losses and improve the voltage distribution. A power loss sensitivity synthesis method was proposed to correct the size and position calculation method of DG for minimization of loss and improvement of voltage waveform [15].

Manafiet.al. [2013]presenta more recent discussion of dynamic particle swarm optimization (PSO) and the improved differential evolution (DE) algorithm to distributed network optimization radial distribution DG. The target herein is the power injection may be reduced by minimizing DG total active power loss of the light distribution system. Since both excellent convergence characteristics, using evolutionary algorithm to optimize the placement and dimensions DG and based on Swarm techniques. DE PSO techniques and compositions may be effectively used for DG placement problem [16].

Malehet.al. [2013] an optimized configuration method was proposed to determine the size and location of the DG in the distribution network. Herein, considering the objective function and the system active power loss of voltage distribution rated load. First of all, the issue is written in the form of the optimization problem, the objective function is defined and written in the time domain, the problem with SA resolved [17].

III. ELMITWALLYET AL

[2013] IN HIS STUDY MEDIATION INTRODUCE A SIMPLE METHOD OF ALLOCATING A PLURALITY OF MESH PROFILE GENERATOR UNIT / NETWORK RADIATION. THIS PAPER INTRODUCES AND EXPANDS THE CONCEPT OF EQUIVALENCE LOAD AND USES TWO METHODS TO DIRECTLY DIFFERENTIATE THE LOAD CENTER OF MASS. ON THE BASIS OF THE LOAD CENTER OF MASS AND PERFORMANCE INDEX, THE LOCATION AND SELECTION ALGORITHM OF MULTIPLE DG UNITS WERE DEVELOPED. THE DOCUMENT DISCLOSES, DG UNITS OBTAINED EMBODIMENT MAXIMIZE THE POWER LOSS IS MINIMIZED, AND THE VOLTAGE HOLDING NODE OF BETWEEN 0.95 AND 1.05PU. THIS IS DETERMINED BY THE MORE RECENT TWO METHODS, WHICH DEPEND ON SOPHISTICATED HEURISTIC OPTIMIZATION TECHNIQUES [18].

Nadhiret.al [2013] developed a method for optimum layout and size of the system DG. In this, the Firefly algorithm is proposed, which is a meta-heuristic algorithm driven by the firefly flicker behavior. This article also describes the power flow calculation method. This article by comparing the genetic algorithm and SFLA (SFLA), to study the firefly algorithm (FA) performance in solving DG optimizing the layout and scale of problems. This study showed that the system DG was added so that the total power loss can be minimized and L level voltage curve. [19]

Kanwaret.al [2014] Radial distribution system proposed in the SC and with DG distribution optimization is proposed based on evolutionary algorithms and improved version of a cluster, as the IGA (improved genetic algorithm), IPSO (improved PSO) and ICSO improvement of cat swarm optimization). A method for simultaneously dispensing SC DG and the proposed energy loss is minimized, while using a penalty factor methods maintain better voltage distribution node. After allocating SCs and DGs in a radiation distribution network, it is also necessary to study network reconfiguration [20].

Arora et al. [2015] Particle group is proposed for improving the distribution voltage distribution system optimization (PSO). This article aims to assess the optimal size and location of DG. In this paper, the authors propose the optimal allocation and use of PSO estimate DG capacity method, in order to reduce power losses and increase the actual improve the voltage distribution [21].

Hosseini et al. [2014] A genetic algorithm (GA) -based optimization technique was proposed , and for reliability improvement, load shedding and power distribution system reconstruction were implemented . Herein, the objective function is to determine the best location and dimensions DG, to minimize power consumption, and improve the reliability at the lowest cost improvements in the distribution system. For this motivation, we consider an annual load duration curve that takes into account four load levels with different weighting factors. Studies have shown that, in the power distribution system DG embodiment results in lower costs, reduced loss, while using the network installation and DG reconstruction method, resulting in improvement in reliability [22].

IV. SHUNT ACTIVE POWER FILTER (DVR)

DVR It is controlled to draw or supply a compensating current from or to the utility, so that it cancels current harmonics on the ac side. In this manner a shunt active power filter can be used to eliminate current harmonics and reactive power compensation [20].

Shunt Active Power Filter design shown in fig 1.

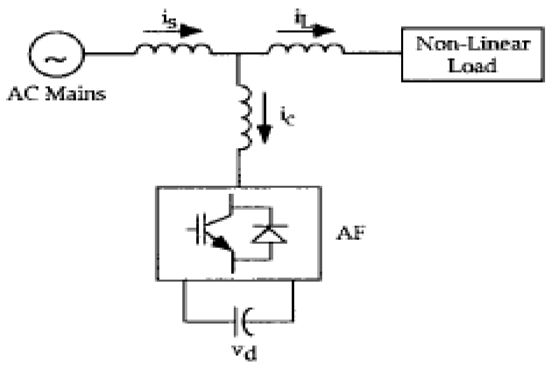

Fig.1 Design of Basic Active Power Filter

The load current will be a fundamental component, when a nonlinear load is applied and harmonic components can be described as;

$$V_s(t) = V_m \sin \omega t \quad (1)$$

$$i_s(t) = i_L(t) - i_c(t) \quad (2)$$

There are also some PWM converter switching losses. In addition to the true load capacity, the plant must therefore have a limited overhead for the condenser to leak and to transfer losses.

$$i_L(t) = \sum_{n=1}^{\infty} I_n \sin(n\omega t + \phi_n) \quad (3)$$

$$i_L(t) = I_1 \sin(\omega t + \phi_1) + \sum_{n=2}^{\infty} I_n \sin(n\omega t + \phi_n) \quad (4)$$

Instantaneous Load Power (P_L)

$$P_L(t) = V_s(t) * i_L(t) \quad (5)$$

$$P_L(t) = V_m I_1 \sin^2 \omega t^* \cos \phi_1 + V_m \sin \omega t^* \sum_{n=1}^{\infty} I_n \sin(n\omega t + \phi_n) \quad (6)$$

$$P_L(t) = p_f(t) + p_r(t) + p_h(t) \quad (7)$$

Fundamental Power (P_F)

$$p_f(t) = V_m I_1 \sin^2 \omega t^* \cos \phi_1 = v_s(t) * i_s(t)$$

(8)

$$i_s^*(t) = \frac{p_f(t)}{v_s(t)} \quad (9)$$

$$i_{sa}^* = I_{sp}\sin\omega t$$
$$i_{sb}^* = I_{sp}\sin(\omega t - 120°),$$
$$i_{cb}^* = I_{sp}\sin(\omega t + 120°),$$

(10)

Where,

V_s = Source Voltage

I_S = Source Current

I_L = Load Current

I_C = Compensating Current

The total reactive and harmonic force of the active filter is with the utility voltage is pure sinusoid. The active filter shall provide as shown in the equation the following compensating current. As the benchmark current for accurate immediate compensation of reactive and harmonic power, the fundamental component of the load current must be determined.

By regulating the dc side capacitor voltage the peak value of the reference current i_s can be calculated. The ideal offset includes sinusoidal main-current and the voltage of the source in phase with each current, regardless of the load. The source of the reference currents can be determined after compensation. The reference source current amplitude, while the source voltages can be extracted from phase angles. Therefore, only the extent of the source currents must be described in the waveform and phases of the source currents. By controlling the DC-side capacitor voltage of the PWM converter, the peak value of the reference current was calculated. Compare this voltage with a reference value and make a mistake in a PI controller. The output from the PI control was shown by multiplying the peak value by unit sine vectors in phase with source voltage and as amplitudinal source present. The dc side condenser has two main functions.

(i). Maintaining the steady-state, ripple free dc voltage.

(ii). Providing the true power difference between the load and source during the transient time as an energy storage feature.

In a continuous state the actual power from the source should be equal to the actual load demand, adding a slight force in order to offset losses in the active filter. DC condenser tension can thus be held at a reference value. But the real power balance between the source and the load is disrupted if the load condition changes. The dc condenser must compensate for this true power difference. This switches the voltage of the dc condenser off the reference voltage. The maximum value of the reference current needs to match the actual source power to maintain the successful operation of the active filter. The charge or unloading of the condenser offsets the true power absorbed by the load. When the voltage of the dc condenser is recovered and the reference voltage is reached, the actual source power is identical to the power of load. The actual reactive power injection will lead to the dc capacitor ripple voltage. In general, a low-pass filter is used to filter the ripples, which contribute to a finite lag. The capacitor tension is sampled at the zero crossing of the source voltage to prevent using this low pass filter. A shifting reference current makes the payout non-instantaneous. Therefore, at zero crossing of every phase voltage this voltage is sampled. This instantaneously allows the payout. Two cycle sample results in just a slightly higher dc capacitor voltage, or the drop, of transient voltage compared to six times in a cycle, but the set-up time is less. The basic component is given a reference output value in order to form the equation set and all other harmonics are equated to zero. Switching angles of the 5th, 7th and 11th harmonics are evaluated in the current simulation model. The equation is used in order to minimize harmonics for a complete harmonic distortion of the output voltage and current of the inverter.

$$\%THD = \left[\frac{1}{a_1^2}\sum_{n=5}^{\infty}\ (a_n^2\right] \times 100 \quad (11)$$
Where $n = 6i \pm 1(i = 1,2,3 \dots)$

II. PROPOSED METHODOLOGY

A The use of fluffy set theory or fluid logic in control systems, particularly in Japan, has grown widely over the last several decades. The theory of fuzzy logic was turned into a technical realization by Japanese scientists in the 1970. Nowadays it has become possible to find floated logic-based control systems (FLCs) in an increasing number of items, including washing machines, speed boats, air conditioners, handheld car focal cameras and others. The inference motor is central to a fluid controller and the application of fluid rules. Its current operation was divided into three stages, as shown in fig 2.

i) Fuzzification – The inputs in actual system are fuzzified.

ii) Processing of fuzzy inputs – Processing in compliance with rules and generating fuzzy outputs.

iii) Defuzzification – Creates a crisp actual fuzzy output value.

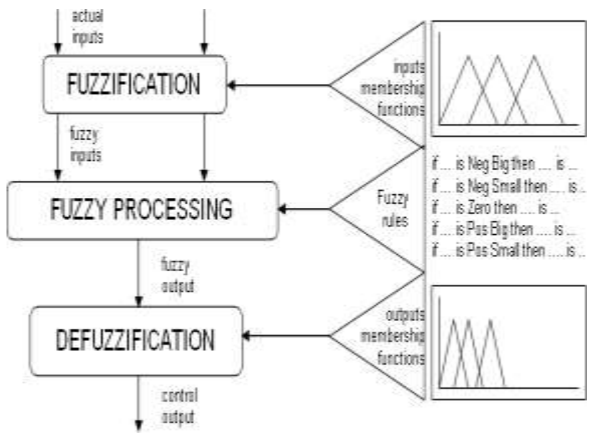

Fig. 2 Design of Fuzzy Logic Operational Parameters

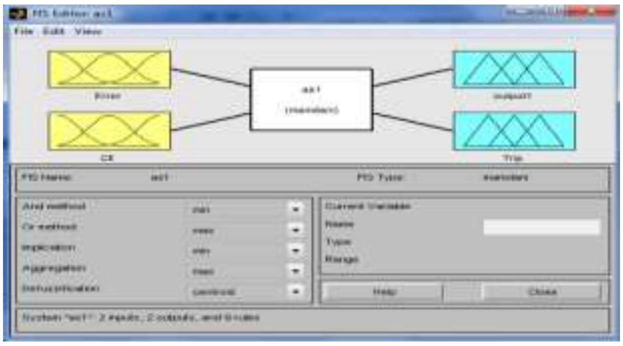

Fig.3 Design of Fuzzy Inference System

MATLAB and Simulink software simulated the proposed algorithm. Interference for the fuzzy rule input is shown by fig. 3 The simulation model should be balanced and sinusoidal for the three-phase source voltage. For load compensation a load with highly nonlinear features is considered. Fig. 4 shows the structure of Fuzzy controller.

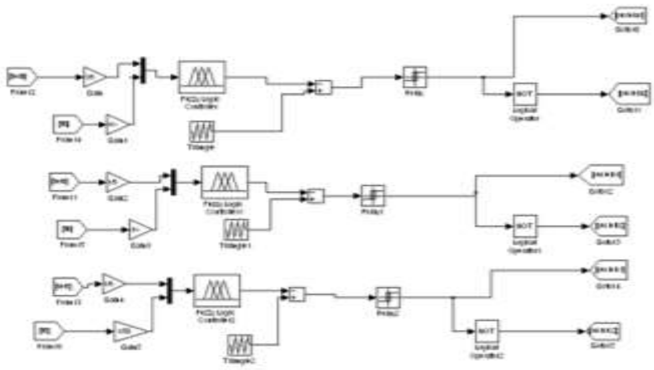

Fig.4 Structure of Fuzzy Based Controller for APF Control

The standard of electrical energy supplied to consumers has come up with a challenge. This is because non-linear loads are increasingly present in a network. It constitutes a harmonic network emission source, causing many disruptions and disturbing the optimum functioning of electrical systems.

The goal of shunt active power filter is to eliminate the harmonics introduced by nonlinear loads. This design simulates the design of fuzzy logic controller for the control and mitigation of harmonics in the unbalanced system. Matlab / Simulink were used to create fuzzy logic controllers to demonstrate the usefulness of the APF simulation approach.

V. SIMULATION & RESULTS

Models In this work, Simulation design and performance assessment of power conditioning devices such as shunt active power filter has been discussed and simulated for harmonic mitigation and power quality improvement. The objectives can be classified into following points.

- Design of Shunt Active Filter for Harmonics Mitigation.

- Design and Simulation of Fuzzy Logic controlled Shunt Active Power Filter.

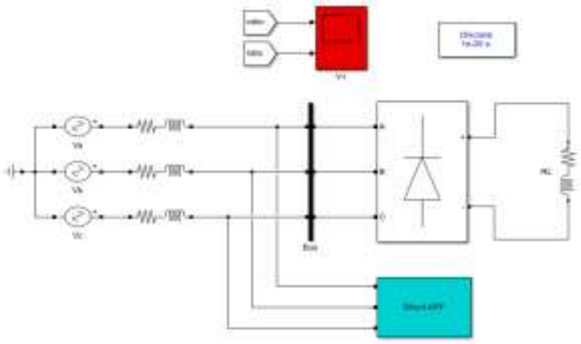

Fig. 5 MATLAB / Simulink Model of Shunt APF with Compensation

When nonlinear loads (industrial drives) are connected in our system produces harmonics in the line. For mitigation of these harmonics we use Shunt APF as shown in fig. 5

Table 1 lists the device parameters used in the simulation studies of shunt active power filter. It is assumed that the three-phase source voltages are balanced and sinusoidal. For load compensation, a load with extremely nonlinear characteristics is considered. Simulation model of fuzzy logic controller for controlling Shunt APF is shown in fig. 5.1.

Table 1: Simulink Model Parameters for Shunt APF

System Parameter	Values
Supply Voltage (RMS-Phase)	220 V
Supply Voltage (Peak-Phase)	311 V
Frequency	50Hz
Source Impedance	0.05Ω,0.5mH
Filter Inductance	1.25mH
Filter Capacitance	21e-5F
Line Voltage	398 V
Number of Phases	03
Capacitance Voltage	400 V
Load (R-L)	100 ohm, 5mH

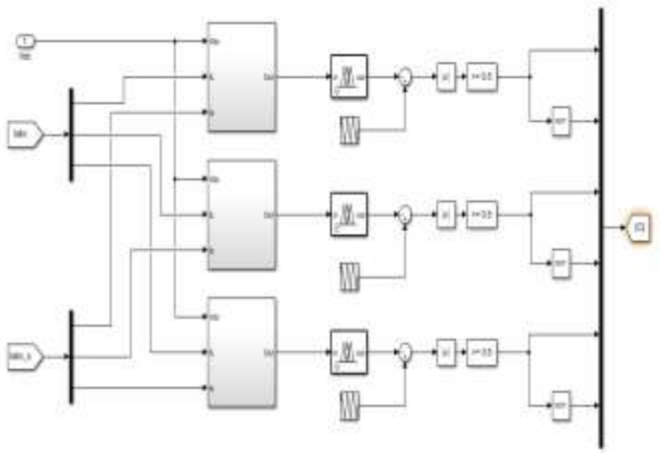

Fig. 6 MATLAB / Simulink Model of Fuzzy Logic Controller

Fuzzy logic model simulation some required rules are shown by Table 2 and import in MATLAB by using a fuzzy inference system file.

Table 2: Fuzzy Rule Base for Design of Fuzzy Logic Controller

Rule No.	Input	Output
1	(Error ==NB)	(output1=NB)(Trip=Right)(1)
2	(Error ==NB)	(output1=NB)(Trip=Right)(1)
3	(Error ==NB)	(output1=CZ)(Trip=Wrong)(1)
4	(Error ==CZ)	(output1=NB)(Trip=Right)(1)
5	(Error ==CZ)	(output1=CZ)(Trip=Wrong)(1)
6	(Error ==CZ)	(output1=PB)(Trip=Right)(1)
7	(Error ==PB)	(output1=CZ)(Trip=Wrong)(1)
8	(Error ==PB)	(output1=PB)(Trip=Right)(1)
9	(Error ==PB)	(output1=PB)(Trip=Right)(1)

When nonlinear loads (industrial drives) are connected in our system produces harmonics in the line. For mitigation of these harmonics we use Shunt APF which helps to mitigate harmonics due to unbalanced load condition. The circuit. The system is connected to nonlinear load and it is subjected to harmonic distortion. Shunt active power filter enables to mitigate the harmonics by proper injection and helps to improve the quality of power. The circuit diagram of the conventional system is explained and the circuit of shunt active power filter is explained .The waveforms of the voltage along with the harmonic analysis is also explained in the figure shown respectively.

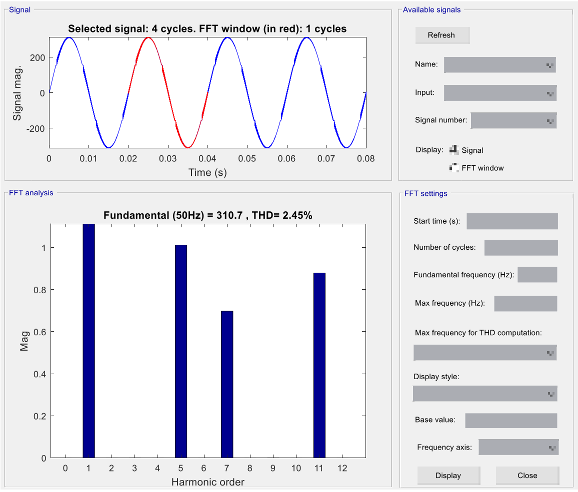

Fig. 6 THD of Voltage using Shunt APF with Conventional Controller

The application of a fuzzy logic controller to regulate the compensating voltage is presented in this study. The fuzzy inference and defuzzification methods are both based on the mamdani max-min approach. The input and output membership architecture for the fuzzy logic controller is crucial to the system's success. The simulation results show that the fuzzy logic controller controls the compensating voltage of a shunt active power filter effectively. IEEE Std. 519-1992 can be used to measure the percent THD of voltages at the PCC stage. Harmonic analysis after using shunt APF is shown . The waveform of the output has been shown in the form of line voltage as well as phase voltage in form of single phase and three phase waveform. The representation has been shown to compare the conventional and improved system for compensation of harmonics in the proposed unbalanced system.

Table 3: Harmonic Analysis of Proposed Methodology

Methods	%THD
Compensation with Conventional Controller	2.45 %
After Shunt APF	1.06 %

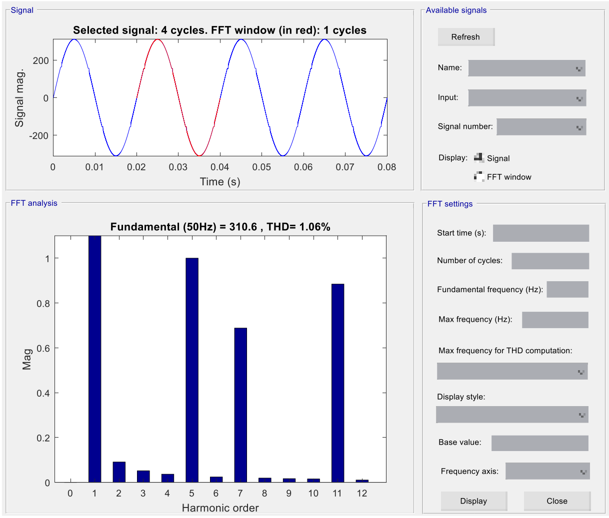

Fig.7 THD of Voltage using Shunt APF with Fuzzy logic Controller

Figure of merits as discussed above illustrates the application of proposed methodology in application of reducing harmonics through the fuzzy logic controlled shunt active filter (APF). The method has been successfully implemented for the reduction of harmonics in unbalanced load condition and has been compared with traditional methods, uncompensated and contemporary research for analysis and enhancement. Harmonic analysis of proposed methodology is also shown by Table 3.

VI. CONCLUSIONS

This research proposes the use of a fuzzy logic-based shunt active power filter algorithm for systems. It consists of a special-purpose voltage source converter (VSC), a three-phase grid, and nonlinear load. This system combines VSC and functions as both a three-phase active and static power supply. A compensator is used to regulate reactive power. Additionally, it adheres to the regulations by improving the quality of the IEEE-519 standard on harmonics. There is power in the three-phase distribution network. As a result, this technology contributes to harmonic reduction, load balance, and power consumption reduction. Factor correction and adjustment of the terminal voltage at the point of failure coupling are extremely common. To maximize production and efficiency, the amount of power that can be extracted from the SPV array under various environmental conditions is calculated. In these scenarios that incorporate fuzzy control technology, a single-stage system is used in conjunction with perturbation. The system is modelled and simulated using the MATLAB/Simulink combination. Simpower system toolboxes, as well as the system's behavior, are included. Experimental verification is conducted out using a laboratory-developed system under a variety of loads and environmental conditions.

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Implementation of Unified Power Flow Controller for Wheeling charges Reduction in a Deregulated Power System

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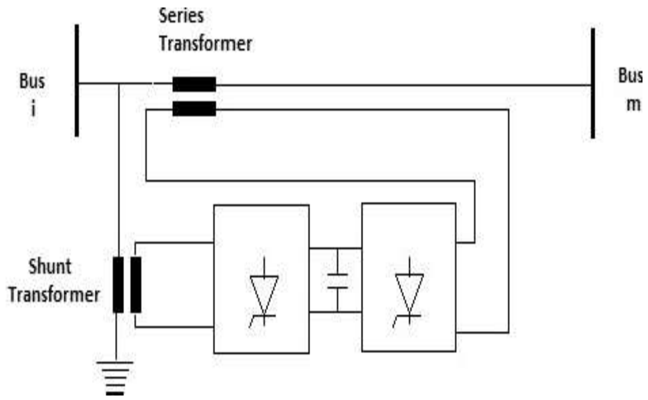
Abstract-We deal with the effect of unified power flow controller installation on the objective function of an electricity market. Also this paper proposes a novel UPFC modeling The OPF which facilities the consideration of the impact of four factors on the power market. Transmission pricing is an important issue in view of increased deregulation. Purpose of pricing is to recover cost of transmission encourage efficient use and investment. The unified power flow controller (UPFC) integrates properties of both shunt and seri es compensations, and can effectively alter power system parameters in a way that increases power transfer capability and stabilizes system.

Keywords- FACTS, UPFC, Wheeling charges, Pricing, MW-Mile method.

INTRODUCTION

Transmission pricing has been an important issue on the ongoing debate about power system restructuring and deregulation.[1] The rapidly increasing cost of electricity in recent years has brought about awareness to the importance of pricing policies in maximizing the social welfare. Electric energy must be treated commodity which can be bought, sold and transmitted taking into account its time varying values and costs, known as "spot pricing". Some efforts have been made to study the impact of FACTS devices on transmission charges. Oliveira have shown the ability of FACTS devices to change the production cost and their impact on transmission charges [2] . They made clear in [3] that effect of FACTS devices on transmission charge varies according to the pricing methodology adopted. They considered production cost minimization as the objective function. [4] was provided the index which reflects the FACTS device operation, wheeling transactions and network congestion. [5] has described a new approach of transmission pricing calculation taking social welfare maximization as the objective and has studied the impact of FACTS devices on it The motivation to use FACTS devices has been their potential to control the flow of power. They control the power flow in the transmission lines by handling one or more of these parameters: nodal voltage, nodal angular difference, and line series impedance. Optimal power flow is one of the most important operational functions of the modern day energy management system. The purpose of the optimal power flow is to find the optimum generation among the existing units, such that the total generation cost is minimized while simultaneously satisfying the power balance equations and various other constraints in the system. In [6] OPF has been solved by dynamic programming, considering the uncertainty in the loads demand and generation using fuzzy logic and possibility of using TCSCs to satisfy the transmission capacity constraint in the OPF has been explored . [7] presented a theory and simulation results of real-time pricing of real and reactive powers that maximize social benefits. Optimal location of FACTS devices is also an important issue in a restructured power system. A method [8] for the suitable locations of unified power flow controller, with a static point of view, has been used in this paper for different objectives, based on the real power flow performance index sensitivity with respect to control parameters of the unified power flow controller (UPFC).A sensitivity-based approach has been developed in [9] for determining the optimal placement of FACTS devices in an electricity market having pool and contractual dispatches.



STRUCTURE AND OPERATION OF UPFC

FACTS devices have been newly developed and applied in some well-developed countries. Their operations are realized using advance power electronics components which make them respond quickly to control inputs. Their instant response grants a high ability for power system stability enhancement in addition to control of steady state power flow. The UPFC is the fastest, most flexible, and the best-featured FACTS device. It can be seen as a combination of the STATCOM and SSSC.[10][11] It has the power full advantage of providing, simultaneously and independent, real time control of voltage, impedance and phase angle, which are the basic power system parameter on which system performance depends. Therefore, UPFC can be used efficiently and flexibly to optimize line utilization and increase system reliability, to enhance system stability, and to dampen system oscillations. The schematic diagram shown in figure 1 represents the basic structure of UPFC. A UPFC consists of two linked self-commutating converters share a common dc capacitor, which is connected to the ac systems through series and shunt coupling transformers. The ac/dc converters are switching voltage –sourced converters with semiconductor device having turn-off capability. The dc side of both converters is connected to a common dc capacitor, which provides a dc voltage support for the converter operation and functions as energy storage element. Real power flows between the shunt and series ac terminals of UPFC through the common dc link, UPFC generates or absorbs the needed reactive power locally by the switching operations of its converters. Each converter generates or absorbs the reactive power independently, i.e. reactive power does not flow through the dc link.

Figure 1. Basic circuit arrangement of UPFC

The power transfer between the shunt converters and series convert sets the UPFC rating. This rating should be at least as least as large as the real power exchanged between the two converters. The series converter performs the main function of the UPFC, where it produces an ac voltage of the UPFC, where it produces an ac voltage of controllable magnitude and phase angle, and injects this voltage at this fundamental frequency in series with the transmission line through a booster transformer. It also exchanges real and reactive power at its ac terminals through the series connected transformer. The active power needed by this converter is provided from the ac power system by the shunt converter through the dc link. The line thermal limit (current) sets the maximum limit through the series converter. The series converter can be used to increase the transmission capability. The ac side of the shunt converter is connected in parallel with the transmission line through a transformer where a current of controllable magnitude and a power factor angle is injected to or absorbed from the power system. The basic function of this converter is to supply or absorb the active power demanded by the series converter at the dc terminals. It also can generate or absorb controllable reactive power and provide independent shunt reactive compensation for the line. The shunt controller can be used for local voltage control, which in turn improves system voltage stability. The shunt voltage and its current are limited by the rating of shunt converter. [1]

I. Transmission Pricing

Many pricing schemes have been proposed and implemented in different markets. The postage stamp method is based on the average system costs, which include separate charges for peak and off-peak periods. According to this method the users are not differentiated by the extent of use of transmission facilities but charged based on an average embedded cost and the magnitude of transacted power. The other method is the contract path method, which assumes that the tra sacted power is confined to flow along an artificially specified path through the involved transmission systems and does not refl ct the flows through the grid that include the loop and parallel path flows. An improvement to the above methods is the MW-mile method in which, power flow and the distance between the injection and withdrawal locations reflect the transmission charges. However all these methods do not consider the aspect of transmission congestion. The MW- Mile method is one of the first pricing methods proposed for the full recovery of the fixed transmission costs based on the actual use of the transmission network[13] [14]. The “transmission network capacity use” defines the extant of use of transmission network facilities by the users of transmission service including wheeling transactions [15] and the “wheeling transactions” define the transmission of electric power for other entity (ies) by a utility that neither generates nor intends to use the power as system resources. It is also called the line-by-line method as it considers changes in MW transmission flows and transmission line lengths in miles and the charges are calculated based on the transmission capacity usage as a function of magnitude of transacted power, the path followed by the transacted power as well as the distance travelled by the transacted power. Thus it is also useful for identifying transmission paths for a power transaction. In this method the nodal power injections

$$\Delta P_i = |\pm P_{t,i}| - |\pm P_{b,i}|$$

involved in transaction t, are used to calculate the transaction related flows on all the network lines using an approximate dc model, which are multiplied by its line length and the cost per MW per unit length of the line and summed over all the lines. The net power flow impact is determined using an incremental absolute approach which considers the difference in magnitude irrespective of the flow direction.

Here ΔP_i is the power flow impact in line i, ΔP is thepower flow in line i during transa tion in MW and is the power flow in line i for base case in MW . is the negative power flow impact if $|\pm P_{t,i}|<|\pm P_{b,i}|$ i.e. flow in a particular line decreases after the transaction. The contribution of each transaction t to the total transmission capacity cost can be summarized as follows:
Where,

$$TC_t - TC * \frac{\sum_{k\in K} c_k L_k MW_{t,k}}{\sum_{t\in T}\sum_{k\in K} c_k l_k MW_{t,k}}$$

TC_t = price charged for transaction t in $/MW

TC =total cost of all lines in $ l_k = length of line k in mile

c_k = cost per MW per unit length of line k

$MW_{t,k}$ = flow in line k due to transaction t

T =set of transactions

K =set of lines

An analysis of the contribution of each transaction is done before and after the placement of the FACTS devices to show how the share of each transaction changes with the inclusion of the FACTS devices. The pricing methodology is given below:

Step-A: Find the total cost of the line by multiplying the unit cost of the line with line length.

Step-B: Find the base case power flow o all lines. (This is obtained here using MATLAB/Simulink model)

Step-C: find the new power flow solution with the transaction T1, and hence the power flow on each line. (A negative sign indicates a reversal of flow direction wit approach) respect to the base case power flow. Here negative sign is dropped because of absolute

Step-D: Find the new power flow solution with the transaction T2, and hence the power flows on each line. Step-E: Calculate the incremental power flow on each line caused by the transaction T1.

Step-F: Calculate the incremental power flow on each line caused by the transaction T2.

Step-G: Calculate each line usage due to transaction T1 and hence find the total transmission system usage by T1. Step-H: Calculate each line usage due to transaction T2 and hence find the total transmission system usage by T2. Step-I: Calculate the total transmission system usage by T1 and T2 for proportional allocation of the cost.

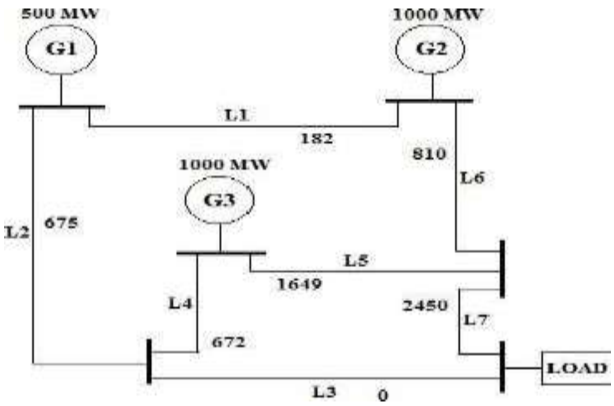
Step-J: Calculate the proportional allocation of costs to transactionT1. Step-K: Calculate the proportional allocation of costs to transactionT2.

The primary objective of this paper is to calculate wheeling charge for each participant according to their contribution in MW power flow for each line. Here it is assumed that the generators pay

100% of the transmission cost of services to the transmission utility.

II. Test System For Pricing Analysis

The system having seven transmission lines with three generators supplying an industrial load is chosen for analysis purpose. The load is



supplied by the three generators with G1 supplying 500 MW, G2 supplying 1000 MW and G3 supplying 1000 MW. Table 1 shows the line lengths and the cost per MW per unit length of the line. This data is used for calculating the contributions of each generator transaction towards the total transmission capacity cost using the MW-mile methodology. The main aim of the analysis is to look at the impact of the FACTS devices on the system pricing and how the contributions of each transaction change with the inclusion of FACTS devices.

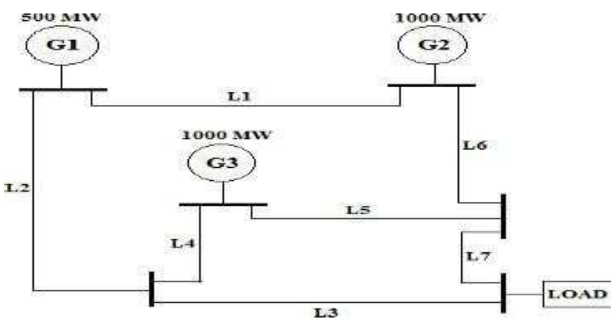
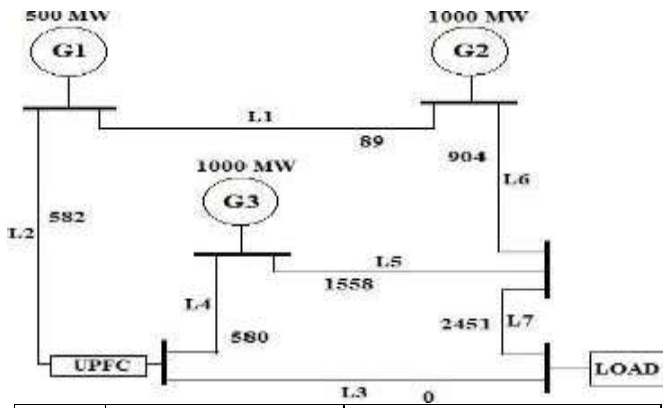


Figure 2. Test System

TABLE I

Line Flows With And Without UPFC

Line	P(MW) without UPFC	P(MW) with UPFC
1	182	89
2	675	582
4	672	580
5	1649	1558
6	810	904
7	2450	2451



TRANSMISSION PRICING FOR THE TEST SYSTEM

The MW-mile method described in section 3 is used to

find the contribution of each generator towards the total transmission cost. Table II and Table III shows the individual contribution of all the three generators toward the network. $MW_{t,i}$ due to T1 in the table represents the

flow of generator G1's (500 MW) power in all the lines similarly transactions T2 and T3 are for generators G2(1000MW) and G3(1000MW) respectively.

Figure 3. Flow in lines without UPFC

Figure 4. Flow in lines with UPFC

III. SIMULINK MODEL OF TEST NETWORK

A UPFC is used to control the power flow in a 500 kV /230 kV transmission system. The system, connected in a loop configuration, consists essentially of seven transmission lines (L1 to L7) two 500 kV/230 kV transformer banks Tr1 and Tr2. Three power plants located on the 230-kV system generate a total of 2500 MW which is transmitted to a 500-kV 15000-MVA equivalent . The plant models include a speed regulator, an excitation system as well as a power system stabilizer (PSS). Using the load flow option of the powergui block, the model has been initialized with plants G1,G2 and G3 generating respectively 500 MW,1000 MW and 1000 MW and the UPFC out of service (Bypass breaker closed). The UPFC located at the right end of line L2 is used to control the active and reactive powers at the 500- kV bus B3, as well as the voltage at bus B_UPFC. It consists of a phasor model of two 100-MVA, IGBT-based, converters (one connected in shunt and one connected in series and both interconnected through a DC bus on the DC side and to the AC power system, through coupling reactors and transformers). The series converter can inject a maximum of 10% of nominal line- to- ground voltage (28.87 kV) in series with line L2.

TABLE II

Calculation Of Cost Allocation Based On The Mw-Mile Method Without UPFC In The System

Steps	L1	L2	L4	L5	L6	L7
Cost($) Base power flow(MW) Power flow due to T1 Power flow due to T2 Power flow due to T3	364 000 182 80 530 142 102 347 39.9	20250 0 675 1068 1021 635 392 345 39.9 $MW_{t,h}$ $MW_{t,h}$ $MW_{t,h}$	1344 00 672 1061 1041 632 388 368 45	19788 0 1649 2030 1982 257 380 332 923	4860 0 810 913 1444 850 103 634 40	24 50 00 24 50
T1 T2 T3						
(Incremental power $MW_{t,h}$ $MW_{t,h}$ $MW_{t,h}$ flow)						

TABLE III

Calculation Of Cost Allocation Based On The Mw-Mile Method With UPFC In The System

Steps	L1	L2	L4	L5	L6	L7
Cost ($)	178000	174600	116000	186960	54240	24510 0
Base power flow (MW)	89	582	580	1558	904	2451
Power flow due to T1	18	970	963	1935	1013	2933
	450	941	935	1903	1526	3391
Power flow due to T2	71	565	563	2504	922	3412
	71	386	382	375	109	482
Power flow due to T3	360	358	354	343	622	940
	18	17	16	944	18	961
due to T1 due to T2 due to T3 (Incremental power flow)						

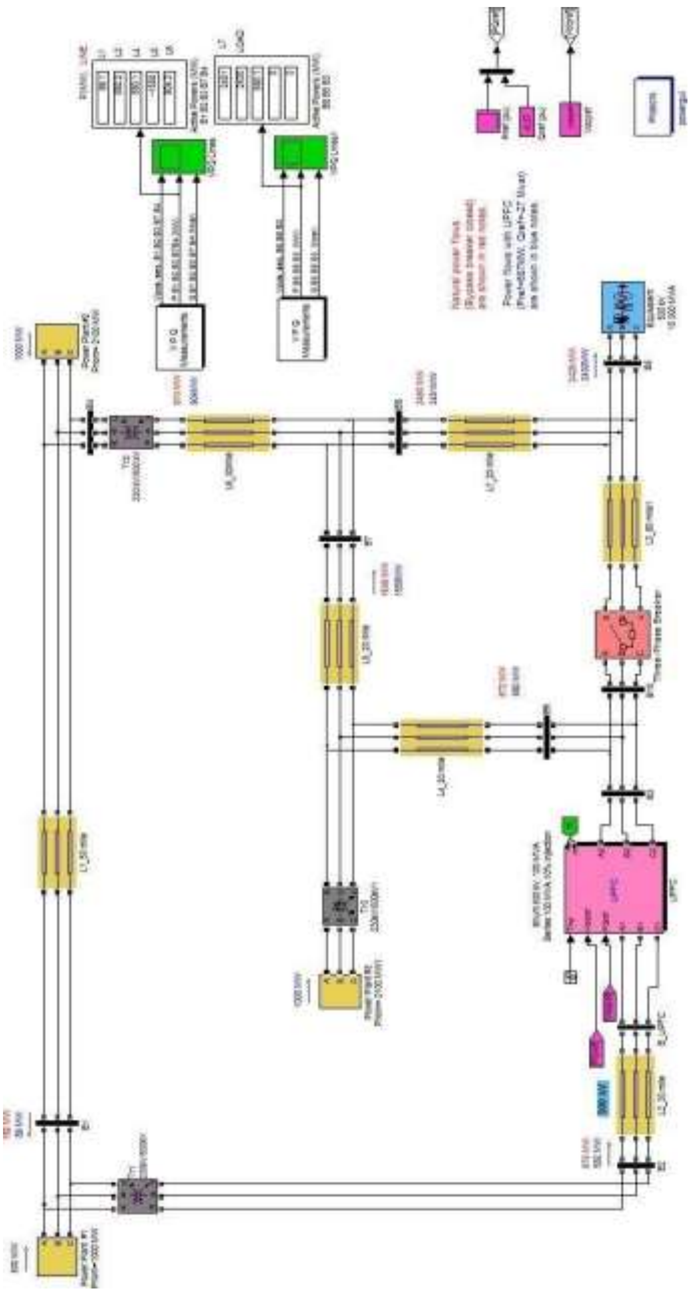


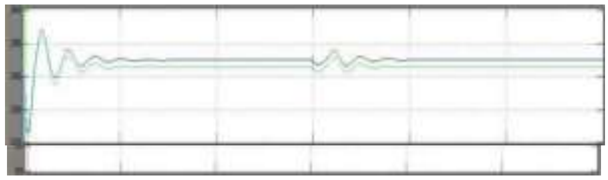
Figure 5. Simulink model of test system with UPFC

I. POWER MEASUREMENT AT VARIOUS

LINES:

(a) **Effect of UPFC on Power flow injection at line L1**

(b) **Effect of UPFC on Power flow injection at line L2&L4**



(c) **Effect of UPFC on Power flow injection at line L5**

(d) **Effect of UPFC on Power flow injection at line L6**

(e) **Effect of UPFC on Power flow injection at line L7 and load Figure 6. Dynamic performances of UPFC**

TABLE IV

Pricing With and Without FACTS

Pricing Generator	Without FACTS ($)	With FACTS ($)
G1	322777	234007
G2	671083	583978
G3	198567	136923

IV. CONCLUSION

The deregulated power system posses many advantages over the vertically integrated power systems however a deregulated power system faces various technical and non- technical problems like pricing issues, available transfer capability, congestion management and market power. FACTS devices can be an alternative to reduce the flow in heavily loaded lines, resulting in an increased loadability of network, reduced cost of production and fulfilled contractual requirement by controlling the power flows in the network. 6-bus test system simulated in Simulink shows numerical results and demonstrates the saving in transmission cost to generation companies in delivering the power to loads. Results also present the dynamic performance of UPFC on the system.

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Track – 2 Paper

Dr. Renu Bagoria

A Promising Approach of Service Selection in Cloud Computing

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Abstract:

Cloud computing has emerged as a dominant technology, offering a wide range of applications and services over the internet. Efficient resource management is crucial for optimal utilization of cloud resources, achieved through scheduling, allocation, and scalability techniques. Service level agreements (SLAs) play a vital role in formalizing the relationship between cloud providers and users, ensuring that services meet quality and performance requirements.

To aid in cloud service selection, Service Measurement Index (SMI) frameworks have been developed, allowing users to compare and evaluate different cloud providers based on key performance indicators (KPIs) such as accountability, agility, cost, assurance, performance, security, and usability. Multi-criteria decision analysis (MCDA) techniques, including Analytic Hierarchy Process (AHP), Analytical Network Process (ANP), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), and others, are used to rank and select cloud services based on various criteria.

In conclusion, the effective use of MCDA techniques can assist organizations in making informed decisions when selecting cloud services, ensuring that their specific requirements are met while optimizing the benefits of cloud computing

Key Words: Quality of Service, Cloud Service Provider, Service Level Agreement

Introduction:

Cloud computing is the rapidly growing technology which is growing at a rapid pace. Cloud computing is a technology that provides a complex number of applications in different topologies and each topology gives some expert specialized service. Cloud computing offers computing services and resources over the internet.A cloud computing model is considered best if its resources are utilized efficiently. Resource management [1] in cloud computing is achieved by using scheduling, allocation and scalability effective techniques. Resources [2] can be used by the end user in the form of virtual machine and the process used is known as virtualization and the technique known as hypervisor. Cloud Computing is service which provides on-demand and simple access to the network to several servers which provides computing resources like applications, storage, networks in presence of other services which cloud provides and can be used to gain maximum efficiency[3]. User retrieved data and modified data which is stored by client or an organization in centralized data called cloud.

Intact cloud system [4] we have two major cloud entities that are Cloud provider and the cloud user.Cloud provider [3][4] provides services like hosting, storage, application setup ,service setup etc to user on demand and this vital feature is known as CSP that stands for "Cloud Service Provider" . On the other hand Cloud user is the user or the client who uses these services and must pay for whatever he/she is using or being used and served on the basis of QoS requirement. Cloud service provider act as a company or an organization which provides services to the various users at different level of features and characteristics. As we have various service providers [5] which offer similar type of service by varying cost and performance level so it becomes very difficult to select the appropriate service provider which can fulfill QoS requirements.

Now one very important entity that works as an intermediately between cloud provider and cloud user is known as a Cloud Broker. A Cloud broker [4][5] act as a third party which provides the user with best service without redundancy and also provide the trusted environment for installing their application. Broker also does service level agreement negotiations while drawing a contact with both the parties. When the broker starts collecting metrics from the Cloud service provider data becomes so huge. So, at this time broker applies any of the Multi criteria decision making methods like TOPSIS, VIKOR, PROMETHEE, AHP etc to select the best service.

Service Level Agreements:

SLA acts as a formal contract between user and provider.A contract consists of everything required by organization like business co-workers, specification of functional commitment, quality and price [6].SLA requirement [6]during implementation is that First, SLA clear structure should be defined based on cloud implementation .Second, proposed SLA should match with QoS requirement and the cost model so that it is easily acceptable by user. If the service provider will not fulfil the terms and conditions mentioned in contract than he will be penalized for the same. The major concern is to select the service with high efficacy, accuracy and to do optimal composition of services.

Service Measurement Indexes:

A number of measurement indexes are used to contrast different cloud services which are known as Service Measurement Index.SMI is developed by CSMIC(Consortium-Service Measurement Index)has been used as a standard metric to measure and compare different cloud providers on the basis of their performance [5][7]. SMI consists of QoS characteristics or Key Performance Indicators (KPIs) which is divided into seven categories and four or more sub category which is used to calculate any type of services provided by the service provider. SMI(Service measurement Index) is calculated where cloud criteria is categorized and sub categorized :Accountability(Compliance,SLAVerification),Agility(Scalability,Portability,Elasticity),Assurance(Availability,Reliability),Financial(on-going,transition Cost), Performance(service response time, Interoperability, Functionality),Security and Privacy, Usability(Accessibility ,Learn ability, suitability)[7].These SMI can be used by the customers to measure different cloud services.

Based on SMI, a Service Measurement Index Cloud Framework (SMIcloud) framework is evaluated;SMIcloudhelps cloud customers to search the most appropriate cloud provider. It offer features such as cloud service selection on the basis of QoS requirements and ranking of services on the basis of customers previous experience and services performance. So, there is a requirement for a cloud service selection[6] approach that takes into account the multitude of existing cloud services, variations in QoS performance (along with price), and the user's criteria to rank existing cloud services, and then assists in selecting the best and most beneficial service.

Quality of Services:

QoS conceding services to the user is depended on the service level agreement between the user and the provider. Quality of Service [8] is a major concern for the end users. Quality of Service (QoS) depends on various factors such as user-specific, service-specific and environment-specific parameters [9]. QoS is the competence to achieve user requirement such as response time, delay, usability, availability, security, privacy and throughput [10]. QoS value for the same service and to different user may vary based on the location and network environment [10].

Multi Criteria Decision Analysis:

To calculate the performance of each attribute various techniques and models [11] have been discovered to solve the service selection problem which includes multi criteria decision analysis (MCDA). In MCDA a number of techniques, approaches and methods have been developed but the basic requirement is same for all i.e. a finite or infinite set of actions, minimum two criteria and a decision maker [11].MCDA takes decision mainly in terms of selecting, ranking and sorting. MCDA basically works on three broad categories that is 1)Multi-attribute Utility Theory(MAUT) methodologies used are Min-Max, Max-Min and TOPSIS 2)Outranking methods methodologies used are ELECTRE and PROMETHEE and 3)Hierarchal methodology used is AHP and network based method is ANP [6] .MCDA helps in determining the best alternatives among the various alternatives with different set of criteria [12].

Cloud providers are encompassing of data centres which provides space to the various users. The process of mapping user request to the VMs based on the user requirement which is termed as multi-criteria task scheduling [13] .Scheduling [14] is basically consider as a NP hard problem due to which it is very difficult to find the optimal solution. Scheduling helps in improving overall execution time of the provided task.Scheduling [14] can be done in two ways that is independent scheduling in which all the tasks are independent and can be assigned to the processors independently without any prior order of execution and other one is dependent(workflows) scheduling which is very complicated as it defines the dependency between the tasks to be executed. An effective scheduling technique helps in load balancing.In multi criteria scheduling[13] the main issue lies in predicting values for different criteria and doing scheduling based on QoS preferences of users. Many researchers in task scheduling focused only on single criteria but considering the multi criteria is the requirement of today.As multitude attributes of QoS considered in cloud service selection which is termed as multi criteria decision-making(MCDM) problem. MCDM[12] method helps decision makers (DMs) in combining objective measurements with value judgements which is based on collective group idea not on individual decision.

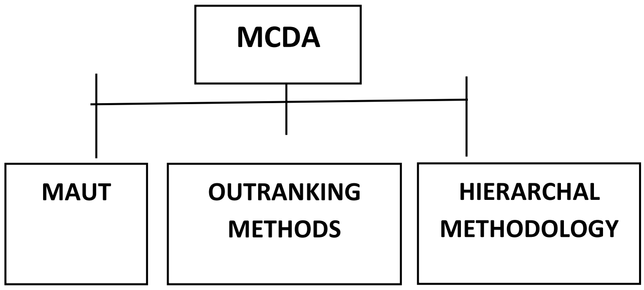

Figure 1: Broad Categorization of MCDA

Service Measurement Index (SMI): - SMI attributes designed on the basis of International Organization for Standardization (ISO) standards developed by CSMIC(Consortium-Service Measurement Index) has been used as a standard metric to measure different cloud providers[7].

SMI consists of QoS characteristics or Key Performance Indicators (KPIs) discussed below [5][15][16]:

1) **Accountability:** Accountability is important to build up customer trust on CSP without this characteristic no company or organization will deploy his/her secure data in a place. So, Accountability ensures security measures and compliance to a particular organization. Subcategories of accountability are: audibility, compliance, data ownership, provider ethicality and sustainability etc.

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2) **Agility:** This is one of the most important features of cloud computing as it allows organization to expand their infrastructure and can add on new services anytime without much additional cost. Subcategories of agility are portable, adaptable, flexible and elastic.
3) **Cost:**It is the only qualifying factor which helps the organization to decide whether to switch to cloud or not. Hence, it is necessary to represent cost as characteristics which are important for the organization. Subcategories of Cost are acquisition and on-going.
4) **Assurance:**This attribute specifies thecloud service performing as promised between the user and the provider or as expected by the user. So, the quality of service depends on the actual performance and the original contract made between user and the service provider during service level agreement. Subcategories of assurance are availability, reliability and resilience etc.
5) **Performance:** Each cloud service provider provides different services based on the organization or individual business requirement. So, organization needs to access the services on the basis of their requirement. Subcategories of performance are suitability, functionality, interoperability, accuracy and service response time.
6) **Security and Privacy:**Cloud computing act as a group of servers which provide services to the cloud users. So, the overall operation of cloud user depends on the other organization which is a critical issue and requires rigorous security and privacy policies from CSP. Subcategories of security and privacy are availability, data integrity, access control, confidentiality and privacy.
7) **Usability:**Cloud services provided by the CSP must be easy to understand and learn by the normal user so that he can easily adapt to the new technology without any hassle. Subcategories of usability are accessibility;learn ability, insatiability, transparency and operability.

TYPE	ATTRIBUTES
ACCOUNTABILITY	Audibility, Compliance, Data Ownership, Provider Ethicality and Sustainability
AGILITY	Portable, Adaptable, Flexible and Elastic
COST	Acquisition and On-Going
ASSURANCE	Availability, Reliability and Resilience
PERFORMANCE	Suitability, Functionality, Interoperability, Accuracy and Service Response Time
SECURITY AND PRIVACY	Availability, Data Integrity, Access Control, Confidentiality and Privacy
USABILITY	Accessibility; Learn Ability, Insatiability, Transparency and Operability

FIGURE 2: Service Measurement Index ATTRIBUTES

Service Monitoring: As the clouds are dynamic in natureso continuous monitoring of SLA parameters need to be dynamic and regular monitoring of QoS is important to achieve the desired SLA. Monitoring[16] is performed for collecting information about the quality of services. Service provider monitors the application to better understand the service performance and secondly monitoring is done to observe the application from others point of view those who are not provider but observe the service for getting better insight about the service. Cloud monitoring [8] tools are significant in providing fault tolerance and migration of task in case of failure. Monitoring is of two types low level monitoring and high level monitoring. Low level monitoring provides the status of physical infrastructure whereas high level monitoring provides status of virtual platform. Monitoring is important in terms of performance management, resource planning and management to fulfill SLA agreement. In monitoring two types of tests are performed computational-based tests and network-based. Both the tests are equally important to know better understand the behavioral changes that directly impacts QoS.

Cloud Services Ranking: Ranking is sorting and assigning a quantity to the provided choices.It is required that a ranking system receives user's requests with different requirement levels. Then, it finds various services which satisfy user requirements and ranks them for each user based on QOS. The goal of ranking of services is helping users to evaluate and contrast different services. So, users can select the most appropriate service that satisfies their requirement. Service rankings [16] are divided in two parts. First part consists of evaluation and contrast of services and the second part consist of service ranking.

Various Multi Criteria Decision Making (MCDM) Techniques are:-

1) Analytic Hierarchy Process (AHP): AHP is developed by Saaty in 1980. It is useful in various domains like planning, choosing best alternative, resource allocation and resolving conflicts. AHP [17] based on three operations mainly are-hierarchy construction, priority analysis and consistency verification. In hierarchy construction decision makers divide the multi criteria service selection problem into sub problems in which all the attributes are arranged into multiple hierarchical levels. After that decision maker [18] compare each group in same level in a pair wise manner with his own knowledge and expertise.This is converted into numerical weights used for calculating score for each alternative. As comparison [17] is carried out by personal interactions so certain level of inconsistency may occur. To ensure judgment is correct so the final step consistency check is performed by finding out consistency ratio. If the consistency ratio extends the limit than decision makers need to evaluate and modify the pair wise comparison. Once the decision is finalized it can be combined to find out the priority ranking of each criterion and its attributes.AHP advantages are easy to use, scalable and easily adjustable in size .The main disadvantage of AHP is rank reversal. To overcome this problem a fuzzy version of AHP is introduced. A fuzzy AHP[19] helps in calculating the weights of the non-functional properties that is service ranking criteria according to user preferences. Fuzzy AHP [20] reduces the time by using micro functions for comparing the criteria with minimum difference.

2) Analytical network process (ANP): In this decision making problem is modeled as network.During decision making if dependencies exist between the criteria which is not highlighted by AHP. So, by using ANP[21]we can model dependencies and feedback between the decisions making elements which consider the weights more precisely and then rank the alternatives.

3) The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS):TOPSIS was first developed by Hwang and Yoon for solving issues and later the TOPSIS methodology is developed by C.T.Chen. In TOPSIS performance rating and weights of the criteria is granted with crisp values [12].It chooses the alternative which is closest to the ideal solution and farthest to the negative solution.The main advantages of TOPSIS are that it is easy to use, programmable and the steps remain same regardless of the number of attributes or problem size. The main disadvantage of TOPSIS is Euclidean distance doesn't consider the correspondence of attributes. In case of additional attributes it becomes difficult to measure weights of attributes and keep uniformity of decision. To overcome this problem fuzzy TOPSIS comes into existence.

4) Elimination and Choice Expressing Reality(ELECTRE) [12][18][22]: It is based on outranking methodby performing pair wise comparison among each alternatives under each criterion individually. This helps in finding the outranking relationship and also in removing the ambiguous alternatives. The main advantage is that it considers vagueness and uncertainty. The main disadvantage is that it's process and outcome is difficult to understand by layman. Later on several versions of ELECTRE are introduced.

5) Preference Ranking Organization METHod for Enrichment Evaluations (PROMETHEE)[18][22]: It is developed by Brans in 1982. It performs pair-wise comparison and outranking method for comparing a finite set of alternatives. PROMETHEE allows partial and complete ranking according to user requirement. The main advantage is easy to use and don't require any assumption for the criteria to be impartial. The main disadvantage is that it requires the assignment of values but doesn't provide any clear method to do so. Further various fuzzy versions of PROMETHEE areintroduced to overcome the above mentioned disadvantage.

6) Goal Programming [12][22]: It is very useful in the multiple conflicting objectives. In Goal programming mathematical programming is combined with logic of optimization in taking decision where several objectives involved in different multi criteria decision making problem. The main advantage is that its ability to handle large-scale problems. The main disadvantage is that its incapability to handle weight coefficients.

7) VIKOR[18]: It is used to solve the decision making problems with incompatible and different units of criteria. It attempts to rank and select the alternatives from a given set which find out the compromise solution for a given problem. The solution helps the decision maker to reach to the ideal solution.

8) Grey Theory [18]: Grey Theory is based on mathematical formulation where the data is not adequateand knowledge base is also feeble. It is effective technique when the data is insufficient and the problem is undefined.

9) Best-Worst Method (BWM)[18] : BWM is a vector -based method which requires less number of comparisons. In this decision maker derives the weights on the basis of pair-wise comparison between best criteria and the worst criteria with the other criteria. It applies structured method and consistency ratio which produces more reliable results.

10) Simple Additive Weight (SAW)[18] :SAW method is known as weighted linear combination or scoring method. It is based on simple aggregation method to join the criteria weights into a single parameter value. This method finds out the evaluation score for all the given alternatives of that attribute with the weights fixed by the decision maker followed by summing of the products for all given criteria. The main advantage of this method is that it presents proportional linear transformation of the raw data.

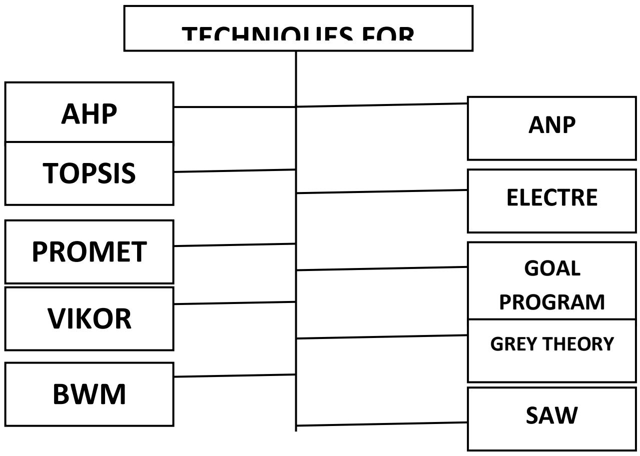

Figure 3: Various Techniques for MCDA

TECHNIQUE	**ADVANTAGES**	**DISADVANTAGES**
AHP	Easy to use, Instinctive approach to decision maker,Adaptable, Potential to check Inconsistencies, Scalable and Easily adjustable in size.	Rank Reversal, Pair wise comparison makes the task lengthy, Aggregation leads to loss of Information and artificial limitation is use of 9 point scale.
ANP	Consent to Interdependence, Simplifies complex task, Modelled as network, Allow tangible and intangible criteria's,Prioritize Indicators.	Identifying attributes needs extensive brainstorming session, Data accession is a time overwhelming process, Requires masses of calculation and Subjectivity of calculation not measured.
TOPSIS	Easy to use, Consistency, Unambiguousness, Programmable, Good computational competence, Capability to evaluate relative performance of each attribute in mathematical form and the steps remain same regardless of the number of attributes or problem size , mathematical form	Euclidean distance doesn't consider the correspondence of attributes and With additional attributes it becomes difficult to measure weights of attributes only by objective and subjective methods and keep uniformity of decision.
ELECTRE	Vagueness, uncertainty, Reliable, Ability to handle qualitative and quantitative data.	Complex method requires lots of primary data and difficult for layman to understand.
PROMETHEE	Easy to use and Don't require any assumption for the criteria to be impartial, Ability to handle qualitative and quantitative data, Require less Input, Works on group level decision making Fuzziness and Uncertainty.	Rank reversal, Impractical to really structure the decision problem, Requires assignment of values but doesn't provide any clear method to do so, Inappropriate guidelines for weights and Processed information complicated.
GOAL PROGRAMMING	Ease of formulation, robustness, ability to handle large-scale problems and computational performance	No assurance for global optimal solution to be found by algorithm, Difficult to analysis which method is most competent in the sense of requiring the least number of point for assessment of simulation in order to attain an optimum,

		Don't consider the stochastic activities of the simulation response on the performance of the algorithm and incapability to handle weight coefficients.
VIKOR	Maximizes the utility group and minimizes regret group for finding best alternatives, Finds ratio of positive and negative ideal solution for proposing a compromise solution with an advantage rate, Allows changeability of real world when determining value of each criteria and Determines stability intervals in weights.	Ranking needs can be achieved with different values of variable weights, Performance rating enumerated as crisp values, Appropriate in those cases when information is in numerical values and In case of conflicting values decision makes takes ambiguous and imprecise data.
GREY THEORY	Provide suitable results from small quantities of data and a lot of factors of variables, No restriction on sample size and usually distributed data and computational method is easy, Easy Calculations	Multiplying two grey number increases the size of interval which leads to reduction in accuracy
BWM	Requires less number of comparisons, Produces more reliable results, Integral value is used	Consistency issue between comparisons, Interval-valued intuitionistic preference relations.
SAW	Accurate judgement as it is based on pre-defined value and weight and Based on proportional linear transformation of the raw data.	Ignores fuzziness during decision making process.

Figure 4: Advantages and Disadvantages of MCDA

Conclusion:

In conclusion, cloud computing has revolutionized the way businesses and individuals access and utilize computing resources. Its flexibility, scalability, and cost-effectiveness have made it a preferred choice for many organizations. However, efficient resource management, ensuring quality of service through service level agreements, and selecting the right cloud services provider remain key challenges.

To address these challenges, various multi-criteria decision analysis (MCDA) techniques have been developed, such as Analytic Hierarchy Process (AHP), Analytical Network Process (ANP), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), and others. These techniques help decision-makers evaluate and rank cloud services based on multiple criteria, such as performance, cost, security, and usability.

Overall, the proper application of MCDA techniques can help organizations make informed decisions when selecting cloud services, ensuring that their specific requirements are met while maximizing the benefits of cloud computing.

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Advancements in Artificial Intelligence for Space Exploration

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Abstract: In the realm of high-risk space missions, a delicate balance between audacious thinking and meticulous engineering, especially in risk management, is imperative. Incremental innovations, whether propelled by artificial intelligence or other technologies, are embraced only when they offer significant advantages to a mission. Yet, the perils associated with introducing new capabilities must be thoroughly acknowledged and actively mitigated. Space exploration, whether conducted by unmanned spacecraft or manned missions, demands courage and unwavering resolve. Since 1998, artificial intelligence has steadily advanced in the realm of space exploration. Landmark trials such as the RAX manned spacecraft innovation in 1999 and the ASE 2 deployment on the Earth Observing One platform in 2003, which remains operational to this day, have validated the effective utilization of AI-based technologies for future human endeavors in space. These advancements are poised to bolster NASA's endeavors in exploring the Moon, Mars, and beyond, leveraging both robotic and human exploration.

Keywords: Artificial Intelligence, Remote Agent Experiment, Robotic Space Craft, Planets, Application, AI management.

VII. INTRODUCTION

Flight technology experiments represent targeted efforts by NASA to develop the necessary equipment for exploring various regions of space. These tests evaluate the capabilities of new spacecraft while also assessing their potential and value, all while minimizing risks. Typically conducted on specialized spacecraft, experiments can also be transmitted to lunar rovers that have completed their primary missions. For instance, in 1999, the RAX distant agent was deployed to Deep Space One (DSO) and managed the DS-1 expedition for several days. This marked the first instance of AI flight software commanding a spacecraft, with RAX pioneering this breakthrough. Equipped with an onboard model-based diagnosis, execution engine, planning system, and recovery capability, RAX successfully met all of its experiment goals, showcasing the value and potential of spacecraft autonomy. The success of RAX led to the development of the Mars Exploration Rover's tactical planning system, known as the Mixed Initiative Activity Planning Generator (MAPGEN), which integrated RAX's planning technology into the Jet Propulsion Laboratory's activity planning system. Additionally, RAX's legacy includes the LS model design diagnostic engine, now under consideration for system-health management onboard NASA's upcoming human space exploration mission, the Crew Exploration Vehicle (CEV). The ASE program demonstrated independent tracking of volcanic activity, floods, and freeze-thaw occurrences on Earth as a technical demonstration. This experiment was so successful that EO-1 mission resources were allocated for ASE's operational capability, resulting in significant cost savings and an extended mission duration. The CASPER software planner, a powerful execution engine, and various AI-based technological event observation software were incorporated into EO-1, including change detectors, recognizers, and classifiers. In 2004-2005, the second version of the Livingstone software was flown aboard EO-1, demonstrating the diagnosis and monitoring of simulated malfunctions in scientific equipment. Another notable AI application is the Descent Image Motion Estimation Subsystem, which is integral to the landing system of Mars rovers, featuring a machine vision component called 7 DIMES. During descent, 7 DIMES tracks objects such as craters while estimating wind speed rates and automatically adjusting propellers to compensate for wind shear.

Artificial intelligence (AI) has emerged as a transformative force in the realm of space exploration, revolutionizing the way we conceptualize and conduct missions beyond Earth's atmosphere. This paper delves into the remarkable advancements in AI technologies that are reshaping the landscape of space exploration. From autonomous spacecraft operations to intelligent data analysis, AI is unlocking new frontiers and expanding our understanding of the cosmos. In this exploration, we will examine the pivotal role of AI in navigating the complexities of space missions, optimizing resource utilization, and driving innovation in scientific discovery. Join us as we embark on a journey through the cutting-edge developments that are propelling humanity further into the depths of space.

VIII. APPLICATIONS OF A.I. IN SPACE RESEARCH IN THE FUTURE

The recent achievements in AI-based capabilities have ignited discussions about their potential applications in future space exploration. These advancements enable onboard decision-making AI techniques to assist satellites in identifying and reporting scientific phenomena. This allows spacecraft to respond to occurrences by conducting further examinations, representing the most aggressive implementation of such technologies. Dynamic environments, such as comets, could potentially benefit from onboard decision-making capabilities.

A. *Applications in Earth Science*

ASE has enabled the establishment of a sensor-web onboard EO-1 that connects autonomous decision-making nodes to research Earth scientific occurrences. EO-1 is integrated with other space-faring surveillance facilities as well as surface devices such as seismographs, tilt meters, and thermostats to monitor geological eruptions, storms, lagoon and snowfall. In the deployments of the ASE and EO-1 sensor webs, AI performed a number of roles, highlighting the potential of onboard decision-making to improve Earth science:

- Machine learning is used to create event detectors that follow scientific occurrences while also understanding noisy and incomplete data.
- Automated planning systems prioritise the highest-priority objectives for observational resources.
- Task execution systems deal with the execution irregularities that come with real-time systems.
- Future sensor-webs in other planetary orbits will benefit from the applications pioneered in Earth orbit [4, 8-10].

B. *Applications on Mars*

Recent discoveries have revealed that Mars is significantly more active than previously thought. Image processing software will be sent to Opportunity and Spirit rovers in July 2006, allowing on the ship evaluation of clouds and dust devils. [6] The rovers can now easily valuate these random events because to the new software, which allows them to downlink just the photos or image parts containing the targets of interest. Such research will help us learn more about the atmosphere of Mars. THEMIS, a Mars Odyssey Orbiter sensor, will aid in the detection and tracking of phenomena like include thermal anomalies generated by volcanic eruptions, climatic variables in the northern freeze - thaw, sandstorms, and cloud formations of water ice. [9] Other fascinating dynamic elements are dust devil streaks and black slope tails. Surface missions to research Mars geology might benefit from onboard decision-making. A rover that can identify when it goes from a lava flow to a water deposition location, for example, might allow for more efficient exploration of the Martian surface.

C. *Applications on other planets*

Consider taking a voyage to IO, one of the Jupiter's moons that are in our solar system, the most active volcano, in order to illustrate the benefits of onboard artificial intelligence and spacecraft independence. Despite the extensive research of Io conducted by NASA's Galileo spacecraft, numerous doubts remain concerning the particular nature of the planet's volcanic movements, such as the lava's composition spilling on the surface of the planet [2, 5]. Because of the high temperatures associated with lava eruptions, Io's interior composition and evolution models are restricted. Rare lava fountain events that show relatively extensive expanses of liquid lava at or near the temperature of the liquid lava's eruption are suitable for investigating lava temperature since they occur seldom. A star ship equipped with onboard decision-making might notice such an incident within seconds, even if it was a long distance away [6, 9]. It might then make use of such data to gather findings while close approach and to reset equipment in order to reduce detector saturation caused by the heat source [7]. The addition of extra instruments to study the eruption site and collect compositional data, such as high-resolution infrared spectra, might be part of a later inquiry.

Europa

For a proposed mission to Europa, one of Jupiter's moons, to exist, much alone explore, it would need a great deal of autonomy. After landing on the icy surface of Europa and breaking through the ice sheets, submersibles may next be released to investigate the ocean depths under the ice cover are all necessary processes to access the subterranean ocean on Europa's frozen surface. The thickness and nature of the ice cover, the emission necessary for piercing the sheets, and the sensor efficacy in the subsurface ocean would all be factors to consider for such a probe. Onboard autonomy has an enormous challenge in surviving the voyage, operating with limited contacts with Earth, and achieving research goals [4, 11].

Titan

The Cassini spacecraft discovered that Saturn's moon Titan has a rich and varied topography. Its gravity is very less (one-seventh that of the Earth) and voluminous airspace (4X times of the Blue planet) make it an attractive destination for astronauts, appealing location for airborne exploration. In this investigation, there are two main reasons for claiming autonomy [1]. First, because approximately two to two and a half hours is required for two-way light operation interactive operations are basically ruled out. If a balloon is drifting at 1 m/s and at height of 5 kilometres it can picture adequately. By the time the aerobat can transmit a message to Earth and get a feedback that will be outside the range of whatever thing prompted the signal [2]. Downlink bandwidth is the second concern. An aerobot with a point able antenna can transfer data directly to Earth at a few kilobits per second (when the Earth is above the horizon) [10]. An expedition in the North Pole in the 2015–2020 timescale) would've had a steady vision of Earth; on the other hand, a mission at lower altitudes would be visible to Earth only about a third to two - thirds. Generally, the aerobat would be maintained by a shuttle via a low-gain antennae and a UHF link [3, 11]. However, owing to Titan's orbital dynamics, the relay link will be known for just a few tens of minutes at a time, perhaps once or twice a day. This relay link is capable of transmitting hundreds of megabits per second and necessitates the separation of high-priority data for immediate transmission enabling lower-priority data to be buffered and down linked when a relay opportunity arises in the foreseeable future In most cases, a Titan aerobot would have the following instruments: The use of a subterranean radar sounder to detect underlying stratification, concealed fissures, and other anomalies in organic deposits; in situ measurements of temperature, humidity, and methane abundance; and other methods and a Titan aerobat with inbuilt decision-making might possibly examine dynamic phenomena like methane thunderstorms. cryovolcanic eruptions, or methane geysers. While such events would be dangerous to study, the findings would be of enormous scientific value. It's possible that a self-contained system might collect data from such an incident [11].

D. *Various other missions*

AI as well as on-board choice will be easily accessible applicable to missions to comets and other dynamic bodies. Approaching a comet necessitates circling a tiny entity in a hostile system. Geysers or plumes erupting from surfaces of different comet are both fascinating scientific phenomena and potential threats to the spacecraft. Mission capabilities include capturing these occurrences in detail, taking their samples, gathering and landing sample of subsurface. Landing and drilling for samples are both difficult tasks [2]. Uncertain surface hardness, for example, makes predicting the time or power necessary to drill to particular depths challenging. NASA astrophysics missions, such as ones designed to locate planets near other stars, will benefit from onboard decision-making. Another promising area for AI use is space weather. Several satellites operated by NASA and other organisations monitor the sun for different events, including coronal mass ejections. These occurrences have a significant impact on power grids, communications, and satellites close to the Earth surface, and a space weather sensor-web of equipment might detect and track them [10-11].

IX. HUMAN SPACE EXPLORATION AND UTILIZATION OF AI

As part of NASA's current exploration strategy, a new spacecraft is being developed that will put an emphasis on human space exploration once again. Low-Earth orbit missions, returning humans to the moon, supporting a prolonged stay on the moon's surface, and eventually allowing humans to visit Mars are all goals of the CEV [2, 4, 8]. As a first step, it may seem like an odd choice to look at AI's future in the context of human endeavours. To put it another way, it's a crucial factor in the development of more intelligent spacecraft. Human spaceflight will undergo a number of important modifications when it advances beyond low Earth orbit. As missions get longer and more complicated, they'll require improved management of operations plans and crew scheduling in addition to other issues requiring task coordination [10-11].

X. OPERATIONS AND CREW INTELLIGENCE

The involvement of ground operations staff is significant in traditional mission planning, including crew scheduling. However, this approach is often at odds with both human nature and the purpose of human space travel. For instance, crew members aboard Skylab were discontent with the rigid planning imposed on the mission. In contrast, the International Space Station (ISS) now offers crew members greater autonomy in choosing their work schedules, thanks to its more flexible operations. Nevertheless, spaceflight operations are too intricate and hazardous to rely solely on ad-hoc decisions. The complexity arises from interdependencies across processes, resource constraints, and demanding tasks, making it challenging to modify operational plans. AI-driven mission operation systems have already demonstrated their effectiveness in planning scientific operations. These technologies, facilitated through interactive systems, can aid crews, ground operations professionals, and others in managing operational plans. These tools enable the crew to securely coordinate their own schedules while aligning with Earth-based mission objectives and constraints.

XI. MANAGEMENT OF INTELLIGENT SYSTEMS

As human space travel becomes increasingly intricate, sustaining the level of specialized expertise and personnel required to oversee and manage all systems from the ground will become unfeasible. As humans venture beyond low Earth orbit, collaboration between crew and ground staff will be hindered by light-speed latency and communication disruptions. Consequently, crew members will assume responsibility for maintaining and monitoring their own systems. Artificial intelligence (AI)-based systems emerge as an attractive solution to aid in system management, given that crew members have additional responsibilities and may lack comprehensive knowledge of system operations. Intelligent process automation combines AI-based control features with significant human input, including state evaluation, decision-making, and execution.

Figure 1. Space Exploration mission using AI [5]

To cater to the needs and preferences of the crew, AI software can offer situational awareness, explanations, and summarized information. Consider, for instance, the power system of a spacecraft. Managing production, such as energy generated by solar panels, storage in batteries, load control, crucial system protection, distribution, and more, all fall under power management. This task is not suited for crew members; instead, the specifics should be handled by automated control software. In routine operations, this involves adhering to a plan, monitoring the system's status, making load management decisions, and other related activities. It's evident that the power system doesn't operate in isolation; other systems reliant on electricity must work in coordination with power management. Additionally, the orientation of the spacecraft significantly impacts the efficiency of solar panels in generating power. Moreover, crew actions and demands exert a significant influence on power management. Automated software must be capable of identifying the root cause of a problem and, if necessary, providing a prompt initial response in this environment. Furthermore, comprehensive awareness of crew activities, including the criticality of failures and ground communication, is essential. In emergency situations, repairs and system adjustments may be carried out by the software, in collaboration with the crew and possibly ground control. AI-based management systems present compelling arguments for lunar exploration and development, although current system operations may suffice for near-term exploration and development in Earth's orbit.

XII. EXPLORATION BY HUMANS AND ROBOTS

The final human's objective presence in space to establish a permanent presence on celestial bodies throughout the solar system, beginning with the Moon and continuing on to Mars and beyond. Extensive study in space, moons, and Mars will be required to achieve these aims. However, human space explorers are capable and flexible, but they have a limited capacity and population [7]. From data-gathering scout rovers to in-situ resource use and habitat construction, the use of robotics in future investigations seems inevitable. Take a look at how things could develop on the surface of the moon in the future [8]. Some astronauts are stationed in a domain close to the lunar South Pole.

Figure 2. The robotic device to hover over the surface [8]

Both of these initiatives are crucial for the crew, as they aim to enhance their capabilities while deepening their understanding of the area. Due to the vulnerability of cosmic waves and the limitations posed by lunar dust, the crew's ability to operate outside for extended periods is restricted, leading to the utilization of robotic devices for tasks that do not require human involvement. These tasks include scouting the arctic region, gathering data for research and technical operations, executing specific building and setup tasks, and more. Many of these robotic functions can be directed by the crew from within the habitat, while robotics continue to assist them when crew members venture outside. Depending on the requirements and circumstances, humans or automated software may control the robotics. Collaborative human-robotic operations on Earth and other planets, such as Mars, present some of the most challenging aspects of space travel for artificial intelligence. AI applications have traditionally involved the management of robots, such as rovers, but they also encompass human-robot interaction, location awareness for both robots and humans, and dynamic operational scenarios. NASA's investment in space-based network systems has been driven by the success of using relays on Mars to download information from Spirit and Opportunity rovers, and sensor-web situations are becoming increasingly common. The Mars Reconnaissance Orbiter, launched by NASA, serves as a relay for the Mars Lab rover mission, and the Mars Science Telecom Orbiter is expected to act as a specialized networking platform on Mars. Space-based networking will facilitate missions that utilize space platforms to achieve their objectives. While EO-1 has demonstrated the capabilities of sensor webs on the ground, scenarios on Mars, where an event's detection begins on an orbiting platform and is followed up on by ground assets, are within reach. Such scenarios highlight the platform's ability to adapt over time. As space assets continue to participate in various coordination arrangements enabled by space networks, their versatility grows. Further research in rationality, reasoning, genetic systems, and other machine intelligence technologies is necessary to achieve these objectives. Systematic space platform data feed into AI research in areas like distributed design and control, as well as distributed fault management. With time, space platforms, if they can endure for over a decade, may enhance mission goals over years and ultimately accomplish tasks beyond their initial design scope.

XIII. CONCLUSION

Artificial intelligence (AI) is assuming an increasingly vital role in space exploration, as highlighted in this article, ranging from the coordination of spaceship operations to the development of AI-based aides. Thanks to significant advancements in AI, it has even enabled the capture of the first image of a black hole. However, amidst these achievements, concerns regarding privacy and maintenance must not be overlooked. NASA is already strategizing space missions that may leverage a network of autonomous spacecraft, deploying intelligent agents into space. These fleets could undertake complex scientific endeavors, traveling to diverse locations, exchanging findings, and efficiently distributing tasks among themselves. Distributed AI methodologies are expected to be employed for tasks such as modeling, routing, resource management, networked fault detection, and coordination of the constellation's components.

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AI Revolutionizing Education: Opportunities and Challenges

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Abstract. The integration of computers within educational settings has been a longstanding practice. However, recent advancements in artificial intelligence (AI) research have profoundly impacted teaching and learning processes. AI applications have ushered in significant changes in education, facilitated by the rapid progress of computing technologies, which have enabled the execution of AI in Education (AIED) applications. AIED encompasses the utilization of AI methodologies or application programs in educational contexts, with the aim of simplifying teaching methods, enhancing decision-making processes, and optimizing learning outcomes.

This study aims to thoroughly investigate the role of artificial intelligence in education. Through a meticulous content analysis of scholarly literature, the research endeavors to elucidate the diverse applications of AI within the education sector, identify emerging research trends, and underscore the inherent advantages of AI in education. Additionally, the study seeks to identify and analyze challenges associated with AI integration in education, offering insights to inform education reform initiatives utilizing AI technologies.

Keywords: Artificial Intelligence, AIED, Education, Advantages and Challenges of AI in Education.

1 Introduction

Education holds a paramount position within society, exerting substantial influence across diverse spheres. Its pivotal role necessitates universal access, transcending barriers of any nature. For instance, the onset of the COVID-19 pandemic highlighted the formidable challenges confronting educators, catalyzing heightened research attention. However, persistent societal issues endure, encompassing disparities in educational access, logistical hurdles in reaching remote classrooms, and financial constraints. This study, recognizing the multifaceted nature of these challenges, seeks to explore potential avenues for resolution, with a particular focus on technological solutions, notably Artificial Intelligence (AI)[1].

The emergence of cloud computing, big data, machine learning and artificial neural networks has allowed engineers to form a machine that can assemble human intelligence. Building on these technologies, this concept states to machines that are intelligent to observe, identify, learn, react, and explain problems as artificial intelligence. Artificial intelligence is changing every area of society and the education sector as well [2].

AI's strategic significance in education is increasingly apparent. Prior studies have illuminated AI's role as an effective learning facilitator, easing the burdens on educators and students while fostering enhanced learning outcomes. This underscores the integral connection between the trajectory of education and the ongoing advancements in technology[3][4].

The continuous evolution of AI holds promises in addressing persistent challenges within the education sector with greater precision. Moreover, these advancements are poised to bring about substantial transformations in future workplaces. While AI presents opportunities to augment human capabilities, its disruptive potential cannot be overlooked. As such, economists, political analysts, military advisors, security experts, and education stakeholders are turning their focus towards the emerging opportunities and implications of AI. [5].

This paper is intended to revisit the role of AI in education that have been accomplished by emphasizing their key aspects along with the related challenges. The main aim of this paper is to highlight the current usages of AI in education along with its advantages in education. This paper is structured in four sections. This section, being an introduction, offers a brief outline of AI in education and its usage in education have been reviewed in section II; Section III – advantages of AI in education; section IV- Challenges of AI.

Finally, conclusions and future research are given in section V.

2 AI in Education

Artificial intelligence has played a very important role in education that has been further increased over the last few years by the COVID pandemic. The adoption of AI may have been potentially amplified in the educational sector, as it plays many roles (e.g. accessing information, communication between teachers and students) and im- proves trends in education. Over the past few years, we've seen personalization be- come popular as an educational method, where educating someone depends on their knowledge level, how quickly they learn, and what skills or goals they want to achieve from their education or course. Unlike with traditional teaching methods, artificial intelligence plays an incredibly important role here [3][6].

In addition, AI has also solved the issue of quick responses. It can answer repetitive and commonly asked questions in seconds and overcome the frustration of long de- lays. There are many different roles that AI can be used for educational purposes that is, helping as an intelligent tutoring, smart learner, intelligent learning model/partner, or policy-making advisor, task automation, as shown in Fig. 1. In previous research, many AIED studies have been conveyed by researchers. These research works can generally be considered into five functions.

2.1 Intelligent Tutoring: The predominant category within AI in Education (AIED) applications encompasses intelligent tutoring systems, personalized learning platforms, and recommendation systems. Extensive meta-analytic research has consistently underscored the effectiveness of intelligent tutoring systems in promoting learning outcomes [7]. Cognitive Tutors stand out as a pioneering example of intelligent tutoring systems, renowned for their efficacy in supporting instruction in sciences and mathematics. AutoTutor represents another notable advancement in this realm. For instance, ASSISTments exemplifies the integration of smart tutoring with assessment features, facilitating real-time feedback for students during assignments and providing data-driven summaries for teachers following each assignment.

2.2 Smart Learner: Most AI-based educational systems focus on learning process. Rather than to provide opportunity to motivate learners to perform as tutor. Nevertheless, involving learners in the process of teaching known as smart learners(tutee) may help promote their higher-order thinking skills and knowledge levels. Although there were lack of studies which claim to develop intelligent learner intentionally and clear- ly, many artificial intelligence models have been developed that can learn from inter- action with people. As people interact with AI, the models and methods are better able to develop intelligent tutee in the future. For example, a smart learner could be a chatbot such as Microsoft Tay [8][9] with NLP interface and artificial neural net- works.

2.3 Intelligent Learning Models or Partner: From the constructivist and student- centered learning perspective, the facility of an intelligent learning tool or a partner is an important issue. The device can aid learners to gather and study data in effective and actual ways, empowering them to emphasis on serious points or higher-order thinking instead of low-level tasks. Some tools can even examine and produce data in a "smart" way that supports learners deliberate in depth and find appreciated suggestions underlying the data. Recently, knowledge graph is a successful field in artificial intelligence. Knowledge graphs can create relationships between different entities, using AI models [10]. There has been some research in the area of using knowledge graphs for educational purposes, which could be promising if taken on as an area of exploration by intelligent learning tools or partners.

2.4 Policy-making Advisor: AI techniques have been working in notify and guide progress of policy or laws in the recent years [8][10]. With help of AI technologies, policymakers can more exactly understand the drifts and difficulties in educational settings from both small and vast viewpoints, which can support them shape and estimate effective educational policies.

2.5 Task Automation: There are two types of difficulties in education; academic and administrative difficulties. AI has the potential to automate the respective personnel and departmental tasks. Admission departments are embracing AI tools to alleviate the administrative workload. These innovative solutions assist in tasks such as application review, document management, and applicant correspondence. Similarly, AI is also supporting teachers by taking care of their tasks successfully, such as grading paper, assignment checking, reducing admin- istrative labor, exam assessment, attendance, and records. teachers can use support automation systems and software to automate the manual task, so they can focus on improving their teaching skills [8][9].

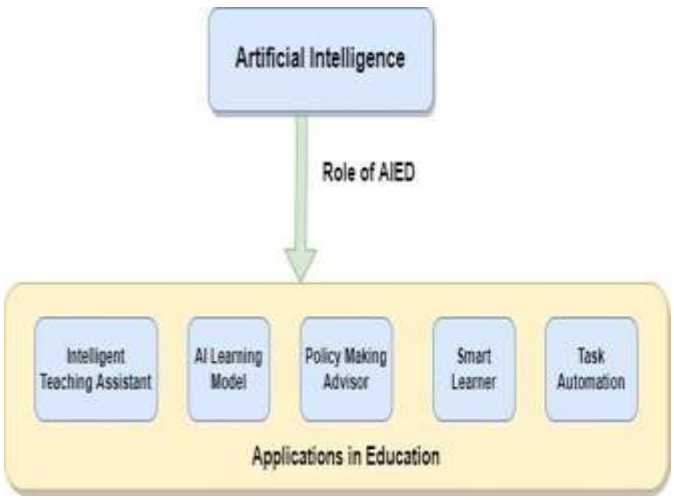

Fig. 1. Role of AI in Education

3 Opportunities of AI in Education

- In today's digital age, schoolchildren frequently spend considerable time on their smartphones. Intelligent AI applications leverage this trend by offering students the opportunity to study during their free time on smartphones or tablets. Through gamification, these applications present educational content in engaging formats, aiding students in grasping concepts more effortlessly.
- Moreover, AI serves as a valuable support for students encountering difficulties during lectures by harnessing Gesture Recognition technology. This pioneering method empowers AI systems to interpret students' facial expressions and gestures, enabling timely adjustments to lesson delivery to enhance understanding and engagement [11].
- AI offers a plethora of resources to individuals with varying language proficiencies or learning challenges. One such resource is the Presentation Translator, an AI-powered system that generates real-time subtitles. This technology enables students to engage with educational content in their native language using platforms like Google Translate [12].
- Social robots, designed to emulate human social behavior and engage in interaction, are becoming increasingly integral to education. These robots fulfill various educational roles, including training and teaching, through their adeptness at eliciting social responses from individuals.
- Within AI in Education (AIED) systems, key components include the Domain Knowledge model, which enables the system to guide students towards solutions, the Student Model, providing insights into each student's skills and knowledge, and the Pedagogy Model, facilitating communication between learners and the system [12].
- Voice Assistants represent a transformative application of AI in education, allowing students to access educational resources directly from the internet or installed devices without teacher intervention. Some educational institutions have adopted voice assistants to replace traditional materials or complex websites, with notable examples including Cortana, Google Assistant, Alexa, and Siri.
- Speech recognition and analysis, a prominent AI feature, supports foreign language instruction and pronunciation correction for educators [13].

- AI-driven sensors and cameras meticulously document classroom dynamics and student engagement, furnishing educators with instantaneous feedback and tailored recommendations[14].
- Intelligent Tutoring Systems are meticulously crafted to deliver personalized, one-on-one tutoring experiences. Educators harness sophisticated neural networks and algorithms to fine-tune instructional approaches for individual students [15].
- AI-powered tools facilitate the customization of academic curricula, paving the way for the establishment of global classrooms that cater to the diverse needs of special education students. Additionally, AI streamlines the laborious task of grading homework and assessments in traditional educational settings.
- AI is poised to play a pivotal role in higher education, potentially reshaping administrative structures and even redefining the role of university professors [13][14].
- AI streamlines and enhances admissions and enrollment procedures within educational institutions, with untapped potential yet to be fully realized [8][9]. Education policies undergo transformation with the integration of AI-driven curricula. Smart systems are revolutionizing educational institutions across all tiers, from elementary schools to universities, fostering enhanced learning outcomes and empowering individuals to achieve their educational aspirations.

4 Challenges of AI in Education

AI is finding extensive application across diverse educational sectors, including K-12 education, language learning, corporate training, quality assurance, higher education, and literacy programs. However, the integration of AI into education faces numerous challenges.

4.1 An all-inclusive public policy on AI for development.

Though we know AI has the potential to make education systems much better, we don't have the right policies in place to support its implementation. The government needs to offer funding and ethics guidance for teachers who want to reach their stu- dents in the future [16]. The private sector has been doing its share of work, providing innovation in education systems, but the government is behind. We need a robust policy focus and it'll be coming soon as AI becomes increasingly integrated into our lives.

4.2 Inclusion and Equity in AI in Education

Policymakers should take into account equity and inclusion when designing policy. People without access to information technology will be left behind in the digital world. When designing policies, it is important to think about equity and inclusion. Policies should be designed with these aspects the urgency of infrastructure in devel- oping countries, what we've learned from last time about digital rights, and the bene- fits AI can have for those disadvantaged groups and bridge the gap between economically rich and poor students [17]. Additionally Multiple policies must be put in place to remove these basic obstacles such as internet reliability, ICT hardware availability, Data costs and basic skills etc. For a successful development, we need to remove these obstacles. Internet is as important as a human right and should be considered by international organizations.

4.3 Preparing teachers for AI-powered Education

It is important to address the existing problems that teachers experience. Creative and social-emotional aspects of teaching cannot be neglected, and AI must provide a solid foundation for cognition. Several countries have created policies to support efforts to promote innovation and intensify efforts while empowering teachers and schools [18].

4.4 Develop quality and inclusive data systems

The available data is constrained, thus making learning outcomes closely intertwined with factors such as students' emotional health, socio-economic background, family circumstances, and governmental regulations. Consequently, it is essential to approach the evaluation of system benefits with careful consideration of the associated costs of data collection. [17].

4.5 Ethics and Transparency

There are many sources of ethical concern when it comes to the use of artificial intel- license. For example, data privacy is an immediate question that must be addressed when discussing how to ethically use any data. Getting pre-informed consent before collecting and using personal data is important for the protection of individuals' priva- cy and personally identifiable information [18].

4.6 Enhancing research on AI in education

Certainly. Despite the increasing interest in the application of AI within education, the sector continues to face challenges in translating research findings into actionable practices and policy frameworks. These difficulties arise from the sheer volume of research output, the gap between researchers and practitioners, and the need to align with the rapid evolution of technology. Addressing these challenges necessitates fostering robust collaboration among researchers, educators, and policymakers to ensure that AI integration in education is both effective and impactful. [18][19].

4.7 Learning for Life

A pressing need emerges for technology that empowers learners to engage in personalized learning experiences while fostering effective collaborations between educators and students. This imperative emphasizes the importance of efficacy not only at individual levels but also within groups and broader societal contexts. Unlike previous challenges, this mandate extends beyond individual learners, highlighting the critical role of enhanced student-student communication. With the increasing reliance on AI platforms for learning, there arises a concern about the potential impact on students' social communication skills if their primary interaction occurs with machines rather than peers. To mitigate this issue, it is essential to prioritize collaborative learning among students. AI education initiatives can establish distance learning models that prioritize social interaction, allowing students to engage in online study while also participating in group activities and interactions with peers across different settings [18][20].

5 Conclusion and Future Work

The fusion of AI and Education represents a profound shift not only in pedagogical practices but also in cognitive frameworks, human understanding, and philosophical paradigms. This convergence has garnered significant scholarly attention within the realms of computer science and education, offering a contemporary approach to learning and instruction. By harnessing the power of AI, students are afforded a transformative learning experience, free from the constraints of traditional educational barriers such as teacher shortages and limited content accessibility.

This study serves to illuminate the transformative impact of Artificial Intelligence on the educational landscape, offering invaluable insights into its potential to aid educators in navigating complex pedagogical challenges. Additionally, it provides a nuanced examination of the inherent challenges, advantages, emerging research trends, and future trajectories within this dynamic field. As scholars continue to explore the multifaceted applications of AI in education, future research endeavors hold promise for further elucidating its potential and refining its implementation in educational contexts.

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Automated Diabetic Retinopathy Using Improved Neural Network Based Classifier

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Abstract: The field of human services is wholly distinct from any other. It is a high-demand segment, and people expect the most attention and services regardless of cost. Despite the fact that it consumes a large amount of money, it did not achieve social desire. Medical masters complete the majority of the elucidations of medical information. A human master's ability to comprehend a picture's subjectivity, complexity, wide variation in translations, and exhaustion limit their ability to comprehend a picture. It is additionally giving stimulating courses of action high accuracy for clinical imaging and is viewed as a vital method for future applications in the prosperity area after it accomplished profound learning in other authentic applications. To begin, we discussed cutting-edge deep learning engineering as it relates to medical image classification and order. For medical imaging, deep learning-based techniques face difficulties and open research questions. Detection of diabetic retinopathy, which is the primary cause of vision loss in the working-age population, is of fundamental importance. Retinal images are still tedious even for clinicians who have been trained in the extraction of diabetic retinopathy events, so early detection of the disease can be helpful in the treatment of the disease. Recently, deep convolution neural networks have performed better than previous high-quality component based picture characterization techniques when it comes to analyzing the order of images. Our findings show that using a neural network system for diabetic retinopathy classification is more accurate than using traditional met.

Keywords: Diabetic Retinopathy, ML, Neural Network Based Classifier, CNN, Deep Learning, Image Processing.

Introduction

Diabetes, which is a life-threatening disorder, is caused by insulin insufficiency [1]. Blood sugar levels stay high and flow throughout the body because insulin release is restricted. As a result, blood sugar levels climb dangerously high. This disease affects every organ in the human body. Diabetes can harm the kidneys, heart, and eyes, to name a few organs [2]. Diabetes is divided into three types. Insulin secretion is completely absent in type 1 diabetes. Insulin shots are required for people with this kind of diabetes. Most people get type 2 diabetes by the age of forty. Obesity is frequently caused by both a genetic predisposition to being overweight or obese and a lack of physical development. During pregnancy, gestational diabetes develops [3].

Diabetes causes retinal damage, which leads to diabetic retinopathy (DR). In persons with diabetes, diabetic retinopathy (DR) is a micro vascular obstruction that causes retinal distortion. DR frequently manifests itself first in the veins of the retina. DR is the leading cause of vision loss and impairment in the vast majority of cases. Patients with diabetes have a higher chance of acquiring diabetic retinopathy (DR) than those who do not [4]. To begin with, there are no symptoms that indicate DR illness. Most patients begin to consider about DR improvement as their condition progresses or nears its end. If left untreated, DR worsens, resulting in vision loss and eye injury. Diabetics with the illness for more than 20 years are 80 percent likely to get DR. For successful treatment of DR, early detection is crucial. For diabetics, it is recommended that they see an ophthalmologist at least once a year. The DR will be thoroughly investigated at first. Ulcers and abnormalities in the veins are detected using a retinal fundus imaging. Photographs of the retinal fundus are taken with a fundus camera. Ocular drops are commonly used to extend the range of vision of the understudy when getting fundus photographs. The understudy expands as a result of these eye medicines. The shading fundus image is the most widely utilised method when compared to other ways. This is mostly due to its quick and unobtrusive nature. When trying to detect the DR in a photograph of a darkened retinal fundus, ophthalmologists have a severe issue. Manual DR conclusion by ophthalmologists is a time and resource costly task. If damage and anomalies in the fundus image can be pre-programmed, ophthalmologists should be able to diagnose and treat dry eye illness more effectively (DrD) [5].

When exudates are found and treated early, diabetic individuals' vision can be safeguarded. Students' eyes are often opened wider than necessary (a practice known as "mydriasis") in order to magnify the retina with an ophthalmometer. Mydriasis is widely treated with Tropicana, atropine, cocaine, mescaline, lysergic corrosive diethylamide, amphetamine, and other medications. This operation has an impact on the patient and lasts 15–20 minutes. The expanding drops may produce stinging, retching, dry mouth, and increased activity for a few hours, and may impair vision [6]. Short-term use of screening medications may compromise vision, in addition to diabetes-related retinopathy. Patients with diabetic retinopathy who have non-enlarged retinal pictures may have exudates that can be detected in the suggested work based on the facts previously mentioned [7]. For division and order, restorative image processing employs neural networks and fuzzy computations [8]. As a result of these AI calculations, the perfect opportunity for using a trained neural system to cope with therapeutic picture handling concerns is insignificant. However, building a brain system takes time, and restoring images often necessitates mind-boggling calculations [9]. The first automated identification algorithms for diabetic retinopathy to differentiate micro aneurysms from fluoresce in angiograms. Little round molded micro aneurysms were distinguished from associated extended structures, such as vessels, using a morphological top-cap alteration with a straight organizing component at various orientations. Despite the fact that the top-cap alteration was prone to micro aneurysms, there were so many false warnings.

Methodology

Here, the goal is a 1x20 grid with ten zeros and ten ones in each cell. To ensure that the error is minimized, the system is prepared on multiple occasions. Using associating loads, we can trace back errors from the yield layer to determine weight changes in the hidden layer. In the preparation set, this procedure is repeated for each new example. An age is defined as a single rotation of the preparation set. The number of ages required to prepare the system depends on a variety of factors, including the blunder in the yield layer [10]. A neural system has completed the characterization of information pictures. Counterfeit neural systems are able to sum up, adjusting to flag contortion and commotion without losing their strength. Because they are built on precedent, they don't necessitate an exact representation of examples or any sort of ordering criteria. Given the edited picture's pixel count, standard deviation, exudates and drains are referred to as typical, exuding, and draining. A retinal image was no problem for the system because it was pre-programmed to recognize it. A two-layer system of directed back engendering is employed in this project. There are two layers: the first is the input layer, and the second is the output layer [11]. The information layer has three neurons. Extracted highlights are used to determine how many neurons are needed in the information layer. The pixel tally, median, and range are the mathematical terms for these concepts [8]. Each image is now grouped according to the number of pixels it has in its background. Finally, exudates and ordinary must be grouped together. This is why two-layer systems are preferred. In the event that additional layers are needed, they can be added. "Shrouded layers" refer to these additional layers [12]. ANN is a logical or computational model and includes an interconnected assembling of phony neurons and methods information using a connectionist method for managing estimation [13-16]. In fig 1 shows multilayer organizes models. It would prefer not to have an inclination in a specific neuron, it very well may be precluded. Note that 'w' and 'b' are both flexible scalar parameters of the neuron. Regularly the exchange capacity is picked by the originator and afterward the parameters 'w' and 'b' will be balanced by some learning guideline with the goal that the neuron input/yield relationship meets some particular objective [17]. This new engineering presents another inquiry: how to prepare the concealed units for which the ideal yield isn't known. The Back propagation calculation offers an answer for this issue [18].

The preparation happens in a managed style. The essential thought is to display the info vector to the system; ascertain in the forward course the yield of each layer and the last yield of the system. For the yield layer the ideal qualities are known and in this way the loads can be balanced with respect to a solitary layer organize; on account of the BP calculation as indicated by the slope not too bad standard.

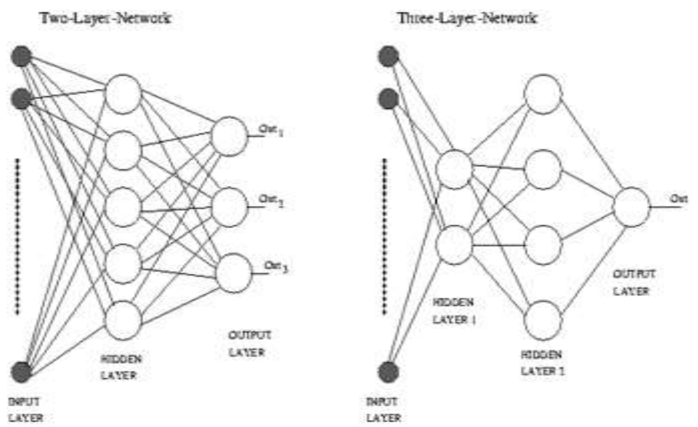

Fig. 1. Network laye

We made the principal malady ID that is 'drain' for those pictures having pixel tally more prominent than 5000. The exudates and the typical pictures can't be characterized dependent on pixel tally in light of the fact that their pixels checks are practically comparable. So we go for another two parameters which are mean and standard deviation by testing and preparing of picture we look at the yields of the yield layer neurons with the foreordained targets and in the event that they coordinate, relating yield is shown. The test execution of the system is assessed by figuring the measurable parameters, for example, mean and standard deviation which are given beneath. While taking the mean value it is observed that for normal images the values are less than 150, and for exudates it is greater than 150. In the case of standard deviation the values are less than 25 for normal images and greater than 25 for exudates [19].

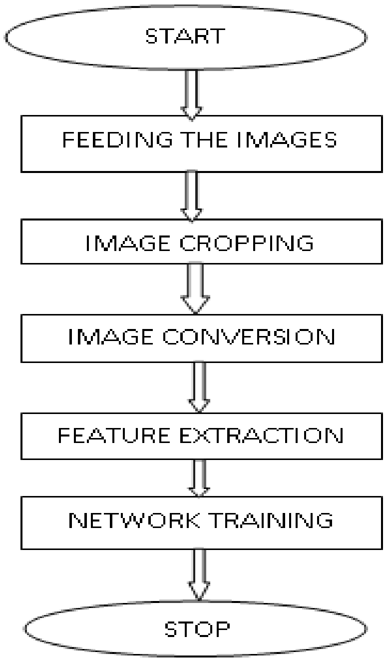

Fig. 2. Flow chart for training the neural network

Simulation And Result

Images from a range of patient groups, each with a distinct illumination setup for fundus imaging, are included in the data set. The illumination affects the image's pixel intensity values, causing the classification level to fluctuate in unanticipated ways. To detect and match input photos with target images, a multi-level neural network was deployed. Simulations were done in MATLAB, and methods were assessed for execution speed and precision of specific images.

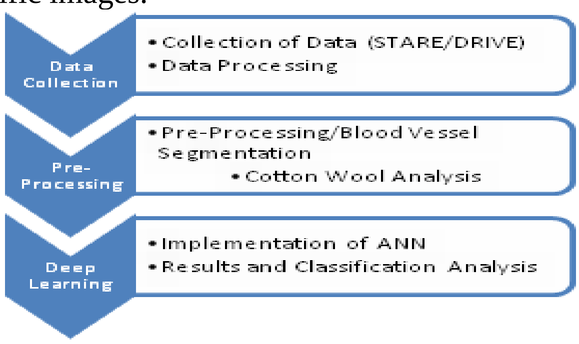

Fig. 3. Process flow Diagram

A consistent approach to grading the severity of diabetic retinopathy and treating patients with the condition is critical. Diabetic and non-proliferative diabetic retinopathies are both graded in this brief overview of diabetic retinopathy. The ophthalmologist uses the i4-2-1 rule to grade in on proliferative diabetic retinopathy, and it is put into action. An image is classified into one of the many different types of in on-proliferative diabetic retinopathy that have been developed by analysing various methods for extracting pathology associated with diabetic retinopathy. It is possible to use laser technology to treat diabetic retinopathy. As long as it is used correctly and on time, the risk of vision loss can be reduced by using lasers. It's important to understand the likelihood of losing money in a divorce, and to use appropriate management techniques to reduce the risk of losing money in a divorce. There are distinct patterns of retinal features that appear as the disease progresses (dark and bright lesions). If you recognise these patterns, you can use them to improve your vision. Based on the pixel count, mean, and standard deviation of three extracted features, the retinal images are classified and disease conditions are identified as exudates and haemorrhages or normal images. In order to accurately identify a disease, these features have certain threshold values. The threshold value of 5000 is used to detect haemorrhage (pixel count).The mean and standard deviation are used to classify normal images and exudates. This table shows the average pixel count of twenty images, the mean and standard deviation.

Table 1. Classification table

Mean	Standard Deviation	Output
< 150	<25	Normal
>150	>25	Exudates

Consider an exudates retinal image, then its corresponding cropped, binary, grey scale images will be appeared as shown below

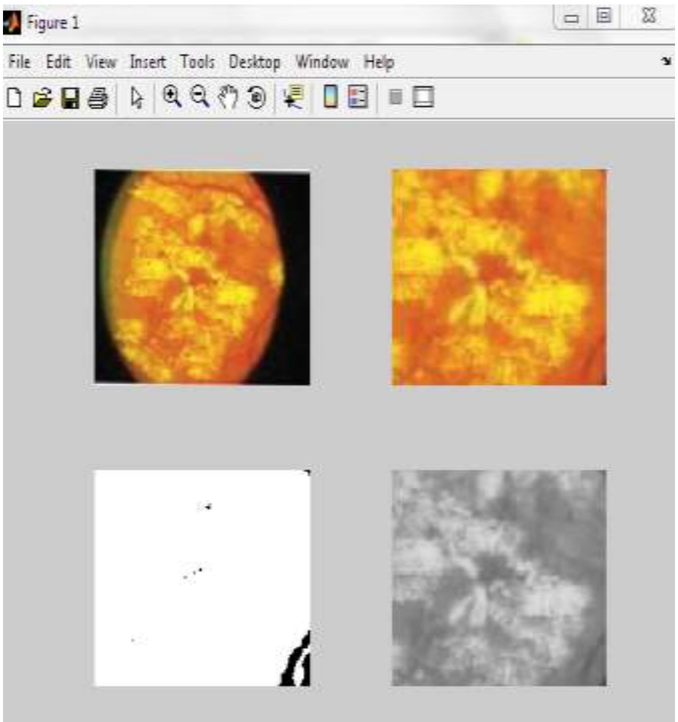

Fig. 4. Output figure window

Assume we fix the quantity of ages as 1000 and objective as 0.01. The organization will quit preparing when one of the, it is fulfilled to follow conditions. Whenever, the most extreme number of ages is reached. At the point when the exhibition is limited to objective. Most extreme measure of time is surpassed. At the point when the objective is accomplished in 5 ages, then the exhibition qualities will be as displayed below.

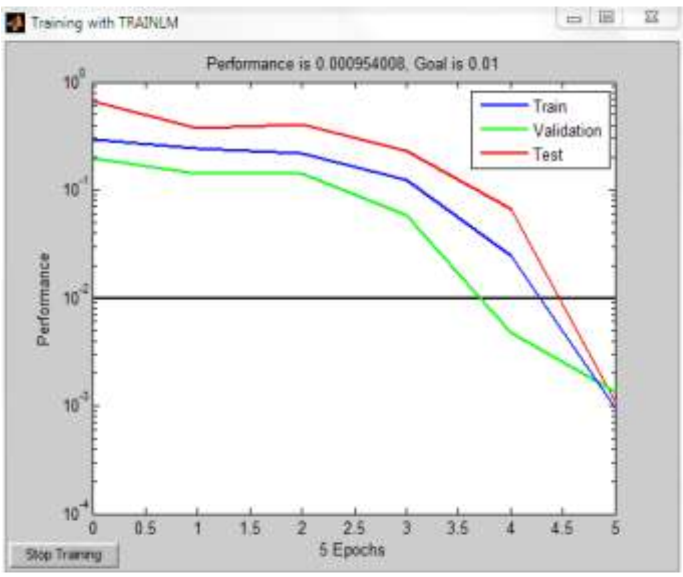

Fig. 5. Performance characteristics

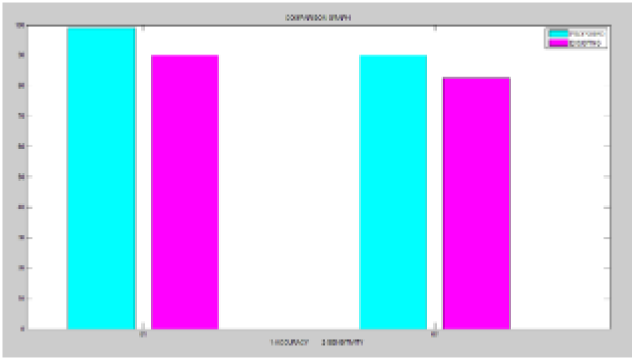

Fig. 6. Comparison between existing and proposed approach

Above figure shows that the proposed approach is better from the existing approach. It demonstrates a thorough examination of the accuracy and analysis of the suggested work. A recently created formula for increasing variations in the retinal veins has been evaluated in this study effort when it comes to fundus imaging. When a PC-supported structure of an advanced knowledge based retinal disease prediction framework is used, it was discovered that pre-preparation methods are more effective. The STARE and DRIVE databases' graphical user interfaces were used to create a vein division model that is both scientific and exhibitory in character. A suggested convolution neural network technique was used to identify diabetic retinopathy utilising data from two different sources. The proposed study can be used to successfully segment blood vessels and detect diabetic retinopathy

Conclusion

The most common cause of blindness is eye illnesses, which are frequently incurable because the patients have been found to be too sick to be cured. The purpose of this research was to offer image-preparation techniques that could aid in the diagnosis of diabetic retinopathy. The neural system classifier is constructed in this study as a mechanised demonstration equipment to assist the doctor in detecting these outliers in the typical eye structure. A multitude of factors, including the parameters utilized and the capabilities specified, determine the amount of precision attained. A framework for characterising diabetic retinopathy has been developed that includes improved image processing and a fake neural system. From what is revealed in this piece of art, medical applications can be developed. We're currently testing the framework on a large unconnected patient database, but it could be utilized in clinical practise in the future. Using fake neural circuits, this way of simulating diabetic retinopathy closely resembles the predicted state of the retina. In the research of diabetic retinopathy, these discoveries will be essential. This approach alerts diabetic patients to departures from the norm in diabetic retinopathy early on.

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EFFECTIVENESS OF DIMENSIONALITY REDUCTION IN BIOMETRIC MEASURES: A REVIEW

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Abstract

In recent years, biometrics have become an important part of personal identification and are widely used in many organizations around the world. We present a more in-depth analysis of the effectiveness of dimensionality reduction methods in biometric authentication. This is completely unacceptable when working on high volume biometric datasets, as the raw data generated by many applications is often unusable due to the curse of dimensionality, and data analysis is often difficult. Reducing feature dimensionality is one of the important links in the pattern recognition process, and therefore pattern recognition has become a hot and difficult topic in machine learning and information search. In surveillance-based biometric applications, large data sets with many features are often created. The process of mapping high-dimensional data to low-dimensional space via projection inevitably results in the loss of some original data. In order to benefit from large data sets obtained from various biometric applications, losses must be compensated.

1.0 Introduction

Big data, which has many features, is called high data and is attracting more and more attention today.

The speed of development and updating of the data set is increasing exponentially, and the data is created in a high-dimensional and unstructured manner. In many organizations, we use biometric systems that measure the accuracy of the selection process to achieve better results. Biometric system is a system that can identify a part of the body through its biometric information and this information can be stored in a database and defined as a matrix. This is a unique identification method that cannot be duplicated by anyone. Some popular biometric recognition technologies include DNA recognition technology, facial recognition technology, fingerprint recognition technology and iris recognition technology. An important task in machine learning algorithms is dimensionality reduction, which facilitates the integration, classification, compression and visualization of high-dimensional data by reducing the negative characteristics of high ground.

2.0 Importance of Biometric measures

Biometric systems are automatic systems essentially using various modalities to identify or / and recognize an individual [1], including fingerprint, face, hand geometry, iris, retina, signature, gait, palm print, voice model [2], ear[3], vein of the hand [4], DNA [5], etc. Biometric technology has emerged as a game-changer in the realm of internet security, and its significance can be attributed to several key factors:

Enhanced Security and Reliability: Biometrics offers increased security and reliability due to the inherent uniqueness of individual physical and behavioural traits when compared to traditional measures like passwords and tokens, which can be easily compromised, biometrics significantly reduces instances of security breaches and unauthorized access [6].

User-friendly Experience: Biometric systems often provide a more seamless and user-friendly experience than traditional authentication methods. Users no longer need to remember multiple passwords or carry access cards, as their unique traits can serve as their identification. This ease-of-use means compliance rates improve, leading to a more secure environment [7].

Reduced Dependency on Passwords: Passwords are vulnerable to numerous problems such as being easily forgettable, weak, or prone to theft. Biometrics offers a much stronger alternative that can bypass many of these password-related issues, contributing to the overall enhancement of internet security.

Multi-factor Authentication (MFA): Biometrics can be included as an additional layer in multi-factor authentication systems. By utilizing multiple independent verification methods (such as a password combined with a fingerprint scan), the chances of unauthorized access decline dramatically, bolstering online security.

3.0 Significance of dimensionality reduction

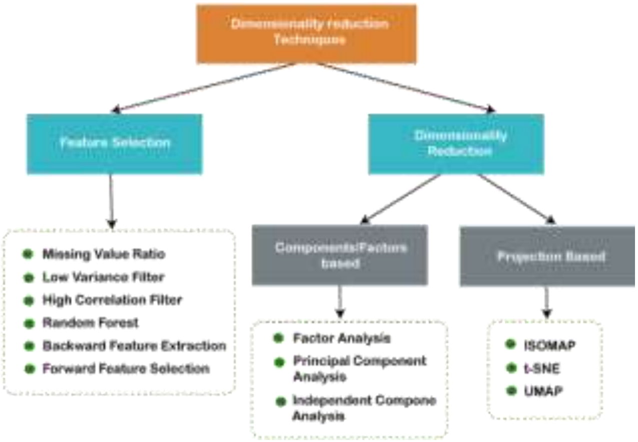
Real-world data, such as speech signals, digital photographs, or f MRI scans, usually has a high dimensionality. In order to handle such real-world data adequately, its dimensionality needs to be reduced. Dimensionality reduction is the transformation of high-dimensional data into a meaningful representation of reduced dimensionality. **Ideally, the reduced representation should have a dimensionality that corresponds to the intrinsic dimensionality of the data.** The intrinsic dimensionality of data is the minimum number of parameters needed to account for the observed properties of the data [8]. Dimensionality reduction is important in many domains, since it mitigates the curse of dimensionality and other undesired properties of high-dimensional spaces [9]. As a result, dimensionality reduction facilitates, among others, classification, visualization, and compression of high-dimensional data. Traditionally, dimensionality reduction was performed using linear techniques such as Principal Components Analysis (PCA) [10], factor analysis [11], and classical scaling [12]. Dimensionality reduction is a method for representing a given dataset using a lower number of features (i.e. dimensions) while still capturing the original data’s meaningful properties. This amounts to removing irrelevant or redundant features, or simply noisy data, to create a model with a lower number of variables. Dimensionality reduction covers an array of feature selection and data compression methods used during preprocessing. While dimensionality reduction methods differ in operation, they all transform high-dimensional spaces into low-dimensional spaces through variable extraction or combination. In

Figure -1: Classification of various Dimensionality reduction techniques

machine learning, high-dimensional data refers to data with a large number of features or variables. The curse of dimensionality is a common problem in machine learning, where the performance of the model deteriorates as the number of features increases. This is because the complexity of the model increases with the number of features, and it becomes more difficult to find a good solution. In addition, high-dimensional data can also lead to overfitting, where the model fits the training data too closely and does not generalize well to new data. Dimensionality reduction can help to mitigate these problems by reducing the complexity of the model and improving its generalization performance. There are two main approaches to dimensionality reduction: feature selection and feature extraction.

Feature Selection: Feature selection involves selecting a subset of the original features that are most relevant to the problem at hand. The goal is to reduce the dimensionality of the dataset while retaining the most important features. There are several methods for feature selection, including filter methods, wrapper methods, and embedded methods. Filter methods rank the features based on their relevance to the target variable, wrapper methods use the model performance as the criteria for selecting features, and embedded methods combine feature selection with the model training process.

Feature Extraction: Feature extraction involves creating new features by combining or transforming the original features. The goal is to create a set of features that captures the essence of the original data in a lower-dimensional space. There are several methods for feature extraction, including principal component analysis (PCA), linear discriminant analysis (LDA), and t-distributed stochastic neighbour embedding (t-SNE). PCA is a popular technique that projects the original features onto a lower-dimensional space while preserving as much of the variance as possible. Figure -1 illustrates various dimensionality reduction techniques.



4.0 Conclusion

It is very important to deploy right dimensionality reduction technique to increase the effectiveness of machine learning model for applications with high dimensional biometric measures. This will enhance the quality outcomes so that better result / inference could be made with respect to big data set.

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Examination of Role and Challenges in Implementing Recent Technologies in Agriculture: A route to Smart Agriculture

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Abstract: The Internet of Things (IoT), in which devices communicate and processes are automated and managed over the internet, has made great development in the digital age. In the field of agriculture, an IoT architecture provides numerous benefits for crop management and monitoring. As IoT sensors offer information about agricultural land and act on it based on user input, the notion of smart agriculture is gaining traction. This study focuses on smart agriculture's utilization of emerging technologies such as Machine Learning, Deep Learning, IoT, and automation. It investigates the tools and equipment used in this environment, as well as the anticipated difficulties connected with incorporating technology into traditional farming operations. Farmers and Home growers will benefit from the technical insights supplied throughout the crop.

Keywords: Smart Agriculture, Internet of Things, Machine Learning, Deep Learning, Neural Networks, Support Systems, Engineering.

1. Introduction

In the past, Historical agricultural practices were primarily focused on producing food in cultivated regions to ensure human survival and animal breeding. This age, known as traditional agriculture 1.0, relied primarily on physical labour and animals, as well as simple tools such as sickles and shovels. Because to the manual nature of the task, productivity remained poor. The nineteenth century saw the introduction of new agricultural machinery, particularly steam engines. This marked the start of the agricultural period 2.0, which was distinguished by the widespread use of machines and the increased use of pesticides by farmers. While this resulted in evident advances in farmer and farm efficiency and output, it also resulted in substantial downsides such as chemical contamination, environmental degradation, and depletion.

The rise of the agricultural era 3.0 in the twentieth century was distinguished by rapid advances in computation and electronics. To dramatically improve agricultural processes, this period adopted robotic methods, automated farming machinery, and numerous technology. The issues of the second agricultural era were successfully resolved, and policies for the third era were changed. This included, among other things, improving work distribution, executing precision irrigation, limiting chemical usage, applying site-specific nutrients, and implementing effective pest control methods. Agriculture's current phase, known as agricultural era 4.0, reflects the most recent progress in farming practices. It makes use of cutting-edge technology such as the Internet of Things, big data analytics, artificial intelligence, cloud computing, and remote sensing. The incorporation of these cutting-edge technologies has resulted in considerable improvements in agricultural processes. This includes the development of low-cost sensor and network platforms that maximize manufacturing efficiency while simultaneously lowering water and energy usage with minimal environmental impact. Big data in smart farming provides complete real-time insights into agricultural conditions, enabling farmers to make informed decisions. Real-time programming, based on artificial intelligence concepts, is implemented in IoT devices to help farmers make the best decisions.

Precision agriculture, enabled by smart farming, employs advanced technology to enable farmers to remotely monitor their crops. By automating sensors and gear, this strategy improves many agricultural processes, such as harvesting and crop yields, while also enhancing the efficiency of the farming labor. This transition from traditional farming practices to automated technologies is an agricultural technological revolution. The inclusion of technology in agriculture has transformed the way farming is done today, with the Internet of Things playing a critical part in changing traditional methods.

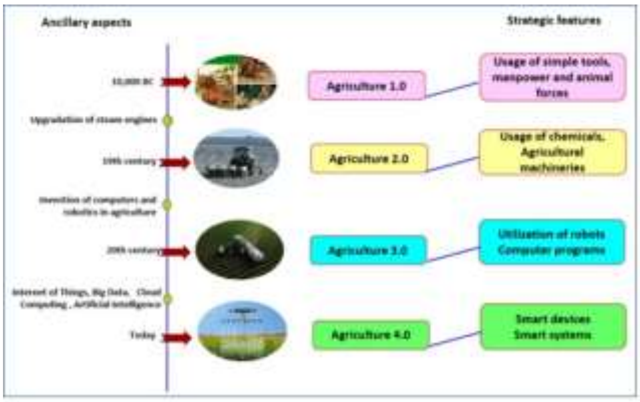
Smart farming is a new modern strategy that employs information and communication technology (ICT) to boost farm labor efficiency as well as the quantity and quality of agricultural products. By integrating modern ICT technologies such as the Internet of Things, GPS (Global Positioning Systems), sensors, robotics, drones, precision equipment, actuators, and data analytics, this technique examines farmers' needs and provides tailored solutions to address their difficulties. These technological advances improve decision-making precision and timeliness, resulting in higher agricultural productivity. Many multilateral organizations and poor countries worldwide have recommended the deployment of smart farming technologies to increase agricultural output. Crop sensor monitoring that is continuous and precise enables for the early detection of unfavorable conditions in the early stages of the crop's life cycle. From sowing to harvesting, storage, and transportation, intelligent tools are used throughout the farming process. The effective deployment of a diverse range of sensors has boosted the overall efficiency and profitability of the operation due to their accurate monitoring capabilities. Furthermore, because these sensors collect data quickly, they are immediately accessible online for in-depth research, delivering site-specific agricultural insights for each region.

Smart agriculture and monitoring tackle a range of issues related to crop production, specifically addressing shifts in soil characteristics, climate variables, and soil moisture levels. The primary goal is to optimize spatial management practices, ultimately boosting crop yield while minimizing the excessive use of fertilizers and pesticides. Artificial Neural Network (ANN) models are pivotal in Smart Irrigation Water Management (SIWM), overseeing irrigation scheduling support systems (DSS) and providing real-time data on metrics like irrigation efficiency, water productivity index, and irrigation water demand and supply. An emerging technology in developing nations is Climate-Smart Agriculture (CSA), holding promise for enhancing food security, fortifying farm system resilience, and reducing greenhouse gas emissions. Smart agriculture technology, grounded in IoT technologies, delivers immediate benefits across various agricultural processes such as irrigation, plant protection, quality improvement, fertilization, and disease prediction.

The merits of smart agriculture encompass real-time data collection on crops, precise assessment of soil and crops, remote monitoring by farmers, oversight of water and other natural resources, and improvement of livestock and agricultural production. Consequently, smart agriculture signifies the evolution of precision agriculture by employing modern and intelligent methods to gather diverse information on farm activities, enabling remote management supported by suitable real-time farm maintenance solutions. [1]

Fig 1: Framework for a system that assists farmers in making agricultural decisions.[1]

The Internet of Things (IoT) is a concept that



empowers the integration of technologies, fostering collaboration, communication, and the wireless transmission of real-time data from sensors for processing. This enables more informed decision-making in various research domains. IoT is rapidly advancing and finding applications in diverse areas such as healthcare, defense, industry, agriculture, and beyond. The capabilities of IoT are limitless, offering the potential to contribute to the advancement of civilization and the creation of a better quality of life [2]. To deploy IoT, one must possess knowledge in the relevant research area, along with the necessary hardware equipment and internet connectivity for device access. IoT involves the connection, communication, and data sharing among physical objects, namely smart devices. While the concept of IoT is not new, recent advancements in hardware technology have propelled its popularity for implementation [3]. The use of IoT in Auto-ID in 1998 garnered positive remarks from the U.S president, leading to significant encouragement and development in the field. When coupled with sensor networks, IoT introduces a novel way to interact with and observe real-time data in the physical world. This facilitates automation and decision-making processes. Creating an intelligent system using IoT for agriculture holds the potential to monitor crop growth and environmental conditions. Although the collection of raw data is crucial, the subsequent mining and analysis of this data are equally essential tasks [4]. The agricultural sector faces various challenges related to IoT, which can be effectively addressed, enabling us to forecast, monitor, and oversee the entire lifecycle of agricultural products. In India, where agriculture serves as the primary livelihood for a significant population, with nearly half relying on it for income, there is a crucial need for solutions in this domain. Our proposed architectural model encompasses three distinct layers: the physical layer, the IoT layer, and the Com-op layer. These layers collectively form a comprehensive management system, integrating consumer monitoring and automation services. The system possesses the capability to address diverse agricultural issues, including animal control, quality management, and supply-chain management [5].

1.1 Internet of Things

The Internet of Things (IoT) is an emerging technology facilitating remote connectivity of devices, particularly in the context of smart farming. Its impact extends across various industries, including health, commerce, communications, energy, and agriculture, with the aim of improving efficiency and performance across diverse markets. Existing applications offer insights into the impact of IoT and reveal practices that are yet to be fully explored. However, considering technological advancements, one can anticipate the pivotal role of IoT technologies are integrated into various agricultural activities, utilizing communication infrastructure, collecting data, employing smart objects, sensors, mobile devices, and cloud-based intelligent information to support decision-making and automate farming operations [6]. The implementation of IoT involves monitoring plants and animals, enabling the remote retrieval of information through mobile phones and devices. Farmers can utilize sensors and instruments to evaluate weather conditions and forecast production levels. In water harvesting, IoT plays a crucial role in monitoring and controlling flow, assessing crop water requirements, determining supply timing, and optimizing water conservation. Through sensors and cloud connectivity via gateways, this technology enables remote monitoring of soil and plant needs, facilitating effective water supply management. Addressing nutrient deficiencies, pests, and diseases manually for each plant is impractical, but IoT technology proves beneficial, marking a significant advancement in modern agriculture. [7].

1.2 Smart Agriculture

Smart Farming is a contemporary farming management approach that leverages advanced technology to enhance both the quantity and quality of agricultural products. In the 21st century, farmers have access to a range of technologies, including GPS, soil scanning, data management, and Internet of Things (IoT). The primary objective of research in smart agriculture is to establish a decision-making support system for effective farm management. This approach is crucial in addressing challenges related to population growth, climate change, and labor shortages, spanning activities from planting and irrigation to health monitoring and harvesting [8]. In IoT-based smart agriculture, a system is constructed to monitor crop fields using sensors for variables like light, humidity, temperature, and soil moisture, while also automating the irrigation system. The term IoT in agriculture involves the use of sensors, cameras, and other devices to convert every aspect of farming into data. The expansion and development of smart agriculture are imperative to significantly reduce the adverse environmental impacts associated with modern agricultural practices. Similarly, in smart cities, IoT devices such as connected sensors, lights, and meters are employed to collect and analyze data. This data is then utilized to enhance infrastructure, public utilities, services, and more. However, it is acknowledged that farmers face challenges in understanding technical terms and utilizing technology due to both the complexity and cost-effectiveness of these solutions [9]

1.3 Role of IoT in Advanced Farming Practices

Embracing novel approaches rooted in sensor and IoT technologies has significantly boosted crop yields compared to traditional agricultural methods. The integration of advanced sensor-based technologies in controlled environments is instrumental in elevating both the quality and quantity of agricultural produce.

1.3.1 Greenhouse Farming and Protected Cultivation

Cultivating plants in a controlled environment, dating back to the 19th Century, stands as one of the earliest forms of smart farming. This method gained further traction in the 20th Century, particularly in regions with challenging weather conditions. Plants grown indoors are less susceptible to environmental influences. Consequently, crops traditionally limited to specific conditions can now be cultivated at any time and place through the integration of sensors and communication devices. The success of crop production in controlled environments relies on several factors, including the design and materials of structures to mitigate wind effects, aeration systems, the precision of monitoring parameters, and the implementation of decision support systems. Precisely monitoring environmental parameters poses a significant challenge in greenhouses, necessitating multiple measurement points to predict and control various factors that ensure a conducive local climate. In IoT-based greenhouses, sensors play a crucial role in measuring and monitoring internal parameters such as humidity, temperature, light, and pressure.

1.3.2 Hydroponics

Hydroponics, a facet of hydroculture, entails cultivating plants without soil to optimize the benefits of greenhouse farming. In hydroponic irrigation systems, nutrients dissolved in water are uniformly delivered to plant roots as a solution. Modern systems and sensors have the capability to detect a broad spectrum of parameters, conducting data analysis at specified intervals. The precise measurement and monitoring of nutrient concentrations in the solution are vital for satisfying the requirements of plant growth. A real-time, wireless-sensor-based prototype has tackled soilless cultivation by measuring concentrations of various nutrients and water levels. An integrated automated smart hydroponics system, incorporating IoT, consists of three primary components: input data, a cloud server, and output data. This system allows remote monitoring of lettuce cultivation over the internet, analyzing real-time parameters such as pH level, nutrient-rich water-based solution, room temperature, and humidity. The deep flow technique in hydroponic systems involves cultivating plants by submerging roots in deep water layers, ensuring a continuous circulation of the plant nutrient solution. Sensors integrated into Raspberry Pi collect data on plant growth elements such as pH, temperature, humidity, and water level in the hydroponic reservoir. This data is automatically processed and monitored in real-time to ensure proper water circulation.

1.3.3. Vertical Farming

Traditional agricultural methods in the industrial sector degrade soil quality at a rate that outpaces the natural regeneration process. The alarming levels of erosion and the extensive use of freshwater in agriculture contribute to a decline in arable land and impose additional pressure on existing water reservoirs. Vertical farming (VF) provides an opportunity to cultivate plants in a precisely controlled environment, significantly mitigating resource consumption while concurrently enhancing production at various intervals. Furthermore, VF necessitates only a fraction of the ground surface, depending on the number of stacks. This approach proves highly efficient in achieving increased yields and reducing water usage compared to conventional farming. In the context of vertical farms, the measurement of carbon dioxide is a crucial parameter, and nondispersive infrared (NDIR) CO2 sensors play a pivotal role in monitoring and controlling environmental conditions.

2. Challenges in Adopting Smart Farming Technologies

The adoption of technology involves a process influenced by various heterogeneous factors. The integration of technology into farming systems has brought about improvements in accuracy, efficiency, and time management. Despite the enhanced productivity that smart farming offers, there remain challenges in the widespread adoption of these technologies.

2.1 Technology cost

Current technologies reduce the need for human labour and operate at a rapid pace with high precision. Consequently, there is an expectation that machines may eventually replace human workers. However, this is not a feasible scenario, especially in countries where the workforce serves as the primary resource for the agriculture sector, often linked to poverty. The adoption of devices and technologies involves significant financial investment, posing affordability challenges for farmers when they consider moving beyond conventional tools.

2.2. Lack of Financial Resources

In cases where farmers do not achieve the expected yield due to unforeseen events such as drought, flood, pests, or diseases affecting the crops, financial institutions/individuals have the option to offer sufficient loans to support the farmers.

2.3. Literacy Status of Farmers

The educational level among farmers poses a significant challenge in the adoption of technologies, particularly in developing countries. The necessary knowledge includes both educational and technical skills to effectively manage these tools. A higher level of education enhances a farmer's ability to process information, enabling them to make informed decisions using smart farming technologies. This, in turn, facilitates farmers' proficiency in using computers. In many developing nations, farmers often lack education and skills due to a lack of interest in acquiring knowledge or awareness of new technologies. Consequently, this becomes a factor that leads farmers to opt for traditional farming over smart farming. The perceived complexity of usage is another issue, with farmers sometimes struggling to recognize icons used in mobile applications, which are often based on traditional symbols. To bridge this gap, farmers need to be digitally literate, and agri-tech companies should ensure that farmers easily understand both the advantages and limitations of the technology.

2.4. Lack of Integration between the Systems

Advancements in smart farming technologies should focus on enhancing integration across systems, which involves the incorporation of production, property management, and decision-making tools. Bridging the gap between agricultural and information science requires improved communication between academics and interdisciplinary groups. The development of information systems places a greater emphasis on increasing user effectiveness. Enhanced decision-making relies on the timely availability of high-quality data; therefore, integration of data is crucial to generate comprehensive information and knowledge.

2.5. Management of data

Farmers encounter challenges in managing and processing data collected by sensors. Although weather stations generate data, farmers often lack the knowledge on how to utilize this information and convert the data into a more accessible format. The complexity of systems, coupled with issues of acceptability and usability, can result in inaccurate calculations. To address this, it is crucial for farmers, consultants, and other stakeholders in the production process to enhance accessibility to data and information within productive systems.

3. LITERATURE REVIEW

Fuentes et al. [23] study evaluated the effectiveness of different deep learning networks, including Faster R-CNN, R-FCN, and SSD, for categorizing diseases in tomatoes. The classification involved applying a Front Viewpoint to RGB images. The Keras framework, utilizing the TensorFlow language, implemented Data Augmentation as the primary methodology. The researchers introduced a method for local and global class annotation, along with data augmentation as the foundation of their approach. The results demonstrated improved accuracy and a reduction in false positives.

Natarajan et al [26] introduced an automated system designed for detecting diseases in cultivated land. Faster R-CNN with feature extraction was employed to identify and categorize tomato diseases in plants. The proposed model underwent training and testing using a dataset comprising approximately 1090 images depicting early and late stages of tomato diseases. The suggested system, utilizing ResNet50, demonstrated effective prediction of early blight, leaf curl, septoria, and bacterial leaf spot even in intricate plant environments.

Alvaro et al [28] produced a deep learning method for the real-time identification of diseases and pests in tomatoes using images captured by cameras. The focus was on three detector families: Single Shot Multibox Detector, Region-based Fully CNN, and Faster Region-based CNN. Each meta-architecture was combined with VGG net and Residual Network. The researchers also proposed a technique for local and global class annotation, along with data augmentation, to enhance precision and reduce false positives during training. The Tomato Diseases and Pests Database, containing images with various inter-class variations such as infection portions in leaves, was utilized for comprehensive model training and testing. The suggested method demonstrated the capability to identify nine distinct diseases and pests while effectively handling complex situations that may arise in the plant's surroundings.

Nagamani et al [30] explored machine learning tools such as Fuzzy-SVM, CNN, and Region-based CNN for the detection of diseases in tomato leaves. Images of tomato leaves exhibiting six diseases and healthy samples were utilized to validate the findings. The images underwent training using techniques such as picture scaling, color thresholding, flood filling, gradient local ternary pattern, and Zernike moments' attributes. The analysis and comparison of Fuzzy SVM, CNN, and R-CNN aimed to identify the most accurate classifier for plant disease detection. In comparison to other methods, R-CNN achieved an accuracy of 96.735 percent

Li et al [12] proposed method, LMBRNet, is introduced as a classifier for identifying diseases in tomato leaves, utilizing Complementary Grouped Dilated Residual feature extraction blocks. Four subsidiaries were created with convolutional kernels of varying dimensions to extract distinctive data on tomato illnesses and tomato leaf receptive fields. To address network degradation and gradient disappearance issues, a residual connection was incorporated. The performance of LMBRNet was tested on public datasets RS, SIW, and Plantvillage-corn. The results on all three datasets demonstrated high accuracy, with scores of 82.32%, 88.37%, and 97.25% on RS, SIW, and Plantvillage-corn, respectively, showcasing the robust generalizability of LMBRNet. When compared to specific datasets, LMBRNet outperformed MobileNetV3S and MobileNetV3L. Despite having a limited number of parameters (4.1M), its metrics were higher than MobileNetV3S (2.9M) and lower than MobileNetV3L (5.4M), indicating better generalization.

Sunil et al [14] proposed Multilevel Feature Fusion Network is presented for the classification of tomato leaf diseases. ResNet50, MFFN, and the Adaptive Attention Mechanism are employed to categorize leaf images. The suggested technique achieved high accuracy, with 99.88% in training, 99.9% in validation, and 99.8% in test accuracy. It outperformed currently employed methods suitable for the dataset. Additionally, the research provides insights into specific pesticides based on the type of leaf disease.

Astani et al [18] aims to swiftly and precisely detect 13 tomato diseases in both farm and laboratory settings using 260 ensemble techniques developed with feature extraction. The accuracy and precision of the suggested method were evaluated under diverse conditions, including laboratory and outdoor scenarios, with challenges posed by two databases, Plantvillage and Taiwan tomato leaves. The best ensemble classifier achieved a disease identification accuracy of 95.98%, effectively addressing challenges such as background clutter, multiple leaves, brightness changes, disease similarity, and shadow conditions. A comparison was made among the 260 recommended ensemble models and various deep learning models. The proposed approach outperformed most advanced deep learning models.

Wspanialy et al [21] trained a model to identify previously unrecognized tomato leaf diseases, and its ability to forecast disease severity was found to be comparable to human assessment. The shape of leaves was identified as having predictive capabilities for disease detection. To enhance dataset diversity and reduce accidental bias in backgrounds, future data gathering initiatives should address limitations in the PlantVillage information set and its image capturing methods. The idea of a diseased-healthy binary classifier as a predictor of healthy leaves was introduced. Beyond identifying diseases not previously trained on, such a classifier can help reduce the effort required to create an extensive dataset for general disease identification. The study also introduced a new dataset featuring proportional disease severity annotations and an associated classifier. Ordinal categories were found to be more effective for diseases caused by viruses and insects, while proportional area measures worked best for estimating severity in bacterial and fungal diseases. Implementing classifiers into an automated examination system can reduce costs, minimize errors, and enhance accuracy, making the findings applicable in practical settings.

Monika et al [27] conducted a research between 2019 and 2020, during which surveys observed the presence of various pests, including Aphids Myzus persicae and Macrosiphum euphorbiae, the serpentine leaf miner Liriomyzia trifolii, the fruit borer Helicoverpa armigera, and the whitefly Trialeurodes vaporariorum. Aphid species M. persicae were found in low hills, whereas mid hills showed tomato infestations by M. euphorbiae. In the mid-hills of Himachal Pradesh, a higher incidence of tomato pest infestations was noted compared to the low hills.

Ashok et al [29] proposed approach establishes a methodology that correlates the pixel intensity of input images and contrasts it with a trained image instance using Convolutional Neural Networks (CNN) for feature extraction. All metrics for adjusting leaf parts are optimized by reducing the error relative to the training set. This study recommends the utilization of image processing methods based on segmentation and clustering to detect tomato diseases. Leaf images are classified using an image classifier that employs Artificial Neural Networks (ANNs), fuzzy logic, and hybrid algorithms to differentiate between disease-affected and healthy leaves. The accuracy of the suggested method is reported to be 98%.

Bhandari et al [31] In addition to healthy leaves, this study aims to visually identify nine infectious diseases in tomato leaves, encompassing early and late blight, leaf mould, 2-spotted spider mite, Septoria leaf, bacterial spot, and mosaic virus. Without segmenting the dataset, EfficientNetB5 was utilized with 10 cross-folds. The classifier achieved accuracy rates of 99.84%, 98.28%, and 99.07% for training, validation, and testing data, respectively. The recommendation is to consider the integration of Gradient-weighted Class Activation Mapping and locally interpretable model-related discussions into agricultural practices for forecasting effectiveness.

Tian et al [32] proposed DL classifier based on private and public datasets of tomato leaf images for identifying diseases. VGG16, InceptionV3, and Resnet50 were trained and evaluated. To identify 9 different diseases and healthy tomato leaves, they installed trained model into Android application called TomatoGuard. TomatoGuard performed better than APP Plantix with 99% testing accuracy.

Martins et al [43] developed a machine learning classifier to evaluate the severity of leafminer fly infestations in tomatoes. The database comprised images capturing signs of pests on tomato leaves in field conditions. These images were manually annotated into three categories: background, leaves, and symptoms of leafminer fly infestation. Three classifiers and four different backbones were compared using metrics like accuracy, precision, and recall for a multiclass categorization. The U-Net classifier with Inceptionv3 yielded the best results, as indicated by a comparison of segmentation outcomes. For estimating symptom severity, the best classifier exhibited lower Root Mean Square Error (RMSE) values and utilized FPN with ResNet34 and DenseNet121 backbones.

Bouni et al [34] identifying and managing plant diseases, which have a considerable impact on food production, population health, plant quality, and productivity, poses a major challenge in agriculture. Manual identification of various plant diseases is time-consuming. The control of tomato diseases demands constant attention throughout the crop lifecycle and contributes significantly to the overall production costs. In this study, automation and pretrained Deep Neural Networks (DNN) were employed for the classification of tomato diseases. Digital image processing is utilized for monitoring plant diseases. Deep Learning (DL) has demonstrated superior performance compared to traditional methods in digital image processing. The article employs transfer learning and a deep Convolutional Neural Network (CNN) to predict tomato diseases. The core of the CNN classifier includes AlexNet, ResNet, VGG-16, and DenseNet. The relative performance of networks is analyzed using the Adam and RmsProp approaches, revealing that DenseNet with the RmsProp methodology achieves remarkable results with 99.9% accuracy.

Tarek et al [35] evaluated the performance of ResNet50, InceptionV3, AlexNet, MobileNetV1, MobileNetV2, and MobileNetV3, all trained on the ImageNet dataset. MobileNetV3 Small and MobileNetV3 Large achieved precision rates of 98.99% and 99.81%, respectively. The effectiveness of each model was assessed by calculating the detection duration on images of tomato leaves using a workstation where all models were deployed. For the construction of an IoT system for tomato disease detection, classifiers were also implemented on Raspberry Pi 4. On the workstation, MobileNetV3 Small exhibited latencies of 66 ms, and on Raspberry Pi 4, it showed a latency of 251 ms. MobileNetV3 Large had a latency of 348 ms on Raspberry Pi 4 and 50 ms on the workstation.

Bhatia et al [36] utilizing an Extreme Learning Machine (ELM) with a sensor-based dataset on Tomato Powdery Mildew Disease, the authors implemented techniques such as Synthetic Minority Over-sampling, Random Over Sampling, Random Under Sampling, and Importance Sampling to balance the TPMD database. Accuracy and the area under the curve were employed for the analysis of ELM. The findings indicate an increase in classification accuracy (CA) and the area under the curve (AUC) for the resampling techniques applied in this study. ELM exhibited superior performance compared to the IMPS approach, achieving an accuracy of 89.19% and an AUC of 88.57%.

Govardhan et al [37] implemented the Random Forest algorithm for the identification and categorization of tomato diseases. Features were extracted from preprocessed images, and the system diagnosed conditions such as Early and Late Blight, Spider Mite, Yellow Leaf Curl Virus, and Target Spot. Identifying tomato leaf diseases can be challenging due to symptoms that often mimic nutritional deficiencies, such as mosaic virus, and can vary based on the plant's age at the time of contamination. The results showed that all testing images achieved optimal image classification, with the system demonstrating 95% effectiveness.

Qasrawi et al [38] utilizing 3000 photos featuring five tomato illnesses—Alternaria solani, Botrytis cinerea, Panonychus citri, Phytophthora infestans, and Tuta absoluta—taken in Tubas, Jenin, and Tukarem, three West Bank communities, the study employed machine learning (ML) classifiers with image embedding and hierarchical clustering. Neural networks, random forests, naive Bayes, SVM, decision trees, and logistic regression were used for prediction and categorization. The proposed model's accuracy was evaluated against a database of tomato plant diseases compiled by plant pathogen specialists. The clustering model achieved an accuracy of 70% for seven diseases, compared to 70.3% and 68.9% for neural networks and logistic regression, respectively. The suggested method demonstrated accuracy in clustering, identifying, and categorizing tomato plant diseases, showcasing the potential benefits of applying ML techniques to agriculture for Palestinian farmers in enhancing their disease control capabilities.

Mokhtar et al [39] suggested the use of Support Vector Machine (SVM) for the identification of two distinct tomato leaf diseases. Both the training and testing phases utilized datasets containing 200 images of leaves affected by Powdery Mildew and Early Blight. Cauchy, Invmult, and Laplacian kernels were employed in the SVM. The proposed approach was selected through grid search, and its performance was evaluated using N-fold cross-validation. Results indicate high accuracy provided by the recommended strategy, with Cauchy and Laplacian kernels achieving 100% and 98% accuracy, respectively, in comparison to the Invmult kernel's 78% accuracy.

Dhaya et al [40] concentrated on Fusarium wilt disease, a common affliction affecting various plants. Fusarium oxysporum, primarily impacting tomatoes, sweet potatoes, tobacco, legumes, and cucurbits, is often soil-borne. The proposed algorithm constructs models by predicting the disease twice to enhance accuracy. The public dataset comprises 87,000 images, with 60% depicting affected leaves and 40% depicting healthy plant leaves. With this extensive dataset, the suggested hybrid approach using Naive Bayes and image recognition accurately detected the disease with a 96% accuracy rate.

4. CONCLUSION

There is a need of the era for more intelligent and efficient approaches to crop production to tackle the challenges of diminishing arable land and the growing food demands of an expanding global population. It is imperative for everyone to prioritize food security through sustainable agricultural practices. The emergence of new technologies plays a crucial role in enhancing crop yields and fostering the adoption of farming as a viable and innovative profession, particularly among young individuals. This paper underscores the significance of various technologies in agriculture, including Machine Learning, Deep Learning, and IoT, in making farming more intelligent and adept at meeting future demands. It tackles the present challenges encountered by the industry and investigates future possibilities to provide guidance for scholars and engineers. Consequently, optimizing the productivity of each parcel of farmland becomes crucial, accomplished through the application of sustainable IoT-based sensors and communication technologies that encompass every aspect of the land.

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Study and investigation on 6G Technology: A Systematic Review

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Abstract: 5G mobile communication technology has become very popular now in several countries. Therefore, we should now shift our focus to the next generation. In this paper we are going to present an overview of the sixth generation (6G) mobile network, requirements, basic architecture, applications, and prospects and how this is going to be more efficient than existing popular 5G. 6G

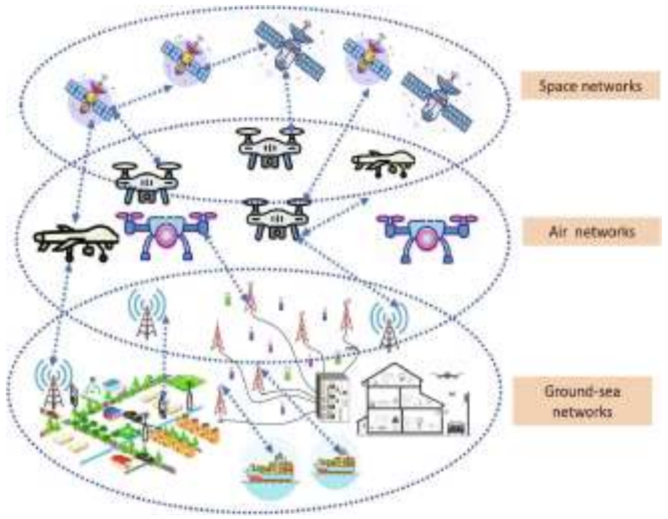
has been discussed in multiple forums, research papers, but mostly in bits and pieces and we have tried here to consolidate and simplify this.

Keywords: 6G drivers, Standardization, 6G requirements, Research activities, E-health, UAV networks, Factory of the future Localization, CAV networks, HW-SW divide, 5G advanced, Cellular communication.

Introduction:

The Implementation of fifth generation (5G) radio networks worldwide was expected to be completed by 2020, with extreme trustworthiness, additional high-capacity connections, and assured low latency.

However, 5G will suffer from a lack of satisfying all the future applications' demands beyond 2030. In addition, to increase coverage and lower power consumption, the sixth generation (6G) mobile network is expected to provide a more extensive spectrum, cost-effectiveness, and a high level of security. Several technological advances, including network slicing, waveform design, multiple access, channel coding methods, different antenna technologies, and cloud edge computing, are used to address these requirements in a 6G network. 6G impacts four significant future developments keys [1]. These keys include global coverage, various spectra, various new applications and services, and



strong security.

- The first key provides a centralized air, ground, space, and sea communication network by merging terrestrial and non-terrestrial networks [2] as shown in Fig. 1.
- The second key in contrast, introduces additional radio bands, including sub-6 GHz, millimeter- wave (mmWave), optical communications, and terahertz (THz). These additional bands will improve the capability and efficiency of connectivity.
- The third key represents the complete applications and services using big data technologies and artificial intelligence (AI). Due to the vast datasets produced by diverse systems with different wire- less access technologies, comprehensive bandwidth utilization and antenna designs are required for 6G technical specifications [3].
- The fourth key includes robust security solutions that provide upgrading and increase network confidentiality. New security solutions must be introduced to support the physical and network layer [4].

6G networks facing several challenges, with detection systems, network monitoring, processing data, and data security among the urgent issues. Because of the wide range of functionalities and challenges to deploy distributed AI, the Internet of Everything presents critical security issues. As these new connected devices are highly mobile, they tend to move among interconnected networks and seek services from different networks, leading to security issues as well as data privacy concerns [5].

Expectation is that the end-to-end latency in 6G will get reduced to one millisecond or even less than to reach a few microseconds for the Enhanced Ultra-Reliable and Low Latency Communication services.

A ten-fold improvement in network energy efficiency over 5G and a hundred-fold increase over 4G will be required for 6G [6].

Fig. 1. The integrated ground-sea-air and space 6G expected network.

1.1. 6G drivers and Mobile traffic growing. A new generation of mobile communications has been launched virtually every decade.

- Advanced Mobile Phone System (AMPS) introduced the first generation (1G) analog cellular networks in the US and Nordic Mobile Telephone (NMT) in Europe circa 1980.
- Around 1990, second-generation (2G) digital cellular networks supplanted a 1G analog system. The Global System Mobile Communications (GSM) is a huge commercial success to allow over a billion people using mobile phone, text and data services [7].
- Third generation (3G) systems based on Code-Division Multiple Access (CDMA) were designed and initially implemented in 2001 to provide high- speed data access at several megabits per second [8].
- The world’s first commercial Long-Term Evolution (LTE) networks launched in December 2009 in Stockholm and Oslo, delivering the world’s first 4G mobile broadband service [9]. The 4G system encourages the growth of smartphones, spawning a trillion-dollar- a-year mobile Internet sector.
- Finally, we entered the 5G era in April 2019. 5G extends mobile communication services beyond humans to objects and vertical businesses like earlier generations. The potential size of mobile subscriptions has grown from billions of people to practically innumerable interconnected persons, computers, and things. It supports services like mobile broadband, Industry 4.0, Virtual Reality (VR), Augmented Reality (AR), IoT, and automated driving [10].

However, 5G is currently being implemented globally; it is time for industry/academics to focus on 6G net- works to meet the future of Information Communication Technology (ICT) needs in 2030.

Here are some pioneering efforts on next-generation wireless networks that have been undertaken:

- In July 2018, the ITU-T standards sector created a focus group named Technologies for Network 2030.The organization plans to research network capabilities for 2030 and beyond [11], including holographic communications, intelligence, multi-sense experience, Tactile Internet, and digital twin.
- Many projects for the necessary 6G technologies were launched at the start of 2020. Intending to shape Europe’s digital future, the European Commission accelerate investments in Giga- bit Connectivity project [12].
- Next Generation Mobile Networks (NGMN) announced its 6G vision in October 2020. ITU-R agreed in February 2020 to initiate research on future technological developments for the evolution of International Mobile Telecommunications (IMT) [13].

The expansion of mobile broadband has exponentially increased the number of smartphones and tablets over the previous decade Mobile broadband (MBB). Mobile device adoption is still low in undeveloped nations; thus, this trend will continue until the 2020s. Fig. 2 shows that by 2030, 17.1 billion people will be using MBB. However, as the number of MBB users grows, the traffic demand per MBB user grows. This is due to the popularity of mobile video services and the constant development in mobile screen quality.

Machine-to-Machine M2M terminals will become saturated in 2030, along with human-centric communications. Global M2M subscribers will reach 97 billion by 2020, and 14 times increase as shown in Fig. 3.

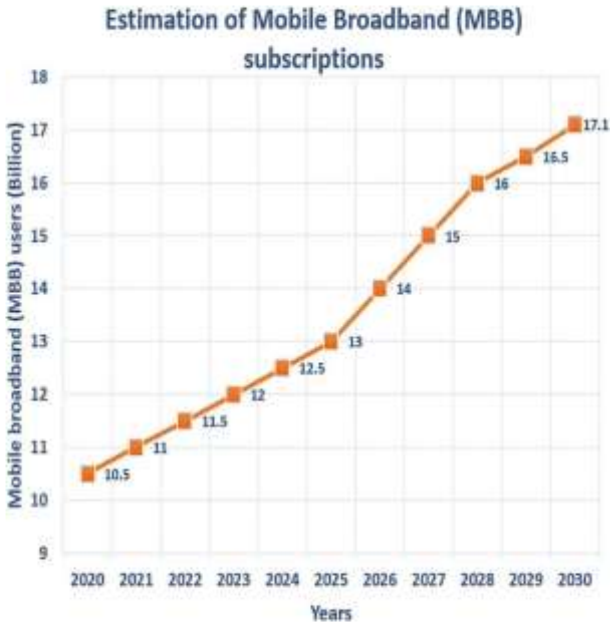


Fig. 2. Estimated mobile broadband users' subscriptions according to ITU-R Report M.2370-0 from 2020 to 2030 in Billion.

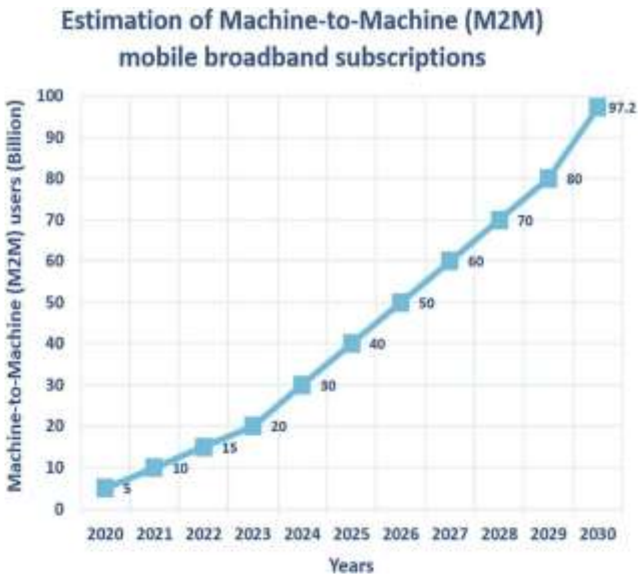


Fig. 3. Estimated Machine-to-Machine (M2M) broadband subscriptions according to ITU-R Report M.2370-0 from 2020 to 2030 in Billion.

1.2 Paper contributions

While investigating previous reports as mentioned in references, we have found that information regarding 6G is not complete and mostly in bits and pieces, so we have tried to combine all aspects of 6G here. We summarize the paper contributions as follows:

- Studying the communication difficulties introduced into the early legacy mobile networks and evolution from 1G to 6G (Section 2.1 and 2.2)
- 6G technological framework components and their requirements (Section 2.3 and 2.4)
- 6G network architectural vision (Section 2.5)
- The latest 6G applications (Section 2.6)
- The hardware-software evolution from a 6G perspective (Section 2.7)
- The latest 6G projects (Section 2.8)

Table 1

Summary of acronyms.

Acronyms	**Definition**
Mm	Wave millimeter-wave
THz	Terahertz
IoE	The Internet of Everything
EURLLC	Enhanced Ultra-Reliable and Low Latency Communication AMPS Advanced Mobile Phone System
NMT	Nordic Mobile Telephone
GSM	Global System for Mobile Communications
CDMA	Code-Division Multiple Access
LTE	Long Term Evolution VR Virtual Reality AR Augmented Reality
ICT	Information Communication

	Technology
NGMN	Next Generation Mobile Networks
IMT	International Mobile Telecommunications
MBB	Mobile Broadband
M2M	Machine-to-Machine
FCC	Federal Communications Commission
MIMO	Massive Multiple-Input, Multiple-Output
3GPP	The 3rd Generation Partnership Project
IAB	Integrated-Access Backhauling CN Core Networks
RAN	Radio Access Network
OWC	Optical Wireless Communications
H2H	Hospital-to-Home service
WBANs	Wireless Body Area Networks
UAVs	Unmanned Aerial Vehicles
FAA	Federal Aviation Administration
LoS	Line-of-Sight
CAV	Connected Autonomous Vehicles

2. Evolution of mobile networks

This section discusses the evolution of different wireless mobile generations starting from 1G to 6G. We also present the evolution of 6G new scenarios and use cases according to the demands of future applications. The evolution of cellular mobile communications is shown in Fig. 4 below [26].

Fig. 4. Evolution from 1G to 6

2.1 Evolution from 1G to 5G

The 1G network was initially designed only to provide voice communications in the 1980s. It uses analog modulation techniques to transport data and does not comply with a defined wire- less standard. This generation has several issues, including handover, security, and transmission. In the second generation of mobile phones, digital modulation technologies like TDMA are used to deliver voice and text messaging services. This era relies heavily on the GSM mobile communication system. The challenge and response technique are used in 2G authentication. The 3G net- work has provided customers with download and uploads rates of up to 2Mbps since its launch in 2000. Modern services such as TV streaming, internet browsing, and video streaming are now accessible at a rate previously unimaginable in mobile communication. Up to 1 Gbit/s transmission rates were achieved in down- link transmission on 4G networks in 2009 [14]. 4G networks can handle high spectrum efficiency and low latency (DVB). Many intelligent mobile terminals are included in 4G networks, IP core networks, backbone networks, and access networks. For 4G networks, authentication and tampering are two of the most critical security issues. As the 5G network nears commercialization, complex systems and high-security designs may increase data speeds. Unique to 5G is its potential to connect ever-increasing devices while still offering higher-quality services to all network participants.

2.2 Evolution of 6G

The New 6G applications will have greater network capacity and more requirements than the current 5G networks. Hence, new 6G applications will need a more robust and extensive network capacity than 5G networks. Next-generation wireless networks will be one of the significant components in our future lifestyles, industries, and societies. Wireless networks will be the link between humans and intelligent machines. Therefore, the research community and industry should improve these networks towards a shared vision [15]. The 2030 era will witness a considerable improvement in wireless communication. Future communication should have fundamental divers: systems trustworthiness; sustainability of devices efficiency, automatization and digitalization for a simplified life, and limitless connectivity to satisfy application demands. It is expected that this era will have a great transformation towards automatization, where 6G will play a vital role as a communication and information backbone. 6G should allow anything to communicate anywhere and anytime. Nowadays, the next generation of wireless networks should achieve several factors to meet these applications' QoS due to new applications requirements. Furthermore, on the road to 2030, we can presume the next evolution to go on with higher needs that the wireless networks should support. Next generations should support extremely high data rate, very low end-to-end delay, more reliability, massive cell-capacity, and extended coverage area to support highly demanding applications such as virtual, augmented, and mixed reality and remote control of sensitive operations. The upcoming generation should achieve the following requirements [16][26].

- High 3D coverage extension including terrestrial, aerial, space, and sea domain.
- The peak data rate is at least 1 Tb/s.
- Support high mobility (≥1000 km/h) to support airline systems. Huge capacity (10 device/km) due to the IoE.
- Very low latency communication (10 ls–100 ls).
- Reduce energy consumption to introduce green communication.
- (100 reduction compared with 5G) Data rate reaches 10 Gb/s (*10 times 5G). Spectrum efficiency (5–10 times 5G).

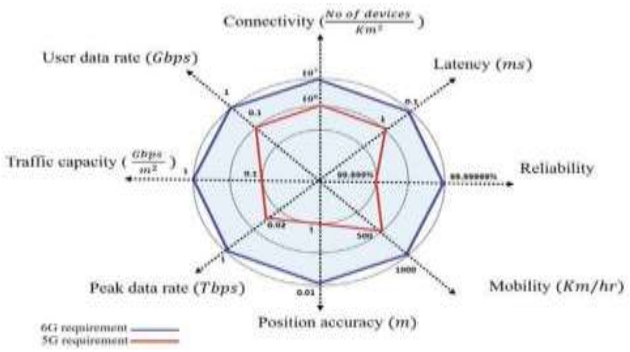


Fig. 5. shows the quantitative comparison between 5G and 6G in terms of basic requirements in each network.

2.3 Additional scenarios of 6G beyond 2030

Additional application scenarios expected to rise until 2030. The scenarios are divided into three categories: intelligent life, intelligent production, and intelligent society. Typical use case after 2030[17][18][26].

2.3.1 Smart Life: Twin body area network and intelligent interaction will likely transform our lives in 2030. A twin body area network (TBAN) refers to a system where two individuals, typically twins, utilize wearable devices or sensors to monitor various physiological parameters and share data between them.

2.3.2 Smart Production: 6G will achieve intelligent manufacturing via informatization. For example, drones will be utilized in agriculture. Robotics and virtual reality will boost production efficiency. With modern technologies like digital twins, 6G will have more significant intelligent manufacturing.

2.3.3 Smart Society: Public service coverage will be significantly extended by 2030 through a universal network of wireless communications, bridging the digital divide between regions. Overall, the 6G network will strengthen society's management and establish a solid basis for improved societies.

2.4 6G requirements and capabilities

The International Telecommunication Union (ITU) has outlined a vision for a global 6G standard, known as IMT-2030. Here are the key points [19]:

2.4.1 Vision for 6G:

2.4.1.1 4G brought us enhanced social engagement, while 5G allowed us to leverage data from machines and sensors.

2.4.1.2 6G is expected to combine the physical and digital worlds, transforming how we live, communicate, and work.

2.4.1.3 ITU Secretary-General, Doreen Bogdan-Martin, emphasized that mobile communications are central to ensuring meaningful connectivity and technical progress that aligns with affordability, security, and resilience.

2.4.2 Capabilities and Use Cases:

2.4.2.1 The IMT-2030 Framework identifies 15 capabilities for 6G technology.

2.4.2.2 Nine of these capabilities will be enhanced versions of existing 5G capabilities, including:

2.4.2.2.1 Security and resilience

2.4.2.2.2 Latency

2.4.2.2.3 Mobility

2.4.2.2.4 Connection density

2.4.2.2.5 Peak data rate

2.4.2.2.6 Spectrum efficiency

2.4.2.3 Additionally, there are six brand-new capabilities:

2.4.2.3.1 Coverage: Providing access to communication services in desired service areas.

2.4.2.3.2 Sustainability: Minimizing greenhouse gas emissions and environmental impacts throughout the life cycle of 6G devices.

2.4.2.3.3 Sensing-related capabilities: Enabling functionality through radio signals, including object detection, localization, imaging, and mapping.

2.4.2.3.4 Applicable artificial intelligence (AI)-related capabilities: Supporting distributed data processing, learning, computing, model execution, and inference.

2.4.2.3.5 Interoperability: Ensuring the radio interface is based on member inclusivity and transparency.

2.4.3 Enabling Technologies:

2.4.3.1 6G is expected to take all 5G capabilities to the next level.

2.4.3.2 It aims for ubiquitous coverage across land, sea, sky, and space.

2.4.3.3 AI-native capabilities and other promising technologies will play a crucial role in 6G’s development.

2.5 6G Architectural vision

Communication components like base stations and terminals may conduct ubiquitous sensing, which is the basis for connecting all intelligent devices on an intelligent platform. ICT and vertical industry ecosystems, create more excellent stability, sustainability, and health. As a consequence, the whole civilization might be digitalized. So, from an architectural standpoint, we define the 6G vision as follows [20]:

2.5.1 Connected Intelligent network: 6G is the next-generation mobile communications technology that will be a distributed neural network to connect the physical and virtual worlds, resulting in an age of sensed, linked, and intelligent networks [21].

2.5.2 Integration of AI and ML: 6G air interface and network designs will use AI/ML to automate system operation and administration. Decentralized intelligence in the cloud gives way to ubiquitous intelligence at the edges as each 6G network integrates computation, communication, and sensing capabilities.

2.5.3 The networked sensing: In order to examine the physical environment by means of radio wave transmission, reflection, and scattering, communications systems will use wireless sensing capabilities. They will also contribute to the creation of a data base for the development of an intelligent digital world, increasing communication performance and enabling a more comprehensive network service situation.

2.5.4 Trustworthiness: The 6G network will combine sensing, processing, communication, and intelligence, requiring a new network design. The new network design should support trustworthiness, collaborative sensing and distributed learning to enable AI applications.

2.5.5 Full coverage connectivity: 6G will provide speeds equivalent to optical fibers. 6G achieves ten times increase in 5G connection density, millimeter-level imaging, centimeter-level localization, and end-to-end reliability. It enables future human- centric services and accelerates full-scale digital transformation and upgrade of vertical industries.

2.5.6 Integration of terrestrial and non-terrestrial networks: Many satellites will be placed in non- terrestrial networks to construct a mega satellite constellation. Low-latency ultra-long-haul transmission will increase the reach of terrestrial cellular infrastructure.

2.5.7 Sustainable development: It is the ultimate objective of the 6G network design. 6G targets to increase the total energy efficiency 100 times throughout the network, preventing infrastructure and terminal energy consumption surpassing 5G while maintaining excellent service performance [22].

2.6 6G applications

- Artificial Intelligence (AI): AI will play a pivotal role in 6G, enabling intelligent decision- making, resource optimization, and personalized services.
- Intelligent Reflective Surfaces: These surfaces enhance signal propagation and coverage.
- Blockchain: Ensuring secure and transparent transactions.
- Dynamic Network Slicing: Tailoring network resources for specific applications.
- Cell-Free Communication: Distributed antennas for seamless connectivity.
- Edge Computing: Bringing computation closer to the data source.
- Big Data Analytics: Extracting insights from massive datasets.
- Terahertz (THz) Communication: THz frequencies promise ultra-high data rates and low latency, making them ideal for futuristic applications.
- Optical Wireless Communication: Leveraging light waves for high-speed, secure communication.
- 6G is not only for more spectrum at high-frequency bands. Instead, it will converge exciting trends driven by underlying services [23].

2.7 6G future hardware and software perspective

- While artificial intelligence will play a key role in the growth of 6G and Tactile Internet services and capabilities, new concepts such as self-sufficiency and evolution are going to be necessary for network infrastructure. According to the 6G self-evolving network, the existing Hardware-Software (HW-SW) design techniques won't work for the research.
- The so-called HW-SW divide is a problem that has to be addressed. Here an embedded system is developed cooperatively by designing both its hardware and software components. The goal is to achieve optimal performance while adhering to design constraints. Increasing the isolation and symmetry between HW and SW are critical to enabling AI-driven 6G. The vast range of Micro-Nano technologies, such as electronics, MEMS/NEMS, and materials recognized to have significant potential for sparking the HW paradigm change outlined above [24].

2.8 6G Projects

In this section, we choose the major 6G projects that launched recently [25][26].

2.8.1 Bharat 6G Project (India):

2.8.1.1 Objective: India aims to roll out high-speed 6G communication services by 2030.

2.8.1.2 Phases:

1. Phase One (2023-2025): Support for explorative ideas, risky pathways, and proof-of-concept tests.
2. Phase Two (2025-2030): Development, use case establishment,and commercialization.

2.8.1.3 Focus Areas:

1. Terahertz communication
2. Radio interfaces
3. Tactile internet
4. Artificial intelligence for

connected intelligence

5. New encoding methods and waveforms chipsets for 6G devices

2.8.1.4 Significance: The project fosters an RCD platform for startups, researchers, and industry players, contributing to India's digital ecosystem.

2.8.2 Inter Digital's EU 6G Projects:

2.8.2 Flagship Projects:

1. 6G-XR
2. CENTRIC
3. PREDICT-6G
4. 6G-BRICKS
5. 6G-SHINE

2.8.2.1 These projects focus on revolutionary technology advancement and experimental infrastructures in 6G.

2.8.3 European 6G Research Investments:

2.8.3.1 Selected Projects:

1. BeGREEN
2. 5G-STARDUST
3. SEASON
4. 6Green
5. VERGE
6. NANCY
7. ACROSS

2.8.3.2 These projects contribute to the evolutionary path toward 6G network development.

2 Conclusion

Existing technologies are improved, and new features are added when new generations of wireless communication networks are developed to satisfy future needs. Thus, 5G technology cannot handle the ever-increasing communication demands.

Therefore, it is necessary to plan for the deployment of 6G networks to meet the needs of this new age in terms of communication technology. This paper presents a simplistic overview of the 6G wireless generation networks including the growth of communication networks from 1G to 5G, research efforts on 6G mobile networks, enabling technologies for 6G networks. The paper also highlights the primary applications of 6G and necessities for 6G enhancement as high coverage, network flexibility, cognitive network, network computing, and trusted systems.

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Track-3 : Paper
Dr. Amit Kumar Saraf

A Comparative Investigation on Utilization of Limestone Dust as a Partial Replacement of Cement and Limestone Chips for Fine Aggregates

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Abstract: During Recent days as there is seen an expandable rise in Construction Works the use of River Sand is also increasing significantly at a rapid rate and due to its fixed amount of availability there is a need to find the replacement of River Sand or Fine Aggregates. So here we are partially replacing the River Sand with Limestone Chips and Ordinary Portland Cement with Limestone Dust to see its properties. The study is done to determine the Compressive Strength Test. The use of Ordinary Portland Cement of 43 grade has been made. The samples of concrete (Cubes) were made for two different Grade i.e. M20 and M25 with variable mix Percentages of Limestone Chips (i.e.10%,20%,30% and 40%) while the Limestone Dust is replaced by 10% of OPC for every mix prepared. The different Design Mixes were Prepared. The results after tests were compared to that of Conventional Concrete and determination of the concrete mixes were made if they are suitable to use for structural members of buildings and related structures.

Keywords: Cement, OPC, Limestone, Dust, Fine Aggregates.

1. INTRODUCTION

Irregularities are inherent in the construction of buildings [1]. This paper focuses on examining the structural characteristics of concrete mixes using various combinations of limestone dust with cement and limestone chips as fine aggregates. Limestone, a sedimentary rock formed from the remains of shells or skeletons over an extensive period [2], is primarily composed of calcium carbonate and may also contain magnesium, iron, or manganese, influencing its whiteness and hardness [3-4]. The chemical composition of limestone collected from Nandini Mines, Jamul, Bhilai, reveals SiO2 at 12.45%, CaO at 45.15%, and MgO at 0.46% [5]. While widely used in the construction industry, limestone also finds numerous applications in everyday life.

Comparative analysis with normal concrete, maintaining the same water/cement ratio and cement types, suggests that concrete with a higher content of limestone powder and a considerable particle size distribution generally exhibits improved characteristic strengths [6]. Concrete incorporating limestone dust as a partial replacement of Ordinary Portland Cement (OPC) can tolerate up to 10% without adversely affecting concrete strength [7]. Similarly, concrete utilizing limestone dust as a partial replacement of cement can accommodate up to 20% without compromising strength [8-9].

Furthermore, employing various combinations of limestone chips and limestone dust as replacements for OPC and river sand, different design mixes were explored to achieve higher compressive and tensile strengths, as well as improved workability for M20 and M25 mix proportions [10-12]. Specifically, compressive strength ranging between 21.06 - 35.2 N/mm2 for concrete mixtures was considered. Multiple mixes were prepared to partially replace river sand with limestone chips at percentages of 10%, 20%, 30%, and 40%, while limestone dust replaced ordinary Portland cement at 10%, and the results were compared with those of conventional concrete.

The utilization of alternative materials in construction processes has become increasingly imperative to address environmental concerns and meet the escalating demands of the construction industry. Limestone, a readily available natural resource, has garnered attention as a potential substitute in concrete production. This paper explores the utilization of limestone dust as a partial replacement of cement and limestone chips for fine aggregates in concrete mixtures. By harnessing these waste materials from crusher mines, the study aims to assess their efficacy in enhancing the mechanical properties of concrete while promoting sustainable construction practices. Through comprehensive experimentation and analysis, this research seeks to provide valuable insights into the feasibility and potential benefits of incorporating limestone dust and chips in concrete formulations.

2. SIGNIFICANCE OF THE WORK

With the Construction Industry expanding rapidly, there is a corresponding surge in demand for construction materials, necessitating the exploration of new materials to meet evolving objectives [13]. Studies have indicated that replacing a portion of river sand (fine aggregate) with limestone chips and ordinary Portland cement with limestone powder yields comparable compressive strength properties. The primary objective of this study is to reduce reliance on river sand and cement while striving to enhance environmental sustainability for future prospects.

Figure 1. Used Materials

3. EXPERIMENTAL WORK

In this study, limestone chips and limestone dust are sourced as waste materials from crusher mines. Limestone dust is substituted for 10% of the quantity of ordinary Portland cement in each mix prepared, while limestone chips are replaced at varying percentages of 10%, 20%, 30%, and 40%. These mixes were formulated for M20 and M25 grades of concrete. Three samples were prepared for each type of mix, and nominal mixes were also formulated for both grades for comparison. In total, 60 samples were prepared and subjected to compressive strength tests at 7 and 28 days.

- Cement – Ordinary Portland Cement (Ultratech OPC) was used. Different tests were performed like Initial setting time, Final setting time, Consistency test and Soundness test.
- Coarse Aggregate – Normal Crusher Stones passing 20mm Sieve were taken into account for the study.
- Fine Aggregates – (A). River Sand was taken for the study passing 4.75 mm Sieve and tests like specific gravity using Picnometer and Sieve Analysis were done. (B). Limestone Dust was collected from the Baloda-Bazar District of Chhatisgarh and Sieve Analysis is performed. The Limestone Dust passing 90 micron Sieve were taken for replacement with Cement.
- Water – Water plays a vital role in making concrete as it the reason behind Chemical reaction between the materials. Water having PH-7 is used for mixing and curing purposes.

4. METHODOLOGY

The Cubes were casted for M20 and M25 grade of Concrete for which Mix Designs were done and the ratio for M20 is (1:2:3.64) and for M25 it is (1:1.73:3.27). Then after calculating the weight of materials.

1. Take the weighted materials i.e. Fine Aggregate and Coarse Aggregate along with the Limestone Chips for which it has to be replaced and Cement replaced with Limestone Dust in a Pan.
2. Dry mix the materials thoroughly. Mix all the materials side by side and by turning it over each other and then make a hollow at the centre.
3. Add Appropiate quantity of water by measuring and mix the dry mixture thoroughly.
4. Now put the mixture in oil polished Cube Moulds for 1/3 part.
5. Now after temping 25 times fill the 2/3 of the mould and repeat the process.
6. Now completely fill the mould and level it then put on Table Vibrator then keep for 24 hours.
7. After 24 hours take the specimen out of the mould and keep for Curing in curing tanks.
8. After 7 & 28 Days the specimens will be taken out of curing tanks and Compressive Strength tests will be performed.

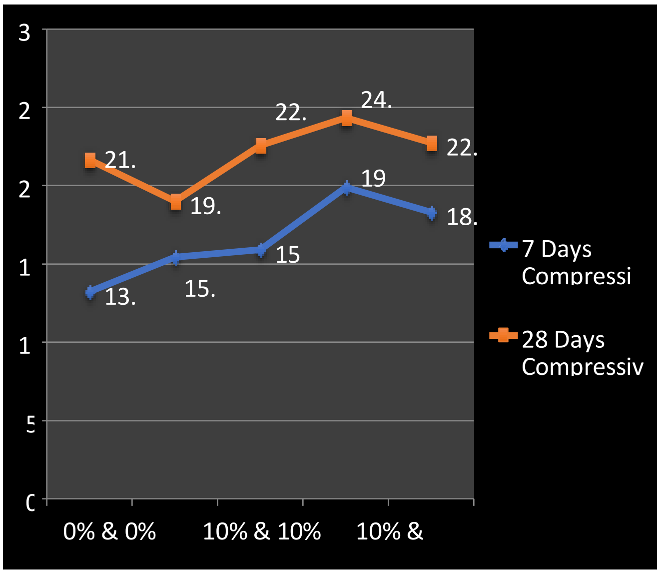
5. RESULTS AND DISCUSSION

Replacing limestone dust in all mixes by 10% of the cement content and limestone chips by 10%, 20%, 30%, and 40% of river sand resulted in varying increments in 7-day compressive strength. For M20 grade, the increments ranged between 16% to 50%, while for M25 grade, it ranged from 0% to 6%. Similarly, for 28-day compressive strength, the increments for M20 grade were between 0% to 12%, and for M25 grade, they ranged from 0% to 8%. It was observed that the highest compressive strength for all grades was achieved when river sand was replaced by 30% limestone chips and cement by 10% limestone dust.

Table 1. Experiment Investigation on Compressive Strength of M20 of M20 Concrete with different % Mix

% age Mix (Cement partially replaced by Limestone Dust)	**% age Mix (River Sand partially replaced by Limestone Chips)**	**7 Days Compressive Strength (MPa)**	**28 Days Compressive Strength (MPa)**
0%	0%	13.23	21.67
10%	10%	15.45	19.01
10%	20%	15.90	22.56
10%	30%	19.90	24.34
10%	40%	18.32	22.76

Table 2. Experiment Investigation on Compressive Strength of M25 Concrete with different % Mix



% age Mix (Cement partially replaced by Limestone Dust)	**% age Mix (River Sand partially replaced by Limestone Chips)**	**7 Days Compressive Strength (MPa)**	**28 Days Compressive Strength (MPa)**
0%	0%	20.48	25.67
10%	10%	21.23	27.45
10%	20%	19.90	23.67
10%	30%	21.67	26.56
10%	40%	18.76	22.32

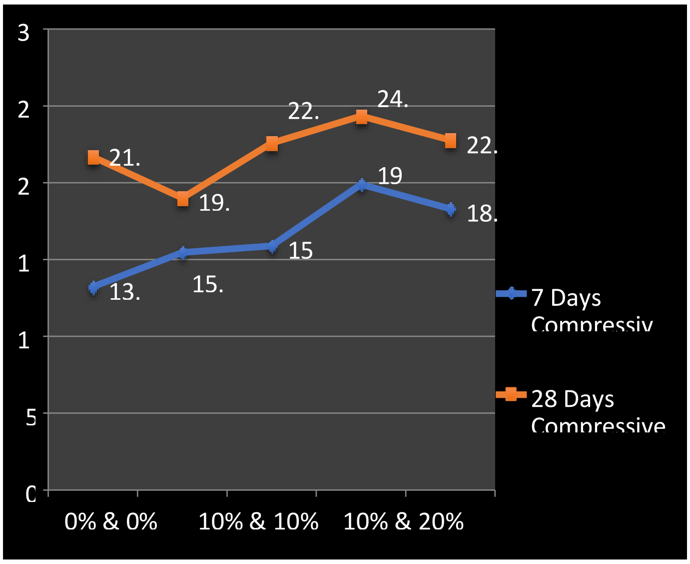


Figure 2. Compressive Strength of M20 Concrete with different % age Mix (Cement partially replaced by Limestone Dust & Limestone Chips) for 7 and 28 Days

Figure 3. Compressive Strength of M25 Concrete with different % age Mix (Cement partially replaced by Limestone Dust & Limestone Chips) for 7 and 28 Days

6. CONCLUSION

Compressive Strength test were done for concrete mixes at age of 7 and 28 days for Limestone Dust to be partially replaced by Cement by 10% for all mixes and Limestone Chips to be replaced partially by River Sand by 10%, 20%, 30% and 40%. The tests result was compared to Conventional Concrete result and it is seen that the mix with 10% and 30% replacement was suitable for making Concrete and in use of Structural Members of building structures. The costs of building construction can also be reduced as the Limestone Dust and Limestone Chips are waste materials of quarries and due to high demand the cost of River sand is also increasing rapidly.

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A Comprehensive Review of Glass Fiber-Reinforced Epoxy Polymer-Based Composites

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Abstract:
Glass fiber-reinforced epoxy polymer-based composites have gained significant attention in various industries due to their exceptional mechanical properties, thermal stability, and corrosion resistance. This review paper provides a comprehensive overview of the fabrication methods, properties, applications, and recent advancements in glass fiber-reinforced epoxy composites. Various aspects such as reinforcement types, fabrication techniques, mechanical behavior, thermal properties, and applications are discussed in detail. Furthermore, recent research trends and future prospects in the field of glass fiber-reinforced epoxy composites are also highlighted.

1. Introduction:

Glass fiber-reinforced epoxy polymer-based composites are widely used in aerospace, automotive, marine, construction, and sporting goods industries due to their excellent mechanical properties, lightweight nature, and cost-effectiveness. The combination of glass fibers with epoxy resin matrices offers high strength-to-weight ratio, corrosion resistance, and dimensional stability, making them suitable for a wide range of applications. This review aims to provide a comprehensive overview of the fabrication methods, properties, applications, and recent advancements in glass fiber-reinforced epoxy composites.

2. Fabrication Methods:

Glass fiber-reinforced epoxy composites can be fabricated using various techniques such as hand lay-up, filament winding, pultrusion, resin transfer molding (RTM), and compression molding. Each fabrication method offers unique advantages in terms of cost, complexity, and production rate. For instance, hand lay-up is a simple and cost-effective method suitable for small-scale production, while filament winding is ideal for producing continuous fiber-reinforced composites with complex geometries.

3. Properties of Glass Fiber-Reinforced Epoxy Composites:

Glass fiber-reinforced epoxy composites exhibit excellent mechanical properties, including high tensile strength, modulus of elasticity, and impact resistance. The properties of these composites are influenced by various factors such as fiber orientation, fiber volume fraction, resin type, curing conditions, and fabrication method. Moreover, glass fibers offer good thermal stability and chemical resistance, making them suitable for high-temperature and corrosive environments.

4. Applications:

Glass fiber-reinforced epoxy composites find extensive applications in aerospace, automotive, marine, construction, and sporting goods industries. In aerospace and automotive sectors, these composites are used for manufacturing structural components, interior panels, and exterior body parts due to their lightweight and high strength properties. In the marine industry, glass fiber-reinforced epoxy composites are utilized for boat hulls, decks, and other marine structures due to their corrosion resistance and durability.

5. Recent Advancements:

Recent advancements in the field of glass fiber-reinforced epoxy composites focus on improving their mechanical properties, thermal stability, and processability. Researchers are exploring novel reinforcement materials, hybridization techniques, and surface modification methods to enhance the performance of these composites. Additionally, the development of sustainable and recyclable epoxy resins is gaining momentum to address environmental concerns.

6. Conclusion:

Glass fiber-reinforced epoxy polymer-based composites offer a wide range of advantages, including high strength, lightweight, corrosion resistance, and thermal stability, making them suitable for diverse applications. This review provides a comprehensive overview of the fabrication methods, properties, applications, and recent advancements in glass fiber-reinforced epoxy composites. Further research efforts are required to explore innovative approaches for enhancing the performance and sustainability of these composites.

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Implementation of Turbocharger in Single Cylinder Diesel Engine

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Abstract

The use of turbocharging in diesel engines to increase performance and reduce emissions is growing in popularity. Turbocharged diesel engines sometimes behave badly when speed and load vary, increasing exhaust emissions and reducing driver comfort. This issue is brought on by features of the turbocharger, such as high inertia and low compressor flow. This work aims to enhance engine dynamics via the investigation of different turbocharging configurations. These include of variable-geometry turbines, coupled supercharging and electrically assisted turbocharging, and two-stage turbocharging. Reducing turbocharger size, using several units, and increasing turbine torque are some strategies to improve transient responsiveness. Moreover, methods to reduce emissions and minimise turbo lag include raising the turbine back pressure and using external energy support. A lot of factors, such as cost, kind of engine, and vehicle use, influence the ideal arrangement. The operational efficiency of a compression-ignition (CI) single cylinder four stroke diesel engine with and without a turbocharger is compared in this research article. The purpose of the research was to determine how turbocharging affected the engine's braking power output when diesel was the only fuel source. Brake power values were recorded for both setups and experimental data was gathered under a range of load circumstances, from 4 to 16 kg.

Keywords: Turbocharger, Diesel Power Unit, Renewable energy, Compression Ignition Engine, Diesel

Introduction

Reducing emissions while maximizing power output is a main challenge in the dynamic field of automotive engineering. The use of turbocharging technology to diesel single-cylinder engines is at the forefront of this endeavor. Numerous studies indicate that employing mechanical supercharging can augment the power and torque output of internal combustion (IC) engines across various operational scenarios. However, the enhancement in thermal efficiency of IC engines remains somewhat restricted due to a portion of the engine actual work being utilized to operate the compressor. In this setup, a transmission shaft links the turbine and compressor. The high temperature and pressure of the IC engine exhaust gas retain substantial energy, which can be harnessed through an exhaust turbine. In an exhaust turbocharging system, the exhaust gas serves as the turbine's employed medium, with the turbine functioning as the power source for boosting pressure within the system. During the expansion process of the exhaust gas, a portion of its energy is recuperated and converted into useful work, subsequently employed to drive the compressor. Another conventional method for pressure boosting is exhaust turbocharging, wherein the energy of IC engine exhaust gas propels the compressor through an exhaust turbocharger. This innovative endeavor holds significant promise and could potentially deliver unparalleled performance and sustainability. Improvements in internal combustion engines (ICEs) will likely be overshadowed by fuel alternatives, advanced fuel technology, improved combustion, and pollution control measures. By increasing the charge air pressure, diesel engine performance and emissions may be enhanced. Today, turbocharging is used to accomplish this. Without expanding the engine's cubic capacity, it increases power production (Sims et al. 1990). Chemical energy is transformed into mechanical energy by diesel engines. Diesel engines release waste products including unburned carbon particles and hazardous gases in addition to mechanical power. Every researcher's main goal is to reduce exhaust emissions that are bad for the environment and increase energy conversion efficiency. Utilizing waste products' energy as much as possible is another crucial goal, and turbocharging helps with this. By using the waste kinetic energy of exhaust gases to increase charge air pressure, turbocharging enhances both the diesel engine's performance and emissions. Unfortunately, the charge air's temperature increases as it is compressed, which is not what is wanted. Air pressure is boosted to make it denser in order to guarantee that there is enough oxygen in the combustion chamber for the fuel to burn properly. However, the temperature rise mostly eliminates the density advantage and may also cause issues with the fuel's ignition timing. The maximum prominent off-design characteristic of diesel engine transient operation that most noticeably separates the torque pattern from the corresponding steady-state circumstances is turbocharger lag, as it has long been known. Because there is no automated connection between the engine crankshaft and the turbocharger, the system's inertia prevents the turbocharger (T/C) compressor air supply from matching the higher fuel flow instantly, even though the fuel pump responds quickly to the increased fueling demand after a load or speed increase. By applying turbocharger in single cylinder diesel engine brake power and efficiency of the engine rises. This phenomenon is further compounded by the T/C compressor's unfavorable characteristics at low loads and speeds. This delayed reaction causes the relative air-fuel ratio to assume extremely low values in the early cycles of a transient event—even lower than stoichiometric—which deteriorates combustion and causes the engine to respond slowly (in terms of torque and speed), take a long time to recover from, and emit excessive amounts of noise, particles, and gases into the atmosphere. Turbocharger uses thermal power wasted could be recovered by expanding the exhaust gas by passing it inside an additional turbine instead of a throttling valve. However, after a speed or load increase transient event, high fuel–air equivalency ratios result in high combustion temperatures, which promote the creation of soot (black smoke emanating from the exhaust pipe) and nitric oxide (NO).

1. Literature Review

Internal combustion engines may generate extra power without adding more cylinders by using turbochargers. This mechanical approach enables automakers to lower the displacement of their engines to smaller sizes, a process known as engine downsizing [1]. Turbochargers are broadly used, especially in racing applications, to increase the power of internal combustion engines that are already quite powerful. But these days, the emphasis is on creating solutions for road cars that are both ecologically sound and commercially feasible. As a outcome, the automobile industry has seen a significant rise in the use of turbochargers. The purpose of this research is to deliver an indication of the most current turbocharging technologies used to reduce exhaust emissions and maximize engine efficiency. In order to evaluate their present usefulness, several kinds of turbochargers and superchargers are analyses in the perspective of current developments. New technologies are constantly emerging in response to the growing need for contemporary, environmentally friendly engines. Increased power output and lower emissions are possible with a turbocharged engine because it promotes combustion with a richer air-fuel combination. The research explores how adding a turbocharger or supercharger affects an internal combustion engine's performance, taking into account the fact that air density decreases with altitude. Nevertheless, power recovery in diesel engines may not be guaranteed by the pumping process or overall system performance, even with the best of intentions. Engine downsizing is a common approach in contemporary cars due to increased customer demand for fuel-efficient vehicles and tougher pollution restrictions. Simultaneously, turbocharging is becoming more and more common as a way to increase the power output of smaller engines so they can function on par with bigger displacement engines. Three main areas of modern turbocharger research are covered in this paper heat transfer, flow dynamics, and mechanical analysis. While flow studies are grouped according to different turbocharger components and study strategies, heat transfer studies include results from both modelling and experimental approaches. Medium-speed diesel engines are used in a diversity of power industries, including as maritime propulsion and the production of electricity. The goal of the research is to model and simulate a medium-speed M.A.N. production engine that has a turbocharger and an intercooler. The inquiry looks at the potential effects of the air temperature in the intercooler on engine cylinder volumetric efficiency using the FORTRAN programming language and applied thermodynamics concepts for internal combustion engines. The findings highlight the important impact of intercooler air temperature on engine performance, showing a noteworthy 98% increase in volumetric efficiency while running with lower intercooler exit air temperatures.

Engine running while the exhaust gas turbo charger is operating. The automobile industry uses turbochargers because they may boost an internal combustion engine's (IC) output without increasing the engine's cylinder capacity. Vehicles undergo minor adjustments to increase economy and regulate the amount of exhaust gas emissions. The project's objectives are to decrease two-wheeler emissions and boost volumetric efficiency. Since diesel engines are still used in truck applications, dropping fuel consumption and CO2 emissions is essential. Under constant load and at moderate speeds, single-stage turbocharged diesel engines are recognized for their fuel efficiency. This work presents a two-stage, in series, air-path system that modifies the turbine expansion ratios to enhance the usual part-load performance at low engine speeds. As long as the engine transient response is preserved, lower engine speeds may provide better EGR rates (for NOx reduction). The performance and pollution results of the IDI CI engine operating on diesel fuel with and without a turbocharger were compared in this experiment. An engine's horsepower may be greatly increased using a turbocharger without causing the engine to become much heavier. A loading panel was used to add load while the engine was operating at its constant rated speed of 1000 rpm. Varied performance, combustion, and emission parameters were assessed under varied engine loads, ranging from 25% to 100%. A thorough testing setup was devised, linking the engine to a smoke meter and five gas analyzers. The engine's performance and emissions were documented across different load conditions. This study delves into the significance of boost pressure recovery in enhancing the operational effectiveness of diesel engines at elevated heights. They suggested that a controlled, two-stage turbocharging system is a workable way to recover power from diesel engines. Their research examines how boost pressure and engine power change at varying altitudes and presents a controlled two-stage turbocharging system made up of a matching low-pressure turbocharger and an original turbocharger. The research showed that even with difficulties brought on by variances in overall turbocharger performance, boost pressure recovery by itself was unable to reliably guarantee power recovery across the engine's working range. Nonetheless, the power recovery goal may be reached by putting fuel injection compensation techniques and valve control schemes for boost pressure recovery into practice. Performance and emission results of an IDI CI engine running on diesel fuel with and without a turbocharger are compared in this single-cylinder diesel engine study. The key to greatly increasing engine horsepower without appreciably adding weight is turbocharging. In the experiment, the engine's rated speed was maintained at 1000 rpm while the engine load was varied between 25% and 100%. Using a loading panel to apply load, performance, combustion, and emission characteristics were carefully measured. By combining the engine with a smoke meter and five gas analyzers, a thorough test setup was created. Mathematical computations were used to determine performance metrics like thermal efficiency and fuel consumption unique to brakes.

An efficient waste heat recovery technique called turbo-compounding enhances a single-cylinder naturally aspirated engine's performance and lowers its exhaust emissions [4]. The engine was fitted with a turbocharger system, and both fuel cases underwent the same testing procedures. The analysis of test results revealed that biodiesel produced somewhat lower braking power and torque as well as higher fuel consumption figures, but its brake thermal efficiency was marginally greater than diesel fuel's in both normally aspirated and turbocharged scenarios [5]. In the near future, jatropha combined with ethanol mix will be a promising biofuel replacement for diesel engines [6]. Because it takes a relatively long time to analyze each transient cycle, the significant problem The control of exhaust emissions while diesel engines undergo transient operation is crucial mostly been researched experimentally rather than via modelling. Manufacturers, however, find that the research of transient emissions is crucial since freshly manufactured engines have to adhere to strict standards for exhaust emissions levels. The parameters are categorized into three groups based on the particular subsystem that is being studied: the engine, the load, and the turbocharger. The evolution of the soot and NO emissions during the transient event is shown in demonstrative figures that show the impact of each parameter taken into consideration. Transient NO and soot emissions are also significantly influenced by load parameters and the mass moment of inertia of the turbocharger (T/C) [7]. Since the performance of the diesel engine with jatropha biodiesel blends is comparable to that of diesel, internal combustion engines may utilize them. Because diesel has a higher calorific value (45 MJ/kg) than jatropha biodiesel (38.00 MJ/kg), the latter has a little poorer brake thermal efficiency [8].

2. Experimental Setup

For the current experimental inquiry, a four stroke, vertical, single cylinder, air-cooled, cold starting, compression ignition, high speed diesel engine is employed. Both Table 1 and Figure 1 provide the engine specifications.

Table 1: Engine specification

MODEL	**4325**
Bore	78 MM
Stroke	68MM
Displacement	325CM
Compression Ratio	18:01
Oil Sump capacity	1.0 litres
Lub Oil Consumption	0.013 kg/hr
Dry Weight	38kg
Maximum Torque	1.48Kgm
RPM	3600
SFC	220gm/bhp/hr

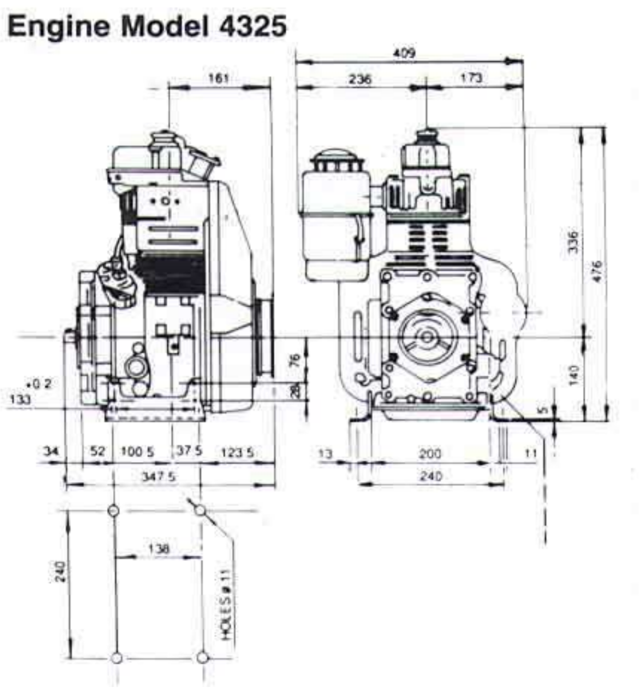

Figure 1: Engine specification

The designs of turbochargers must adapt to changing needs in order to account for variables such as use situations, efficiency attributes, rotor inertia, and map size. This propels ongoing innovation in compressor and turbine variations suited to particular engine needs. Furthermore, different emissions restrictions around the globe encourage the creation of unique technological solutions. A diesel engine with just one cylinder with and without a turbocharger made up the experimental arrangement. In both designs, the main fuel source was diesel. Brake power readings were taken for every load situation in which the engine was exposed to 4, 8, 12, and 16 kg of variation. To make sure the results were reliable, the tests were run many than thrice. This single-cylinder diesel engine configuration might have a turbocharger or not. Below is a discussion of all calculations:-

3.1 Calculations:-

* Diameter of Pulley **(D) - 0.2 m**
* Radius of Pulley **(R) - 0.1 m**

Table 2 shows that a single-cylinder diesel engine's torque output fluctuates depending on the load. For example, the maximum and lowest torque measured with a weight of 16 kg are 15.69 N-m and 3.92 N-m in each case. The torque tests were carried out for both diesel-powered engines—those with or without turbochargers—and the findings were similar for all loads.

Table 2: Load and torque comparison.

Load (Kg)	**Torque (N-m)**
4	3.92
8	7.84
12	11.76
16	15.69

In the diesel engine without a turbocharger, the results from Table 3 and Figure 2 reveal varying power and RPM levels at different loads. Notably, at a load of 16kg, the maximum power output is recorded at 3.12 kW with an RPM of 1900. This experiment demonstrates that as the load increases, the power output also increases, while the RPM decrease.

Table 3: Load vs brake power vs rpm calculation without turbocharger

Diesel engine without Turbocharger		
Load (Kg)	Power (kw)	RPM
4	1.05	2550
8	1.91	2320
12	2.58	2100
16	3.12	1900

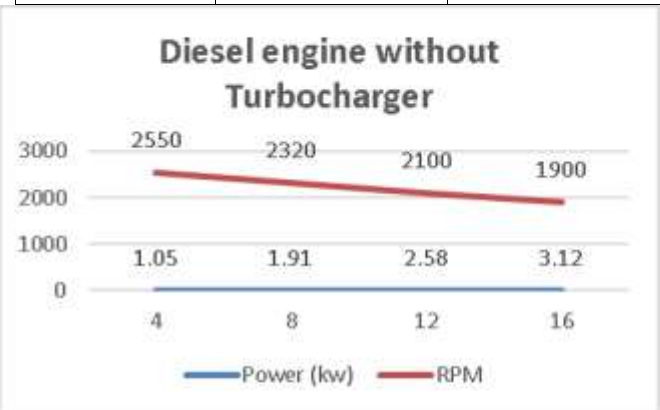

Figure 2: Load vs brake power vs rpm calculation without turbocharger

In the single-cylinder diesel engine equipped with a turbocharger the findings from Table 4 and Figure 3 demonstrate varying power and RPM levels across different loads. Notably, at a load of 16kg, the engine achieves its maximum power output of 3.78 kW at an RPM of 2302. This experiment highlights the trend where increasing the load leads to a rise in power output, while concurrently causing a decrease in RPM.

Table 4: Load vs brake power vs rpm calculation with turbocharger

Diesel engine with turbocharger		
Load (Kg)	Power (kw)	RPM
4	1.19	2894
8	2.15	2618
12	2.95	2400
16	3.78	2302

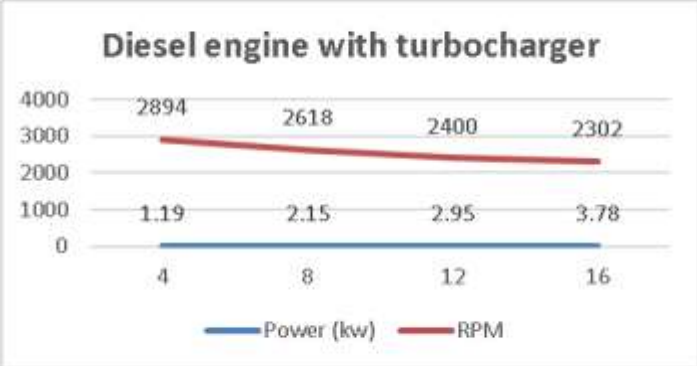

Figure 3: Load vs brake power vs rpm calculation with turbocharger

3. Result

The research's decision show that fitting a turbocharger significantly rises the amount of brake power produced. The turbocharged engine performed the non-turbocharged engine in terms of brake power under all load circumstances. At the highest load (16 kg), the brake power specifically rises by about 21.15%, from 3.12 kW without a turbocharger to 3.78 kW with turbocharger.

4. Conclusion

In summary, the findings of this research show that single-cylinder diesel engines may run more efficiently when turbocharged. The observed increase in braking power demonstrates how turbochargers may enhance engine efficiency and power output without compromising fuel consumption. These results contribute to the amount of study being done to optimise diesel engine performance for various applications. A single-cylinder diesel engine produces greater power as the load increases, but the engine speed decreases as well. This demonstrates the inverse relationship between load, power, and engine speed in the setup under investigation.

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Review of the Method for Using Advanced Materials in Civil and Architectural Engineering

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Abstract- Significant advancements in industrial engineering have produced smart materials, which have a variety of applications. This research looks at several smart materials that are currently being used in building construction from the viewpoints of architecture and civil engineering, along with any potential advantages. These benefits include the façade approach, interior design, and building construction. A new, alluring impact is one of the main reasons people utilize a particular product. This effect is produced through the use of dynamic imagery display, better patterns, and form modification.

Keywords- Smart materials, sustainability, Electro chromic glass, Suspended particle devices (SPD) glass, Gas chromatic glass.

INTRODUCTION

Higher energy efficiency and interaction criteria need the creation of advanced building constructions using special materials and technology. For the design and construction of sustainable buildings that satisfy load bearing capacity and functionality under dynamic and static pressures, intelligent materials are needed. As a result, technologists and civil designers are constantly searching for novel tools and techniques that go beyond traditional design.[1]-[3].

Advanced materials are able to adjust in a positive and controlled way to changes in their state or the environment to which they have been exposed[4]. The following are some examples of inputs that alter the properties of smart materials: mechanical strain or stress; magnetic or electrical fields; and variations in pH, temperature, light, and moisture. They help boost load-bearing capacity, control vibration, lessen noise, and enhance energy efficiency in modern building constructions. Electroactive, piezoelectric, thermoastrictive, photoastrictive, chemoastrictive, magnetoastrictive, and fiber optic sensors are the several categories into which smart materials can be separated. Shape memory alloys are another type of intelligent material that can be used as activators in detecting equipment or as temperature sensors in filtration systems [5]. Glass's qualities can be improved through the application of nanotechnology. There are now self-cleaning gadgets with antimicrobial activity that can reduce pollutants. Titanium dioxide is a highly biocompatible, broad-spectrum bactericide used to provide an anti-adhesive coating.

RESEARCH METHODS

Advanced Materials in Civil Engineering

a constantly evolving collection of specific materials with implications for the development of superior building constructions and stability. Smart concrete holds an important place in this category[6]. Carbon fibers must be added to the concrete mix in order to incorporate electrical impulses, which enable the concrete to change its electrical resistance in response to cracking and deformation. This enables the detection of slight increases in internal tension. The material itself is able to identify cracks or elevated stress. Because of shrinkage and other additional rheological processes, it is impossible to prevent cracks in reinforced concrete[7]. But still,

To reduce the likelihood of such fissures, great caution must be taken. Using reinforcing fibers, like steel, polyvinyl, alcohol, and natural fibers, is one method to lessen cracking[8]. Using bacterial concrete is a more sophisticated and adaptable method whereby the material itself heals fractures as soon as they occur[9]–[12]. In this process, urea is converted to carbonate and ammonium by the enzyme urease, which is produced by bacteria. Decrease heat cracking in concrete can also be achieved by adding PCMs to the concrete mix. A considerable quantity of energy in the form of heat can be absorbed, stored, and transferred by phase change materials (PCMs). Heat is gathered and released during a PCM's transition from a solid to a liquid. Another kind of material commonly used in building engineering is shape memory alloys (SMA) thermal bimetals, which change form in response to temperature changes. Because austenite (the maximum temperature stage) and martensite (the minimum temperature stage) can alter reversibly, as can their mechanical, thermal, and electrical properties, passive control of structures is made possible [13]. Because of their excellent deformation behavior and high resistance, Cu-Zn-Al, Cu-Zn-Ni, and Ni-Ti can be used successfully in vibration damping [14]. According to residual inter-story drifts, the SMA bracing system's introduction decreased (Fig. 1).

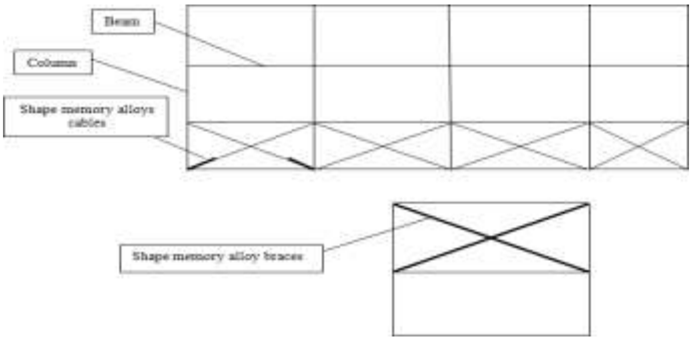

Figure 1: Shape memory alloys braces for steel building structure

Furthermore, SMA tube connections with a shape memory effect could be used to produce structural elements like lattice beams that are skeletal in nature. Furthermore, shape memory alloys (SMA) and its ability to apply high pressures to the resisting element during SMA transition upon heating have been used to create sophisticated concrete beams[15]. In this example, the concrete structure was able to recover from the residual deformation caused by the destructive earthquake after applying electrical heat to the SMA wires. The effectiveness of restoring Shape memory alloy concrete beams is highly correlated with the increase in the wire's initial pre-stress[16]. Magneto rheological liquids (MR) are an intelligent material that is essential to guaranteeing the structural integrity.When an electric field is applied to MR, its viscosity changes from a thick fluid to nearly a solid. The ferromagnetic solution is dispersed using a synthetic oil carrier or mineral in this dispersion technique. The majority of these materials are used in the vibration dampers of buildings that are exposed to strong winds or are in seismic zones. MR dampers, like the ones found on Tokyo's Nihon Kagaku Miraikan tower, are often an integral element of the main bearing structure. Another common application of magneto rheological dampers in building construction is protection against movement of bridge structures [17]. As shown in Fig. 2, they are used to dampen structure cables in suspension bridge structural solutions. An electronic system controls the hydraulic damping element's damping settings independently. A sensor records the natural frequency and sends the data to a computer, which determines the necessary reaction force for the damper and sends the electrical impulses that result to the damper. One of the longest bridges in Europe, the Volgograd Bridge (Volgograd, Russia), was built using this technique.

The likelihood of such fissures must be reduced with the utmost vigilance. One method to lessen cracking is to utilize reinforcing fibers, such as steel, polyvinyl, alcohol, and natural fibers[8]. A more sophisticated and responsive method is the use of bacterial concrete, which heals fractures on their own as soon as they occur[9]–[12]. This activity involves the development of urease by bacteria, which catalyzes the conversion of urea to carbonate and ammonium. Another way to lessen heat cracking in concrete is to add PCMs to the mixture. Heat is a kind of energy that phase change materials, or PCMs, are able to absorb, store, and transport in large quantities. Heat is gathered and released as a PCM changes from a solid to a liquid state. In building engineering, shape memory alloys (SMA) thermal bimetals are another common material type that reacts to temperature changes by changing form. The reversible transition between the austenite (highest temperature stage) and martensite (low temperature stage), along with the ensuing modification in mechanical, thermal, and electric properties, make passive management of structures feasible [13]. Cu-Zn-Al, Cu-Zn-Ni, and Ni-Ti have exceptional deformation behavior and high resistance, making them suitable for vibration damping applications [14]. Based on lingering interstory drifts, the SMA bracing system was introduced, reducing (Fig. 1).

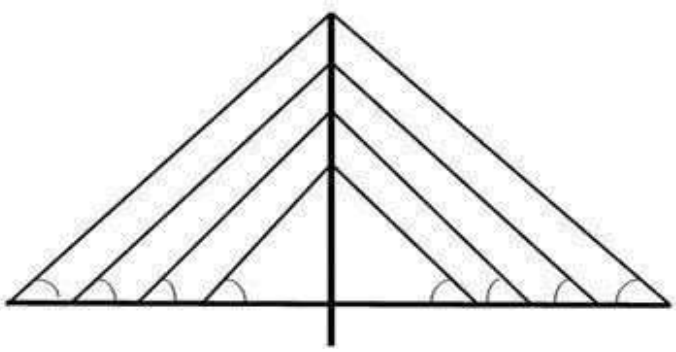

Figure 2: Cable suspension bridge with vibration damping

Smart Materials in Architecture

A varied range of materials that exhibit color or transparency changes in response to specific environmental factors are becoming more and more common in architecture. Glass makes up the bulk of these materials[18]. Certain types of glasses react automatically to changes in light or heat from the sun (thermotropic glasses) (photo chromic glasses). The most widely used glasses have nominally adjustable optical qualities that are powered by electricity. The subsequent methods are as follows:

Electro chromic glass

Between two glass panes that are filling with liquid crystal components, a special coating is applied. The laminate (passive electrode) and electrochromic layer (active electrode) are composed of two layers of electrolyte, transparent conductors, and ion storage. The glass becomes tinted and blue due to ions moving between the electrodes as a result of the applied voltage.

Suspended particle devices (SPD) glass

A thin layer comprising an elongated suspension of particles is sandwiched between two sheets of transparent plastic or glass. A darkened glass plate (gray or black) is the consequence of suspended elements arranged in random orientations and absorbing light when there is no voltage. Light can flow through once the suspended particles align due to the addition of voltage. The potential of the applied voltage precisely controls the quantity (and brightness) of light and heat that pass through such glass, minimizing the need for air conditioning in the summer and heating in the winter. One example of this kind of approach in action is the façade of the Indiana University building in Bloomington, USA.

PDLCD (Polymer dispersed liquid crystal devices) glass

The laminate is a thin layer of liquid crystals in a properly hardened or solidified polymer. Liquid crystals separate from the polymer and remain suspended in the polymer mass as droplets when a polymer changes from a liquid to a solid state. Liquid crystals separate from the polymer and remain suspended in the polymer mass in the form of droplets as a polymer transitions from a liquid to a solid state. The glass turns opaque at the beginning because of the disordered arrangement of the liquid crystals. The glass turns transparent when voltage is introduced because the crystals arrange themselves into an ordered pattern. The transition between states happens quite quickly. One example of this kind of approach in action is the façade of Chanel's Tokyo headquarters building (Japan).

Gas chromatic glass

Active liquid hydrogen flowing from the gaps between the glass layers determines the color of gas chromic glazing. This gas reacts with the active coating WO3, giving it its color. In the passive phase, the glazing is transparent and modest. In the active phase, it takes on a deeper shade of navy blue. One advantage of this method is that the phase shift happens quickly. One example of this kind of solution in operation is the façade of the Frauenhofer Institute Building in Freiburg, Germany.

Micro-blinds

Mini-blinds also control how much light passes through glass when the proper voltage is applied. A multitude of tiny, thin metal blinds installed on the glass pane make up a micro blind. The blind slats are separated using laser lithography or another type of laser technology, and the alloy layer is added during the magnetron sputtering process. The glass plate has a thin film of conductivity (transparent conducting oxide, or TCO). The most often utilized materials are indium tin oxide (ITO), fluorine doped tin oxide (FTO), and doped zinc oxide. Without power, the micro-blinds have rolling slats that let light pass through the structure.

Another task that can be accomplished with the aid of intelligent materials is light emission. After an impulse operation that lasts for the duration that the impulse is active, the particles have attained their maximal energy state. Not all of the energy is released as heat; some of it is released as visible light radiation. Photoluminescent materials—which react to electroluminescent light—and light materials—which react to electric voltage—are the most advantageous materials for architecture. Textiles, paint coats, and wallpapers having phosphorescent or light qualities are used. LEDs are the most well-known product in the area of electroluminescent materials. They are used to create media facades, the surface of which may exhibit any moving image. Originally, these were grid constructions installed on the facades. The most modern techniques involve inserting the diodes inside the glass pane. Polymer semiconductor (OLED) diodes are also being produced in new generations. One example of such a system is the light-kinetic curtain wall façade of Barcelona's Hotel Habitat (Spain).

Certain materials have the ability to generate electrical energy in reaction to specific stimuli, including light, temperature, mechanical force, and chemical environments. In this category, photovoltaic cells are the most common material since they use sun energy to create electricity. They use semiconductor technology and function in the opposite direction as LEDs. Modules are created by assembling individual cells, and they are then joined serially. Modern forms of cells are produced as incredibly thin films that can be joined to the framework of a glass pane. The most modern products are semi-transparent glasses with photovoltaic cells that are also tinted in a wide range of colors and suitable for use on pedestrian surfaces. Less efficiency is achieved by the most structurally efficient choices, like semi-transparent cells.

A more creative approach that fits with sustainable architecture is the photocatalytic self-cleaning coating used on building façades. This method coats the outer surface of the façade with titanium dioxide at the nanoscale. When titanium dioxide absorbs UV light, it turns into a photocatalytic material. This process results in the chemical oxidation of soiling deposits on exposed surfaces[19]. When it rains, the coating's initial breakdown makes it possible to remove them off the building's façade with ease. It has been demonstrated that photocatalytic coatings offer great promise for frequent maintenance and cleaner air. The Manuel Gea Gonzalez Hospital in Mexico serves as an illustration of the application of this kind of solution.

CONCLUSION

The quick development of new materials has made it possible to create buildings and changed the way experts in the domains of architecture and construction think. The number of creative, clever solutions has increased as a result of advances in nanotechnology. The variety of functions that smart materials could fulfill led to the development of smart material systems that modify the behavior of structures. The design and construction process could be improved and transformed by new sophisticated materials technologies and material systems. As they become increasingly interwoven with civil

Early in the design process, they should be taken into account for both engineering and architectural purposes. In the current technology era, the development of complex building structures is becoming more and more important, as the creation of better structural solutions may be the primary force behind technological innovation rather than just a projection of what is already possible.

For instance, it is highly effective to use SMA and MR to enhance a building's reaction to any kind of extreme stress. Other breakthroughs that could significantly reduce the cost of repairing and retrofitting various structures include self-repairing concrete and phase shifting materials, which allow for the formation of large surface areas to improve heat transmission. Greener alternatives could also include thin polymer films applied to a building envelope that mimic the properties of biological skin or self-cleaning structures already in place.

The cost of lighting, heating, and air conditioning, as well as the installation and upkeep of automation and drives for conventional sun visors like awnings or blinds, are all reduced with smart glass. Glass, which is not transparent in its inert state, blocks almost all UV light and helps keep paints, fabrics, and other UV-sensitive materials from fading. All things considered, material engineering tends to bolster the potential of smart materials to modify the comfort, security, and energy efficiency of the interior environment, as well as the ecological and aesthetic features of the structure.

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Track-4 : Paper

Dr. Anil Kumar Sharma

Bio conjugation Strategies for Imaging and Drug Delivery

Priya Gouri., Md.Aziz. Kavita Sharma

Abstract:

Covalently attaching biomolecules, such as proteins, peptides, oligonucleotides, or tiny molecules, to other molecules, surfaces, or nanoparticles is known as bioconjugation. In biomedical research, this method is frequently used for imaging and medication delivery applications. The site-specific attachment of targeted moieties, fluorescent probes, radionuclides, and therapeutic medicines to biomolecules is made possible by bio conjugation methods. An extensive review of the most widely used bio conjugation techniques for medication delivery and imaging is given in this chapter. The importance of bioconjugation and its use in creating therapeutic conjugates and targeted imaging probes are explained in the introduction. The several bio conjugation strategies are described in the methods section along with their underlying chemistries, benefits, drawbacks, and practical concerns. The chapter also discusses the supplies and equipment needed to carry out these bioconjugation reactions effectively.

Introduction

Bioconjugation, the process of covalently linking biomolecules to other molecules, nanoparticles, or surfaces, has emerged as an indispensable tool in biomedical research, particularly in the areas of molecular imaging and targeted drug delivery. This powerful technique enables the site-specific attachment of various functional moieties, such as fluorescent probes, radionuclides, targeting ligands, and therapeutic agents, to biomolecules like proteins, peptides, oligonucleotides, and small molecules. In the field of molecular imaging, bioconjugation strategies are employed to develop targeted imaging probes for various modalities, including fluorescence imaging, positron emission tomography (PET), single-photon emission computed tomography (SPECT), magnetic resonance imaging (MRI), and ultrasound imaging. These imaging probes, consisting of a biomolecule conjugated to a suitable imaging reporter, facilitate the visualization and tracking of biological processes, target expression, and diseaseSimilarly, in targeted drug delivery, bioconjugation plays a crucial role in the development of therapeutic conjugates, where a cytotoxic agent or therapeutic payload is covalently linked to a biomolecule that selectively targets specific cells or tissues. These targeted conjugates aim to enhance the therapeutic efficacy while minimizing off-target effects and associated toxicities.

The choice of an appropriate bioconjugation strategy is governed by several factors, including the nature of the biomolecule, the functional groups available for conjugation, the desired conjugation site, the stability and solubility requirements of the final conjugate, and the intended application. Consequently, a diverse array of bioconjugation techniques has been developed, each with its own advantages, limitations, and specific considerations.

Methods:

This section provides a comprehensive overview of the most commonly employed bioconjugation strategies for imaging and drug delivery applications, including their underlying chemistries, advantages, limitations, and practical considerations.

1. Amine-based bioconjugation
   - Reaction with N-hydroxysuccinimide (NHS) esters
   - Reaction with isothiocyanates
   - Reductive amination
   - **Advantages:** Versatility, mild reaction conditions
   - **Limitations:** Potential for cross-reactivity, heterogeneity
2. Thiol-based bioconjugation
   - Maleimide-thiol coupling
   - Iodoacetamide alkylation
   - Disulfide formation
   - **Advantages:** Site-specificity, stability of conjugates
   - **Limitations:** Potential for disulfide exchange, limited availability of free thiols
3. Click chemistry-based bioconjugation
   - Copper-catalyzedazide-alkyne cycloaddition (CuAAC)
   - Strain-promoted azide-alkyne cycloaddition (SPAAC)
   - **Advantages:** High specificity, mild reaction conditions
   - **Limitations:** Potential copper toxicity (CuAAC), requirement for bioorthogonal handles
4. Enzyme-mediated bioconjugation
   - Sortase-mediated ligation
   - Transglutaminase-mediated conjugation
   - Phosphopantetheinyltransferase (PPTase)-mediated labeling
   - **Advantages:** Site-specificity, mild reaction conditions
   - **Limitations:** Requirement for specific recognition sequences, enzyme stability
5. Photochemical bioconjugation
   - Photoactivated cross-linking
   - Photoinduced insertion of unnatural amino acids
   - **Advantages:** Spatial and temporal control, mild reaction conditions
   - **Limitations:** Potential for off-target reactions, phototoxicity
6. Bioorthogonal bioconjugation
   - Tetrazine-based inverse electron demand Diels-Alder reactions
   - Oxanorbornadiene-based bioconjugation
   - **Advantages:** High specificity, rapid kinetics, biocompatibility
   - **Limitations:** Requirement for bioorthogonal handles, potential instability

Materials and Instrumentation

The successful execution of bioconjugation reactions requires careful consideration of the necessary materials and instrumentation. This section outlines the essential components for conducting bioconjugation experiments effectively.

1. Biomolecules
   - Proteins, peptides, oligonucleotides, or small molecules for conjugation
   - Considerations: Purity, stability, solubility, and functional groups
2. Conjugation reagents
   - Reactive linkers (e.g., NHS esters, maleimides, azides, alkynes)
   - Coupling agents (e.g., carbodiimides, phosphine reagents)
   - Catalysts (e.g., copper sources for CuAAC, enzymes for enzyme-mediated conjugation)
3. Buffers and solvents
   - Appropriate buffers for maintaining biomolecule stability and solubility
   - Organic solvents compatible with the conjugation chemistry
4. Purification and characterization tools
   - Chromatography systems (e.g., HPLC, SEC, ion exchange)
   - Spectroscopic techniques (e.g., UV-Vis, fluorescence, mass spectrometry)
   - Electrophoretic methods (e.g., SDS-PAGE, capillary electrophoresis)
5. Instrumentation
   - Reaction vessels (e.g., vials, microplates, columns)
   - Incubators or temperature-controlled systems
   - Photoreactors or light sources (for photochemical conjugation)

- Centrifuges and filtration devices
6. Safety equipment
    - Appropriate personal protective equipment (PPE)
    - Chemical fume hoods and biosafety cabinets
    - Waste disposal facilities

By ensuring the availability of these essential materials and instrumentation, researchers can successfully execute bioconjugation reactions and characterize the resulting conjugates for imaging and drug delivery applications.

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Bisphenol A: An Insidious Environmental Pollutant and Its Impact on Human Health

Kavita Sharma, Priya Gouri, MD Aziz

Abstract: Bisphenol A (BPA) could be a broadly utilized mechanical chemical found in different customer items, counting nourishment and refreshment holders, warm receipts, and dental composites. In spite of its broad utilize, BPA has been recognized as an endocrine-disrupting compound (EDC) with potential unfavorable impacts on human wellbeing. This chapter investigates the sources of BPA presentation, its components of activity, and its potential suggestions for human wellbeing. It analyzes the developing body of prove connecting BPA presentation to a extend of wellbeing issues, counting regenerative disarranges, metabolic clutters, neurological impacts, and an expanded hazard of certain cancers. The chapter too examines the progressing wrangles about encompassing BPA control and the require for assist investigate to completely get it its effect on human wellbeing and create viable relief strategies.

Introduction:

An industrial chemical called bisphenol A (BPA) has made its way into our food and drinks. Concerns regarding the possible harmful effects of low levels of BPA on human health have been discussed in recent decades. BPA consumption has been linked to a number of negative outcomes, including abnormal penile/urethral development in males, early sexual maturation in females, an increase in neurobehavioral issues like autism and ADHD, an increase in childhood and adult obesity and type 2 diabetes, a decrease in sperm count in a particular area, and an increase in hormonally mediated cancers. Published in vitro studies that indicate potential molecular mechanisms that could mediate such effects have sparked concerns. These days, almost everyone has detectable levels of in their blood, tissues, and urine

BPA was discovered to be connected to "organizational changes in the testis, mammary glands, breast, prostate, body size, brain structure/chemistry, and behavior of laboratory animals" based on several hundred human investigations.

Chemistry:

Bisphenol A (2,2-bis(4-hydroxyphenyl) propane, CAS No. 80-05-7) shown in Fig.1., is an organic compound , commonly known as BPA is widely used as a monomer in the manufacture of polycarbonates and epoxy resins, as an antioxidant in PVC plastics and as an inhibitor of end polymerization in PVC .

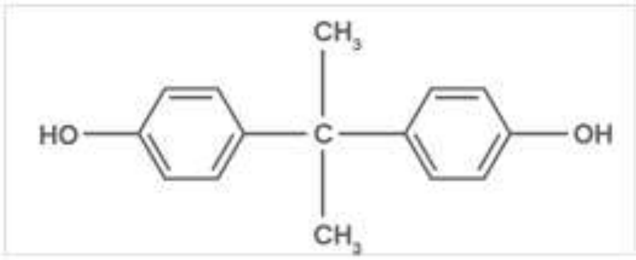
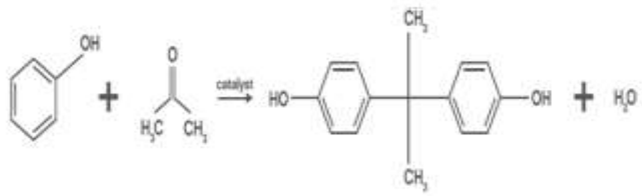


Fig.1. Bisphenol A

BPA was first synthesized in 1891, by Russian chemist Aleksandr P. Dianin, who combined phenol with acetone in the presence of an acid catalyst to produce the chemical. The two phenolic rings are linked by a methyl bridge which, in turn, is attached to two functional methyl groups Fig.2. The presence of hydroxyl group in BPA makes it highly reactive .



Phenol Acetone Bisphenol A Water

Fig.2. Synthesis of BPA

BPA has a molecular weight of 228.29 g/mol. It is a white crystalline solid at room temperature and has a melting point of 156 °C and a boiling point of 220 °C. It is more soluble in ethanol, acetic acid and diethyl ether and less soluble in water.

The broad utilize of BPA-containing items and the potential for human introduction have driven to developing concerns around the potential wellbeing suggestions of this natural pollutant. This chapter points to supply an in-depth examination of the current logical understanding of the impacts of BPA introduction on human wellbeing, including reproductive, metabolic, neurological, and carcinogenic impacts. Also, it'll talk about the continuous talks about encompassing BPA control and the require for further research to completely get it its affect and develop successful moderation methodologies.

Various ponders have connected BPA introduction to a run of wellbeing issues, counting regenerative disarranges, metabolic disarranges, neurological impacts, and an expanded chance of certain cancers .

1. Regenerative Impacts:

BPA introduction has been related with different regenerative disarranges, such as fruitlessness, polycystic ovary disorder (PCOS), and endometriosis . Furthermore, pre-birth BPA introduction has been linked to adverse effects on fetal advancement, counting changed regenerative tract advancement and expanded defenselessness to regenerative clutters afterward in life .

2. Metabolic Disarranges:

A few ponders have recommended a potential connect between BPA presentation and an expanded chance of metabolic disarranges, counting weight, sort 2 diabetes, and cardiovascular illness . The proposed instruments include BPA's capacity to meddled with glucose and lipid digestion system, as well as its potential to disturb adipogenesis and affront affectability.

3. Neurological Impacts:

BPA has been ensnared in various neurological impacts, counting neurodevelopmental disarranges, cognitive impedance, and an expanded hazard of neurodegenerative maladies. These effects are thought to be intervened by BPA's capacity to disturb the typical working of the endocrine framework, which plays a vital part in brain improvement and work .

4. Cancer Hazard:

A few thinks about have recommended a potential interface between BPA introduction and an expanded chance of certain sorts of cancer, counting breast cancer and prostate cancer . The proposed mechanisms include BPA's ability to imitate estrogen and advance cell expansion, as well as its potential to initiate oxidative stretch and DNA harm .

In spite of the developing body of prove connecting BPA introduction to antagonistic wellbeing impacts, the control of BPA remains a subject of continuous talk about. Whereas a few nations have actualized limitations or bans on the utilize of BPA in certain items, especially those intended for utilize by newborn children and youthful children, other nations have kept up more lenient approaches.

Encourage investigate is needed to completely get it the components by which BPA applies its impacts on human wellbeing, as well as the potential long-term results of persistent low-level exposure. Additionally, endeavors ought to be made to develop more secure options to BPA and execute successful methodologies for lessening human introduction to this omnipresent natural poison.

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Blue-fluorescent carbon nanodots for using Toxic Hexavalent Cr (VI) Nano probe

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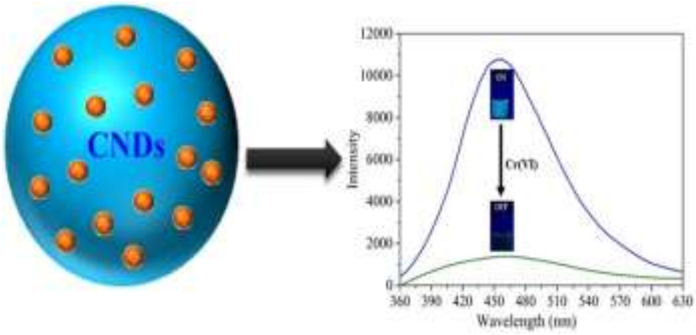
Abstract

A more straightforward methodology is used to synthesize blue fluorescent emission carbon nanodots (CNDs) from the chemical modification of the carbonization process. The fluorescent material has been synthesized by a Straightforward thermal heating process of sulphanilic acid, Dextrose, and boric acid with the presence of sodium hydroxide as a source of carbon and heteroatoms that produce blue fluorescent emission carbon nanodots, which showed the excitation-dependent emissions at ~ 455 nm with high photostability and quantum yield value of approximately 18%. Furthermore, the significant application of the present outcome is to use these CNDs as a novel nanoprobe material for sensing with the help of fluorescence spectrometers.

The blue fluorescence emission of CNDs has been demonstrated as a very selective and sensitive toxic Cr(VI) fluorescence nanoprobe with a detecti on limit of 90 nm compared to other metal ions.

These CNDs can also be used as fluorescent inks i n photography.



Keywords: Carbon dots, blue-emitting carbon nanodots, quantum yield, Toxic Chromium, Nano Probe.

Introduction

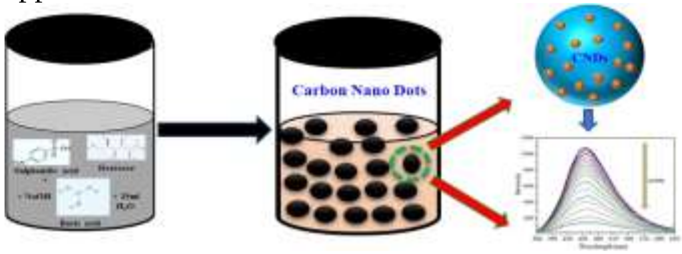
Within the past few years, carbon dots were found in the simple purification of the single-walled carbon nanotube utilizing the bend release strategy, which was surveyed by Xu *et al*. in 2004[1]. After some time, the Ya-Ping Sun was observed by fluorescence to have the smallest nanocarbon dots in 2006[2].The carbon dot is biocompatible, highly water soluble, photostability and excellent photoluminance properties[3, 4]. Carbon nanodots refer to zero-dimensional carbon nanoparticles. Carbon nanomaterials generally refer to a diminutive form of carbon around 10 nanometers (nm) in size[5]. Carbon nanodots are hemispherical particles with a nanocrystalline core and a graphite or carbon subshell[6]. Carbon nanodots are quasi-spherical nanoparticles with a nanocrystalline core and a graphite or carbon subshell[7]. Carbon nanodots have attracted much attention due to their good stability, biocompatibility, nontoxic nature, and excellent photoluminescent properties[3, 8]. The fluorescent carbon dot nanomaterials have good conductivity and are medical, drug delivery, and environment eco-friendly; they have simple synthetic routes and comparable excellent optical properties to carbon dots. Fluorescent carbon nanodots is made of sp2 conjugates core particles and consists of carbonyl, aldehyde etc[9-11]. They are passivated or surface functionalization with oxygen cantoning chemicals for example many other functional groups that gives them unique properties. Other carbon nanoforms such as fullerenes, multiwalled carbon nanotubes[12], single-walled carbon nanotubes[13], carbon nano diamonds, Carbon nanorod[14-16], graphene quantum dots, carbon dots and carbon nano onion are allotropes of carbon. The nano-carbon possesses a high surface area to volume ratio, which was further utilized for surface passivation or functionalization purposes *via* simple surface modifications. Metal-based carbon nanodots exhibit classical quantum confinement due to their size-dependent multicolor emissions. Theoretically, compared to quantum dots, fluorescent carbon dots do not have a clear fluorescence emission bandgap; this is a good property for polychromatic emission from the same nanocarbon. Now a day's carbon nanodots are extensively investigated emission properties which makes them useful for their application in biomedicine, optronics, and catalysis. Photocatalysis[17], degradation photo reduction and sensing[18]. They have the best properties of carbon nanodots and can produce well materials. Physical, chemical, and electronic properties was developed[19]. It has practical applications in many fields. Carbon nanodots have many applications, such as agriculture, photocatalysis, adsorption, degradation, photoreduction, supercapacitors, drug delivery, bioimaging, biosensors for electrochemical energy, electrochemical sensing, gas sensing, and metal sensing[20].

Materials and Methods

Sulphanilic acid, Dextrose, Sodium hydroxide (NaOH), and boric acid) and sodium hydroxide (NaOH), Copper nitrate (Cu $(NO_3)_2$), Bismuth nitrate (Bi $(NO_3)_3.5H_2O$), Potassium dichromate $K_2Cr_2O_7$, Strontium nitrate $Sr(NO_3)$, Cobalt nitrate $(Co(NO_3)_2.6H_2O)$, Cadmium nitrate $[Cd(NO_3)_2 .H_2O]$, Nickel nitrate (Ni $(NO_3)_2.2H_2O$), Zinc nitrate $(Zn(NO_3)_2)$. $6H_2O$), Mercury chloride $(HgCl_2)$, Chromium nitrate (Cr $(NO_3)_2.9H_2O$), Potassium nitrate $[KNO_3]$, Magnesium nitrate [Mg $(NO_3)_2$)], Silver nitrate $[AgNO_3]$, Barium chloride $(BaCl_2)$, calcium chloride $(CaCl_2)$, used for sensing application. All reagents used of analytical grade procured from (Sigma Aldrich).

Preparation of carbon Nano dots

Carbon dot was synthesized by a superficial, easy and general procedure using one step reaction on the heating process by carbonization of Dextrose, boric acid, Sulphanilic acid and NaOH in 25ml of water at 120°C for ~ 3 hours. The various chemical as a carbon source like dextrose, Sulphanilic acid as a source of sulfur and nitrogen as both of these groups are present in Sulphanilic acid and boric acid use for the boron sources. Then we performed optimization reaction for the controlled reaction. These compositions of the mixture such a compound like dextrose 0.015 gm., NaOH 0.064 gm. Sulphanilic acid, 0.023 gm. of boric acid in all the mixing with each other looks like heterogeneous mature heating the mixture of solution carbonization process for thermal treatment at the 120°C and 3h. After carbonization produces carbon nanodots without purification using various field but we are used as nanoprobe application.



Scheme 1: The schematic diagram of the synthesis of Carbon nanodots and Sensing Nanoprobe

Characterization of UV-vis Spectroscopic

Characterization of optical materials as CNDs by UV-vis spectroscopy. The UV-vis absorption spectrum CNDs shows that two distinct peaks are observed; the first is at 283 nm, consistent with π−π* transitions of the C=C/ C=O areas and the remaining second peak is at 365 nm. In figure (a), To be attributed to n−π* C=N transitions is due to the presence of the Carbon dots different energy level by the surface functionalization or surface passivation states figure (a), they are representative property of the carbon nanodots. Figure (b) photographic image Carbon nanodots show a brown-yellowish color under normal day light, which turns blue light emitting under UV light. In the fluorescence spectroscopy characterized, the back-excitation observation spectrum 450 to 200 nm, so fascinating results were observed and show the highest excitation state ~461 nm figure (c); blue fluorescent CNDs emitting excitation wavelength dependent range between 320- 520 nm CNDs figure (d).

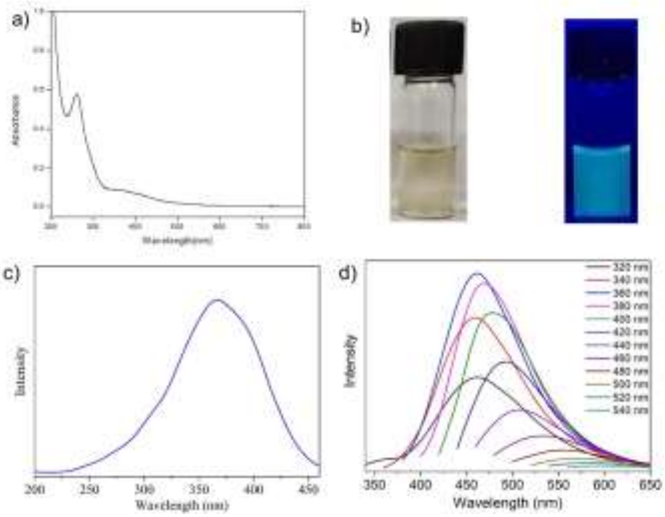


Figure 1. UV-Vis spectra; **(a)** The UV- Vis spectrum of CNDs; **(b)** the photographic image for the under-day light UV light in blue fluorescent and aqueous medium CNDs; **(c)** The back-excitation spectrum 450- 200 nm; **(d)** Excitation dependent wavelength 320-540 nm.

Characterization of TEM and HR-TEM Analysis

The microscopic characterization was analyzed using Transition Electron Macroscopic (TEM) and High Resolution-Transition Electron Macroscopic (HR-TEM). The TEM picture shows well-spreading particles of the CNDs figure (a), and the histogram shows 2 to 10 nm particle size and verify the carbon nanodot structure figure (b) and along with graphitic carbon nanodots shows the selected area electron diffraction pattern (SAEDP) structure figure (c) and high-resolution TEM image shows interlayer pattern visible graphitic fringes size in a 0.30 nm figure (d)

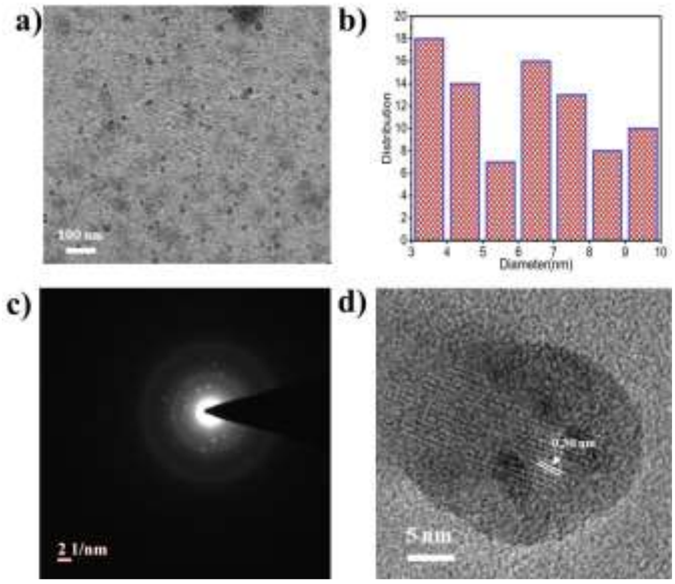


Figure 2. a) TEM internal morphology of CNDs; **b)** CNDs size distribution histogram; **c)** The show SAEDP **d)** HRTEM picture shows of the CNDs a graphitic fringes size in a 0.30 nm

Metal selectivity of the carbon nanodot

The metal selectivity of the carbon nanodots against various metal ions such as Pb (II), Cr (III), Hg (II), Co (II), Mn (II), Zn (II), Mg (II), Cr (VI), Ni (II), Na (I), Al (III), Fe (III), Ag (I), Cd (II), Ba (II), Sr (III), Cu (II), under the fluorescence spectroscopic analysis and shows selectively nanoprobes are toxic Cr (VI) fluorescence turn off Figure 2(a). figure 2b shows the relatively changed bar graph spectrums of metal ions vs. intensity and observed as selectively and sensitively work on the Cr (VI) ion.

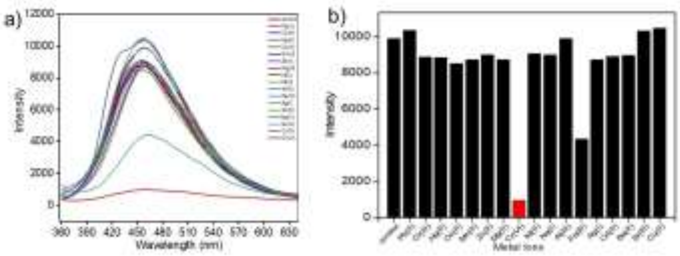


Figure 3. (a) Selectivity of various metal ions against carbon nanodots. **(b)** the relative change shown in the bar chart graph of carbon nanodots.

FT-IR Characterization of Carbon Nanodots

In the characterization of the CNDs, the surface morphology, and the composition, Fourier analyzed various types of vibration transform infrared spectrum (FTIR). The FTIR shows like boric acid dextrose, Sulphanilic acid, and CNDs absorption starching frequency B-O-H, B-O, C=C, S=O, N-H/O-H, at 1192 cm-1, 1449 cm-1, 1645 cm-1 to attribute to the various starching vibration is present starting material. The absorption band of produced to CNDs different vibration was analyzed by FTIR attribute at the N-H/O-H, C=C, C-H, S=O at 3232 - 3400, 2941, 1600, 1427 1678, 1192, 1127, 1032 cm-1 shows the tow type of starching and bending frequency and investigation the help of carbon nanodot. However, the prominent peak is the stretching vibration of N-H and O-H. Indicates the existence of many hydroxyl groups and amino-containing functional groups on the surface of the CNDs. The synthesized carbon nanodots have a good hydrophilic nature, and their Character also shows the stability of the carbon nanodots[21].

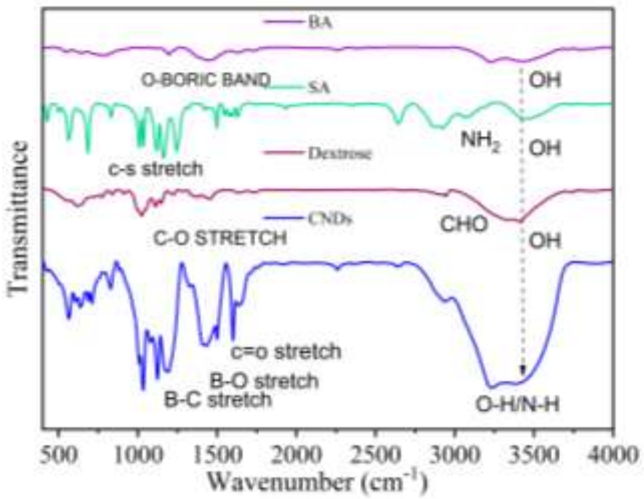


Figure 4. The characterization of initial compound Dextrose, boric acid, Sulphanilic acid and CNDs

Nanoprobe for toxic Cr (VI) against Selective and sensitive CNDs

To check the ability of these fluorescent carbon nanodots towards the metal ions after adding different metal ions solution. First, we make different metal ion solutions with a 5 mM concentration and then do the sensing titration process of carbon nanodots. We measured the intensity of fluorescence and the ratio of the change in the fluorescence of the carbon nanodots we synthesized, which displayed remarkable selectivity towards Cr (VI). The selective nanoprobe CNDs against toxic Cr (VI) metal. The v/v water and CNDs mixture using nanoprobe solution intensity vs concentration of toxic Cr (VI) and conc. Decreases with the increase in the concentration of Cr (VI) metal ions. This process is called nanoprobe. The conc. Range 0 to 500 µM concentration of toxic Cr (VI) and turn off fluorescence of the emission spectra. The lower limit detection (LOD) observed in this process had a detection limit of 90 nm compared to other metal ions.

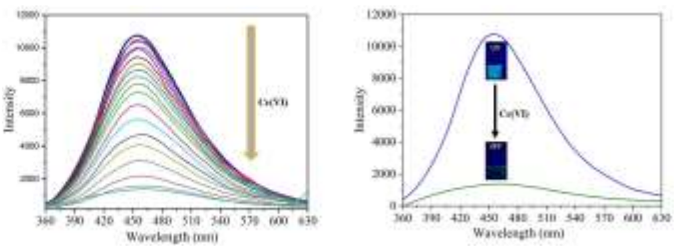


Figure 4. (a) Nanoprobe using CNDs by adding toxic Cr (VI) at variable conc. Of the (0−500 µM) **(b)** blue florescence, CNDs turn off against toxic Cr (VI) metal ions.

Fluorescent Inks in Photography Image

The blue-fluorescent inks are used for security purposes as stamps and have strong fluorescent characteristic properties. It may be helpful for information storage properties and another investigation point of view. Figures a), b), and c) under UV light show blue fluorescence; without others, blue fluorescence.

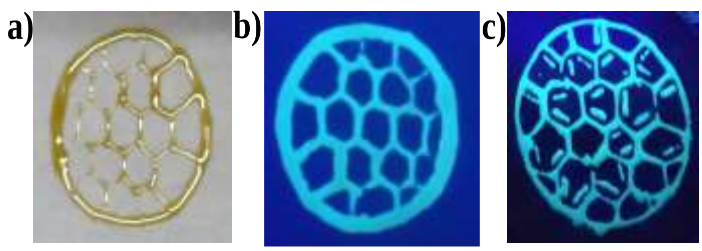


Figure 5. The blue-fluorescent inks picture paper CNDs under **(a)** daylight and **(b)** and **(C)** UV light radiant.

Conclustions

CNDs were used for the selective and sensitive blue-fluorescent nanoprobe materials of Cr (VI) founded on the simpler FL turn-off in an aqueous medium. The nanoprobe capability has high selectivity and sensitivity. Nanoprobe is used to embarrass the Cr (VI) effectively. Blue-fluorescent ink picture paper CNDs can be used as fluorescent ink.

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"Comprehensive Framework for Sustainable Environment Conservation through the Integration of Waste and Water Management Plans"

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Abstract

This chapter explores the critical need for integrating waste and water management plans within a comprehensive framework for sustainable environmental conservation. Recognizing the deep interdependence between these two sectors, the chapter emphasizes the benefits of a holistic approach. By integrating waste and water management, we can enhance resource efficiency, minimize environmental pollution, and foster a circular economy. A more robust policy, comprehensive planning, innovation in technology, public awareness, and recovering resources constitute the key parts of such a framework. This holistic approach brings forward several advantages, such as reduced pollution, improved quality of water, increased resource efficiency, and cost benefits. Above all, integrated management for wastes and waters is necessary for securing an inclusive resilient and sustainable future

Keywords: Life cycle assessment, circular economy principles, sustainable water resource management, integrated waste and water management, and the water-energy-food nexus

Introduction

An integrated strategy to resolving interconnected challenges is necessary for sustainable environmental conservation.. This chapter discusses the urgent need to integrate waste and water management plans into a comprehensive framework. Synergistic approaches in these two areas can help significantly improve environmental quality, promote resource efficiency, and foster sustainable development.

Environmental sustainability has become a global challenge due to urbanization, population growth, and industrialization. Two of the most important issues facing ecosystems worldwide are waste management and water conservation, both of which are interlinked. Inefficient waste disposal and water use threaten biodiversity, climate change, pollution, and resource depletion. The call for integrated approaches to manage these challenges has never been more urgent.

Reducing environmental harm, human impact, and promoting a circular economy can be accomplished through a comprehensive framework for sustainable environmental conservation that integrates waste and water management. Despite their frequent separation, waste and water management are tightly related. Waste management reduces pollution and saves resources, while water management supports agriculture, maintains ecological balance, and safeguards community health. When waste and water management are combined, resources may be used more effectively, waste can be disposed of more effectively, and the result is more environmentally acceptable. One example of technologies that help in waste-to-water solutions, namely wastewater treatment producing energy, use of organic wastes in purifying water can offer sizeable environmental gains. Further, the reused treated wastewater for non-potable use, such as irrigation and industrial processes, can further reduce the consumption of potable water.

The framework should be flexible enough to fit any situation, whether it is an agricultural-based rural area or an urban center with water scarcity and overproduction of waste. It should also be an intergovernmental, inter-industrial, and community-based process supported by policies that enhance sustainability and technological innovation.

Future generations' economic and environmental well-being will be enhanced by this integrated approach, which is in line with the Sustainable Development Goals (SDGs) for waste, water, and climate action.

The Interdependence of Waste and Water

In other words, waste and water management go hand in hand. Because of the significant influence that this dependency has on ecosystem health, waste management and water management are typically viewed as unrelated to environmental protection, the economy, and the well-being of the human population. Understanding their relationship is key to designing adequate strategies for environmental conservation and resource management.

Wastewater and Waste Disposal: Inadequate waste disposal, especially in urban settings, results in the pollution of water bodies. Households and industries produce wastes that can easily find their way into rivers, lakes, and oceans when not treated or disposed of properly. These pollutants contaminate water supplies, harm aquatic life, and make the water unfit for human use by introducing chemicals, plastics, and organic waste. On the other hand, untreated or inadequately treated wastewater itself is a major waste product that must be handled with caution. Water bodies become eutrophic, infections are carried by untreated or insufficiently treated wastewater, and water quality is deteriorated.

Water in Waste Management: Water plays a vital function in waste management. Water is necessary for waste collection, transportation, and disposal. The treatment process in waste involves large quantities of water, such as in the case of sewage systems, landfills, and waste-to-energy facilities. Inadequate use of water during these processes would strain the availability of water in water-scarce regions and contribute to higher costs and more severe environmental impacts.

Waste-to-Water Technologies: Among the promising solutions to this interdependence is the incorporation of waste-to-water technologies. Food scraps and agricultural residues are examples of organic waste that these technologies transform into electricity or drinkable water. For instance, creating biogas from organic waste can minimize water consumption during trash processing while also producing electricity. Furthermore, wastewater treatment methods like membrane filtration or bioremediation can preserve freshwater resources by recycling water for non-potable purposes like industrial operations or irrigation in addition to purifying it.

Using a circular economy model to reuse water and trash is known as the circular economy approach, giving sustainable solutions. It creates closed-loop systems through societies by integrating water and waste management, where water can be recycled and waste minimized or turned into valuable resources, thereby reducing environmental impact and making it more efficient in both sectors for a sustainable future.

In conclusion, the interdependence of waste and water requires a holistic approach to environmental management. We can create integrated systems that conserve water, cut down on waste, and minimize pollution by acknowledging their connections, which will eventually promote social, economic, and environmental sustainability.

Key Components of an Integrated Framework

A comprehensive framework for sustainable environmental conservation through integrated waste and water management should include the following key components:

1. **Policy and Legislation:**

- Enact and enforce strong environmental regulations that cover both waste and water management.
- Establish clear legal frameworks for waste minimization, recycling, and safe disposal.
- Implement policies that encourage water conservation, wastewater treatment, and reuse.
- Integrate environmental considerations into all relevant sectoral policies (e.g., agriculture, industry, urban planning).

2. Planning and Assessment:

- Conduct comprehensive environmental impact analyses for all development projects.
- Develop and implement integrated waste and water management plans at local, regional, and national levels.
- Establish monitoring and evaluation systems to track progress and areas that need improvement.

3. Technological Innovation and Infrastructure

- Invest in high-value waste treatment technologies such as anaerobic digestion, composting, and waste-to-energy.
- Develop and implement efficient water treatment and reuse systems such as wastewater treatment plants and rainwater harvesting.
- Improve the waste collection and transportation infrastructure.
- Promote the use of sustainable technologies in all sectors (water-saving appliances, low-emitting vehicles).

4. Engagement and Public Awareness:

- Campaigns for Public Awareness
- Teaching Communities on Water and Waste Conservation Issues
- Public Involvement in Water Conservation and Waste Management Issues
- Community-Based Methods for Water Resource and Waste Management.

5. Recovery and Reuse of Resources:

- Utilize waste-to-energy conversion, composting, and recycling to maximize resource recovery.
- Promote the use of reclaimed water for irrigation, industrial applications, and other non-potable uses.
- Facilitate the increased utilization of materials recycled from waste.

Benefits of Integration:

The integration of waste and water management plans offers numerous benefits:

- Resource Efficiency: One of the key advantages is the better use of resources. Wastewater treatment and recycling of wastes can recover valuable materials like energy, nutrients, and water for reuse. Thus, the demand for virgin resources decreases, and fewer wastes end up in landfills, creating a sustainable circular economy.
- Environmental Protection: Integrated management curbs environmental pollution by diluting the contamination of the water bodies with untreated wastes. Properly managed and treated wastewater prevents harmful chemicals, heavy metals, and plastics from polluting the aquatic ecosystems, preserving the biodiversity, and ensuring cleanliness in water for human as well as wildlife consumption.
- Water Conservation: Through water reuse in waste management, wastewater can be reused for irrigation purposes or industrial processes and even in municipal applications that do not involve human consumption. This reduces freshwater usage and decreases the strain on the water supply where water is scarce.
- Cost Savings: Coupling waste and water systems could save municipalities and industries hundreds of millions of dollars in costs. Waste-to-energy technologies, for example, can produce power from waste, saving energy dollars. Similarly, the reusing of treated water lowers the cost of purchasing fresh water for industrial or agricultural use.
- Social and Economic Benefits: Communities benefit from cleaner environments and better quality of life through the reduction of pollution and water conservation. The integration of these systems also promotes innovation, generates jobs in the green

economy, and promotes sustainable development, which is essential for long-term economic stability.

Conclusion:-

Therefore, integration of waste and water management is an important step toward achieving environmental sustainability. It helps in reducing pollution by conserving water and protecting ecosystems through efficient resource utilization. It fosters a circular economy by recovering resources and also benefits the environment by providing economic benefits in terms of cost savings and new opportunities in green technologies. It also improves social well-being by enhancing public health and ensuring a more sustainable future for communities. Adopting integrated waste and water management methods that maximize the use of both resources for the benefit of present and future generations is necessary to create a resilient and sustainable planet.

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Exploring the Capabilities of Computational Tools in Analyzing Medical Images

Pachauri Shubham, Gouri Priya,
Sharma Kavita

Abstract:

In many medical fields, volumetric analysis of medical pictures is essential to the diagnosis and treatment of patients. This article provides a summary of the computational techniques used to analyze medical images volumetrically, emphasizing their uses, difficulties, and most recent developments. Important subjects discussed include volumetric model generation through three-dimensional (3D) reconstruction, quantitative measurements of morphological and volumetric parameters, image segmentation techniques for defining anatomical structures and lesions, and validation strategies to guarantee accuracy and dependability. Furthermore covered in the paper are possible clinical uses for volumetric analysis, future developments in the field, and the integration of computational tools with clinical workflows.

The paper also addresses future developments in the discipline, clinical uses of volumetric analysis, and the integration of computational tools with workflows in the clinical setting. Our goal in conducting this thorough evaluation is to shed light on the most recent developments in computer methods for volumetric analysis of medical pictures and their practical applications.

Keywords: quantitative measures, validation, clinical applications, volumetric analysis, computational methods, medical pictures, image segmentation, and three-dimensional reconstruction.

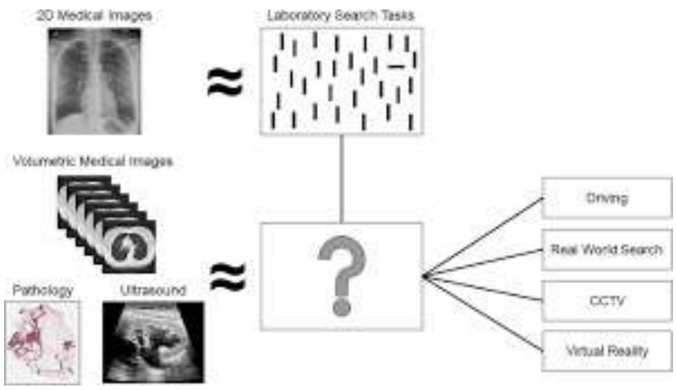
Introduction:

Greetings from the amazing realm where pixels turn into priceless insights! We take a tour around the world of computational techniques for medical image analysis in this chapter. Prepare to learn how these tech wizards are fundamentally changing the healthcare industry.

Seeing Past the Surface: Explore the wonders of picture segmentation methods. Discover how computer algorithms can analyze medical photos to expose complex anatomical features and locate hard-to-find lesions with never-before-seen accuracy.

Flat to Fabulous: Have you ever wondered how a set of 2D pictures may be combined to create a realistic 3D model? Discover the wonders of three-dimensional (3D) reconstruction techniques and watch as medical pictures come to life.

Beyond Quantities: The Vernacular of Volumes: Goodbye to eyeballing and welcome to measurements that are quantifiable! Learn how computational methods precisely determine morphological characteristics and volumes, providing doctors with unbiased information for diagnosis and treatment planning.



Accuracy Trust:

The Validation Process: Come along with us as we pursue dependability! Examine validation techniques intended to guarantee computational analysis accuracy. Discover how these methods enhance self-assurance in the digital sphere and facilitate a smooth transition into clinical practice.

Where Science Meets Practice: See how clinical care and computing are united! Explore the ways that computational tools can be integrated into clinical workflows to transform the way that medical practitioners treat, diagnose, and keep an eye on their patients.

The Future Is Calling:

Beyond the Horizon: Set out on a voyage of vision! Examine the medical imaging industry's crystal ball and consider the bright future of computational methods. Explore the countless options that lie ahead, from AI-driven diagnostics to tailored medicine.

Conclusion

I'm excited about the future and the revolutionary possibilities that computational methods in medical image processing hold for transforming healthcare as we come to the end of our investigation into them. We have seen firsthand how technology may completely transform therapeutic and diagnostic methods throughout this trip.

Each method has opened up new possibilities in medical imaging, from providing exact quantitative measurements to aiding in correct diagnosis and treatment planning to enabling thorough anatomical comprehension through three-dimensional reconstructions. Moreover, the focus on ways for validation highlights our dedication to guaranteeing the dependability of c As we look to the future, we see a wealth of opportunities for advancement and the seamless integration of computational tools into clinical operations. Technology and healthcare have never been more complementary. Artificial intelligence may be used to improve diagnostic precision, and it can also be seamlessly integrated with current clinical systems to streamline treatment regimens. Clinical situations utilizing computational approaches.

Let's continue the innovation and teamwork that have driven us thus far as we move forward, determinedly and enthusiastically forming the healthcare industry of the future.

"It has been nothing short of thrilling to go through computational techniques in medical picture processing. Let us continue the innovative legacy and embrace the revolutionary potential of computational tools in reshaping healthcare as we bid adieu to this chapter"

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INVESTIGATION OF DYE YIELDING COMPOUNDS FROM STEM BARK OF CASSIA FISTULA

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ABSTRACT

Genus Cassia offers diverse therapeutic benefits, including antibacterial and hepatoprotective effects. Various part of this plant rich in chrysophanic acid, dye hair naturally. *Cassia fistula* extracts serve as fabric colorants and possess medicinal properties. Phytochemical examination on the methanolic extract of *Cassia fistula* Linn stem bark led to the isolation of 1,8-dihydroxy-3-methylanthraquinone (I) and 1,8-dihydroxy-6-methoxy-3-methyl-anthraquinone (II). Characterization of above mentioned compounds was done on the basis of various spectral studies i.e. IR, ^{1}H NMR, ^{13}C NMR and MS.

Keywords: *Cassia fistula*, anthraquinone, bioactivity, dye yielding natural compounds, extract.

INTRODUCTION

Genus Cassia is known to be a rich source of anthraquinone derivatives which are used widely against a broad range of ailments. Anthraquinones which occurs mainly in higher plants, insects, fungi and lichens were constitute the basic skeleton for their pigments [1]. Moreover, these anthraquinones showed wide range of biological activities such as antibacterial, antiviral, antitumor, anti-inflammatory, hepatoprotective, lipid lowering, blood pressure lowering, and diarrheic [2]. Anthraquinones in particular rhein and emodin produced from numerous species of Cassia have been used to treat constipation, diabetes and haemoglobin disorders [3]. Cassia leaves are commonly used to dye hair. They are dried and powdered, and are traded as hair conditioner. One of the phytoconstituent, chrysophanic acid isolated from many species of genus Cassia is known as Cassia's dye [4] , which is used to tints gray hairs and bring out golden tones in hair so that powder of Cassia is also known as 'blonde henna'. The different parts of the C. *fistula* plant have high therapeutic value and exert antifungal [5], antibacterial, anti-inflammatory [6], antipyretic [7], antioxidant [8], antiulcer [9], antifertility [10], hepatoprotective activity [11] and wound healing property [8]. It is also used in the treatment of haematemesis, diabetes, leucoderma and pruritus [12]. Phytochemical study of *C. fistula* revealed the presence of anthraquinones, its glycosides, flavones and sterols from flowers, heartwood and leaves, anthraquinones and diterpene from pods, anthocyanins, flavanols, its glycoside and isoflavone from fruits, anthraquinones and its glycoside from fruit pulp, flavonoid glycoside and anthraquinones from roots, leucoanthocyanidin, flavones and anthraquinone from sapwood, dimeric esters and anthraquinones from seeds, anthraquinones, coumarins, chromones flavonol glycosides, leucoanthocyanidin, long-chain hydrocarbons, sterols and terpenoids from stem bark [13, 14]. *C. fistula* also used as a natural coloring agent for nylon fabric. Ripe pods aqueous extract of *C. fistula* without mordant showed a light brownish-yellow shade, while dyed with ferrous sulphate and stannous chloride brighter brownish-yellow colour [15]. The colour strength increased with an increase of metal mordant concentration [16]. Leucoanthocynidins isolated from bark and sapwood of *C. fistula* used as red colour dye [17].

MATERIAL AND METHOD

Experimental procedures: Melting Point of compound/s was determine by melting points apparatus. IR spectra were recorded on FTIR SHIMADZU 8400S spectrometer by using KBr. Using TMS as the internal standard, the ^{1}H-NMR and ^{13}C-NMR spectra were captured in $CDCl_3$, DMSO-d6 at 400 MHz and 75.5 MHz, respectively. Argon/Xenon was used as the FAB gas, and spectra were captured using a JEOL SX 102/DA-6000 mass spectrometer.

Plant material: Stem bark of *Cassia fistula* collected from local area of Jaipur Rajasthan (India).

Extraction and isolation of the compounds: 500 gm stem bark of plant was extracted with methanol for 72 hours. Crude extract (27 gm) was produced when obtained extract was concentrated below abridged force. Methanol extract was converted into slurry by being dissolved in the least quantity of solvent and adsorbed on silica gel. Column chromatography was performed on the dried slurry over silica gel. The succeeding compounds were isolated, purified, and characterised after being eluted from the column using various solvents in order of escalating polarity.

Isolation of compound-I as 1,8-dihydroxy-3-methylanthraquinone

Compound-I, which had a dark orange hue, was separated after the column was eluted in a 4:1 ratio using benzene and chloroform. The melting point range was 187–88˚C. Its anthraquinone origin was revealed by the colour reactions with magnesium acetate and methanolic NaOH. Analysis: MS (m/z): 254 [M^+], 239, 237, 226, 225, 198, 197, 152, etc; Molecular formula: $C_{15}H_{10}O_4$; IR (KBr, cm^{-1}): 3405 (-OH stretching), 2970, 1680(>C=O, str.), 1625, 1600(>C=C< str.), 1270, 1200, 860 and 750; ^{1}H NMR (δ ppm, $CDCl_3$): 12.13 (s, 1H, C-1), 12.05 (s, 1H, C-8), 7.80 (dd, 1H, *J* = 7.5, 1.1 Hz, C-5), 7.65 (m, 1H, C-6), 7.30 (s, 1H, C-4), 7.26 (dd, 1H, *J* = 7.5, 1.1 Hz, C-7), 7.10 (s, 1H, C-2) and 2.46 (s, 3H, C-3, $-CH_3$); ^{13}C NMR (δ ppm, $CDCl_3$): 164.80 (C-1), 118.25 (C-2), 143.60 (C-3), 19.08 (C-3, $-CH_3$), 121.83 (C-4), 134.25 (C-4a), 122.40 (C-5), 129.75 (C-6), 119.60 (C-7), 159.20 (C-8), 113.19 (C-8a), 188.50 (C-9), 108.00 (C-9a), 186.35 (C-10), 136.82 (C-10a).

Isolation of compound-II as 1,8-dihydroxy-6-methoxy-3-methyl-anthraquinone

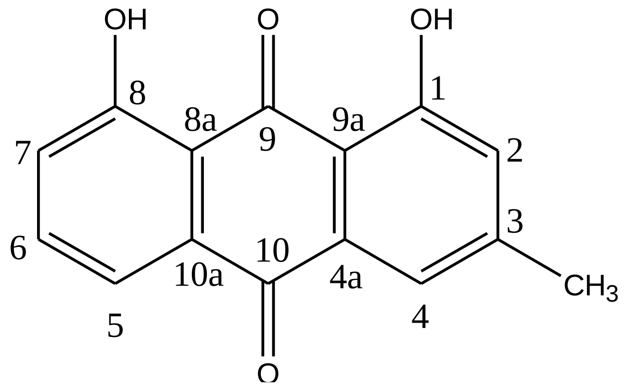
Solid having an orange hue, formed by evaporating the solvent from the fraction obtained after eluting the column with benzene and chloroform in ratio 3:2. Melting point of the compound was observed between 198 to 199˚C. It produced a dark red colour in a 10% KOH solution with a few drops of formamide and a red colour with methanolic NaOH and magnesium acetate. Analysis: MS (m/z): 284 [M^+], 256, 254, 241, 227, 213, 198, 185, 128, 43, etc. Molecular formula: $C_{16}H_{12}O_5$; IR (cm^{-1}, KBr) 3440, 2990, 1710, 1670, 1620, 1590, 1260, 1210, 860 and 780; ^{1}H NMR (ppm, DMSO-d6): 12.33, 12.13 (2×OH, s), 7.64 (1H, br s), 7.37 (1H, d, *J* = 2.7 Hz), 7.09 (1H, br s), 6.69 (1H, d, *J* = 2.7 Hz), 3.94 (3H, s) and 2.45 (3H, s); ^{13}C NMR (ppm, DMSO-d6): 162.30 (C-1), 121.60 (C-2), 23.20 (C-3), 127.10 (C-4), 141.70 (C-4a), 111.00 (C-5), 167.10 (C-6), 16.30 (C-7), 163.20 (C-8), 119.80 (C-8a), 193.10 (C-9), 123.60 (C-9a), 191.90 (C-10), 142.90 (C-10a), 23.20 ($-CH_3$ at C-3), 57.75 ($-OCH_3$ at C-6).

RESULT AND DISCUSSION

Stem bark of *Cassia fistula* was powdered and extracted with methanol. The extract was filtered and the solvent was removed completely under reduced pressure. The concentrated extract was chromatographed over silica gel (60-120 mesh). After elution of column, compounds I and II were isolated, purified and characterized. The isolated compounds were identified by comparing with their melting point, TLC, ^{1}H NMR, ^{13}C NMR and mass spectral data.

Characterization of compound-I as 1,8-dihydroxy-3-methylanthraquinone

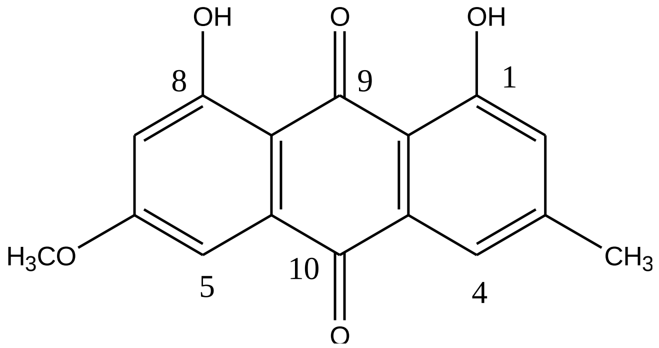
Molecular ion peaks were seen at m/z 254 [M+] in the mass spectrum. There were further notable peaks at 239, 237, 226, 198, etc. Compound's chemical formula, as determined by elemental and mass spectrum spectroscopy, is $C_{15}H_{10}O_4$. Its anthraquinone origin was revealed by the colour reactions with magnesium acetate and methanolic NaOH. Two carbonyl peaks appeared at 1680 and 1625 cm^{-1} in the infrared spectrum (KBr, cm^{-1}), further confirming the presence of the 1,8-dihydroxy system in the compound upon treatment with alkaline formamide. The product also gave off a dark red hue. Additional significant peaks were seen at 3405 (-OH stretching) and 1680, 1625 cm^{-1} (C=O groups that are chelated and non-chelated). Meta-coupled C-2 and C-4 protons produced two broad singlets at δ 7.10 and 7.30 in the ^{1}H NMR spectra. At J = 7.5, 1.1 Hz, the C-5 and C-7 protons manifested as double doublets at δ 7.80 and 7.26. At δ 7.65, the C-6 proton was detected as a multiplet. A methyl group was detected by a singlet at δ 2.46. There were two singlets for the two hydroxyl groups at C-8 and C-1, respectively, at 12.05 and 12.13. Two carbonyl groups were present, as evidenced by the absorption at 188.50 (C-9) and 186.35 (C-10) in the ^{13}C NMR spectra (δ ppm, $CDCl_3$). Two hydroxyl groups that were joined to the carbon atoms at positions C-1 and C-8, respectively, exhibited absorptions at 164.80 and 159.20. The presence of a methyl group is shown by an absorption seen at 19.08. The methyl group's attachment at position C-3 was verified by a signal detected at 143.60. Other absorptions observed at 118.25 (C-2), 121.83 (C-4), 134.25 (C-4a), 122.40 (C-5), 129.75 (C-6), 119.60 (C-7), 113.19 (C-8a), 108.00 (C-9a) and 136.82 (C-10a). Compound-I was identified as 1,8-dihydroxy-3-methylanthraquinone based on the data presented above and literature analysis.



1,8-dihydroxy-3-methylanthraquinone

Characterization of Compound-II as 1,8-dihydroxy-6-methoxy-3-methyl-anthraquinone

A molecular ion peak was detected at m/z 284 in the mass spectrum. The loss of the -CO fragment from the parent ion caused the base peak to emerge at m/z 256. Its infrared spectrum revealed significant peaks at 1670, 1620, and 3440 cm^{-1} (O–H stretching), representing chelated and non-chelated C=O groups, respectively. For meta linked protons at C-1 and C-3, respectively, two broad singlets at δ 7.09 and 7.64 were seen in the ^{1}H NMR spectra. For H-4 and H-5, two doublets were seen at δ 7.37 and 6.69 (J = 2.7 Hz), respectively. The singlet at δ 2.45 looked to indicate a methyl group connected at C-2, whereas the singlet at δ 3.94 indicated the existence of a methoxy group at C-8. At δ 12.33 and 12.13, the two peri-hydroxyl protons were visible. In the ^{13}CNMR presence of two hydroxy groups at positions 1 and 8, as indicated by the chemical shifts of C-9 (193.10 ppm) and C-6 (167.10 ppm), where as methoxy group at C-6 is evidenced by the peak at 57.75 ppm, and the methyl group at C-3 is confirmed by the peak at 23.20 ppm. Othe prominent peaks observed at 123.60 (C-9a), 162.30 (C-1), 121.60 (C-2), 127.10 (C-4), 141.70 (C-4a), 191.90 (C-10), 142.90 (C-10a), 111.00 (C-5), 1.6.30 (C-7), 163.20 (C-8), 119.80 (C-8a), 23.20 (-CH_3 at C-3), 57.75 (-OCH_3 at C-6). From the above evidences, Compound-II appeared to be 1,8-dihydroxy-6-methoxy-3-methyl-anthraquinone.



1,8-dihydroxy-6-methoxy-3-methyl-anthraquinone

CONCLUSION

The phytochemical analysis of *Cassia fistula* Linn stem bark revealed the isolation of 1,8-dihydroxy-3-methylanthraquinone (I) and 1,8-dihydroxy-6-methoxy-3-methyl-anthraquinone (II), confirmed through spectroscopic studies. These findings underscore the plant's potential for therapeutic applications and highlight avenues for further research into its bioactive compounds.

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ISOLATION AND CHARACTERIZATION OF CUCURBITACIN FROM METHANOLIC EXTRACT OF FRUIT OF *CITRULLUS COLOCYNTHIS*

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ABSTRACT

Citrullus colocynthis, known as bitter gourd, is a medicinal plant rich in phytochemicals like cucurbitacins and flavonoids. Its fruits have diverse therapeutic uses, including anti-inflammatory and anticancer properties. In the course of phytochemical study of methanol extract of roots of *Citrullus colocynthis,* compounds were isolated i.e. cucurbitacin-D (I) and cucurbitacin-I (II). Structure of these compounds was identified using spectral data analysis viz. IR, ^{1}H NMR, ^{13}C NMR and Mass.

Keywords: *Citrullus colocynthis*, cucurbitacin, natural compounds, extraction,

INTRODUCTION

Citrullus colocynthis commonly found wild in the sandy soils of North West, Punjab, Sind, and Central and Southern India, and coromandal coast [1]. Also found indigenous in Arabia, West Asia, and tropical Africa and in the Mediterranean region [2]. These species, too known as bitter gourd and is employed as a medicinal plant in the pharmaceutical industry [3]. *Citrullus colocynthis* is locally known as wild watermelon, bitter apple, bitter gourd and bitter cucumber [4]. The fruits, particularly the pulp, have been recognized as natural cathartics since ancient times. The fruit possesses acrid and cooling purgative qualities, making it anthelmintic, antipyretic, and carminative [5]. It has proven efficacy in treating various conditions such as tumors, leucoderma, ulcers, asthma, bronchitis, urinary discharge, spleen enlargement, tuberculosis glands in the neck, dyspepsia, constipation, anemia, and throat diseases [6, 7]. The fruits of *Citrullus colocynthis* boast a rich array of phytochemicals, including cucurbitacins, triterpenoids, alkaloids, flavonoids, and saponins [8]. Cucurbitacins, known for their bitterness, contribute to the fruit's anti-inflammatory, anticancer, and insecticidal properties [9]. Triterpenoids offer potential anti-inflammatory and antioxidant effects [10], while alkaloids may contribute to antimicrobial and anti-inflammatory properties [11]. Flavonoids, with their antioxidant capabilities, further enhance the overall health-promoting aspects of the fruit [12]. Additionally, the presence of saponins, natural surfactants, supports antibacterial and antifungal activities [13]. These phytochemicals collectively underpin the diverse biological activities associated with *Citrullus colocynthis* fruits [15-17].

EXPERIMENTAL

The melting points of the compounds were determined using soft glass capillaries in an electrothermal melting point apparatus. Silica gel with a mesh size of 60-120 was employed as the adsorbent for column chromatography. For qualitative and quantitative thin-layer chromatography, TLC aluminum sheets coated with Kieselgel 60F254 from E. Merck were used. Preparative TLC was performed on TLC glass plates coated with silica gel 60F254, measuring 20 × 20 cm, with a layer thickness of 0.5 mm (also from E. Merck). The spray reagent utilized in TLC was a solution of 2% ceric ammonium sulfate in 2N H_2SO_4. Infrared (IR) spectra were recorded using an FT-IR spectrophotometer from Shimadzu Japan, specifically Model No. 8400S. Proton and carbon-13 nuclear magnetic resonance (NMR) spectra were acquired with a JEOL 400 MHz FT-NMR instrument. Fast Atom Bombardment Mass Spectrometry (FABMS) data were obtained using a JEOL JMS700 spectrometer.

Plant Material: Roots of *Citrullus colocynthis* was collected from locality of Jaipur Rajasthan India. The authenticity of the plant material was rigorously verified through Pharmacognosy studies.

Extraction, Isolation, and Purification of Constituents from roots of *Citrullus colocynthis*

300 gm of completely air-dried roots from the plant were subjected to extraction. The extraction process involved the use of methanol, which was carried out on a water bath. Following extraction, the methanol extract was concentrated under reduced pressure until it reached a state of dryness. This process yielded a concentrated extract yellowish mass weighing 16.0 grams in the form of a semi-solid. Upon conducting thin-layer chromatography (TLC) analysis of extract, it was observed that several compounds were present. To isolate these compounds further, they were subjected to column chromatographic separation using silica gel as the adsorbent.

Isolation of compound-I as Cucurbitacin-D

On elution of column with Petroleum ether : Benzene in the ratio 2 : 2, compound-I was isolated. It was obtain as sticky, off-white compound. It showed m.p. 151.2-152.2 °C. Analysis: MS (m/z): 516 (M+H); Molecular formula: $C_{30}H_{44}O_7$; IR (KBr, cm^{-1}): 3410 (O-H stretching), 3095 (C-H, sp^2, stretching), 2925, 2855 (C-$H_{SP}{}^3$, stretching), 1720 (C=O, stretching), 1620-1510 (C=C). ^1H NMR ($CDCl_3$, δppm): 1.89 (d, 2H, J = 16.2 Hz, H-1), 4.40 (t, 1H, J = 1.7, 2.1 Hz, H-2), 5.80 (t, 1H, J = 6.0, 6.2 Hz, H-6), 3.12 (s, 2H, H-12), 1.79 (d, 2H, J = 4.3 Hz, H-15), 4.09 (m, 1H, H-16), 2.57 (d, 1H, J = 4.9 Hz, H-17), 0.98 (s, 3H, H-18), 1.09 (s, 3H, H-19), 1.42 (s, 3H, H-21), 6.71 (d, 1H, J = 15.6 Hz, H-23), 7.13 (d, 1H, J = 15.2 Hz, H-24), 1.36 (s, 3H, H-26), 1.44 (s, 3H, H-27), 1.26 (s, 3H, H-28), 1.37 (s, 3H, H-29), 1.29 (s, 3H, H-30), 1.96-2.74 multiplet for remaining 4H; ^{13}C NMR ($CDCl_3$, δppm): 33.3 (C-1), 84.8 (C-2), 195.3 (-C=O at C-3), 52.1 (C-4), 151.4 (C-5), 121.7 (C-6), 26.7 (C-7), 48.9 (C-8), 59.2 (C-9), 30.3 (C-10), 197.8 (-C=O at C-11), 44.7 (C-12), 30.9 (C-13), 40.2 (C-14), 39.1 (C-15), 55.9 (C-16), 54.5 (C-17), 18.6 (C-18), 17.6 (C-19), 84.2 (C-20), 22.7 (C-21), 179.1 (-C=O at C-22), 127.6 (C-23), 148.7 (C-24), 72.8 (C-25), 31.8 (C-26), 30.6 (C-27), 21.9 (C-28), 22.1 (C-29), 20.7 (C-30).

Isolation of compound-II as Cucurbitacin-I

On elution of column with Petroleum ether : Benzene in the ratio 1 : 3, compound-II was isolated. It was obtain as sticky, white compound. It showed m.p. 149.3-150.3 °C. Analysis : MS (m/z): 515 (M+H); Molecular formula: $C_{30}H_{43}O_7$; IR (KBr, cm^{-1}): 3415 (O-H stretching), 3085 (C-H, sp^2, stretching), 2930, 2850 (C-$H_{SP}{}^3$, stretching), 1725 (C=O, stretching), 1625-1525 (C=C); ^1H NMR ($CDCl_3$, δppm): 2.96 (s, 1H, H-1), 5.89 (t, 1H, J = 6.0 , 6.4 Hz, H-6), 3.49 (s, 1H, H-10), 3.16 (s, 1H, H-12), 1.60 (d, 2H, H-15), 4.40 (m, 1H, H-16), 2.55 (d, 1H, H-17), 1.02 (s, 3H, H-18), 0.87 (s, 3H, H-19), 1.38 (s, 3H, H-21), 6.73 (d, 1H, J = 15.2 Hz, H-23), 7.10 (d, 1H, J = 15.6 Hz, H-24), 1.32 (s, 3H, H-26), 1.22 (s, 3H, H-27), 1.10 (s, 3H, H-28), 2.03-2.36 multiplet for remaining 3H; ^{13}C NMR ($CDCl_3$, δppm): 111.6 (C-1), 157.4 (C-2), 194.3 (-C=O at C-3), 51.1 (C-4), 150.1 (C-5), 120.6 (C-6), 26.7 (C-7), 47.9 (C-8), 58.2 (C-9), 29.9 (C-10), 196.2 (-C=O at C-11), 43.9 (C-12), 29.8 (C-13), 39.8 (C-14), 38.7 (C-15), 54.9 (C-16), 53.5 (C-17), 19.2 (C-18), 19.5 (C-19), 83.3 (C-20), 23.5 (C-21), 180.6 (-C=O at C-22), 126.4 (C-23), 149.2 (C-24), 73.2 (C-25), 32.2 (C-26), 31.1 (C-27), 22.2 (C-28), 23.2 (C-29), 21.7 (C-30).

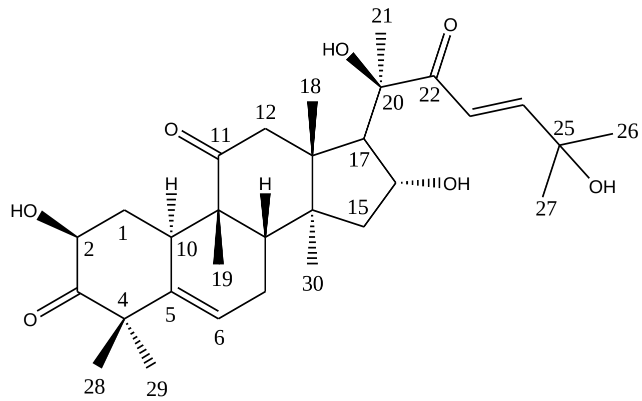
RESULTS AND DISCUSSION

The air-dried roots of *Citrullus colocynthis* (300 grm) were exhaustively subjected to extraction using methanol for 72 hours on a water bath. The resulting extract was then subjected to hot filtration, followed by concentration under reduced pressure, yielding a semi-solid yellowish mass of 16.0 gm. The extract was subjected to chromatography over silica gel (60-120 mesh), ultimately leading to the isolation of compounds. The purity of these compounds was assessed through thin-layer chromatography (TLC). Subsequently, these compounds underwent comprehensive characterization through physical and spectral analyses. The identification of known compounds was achieved by comparing their respective melting points, infrared (IR) spectra, proton nuclear magnetic resonance (^{1}H NMR) spectra, carbon-13 nuclear magnetic resonance (^{13}C NMR) spectra, and mass spectral data with the values reported in existing literature references.

Characterization of compound-I as Cucurbitacin-D

Compound-I

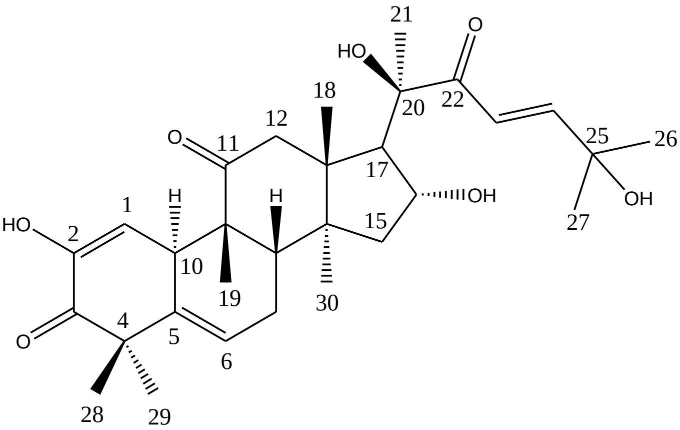
showed homogeneous behaviour on TLC. The Mass spectrum showed [M+H] at 516 corresponding to molecular formula $C_{30}H_{44}O_7$. IR spectrum (KBr, cm^{-1}) showed broad absorption appeared at 3410 cm^{-1} indicating the presence of O-H stretching suggesting the presence of hydroxyl groups, possibly indicative of alcohols or phenols. The peak at 3095 cm^{-1} indicates C-H stretching in aromatic (sp^2) groups, while the signals at 2925 cm^{-1} and 2855 cm^{-1} are associated with aliphatic C-H stretching in sp^3 hybridized carbons. The band at 1720 cm^{-1} signifies C=O stretching, suggesting the presence of a carbonyl group, commonly found in ketones, aldehydes, or carboxylic acids. Furthermore, the absorption range between 1620-1510 cm^{-1} indicates the existence of carbon-carbon double bonds (C=C), suggesting unsaturation in the compound. The ^{1}H NMR spectrum (400 MHz, $CDCl_3$) of the isolated compound exhibits distinctive peaks, providing valuable insights into its molecular structure. Notably, the doublet at δ 1.89 (J = 16.2 Hz) indicates vicinal coupling, suggesting protons on an adjacent carbon (H-1). The triplet at δ 4.40 (J = 1.7, 2.1 Hz) corresponds to a proton coupled to two different types of neighboring protons (H-2). Additionally, the triplet at δ 5.80 (J = 6.0, 6.2 Hz) and doublet at δ 7.13 (J = 15.2 Hz) reveal protons adjacent to diverse environments (H-6 and H-24, respectively). The singlet at δ 3.12 signifies two equivalent protons (H-12), while the doublet at δ 1.79 (J = 4.3 Hz) represents protons on an adjacent carbon (H-15). The multiplet at δ 4.09 suggests a complex proton environment (H-16), and the doublet at δ 2.57 (J = 4.9 Hz) indicates coupling to another proton (H-17). Methyl groups are evident from singlets at δ 0.98 (H-18), δ 1.09 (H-19), δ 1.42 (H-21), δ 1.36 (H-26), δ 1.44 (H-27), δ 1.26 (H-28), δ 1.37 (H-29), and δ 1.29 (H-30). The doublet at δ 6.71 (J = 15.6 Hz) and the multiplet between δ 1.96-2.74 further contribute to the complexity of the spectrum (H-23 and remaining protons, respectively). The low-field region in ^{13}C NMR (75.5 MHz, $CDCl_3$) reveals several notable peaks: δ 195.3, 197.8, and 179.1, corresponding to carbon atoms involved in carbonyl groups at C-3, C-11, and C-22, respectively. These high chemical shifts suggest the presence of ketone functionalities in the molecular structure. Moving to the aliphatic region, the peaks at δ 33.3 (C-1), 84.8 (C-2), and 52.1 (C-4) indicate typical aliphatic carbons, while the peak at δ 121.7 (C-6) corresponds to a carbon in an aromatic environment. The signals at δ 26.7 (C-7), 48.9 (C-8), and 59.2 (C-9) represent additional aliphatic carbons, while the peak at δ 40.2 (C-14) suggests a more complex carbon environment. Notably, the aromatic region is characterized by peaks at δ 151.4 (C-5), 127.6 (C-23), and 148.7 (C-24), indicating the presence of aromatic carbons. The methyl groups are discernible in the spectrum, with peaks at δ 18.6 (C-18), 17.6 (C-19), 21.9 (C-28), 22.1 (C-29), and 20.7 (C-30), each representing unique methyl carbon environments. On the basis of above discussion and literature data this compound-I was identified as cucurbitacin-D.



Cucurbitacin-D

Characterization of compound-II as Cucurbitacin-I

The Mass spectrum of Compound-II showed [M+H] at 515 corresponding to molecular formula $C_{30}H_{43}O_7$. In the FT-IR spectrum (KBr, cm^{-1}) a strong absorption band observed at 3415 cm^{-1} is indicative of O-H stretching, suggesting the presence of hydroxyl groups, commonly associated with alcohols or phenols. The peak at 3085 cm^{-1} corresponds to C-H stretching in sp^2 hybridized carbon atoms, characteristic of aromatic compounds. The absorption bands at 2930 cm^{-1} and 2850 cm^{-1} are attributed to C-H stretching in sp^3 hybridized carbon atoms, indicating the presence of aliphatic carbon-hydrogen bonds within the molecule. The broad peak at 1725 cm^{-1} is associated with C=O stretching, signifying the presence of a carbonyl group, which could be present in ketones, aldehydes, or carboxylic acids. The region between 1625-1525 cm^{-1} exhibits absorption bands indicative of C=C stretching, suggesting the presence of carbon-carbon double bonds in the compound. ^{1}H NMR spectrum (400 MHz, $CDCl_3$): The singlet at δ 2.96 corresponds to a single proton (H-1) in a unique environment. The triplet at δ 5.89 (J = 6.0, 6.4 Hz) represents a proton (H-6) in a spin-spin coupling arrangement, indicating the presence of adjacent protons. The singlet at δ 3.49 corresponds to another isolated proton (H-10). The singlet at δ 3.16 corresponds to a proton (H-12) in a distinct environment, while the doublet at δ 1.60 (J = 6.4 Hz) represents protons (H-15) with a vicinal coupling. The multiplet at δ 4.40 suggests a complex proton environment for H-16. The doublet at δ 2.55 (J = 4.9 Hz) corresponds to a proton (H-17) with coupling to another proton. The singlets at δ 1.02 (H-18), 0.87 (H-19), and 1.38 (H-21) represent methyl groups. The doublet at δ 6.73 (J = 15.2 Hz) and δ 7.10 (J = 15.6 Hz) correspond to protons (H-23 and H-24, respectively) in an aromatic environment. The singlets at δ 1.32 (H-26), 1.22 (H-27), 1.10 (H-28), and the multiplet between δ 2.03-2.36 correspond to methyl groups and aliphatic protons. The chemical shifts in ^{13}C NMR (75.5 MHz, $CDCl_3$) the aromatic region include peaks at δ 111.6 (C-1), 157.4 (C-2), 194.3 (-C=O at C-3), 150.1 (C-5), and 120.6 (C-6), suggesting the presence of an aromatic ring and a carbonyl group. The peaks at δ 126.4 (C-23) and 149.2 (C-24) indicate the carbon environments of aromatic carbons in the compound.In the aliphatic region, the peaks at δ 51.1 (C-4), 26.7 (C-7), 47.9 (C-8), 58.2 (C-9), 29.9 (C-10), 43.9 (C-12), 29.8 (C-13), 39.8 (C-14), 38.7 (C-15), 54.9 (C-16), 53.5 (C-17), 19.2 (C-18), 19.5 (C-19), 23.5 (C-21), 23.2 (C-29), and 21.7 (C-30) suggest the presence of aliphatic carbon environments, including methyl groups and aliphatic sp^3 hybridized carbons. The chemical shifts at δ 196.2 (-C=O at C-11), 180.6 (-C=O at C-22), and 73.2 (C-25) indicate the presence of carbonyl groups in the compound. On the basis of above discussion and literature data this compound-II was identified as cucurbitacin-I.



Cucurbitacin-I

CONCLUSION

These isolated compounds attest to *Citrullus colocynthis*'s diverse phytochemical profile. These substances, which are well-known for their bioactive qualities, add to the plant's therapeutic efficacy and back its historical applications as an anti-inflammatory and anti-cancer agent. This work establishes a foundation for future investigation into the medicinal uses of *Citrullus colocynthis* and advances our knowledge of its pharmacological potential.

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On the numerical solution of Sawada-Kotera equation

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Abstract: In this research paper, a new technique called homotopy perturbation transform method (HPTM) has been used to solve Swada-Kotera equation and obtain the approximate solution of it. This technique is combination of Laplace transform method with the homotopy perturbation method. Nonlinear term can be handled with the help of He's Polynomials. In this technique, the solution is calculated in the form of a convergent series and convergence of the homotopy perturbation transform method solutions to the exact solutions is shown. This technique gives a wide applicability to handling nonlinear wave equations in science and engineering.

Key words and Phrases: Laplace transform method, Homotopy perturbation method, Swada-Kotera equation, He's Polynomials.

1. Introduction

The study of nonlinear problems is important in all the area of mathematics and physics. Differential equations are widely used to describe physical problems. Most of the important phenomena of physical systems are hidden in their nonlinear behavior. The exact solution of these problems may not be available. These phenomena can only be studied with the appropriate methods to solve these nonlinear problems. The Swada-Kotera equation have significant roles in engineering and sciences such as motions of long waves in shallow water under gravity, one-dimensional nonlinear lattice, fluid mechanics, quantum mechanics, plasma physics, nonlinear optics and other areas. The Swada-Kotera equation used to study various nonlinear phenomena in plasma. It has a significant role in the wave propagation. A Swada-Kotera equation is a nonlinear partial differential equation. It is a fifth orser equation [1-5].

Plasma is a complex, quasi-neutral and electrically conductive fluid. It consists of electrons, ions and neutral particles. Due to electrical conductive behavior of plasma, it consists of electric and magnetic fields. Interaction between particles and field’s, plasma support different type’s waves. Wave phenomena are important for heating plasmas, instabilities and diagnostics etc. A magneto-acoustic wave is a dispersionless and longitudinal wave of ions in a magnetized plasma propagating perpendicular to the stationary magnetic field. In the range of low magnetic field, the magneto-acoustic wave behave as ion acoustic wave and in the low temperature range, the magneto-acoustic wave behave as Alfvén wave. In nature magneto-acoustic waves finds in solar corona [6-10].

The general form of fifth order KdV equation is:

$$u_t - u_{5x} = F(x, t, u, u^2, u_x, u_{2x}, u_{3x}) \quad (1)$$

This fifth order KdV equation is the generic model for the study of magneto-acoustic waves in plasma and shallow water waves with surface tension. Researcher has been shown that the travelling wave solutions of this equation do not vanish at infinity [11-15].

Consider the four well known forms of the fifth order KdV equation as [16-20]:

$$u_t + 45u^2u_x + 15u_xu_{2x} + 15uu_{3x} + u_{5x} = 0 \quad (2)$$

with initial condition

$$u(x,0) = 2k^2 sech^2(kx) \quad (3)$$

Equation (2) called Swada-Kotera equation.

It is very difficult to find the analytical solutions of these physical problems when these are highly nonlinear. In recent years, many researchers have paid attention to study the behavior of these problems by using various methods which are not described by the common observations. Among these are the Adomian decomposition method, He’s semi-inverse method, Reduced differential transform method, Lie group analysis method, Inverse scattering method, Hirota’s bilinear method, Laplace decomposition method, Tanh method, Sine-cosine method], Variational iteration method, Homotopy analysis method, Homotopy perturbation method and many more [21-30].

He developed the homotopy perturbation method for solving different physical problems. This method is combination of the homotopy in topology and perturbation method. This provides us with a convenient way to obtain analytic or approximate solutions to a wide variety of problems arising in different fields of science and engineering. The Laplace transform is incapable of handling nonlinear equations because of the difficulties arise due to the nonlinear terms. Various ways have been proposed recently to deal with these nonlinearities such as Laplace decomposition method and Adomian decomposition method. Furthermore, homotopy perturbation method is also combined with the Laplace transformation method to produce a highly effective technique for handling many nonlinear problems. In a recent paper Khan and Wu proposed the homotopy perturbation transform method (HPTM) for solving the nonlinear equations. This method is an elegant combination of the Laplace transformation, the homotopy perturbation method and He’s polynomials and is mainly due to

Ghorbani. The homotopy perturbation transform method provides the solution in a rapid convergent series which may lead to the solution in a closed form. The advantage of this method is its capability of combining two powerful methods for obtaining exact solutions for nonlinear equations. In this article, we apply the homotopy perturbation transform method (HPTM) for solving the nonlinear equations such as nonlinear fifth order KdV equations, Kawahara equation and non-homogeneous fifth order KdV equation to show the simplicity and straight forwardness of the method [31-37].

2. Homotopy perturbation transform method (HPTM)

To provide basic idea of homotopy perturbation transform method, we consider a general nonlinear partial differential equation with the initial conditions of the form:

$$Du(x,t) + Ru(x,t) + Nu(x,t) = g(x,t) \quad (4)$$

$$u(x,0) = h(x)$$

$$u_t(x,0) = f(x)$$

where D is the second order linear differential operator $D = \partial^2/\partial t^2$, R is the linear differential operator of less order than D, N represents the general nonlinear differential operator and $g(x, t)$ is the source term. Taking the Laplace transform (denoted in this paper by L) on both sides of eq. (6), we get

$$L[Du(x,t)] + L[Ru(x,t)] + L[Nu(x,t)] = L[g(x,t)]$$

Using the differentiation property of the Laplace transform, we have

$$L[u(x,t)] = \frac{h(x)}{s} + \frac{f(x)}{s^2} + \frac{1}{s^2}L[g(x,t)] - \left[\frac{1}{s^2}L[Ru(x,t) + Nu(x,t)]\right] \quad (5)$$

Operating with the Laplace inverse on both sides of eq. (5) gives

$$u(x,t) = G(x,t) - L^{-1}\left[\frac{1}{s^2}L[Ru(x,t) + Nu(x,t)]\right] \quad (6)$$

where $G(x, t)$ represents the term arising from the source term and the prescribed initial conditions. Now we apply the homotopy perturbation method

$$u(x,t) = \sum_{n=0}^{\infty} p^n u_n(x,t) \quad (7)$$

and the nonlinear term can be decomposed as

$$Nu(x,t) = \sum_{n=0}^{\infty} p^n H_n(u) \quad (8)$$

for some He's polynomials $H_n(u)$ that are given by

$$H_n(u_0, u_1, \dots, u_n) = \frac{1}{n!}\frac{\partial^n}{\partial p^n}\left[N\left(\sum_{n=0}^{\infty} p^i u_i\right)\right]_{p=0}, n = 0,1,2,3 \dots \quad (9)$$

Substituting eq. (8) and eq. (9) in eq. (7), we get

$$\sum_{n=0}^{\infty} p^n u_n(x,t) = G(x,t) - p\left(L^{-1}\left[\frac{1}{s^2}L\left[R\sum_{n=0}^{\infty} p^n u_n(x,t) + \sum_{n=0}^{\infty} p^n H_n(u)\right]\right]\right) \quad (10)$$

which is the combination of the Laplace transform and the homotopy perturbation method using He's polynomials. Comparing the coefficient of like powers of p, the following approximations are obtained.

$$p^0: u_0(x,t) = G(x,t)$$

$$p^1: u_1(x,t) = -L^{-1}\left[\frac{1}{s^2}L[Ru_0(x,t) + H_0(u)]\right]$$

$$p^2: u_2(x,t) = -L^{-1}\left[\frac{1}{s^2}L[Ru_1(x,t) + H_1(u)]\right] \quad (11)$$

$$p^3: u_3(x,t) = -L^{-1}\left[\frac{1}{s^2}L[Ru_2(x,t) + H_2(u)]\right]$$

$$\vdots$$

3. Numerical Application

In this section, we use homotopy perturbation transform method in solving the three models of KdV equations.

Example: Consider the following Sawada- Kotera equation

$$u_t + 45u^2u_x + 15u_xu_{2x} + 15uu_{3x} + u_{5x} = 0 \quad (12)$$

with initial condition

$$u(x,0) = 2k^2 sech^2(kx) \quad (13)$$

Applying the Laplace transform on both sides of eq. (12) subject to the initial conditions (13), we have

$$L[u(x,t)] = \frac{2k^2 sech^2(kx)}{s} - \frac{1}{s}L[45u^2u_x + 15u_xu_{2x} + 15uu_{3x} + u_{5x}] \quad (14)$$

The inverse of Laplace transform implies that

$$u(x,t) = 2k^2 sech^2(kx) - L^{-1}\left[\frac{1}{s}L[45u^2u_x + 15u_xu_{2x} + 15uu_{3x} + u_{5x}]\right] \quad (15)$$

Now, applying the homotopy perturbation method, we get

$$\sum_{n=0}^{\infty} p^n u_n(x,t) = 2k^2 sech^2(kx) - p\left(L^{-1}\left[\frac{1}{s}L[(\sum_{n=0}^{\infty} p^n H_n(u)) + (\sum_{n=0}^{\infty} p^n u_n(x,t))_{5x}]\right]\right) \quad (16)$$

Where $H_n(u)$ are He's polynomial [38, 39] that represents the nonlinear terms. The first few components of He's polynomials, are given by

$$H_0(u) = 45u_0^2(u_0)_x + 15(u_0)_x(u_0)_{2x} + 15u_0(u_0)_{3x}$$

$$H_1(u) = 45u_0^2(u_1)_x + 90u_0u_1(u_0)_x + 15(u_0)_x(u_1)_{2x} + 15(u_0)_{2x}(u_1)_x + 15u_0(u_1)_{3x} + 15(u_0)_{3x}u_1 \quad (17)$$

$$H_2(u) = 45u_0^2(u_2)_x + 90u_0u_1(u_1)_x + 90u_0u_2(u_0)_x + 45u_1^2(u_0)_x + 15(u_0)_x(u_2)_{2x} + 15(u_1)_x(u_1)_{2x} + 15(u_0)_{2x}(u_2)_x + 15u_0(u_2)_{3x} + 15u_1(u_1)_{3x} + 15(u_0)_{3x}u_2$$

$$H_3(u) = 45u_0^2(u_3)_x + 90u_0u_1(u_2)_x + 90u_0u_2(u_1)_x + 90u_0u_3(u_0)_x + 45u_1^2(u_1)_x + 90u_1u_2(u_0)_x + 15(u_0)_x(u_3)_{2x} + 15(u_1)_x(u_2)_{2x} + 15(u_1)_{2x}(u_2)_x + 15(u_0)_{2x}(u_3)_x + 15u_0(u_3)_{3x} + 15u_1(u_2)_{3x} + 15u_2(u_1)_{3x} + 15u_3(u_0)_{3x}$$

$$H_4(u) = 45u_0^2(u_4)_x + 90u_0u_1(u_3)_x + 90u_0u_2(u_2)_x + 90u_0u_3(u_1)_x + 90u_0u_4(u_0)_x + 45u_1^2(u_2)_x + 90u_1u_2(u_1)_x + 90u_1u_3(u_0)_x + 45u_2^2(u_0)_x + 15(u_0)_x(u_4)_{2x} + 15(u_1)_x(u_3)_{2x} + 15(u_2)_x(u_2)_{2x} + 15(u_1)_{2x}(u_3)_x + 15(u_0)_{2x}(u_4)_x + 15u_0(u_4)_{3x} + 15u_1(u_3)_{3x} + 15u_2(u_2)_{3x} + 15u_3(u_1)_{3x} + 15u_4(u_0)_{3x}$$

$$\vdots$$

Comparing the coefficients of like powers of *p*, we have

$$p^0: u_0(x,t) = 2k^2 sech^2(kx)$$

$$p^1: u_1(x,t) = -L^{-1}\left[\frac{1}{s}L[H_0(u) + (u_0)_{5x}]\right]$$

$$= 64k^7 t\ sech^2(kx)\ tanh(kx) \quad (18)$$

$$p^2: u_2(x,t) = -L^{-1}\left[\frac{1}{s}L[H_1(u) + (u_1)_{5x}]\right]$$

$$= 512k^{12}t^2 sech^4(kx)[2\ cosh^2(5x) - 3]$$

$$p^3: u_3(x,t) = -L^{-1}\left[\frac{1}{s}L[H_2(u) + (u_2)_{5x}]\right]$$

$$\vdots$$

Therefore, the solution $u(x,t)$ is given by

$$u(x,t) = \sum_{i=0}^{\infty} u_i(x,t)$$

$$u(x,t) = 2k^2 sech^2(kx) + 64k^7 t\, sech^2(kx)\, tanh(kx) + 512k^{12}t^2 sech^4(kx)[2\cosh^2(5x) - 3] + \cdots\ldots \quad (19)$$

Using Taylor series, the closed form solution will be follows

$$u(x,t) = 2k^2 sech^2[k(x - 16k^4 t)] \quad (20)$$

4. Results and Discussion

Figure 3.1 shows the comparison of the exact solution with approximate solution of Sawada-Kotera equation for $t = 0.01$ and $-10 \le x \le 10$.

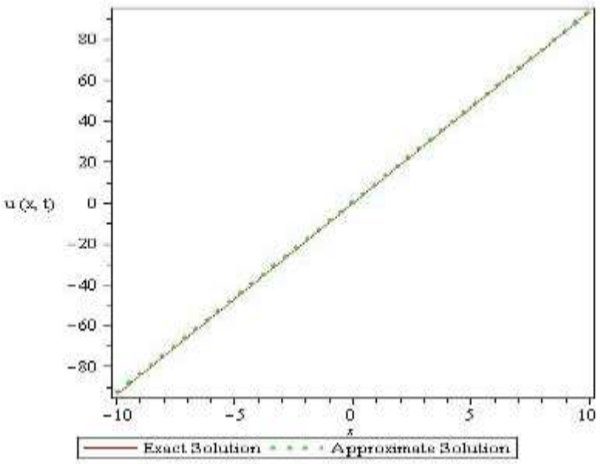

Figure 3.1 Comparison of the exact solution with approximate solution for $t = 0.01$ and $-10 \le x \le 10$.

From Figure 3.1, it is observed that the values of the approximate solution of different grid points obtained by the homotopy perturbation transform method are close to the values of the exact solution with high accuracy at the fifth-term approximation. It can also be seen that the accuracy increases as the order of approximation increases.

5. Conclusions

In this paper, the homotopy perturbation transform method has been successfully applied to find the approximate solution of the Sawada- Kotera equation with initial conditions. The technique is reliable and easy to use. The results show that the homotopy perturbation transform method is powerful and efficient technique in finding exact and approximate solutions for nonlinear differential equations. It is worth mentioning that the method is capable of reducing the volume of the computational work as compared to the classical methods while still maintaining the high accuracy of the numerical result; the size reduction amounts to an improvement of the performance of the approach. The fact that the HPTM solves nonlinear problems without using Adomian's polynomials is a clear advantage of this technique over the decomposition method. In conclusion, the HPTM may be considered as a nice refinement in existing numerical techniques and might find the wide applications.

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PHYTOCHEMICAL STUDY OF METHANOL EXTRACT OF *NERIUM OLEANDER* FRUIT

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ABSTRACT

Nerium oleander, a medicinal shrub native to India and Pakistan, exhibits potent antibacterial, anticancer, and cardiotonic properties. Despite its therapeutic potential, caution is warranted due to its highly toxic cardiac glycosides. Phytochemical evaluation of fruit of *Nerium oleander* obtained urs-12-en-3β,28-diol, and plumeridich acid (13-dehydroxy-15-O-demethyl allamandicin). Characterization of above mentioned compounds was done on the basis of spectral studies i.e. ^{1}HNMR, ^{13}CNMR, IR, MS.

Keywords: *Nerium oleander*, phytochemical, fruit, cardiac glycosides, bioactivity.

INTRODUCTION

Nerium oleander is a significant Apocynaceae family medicinal plant. Nerium oleander, also referred to as "Oleander" or "kaner," is an evergreen shrub [1]. It is native to the subcontinent of India and Pakistan and was first found in the Mediterranean, subtropical Asia, and the areas surrounding arid stream beds [2]. Warm subtropical climates are ideal for oleander growth. Because of its antibacterial, anticancer, antidote, antileprotic, and cardiotonic qualities, Nerium oleander has been utilised in traditional medicine [3-6]. Nerium oleander is said to contain medicinal properties that can be used to treat skin, eye, and edoema conditions as well as leprosy [7, 8]. The leaves have central nervous system depressive, cytotoxic, and cardiotonic properties [9]. Furthermore, Oncomelania hupensis snails were susceptible to the molluscicidal effects of the alcoholic extract of fresh N. indicum leaves [10]. The methanolic extract exhibits anti-inflammatory, anticancer, and cell growth inhibitory properties towards three different types of human cell lines [11]. It also exhibits inhibitory effect against the induction of the intercellular adhesion molecule-1. Digoxin-like cardiac effects and antimicrobial properties are present in the ethanolic root extract [12]. One of the most hazardous plants is oleander, which has a variety of deadly chemicals in it. Because oleander contains certain poisons, like neriine and oleandrin, which are cardiac glycosides, it is extremely toxic [13-15].

EXPERIMENTAL

Experimental procedures: Melting Point of compound/s was determine by melting points apparatus. IR spectra were recorded on FTIR SHIMADZU 8400S spectrometer by using KBr. Using TMS as the internal standard, the ^{1}H-NMR and ^{13}C-NMR spectra were captured in $CDCl_3$, DMSO-d6 at 400 MHz and 75.5 MHz, respectively. Argon/Xenon was used as the FAB gas, and spectra were captured using a JEOL SX 102/DA-6000 mass spectrometer.

Plant material: The plant material fruits of *Nerium oleander* were collected from local area of Jaipur Rajasthan India.

Extraction and Isolation of the Constituents

The shade dried titled plant material (400 gm) was extracted with methanol for 72 hrs on water bath. The extract was filtered hot and solvent was removed under reduced pressure. The solvent free extract was chromatographed over silica gel column and isolated two compounds. For this purpose a column of 1.5 m in height and with 4 cm in diameter was used and it was charged with 550 g silica gel for column (60-120 mesh) chromatography.

Isolation of compound-A as Uvaol

When column was eluted with 25% benzene in petroleum ether, compound A was isolated and after removal of the solvent the product was crystallized with methanol as colourless crystals. It showed m.p. 224°C. Analysis: MS (m/z): 443 ($M^{+}H$), 442 (M^{+}), 425, 408, 203, 135, 119 etc; Molecular formula: $C_{30}H_{50}O_2$; IR (KBr, Cm^{-1}): 3330 (OH stretching), 1650, 1592 (C=C stretching), 1312, 1337 (gem dimethyl group); ^{1}H NMR (δ ppm, $CDCl_3$): 5.02 (s,1H, C-12), 3.74 (d, 1H, *J* =10.8 Hz, C-28a), 3.23 (dd, 1H, C-3), 3.22 (d, 1H, *J*= 11.5.0 Hz, C-28b), 1.13, 0.99, 1.02, 0.94, 0.79 (s, 3H, 5×CH_3), 0.97 (d, 3H, *J =6.9* Hz, C-29), 0.79 (d, 3H, *J =5.6* Hz, C-30). ^{13}C NMR (δ ppm, $CDCl_3$): 38.8 (C-1), 26.6 (C-2), 78.94 (C-3), 39.60 (C-4), 55.2 (C-5), 17.5 (C-6), 31.2 (C-7), 39.65 (C-8), 47.7 (C-9), 33.8 (C-10), 21.4 (C-11), 124.4 (C-12), 137.4 (C-13), 41.5 (C-14), 24.7 (C-15), 23.3 (C-16), 32.9 (C-17), 50.6 (C-18), 37.9 (C-19), 41.5 (C-20), 33.6 (C-21), 29.6 (C-22), 29.7 (C-23), 15.7 (C-24), 16.9 (C-25), 15.7 (C-26), 21.9 (C-27), 59.05 (C-28), 15.4 (C-29), 19.8 (C-30).

Isolation of compound of compound-B as Plumeridich acid

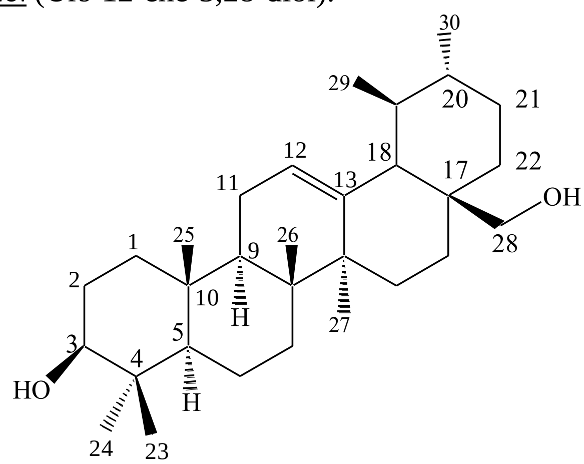
Compound-B was obtained when column was eluted with 5% methanol in chloroform. The solid obtained after removal of solvent was crystallized with peteroleum ether and benzene in the ratio of 1 : 3 as light brown crystals (m.p. 240°C). Its R_f value was found to be 0.73 (10% methanol in chloroform). Analysis: MS (m/z): 278 (M^{+}); Molecular formula: $C_{14}H_{14}O_6$; IR (KBr, Cm^{-1}): 2630 (OH stretching), 1760,1686 (>C=O stretching), 1640 (C=C stretching) and 1300 (C-O stretching of COOH group); ^{1}H NMR (δ ppm, $CDCl_3$): 5.59 (d, 1H, C–1), 7.54 (s, 1H, C–3), 3.99 (td, 1H, C–5), 6.09 (dd, 1H, C–6), 5.66 (dd, 1H, C–7),3.48 (m, 1H, C–9), 4.41 (s, 1H, C–10), 2.77 (m, 1H, C–11), 1.87 (m, 1H, C–13), 1.67 (m, 1H, C–13), 1.11 (t, 3H, C–14); ^{13}C NMR (δ ppm, $CDCl_3$): 101.50 (C–1), 154.39 (C–3), 106.17 (C–4), 37.60 C–5), 126.22 (C–6), 141.42 (C–7), 107.87 (C–8), 53.73 (C–9), 86.76 (C–10), 48.78 (C–11), 176.72 (C–12), 22.70 (C–13), 11.92 (C–14), 170.97 (C–15).

RESULTS AND DISCUSSION

The dried and chopped plant material fruit (400 gm) of *Nerium oleander* was extracted successively with methaol for 72 hours. Solvent is removed under reduced pressure. Solvent free methanol extract was adsorbed on silica gel (60-120 mesh) to form slurry (13 gm) and loaded on silica gel column packed in petroleum-ether. Elution was carried out with different solvent proportions. Fraction eluted with petroleum ether afforded compound A and B. These compounds were characterized on the basis of physical, chemical and spectral data. Characterization of known compounds was done by comparing their melting point, IR, ^{1}HNMR, ^{13}CNMR and mass spectral data with reported values in the literature and also by comparative analysis of spectrum of authentic samples.

Characterization of compound-A as Uvaol (urs-12-ene-3,28-diol)

The unsaturated triterpenoid nature of the compound was confirmed by positive tests with Libermann-Burchard, Nellore's reagents and by treatment with TNM. The FAB mass spectrum of the compound showed significant signals at m/z 443 (M^+ + H), 442 (M^+), 425, 408, 391, 203, 135, 119 etc. On the basis of molecular formula for compound-A was confirmed as $C_{30}H_{50}O_2$. The IR spectrum (KBr, cm^{-1}) of the compound A showed sharp absorption at 3330, which confirmed the presence of hydroxyl group in the molecule. The presence of >C=C< was confirmed by the characterstic absorption of at 1650 and 1592. An absorption at 1050 confirmed the presence of –C-O-C linkage. The other prominent absorption at 1312 and 1337, were characterized for the presence of gem dimethyl group (>CMe_2) in the titled compound. The proton NMR spectrum (δ ppm, $CDCl_3$) showed sharp singlets at 1.13, 0.99, 1.02, 0.94 and 0.79 indicated the presence of five methyl groups at C-23, C-24, C-25, C-26, and C-29 position. The three protons of methyl group at C-30 position was confirmed by the presence of a sharp singlet at 0.79. The presence of hydroxyl group was observed at at 3.23 as sharp double doublet confirmed its position at C-3. The presence of vinylic proton of pentacyclic ring at C-12 position was confirmed by a singlet at 5.02. The methylene proton attached at C-28 showed two double at 3.22 and 3.74 .The presence of remaining twenty eight thirty protons was calculated in the region from 1.24 to 1.70. In the ^{13}C NMR spectrum (δ ppm, $CDCl_3$), absorptions observed at 26.7 (C-23), 14.7 (C-24), 14.7 (C-25), 15.7 (C-26), 15.4 (C-29) and 19.8 (C-30) confirmed the presence of six methyl groups. The signals observed at 125.3 and 137.4 were assigned for carbon-carbon double bond at C-12 and C-13 carbon atoms respectively. The presence of an absorption at 79.1 showed the presence of an hydroxy group attached at C-3 position. The absorption appearing at 69.7 (C-28) clearly indicated the presence of methanolic (-CH_2OH) group. The values of other carbon atoms in compound B were established as 36.6 (C-1), 25.7 (C-2), 37.4 (C-4), 53.9 (C-5), 18.3 (C-6), 31.2 (C-7), 40.1 (C-8), 46.4 (C-9), 36.5 (C-10), 21.8 (C-11), 40.5(C-14), 24.7 (C-15), 23.8 (C-16), 34.1 (C-17), 52.7 (C-18), 37.9 (C-19), 38.4 (C-20), 33.6 (C-21), 29.4 (C-22), 21.9 (C-27). On the basis of above spectral analysis compound-A was identified as uvaol (Urs-12-ene-3,28-diol).

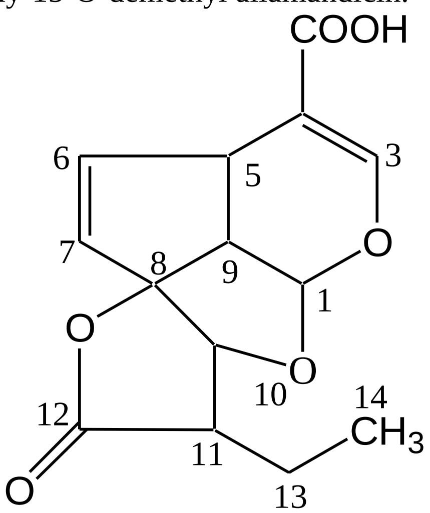


uvaol

Characterization of compound-B as Plumeridich acid

Mass spectrum of compound B established molecular formula as $C_{14}H_{14}O_6$ because its molecular ion peak was observed at (m/z) 278 (M^+) and fourteen protons appeared in ^{1}H NMR spectrum and fourteen protons appeared in ^{13}C NMR spectrum. In the IR spectrum (KBr, Cm^{-1}) of compound B, the >C=O stretching of carbonyl group was observed at 1760. The absorption at 2630 was due to –OH stretching of carboxyl group. The absorption at 1640 was characterized for >C=C< stretching. The ^{1}H NMR spectrum (δ ppm, $CDCl_3$) of compound-B showed a sharp singlet at 7.53 for one proton at C-3 position. The signals for olefinic protons were observed at 6.08 (*J*

= 2.19, 7.68 Hz.) and 5.65 (*J* = 2.01, 7.50 Hz.) as double doublets, characterized for th protons present at C-6 and C-7 positions respectively. The proton attached at C-1 position was observed as a doublet at 5.60 (*J* = 5.85). A sharp singlet observed at 4.42 for one proton was characterized for the proton present at C-10 position. A doublet and a double doublet established for one proton each for C-5 at 3.98 (*J* = 2.01, 9.72 Hz.) and C-9 at 3.49 respectively. A multiplet present at 2.76 confirmed the presence of one proton attached at C-11 position. The quintet for two protons at 1.86 and 1.66 confirmed the presence of methylene group at C-13 position in the title compound. The methyl group located at C-14 position showed a triplet at 1.10 (*J* = 2.01, 7.50 Hz). Thus, the presence of signals at 1.86 and 1.66 as multiplets clearly indicated the presence of ethyl group at C-11 position. The ^{13}C NMR also confirmed the presence of ethyl groups by absorptions at 22.72 and 11.94 respectively. Other absorption in ^{13}C NMR spectrum (δ ppm, $CDCl_3$) were observed at 101.50 (C–1), 154.39 (C–3), 106.17 (C–4), 37.60 (C–5), 126.22 (C–6), 141.42 (C–7), 107.87 (C–8), 53.73 (C–9), 86.76 (C–10), 48.78 (C–11), 176.72 (C–12), 22.70 (C–13), 11.92 (C–14) and 170.97 (C–15) and their assignment was done on the basis of reported values for iridoids. On the basis of above spectral analysis compound-B was identified as 13-dehydroxy-15-O-demethyl allamandicin.



plumeridich acid

CONCLUSION

Using spectral tests such as 1H-NMR, 13C-NMR, IR, and MS, the phytochemical examination of *Nerium oleander* indicated the existence of urs-12-en-3β,28-diol and plumeridich acid (13-dehydroxy-15-O-demethyl allamandicin). The significance of exacting characterisation techniques in comprehending the molecular components of therapeutic plants such as Nerium oleander is highlighted by these results.

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Accelerating Big Data Analytics: Comparative Advancements in Rapid Computation with Apache Spark and Apache Flink

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Abstract. To efficiently handle the vast quantities of expanding big data, it is crucial to possess fast processing and analytical capabilities. The objective of this abstract is to examine Apache Spark and Apache Flink, two renowned open-source frameworks, in order to explore their potential in addressing challenges related to handling massive volumes of data.Spark is an exceptional tool for batch processing since it performs computations in memory and utilises recurrent data structures (RDDs) for iterative methods. Regarding native stream processing, Spark's micro-batching approach achieves near real-time performance, while Flink's continuous streaming architecture and low-latency capabilities clearly make it the superior choice. Spark's micro-batching enables it to achieve near real-time processing.This study aims to analyse and differentiate Spark and Flink by examining their key characteristics. The objective of this comparison and contrast is to showcase the efficiency of each programme in managing diverse types of extensive data processing. The objective of this discussion is to aid users in choosing the framework that best fits their requirements by examining several aspects such as scalability, fault tolerance, and programming simplicity.One notable point highlighted in the abstract's conclusion is that Spark and Flink are mutually beneficial and work well together. Spark's iterative and batch processing capabilities are impressive, however, Flink demonstrates exceptional speed in real-time streaming. Data engineers can ensure the efficient and rapid processing of vast quantities of data by initially comprehending their own abilities and subsequently utilising the tool that is most appropriate for the given work.

Keywords: Distributed processing, in-memory computing, stream processing, batch processing, fault tolerance, real-time analytics.

1 Introduction

There is a direct relationship between the rapid expansion of data and a simultaneous rise in both opportunities and hazards. Big data is a term used to describe datasets[1] that are extremely large and can only be adequately analysed with powerful computer technologies. Apache Spark and Apache Flink, both open-source frameworks, have emerged as frontrunners in this field. This section provides a comprehensive discussion of Spark and Flink, emphasising their ability to provide fast processing of large volumes of data[2]. It also highlights their advantages and prospective uses.The meticulous examination of handling substantial volumes of data will be thoroughly explored, along with the imperative nature of parallel and distributed computing. In this comparison between Spark and Flink, we will study the characteristics of each framework, with a specific focus on Spark's ability to assess data batches and develop iterative algorithms utilising its RDDs. Flink is a very suitable option for real-time analytics due to its efficient design with minimal delay and its built-in ability to process data streams[3]. Both of these features will be examined in this comparison.In this introduction, we will endeavour to establish the foundation for understanding how Spark and Flink enhance the processing of vast quantities of data. We will discuss the key factors that should be considered when selecting one of these frameworks, taking into mind the specific requirements of your data processing processes[4]. In the following sections, which will provide a more in-depth exploration of their talents and uses, this establishes the foundation for what is to follow[5].

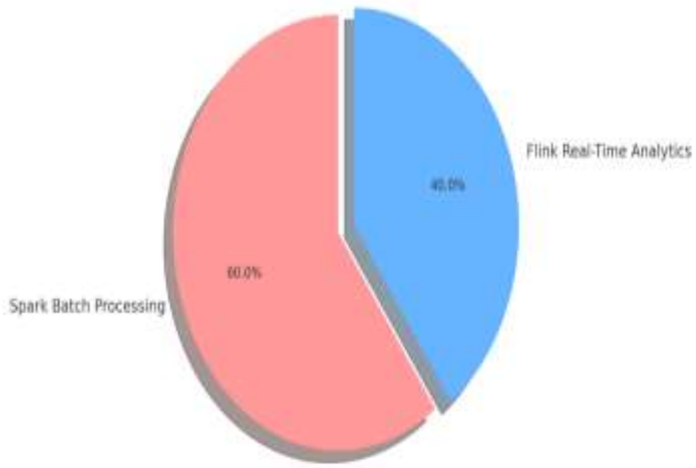

Figure 1: Data processing tasks between Apache Spark and Apache Flink.

2 Related work

Xu et al. (2020)[1] Conducted an experimental analysis on a system designed for the quick application of cohesive soil, with a specific emphasis on engineering and soil mechanics. While the main emphasis of their study is on soil deposition, other studies have examined the implementation of efficient computational methods in various contexts.
Zhang et al. (2023)[2] A dual-clearing methodology was developed for hydropower plants, focusing specifically on rapid and real-time calculations within the energy and power technology industry. The work they perform aligns with the need for efficient computing techniques and aids in enhancing computation operations in critical infrastructures.
Yang et al. (2022)[3] Develop a multiparty computation system that utilises blockchain technology to ensure the confidentiality and visibility of transactions. When using apps that rely on the Internet of Things (IoT), it is crucial to prioritise the security of user data. The research

emphasises the importance of having computing frameworks that are both efficient and secure.

Bai et al.(2020)[4] A discourse was conducted on the need of risk management strategies in renewable energy systems, particularly those related to the prompt assessment of hazards in power system operation, while considering the interdependence of wind generation.

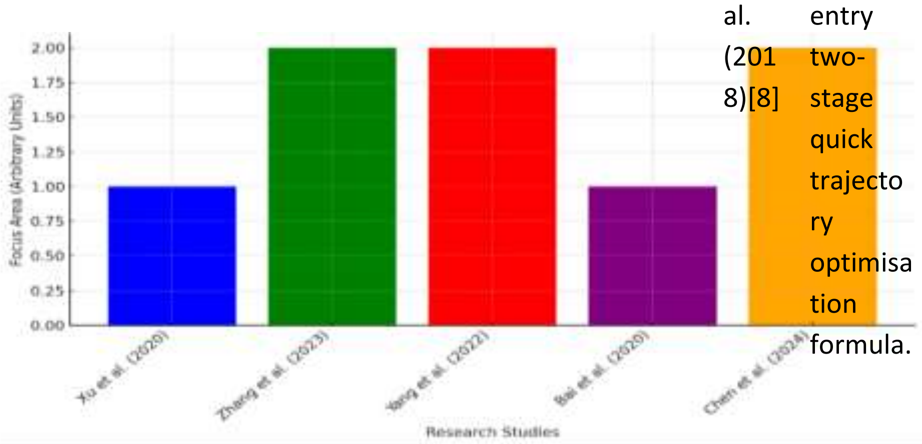

Figure 2: Representing the research studies by Xu et al. (2020), Zhang et al. (2023), Yang et al. (2022), Bai et al. (2020), and Chen et al. (2024), each with an arbitrary unit of focus area assigned.

Table 1. Related Work

Study	Method	Advantages	Disadvantages	Research Gap
Guan et al. (2022)[6]	Fair blockchain-based polynomial computation outsourcing.	Ensures fairness and openness in outsourcing calculations.	Relies on blockchain, which may add complexity and overhead.	Scalability of the proposed technique for large-scale polynomial calculations needs further study.
K et al. (2023)[7]	Rapid prototyping and machine learning tablet customisation.	Allows tablet customisation for varied user demands.	Rapid prototyping may cost a lot and take skill.	Assess how well the machine learning model adapts to changing user preferences.
Wang et al. (2018)[8]	Hypersonic entry two-stage quick trajectory optimisation formula.	Increases hypersonic vehicle trajectory optimisation efficiency.	Predefined trajectory steps may hinder flexibility in changing situations.	Explore real-time environmental and vehicle dynamics-based adaptive algorithms that adjust trajectory phases.

Chen et al. (2024)[5] An efficient and trustworthy evaluation system (RTE) has been developed for the Internet of Vehicles (IoV). This technology facilitates the choice of partners and the execution of time-critical tasks. Their study contributes to improving safety and dependability in Internet of Vehicles (IoV) environments by emphasising the importance of effective assessment methodologies in systems that are both intricate and constantly changing.

3 Proposed Methodology

3.1 Spark and Flink:

A concise instant of Apache Spark and Apache Flink[6], focusing on their individual capabilities in handling large data sets in both batch and real-time processing.In modern workplaces that rely on data, it is crucial to efficiently compute vast quantities of information. Analyse and examine this specific requirement.

3.1.1 Spark

The Spark architecture is a technique for efficiently processing vast quantities of data by utilising in-memory primitives to execute quick distributed computation[7]. The platform's capacity to enable user programmes to store data in memory and subsequently retrieve it is highly advantageous for online and iterative processing, especially for machine learning algorithms[8]. The development of this system was prompted by the limits imposed by the MapReduce/Hadoop paradigm, which need a linear dataflow and significant disc utilisation.Spark is constructed[9] using Resilient Distributed Datasets (RDDs), which are distributed data structures. RDD procedures are designed to automatically split jobs to maintain the data's stored location[10]. Furthermore, RDDs are a flexible and immutable resource that programmers can utilise to store interim results in either memory or disc for future utilization[11]. Furthermore, they can be utilised to optimise data allocation by customising partitions. RDDs are inherently fault-tolerant, which is unsurprising. To the presence of a "lineage" that keeps track of the sequential actions performed on each RDD[12], it is feasible to reconstruct any RDD[13] at any given moment in case of data loss.

3.1.2 Flink

Flink is a newly launched open-source framework designed for distributed processing[14] of data in both streaming and batch modes. One of its primary goals is to minimise data latency and improve the resilience of distributed systems while efficiently handling large volumes of data[12]. The main characteristic of Flink is its capacity to handle real-time data streams, which is also reflected in its name.Apache Flink offers a mechanism[15] that has a high degree of fault tolerance. This approach enables the dependable restoration of the previous state of data streaming applications. This technique is accountable for producing consistent[16] snapshots of the operator state and the distributed data stream. If an issue happens, the system has the capability to restore from these specific moments in time[17].Furthermore, his two primary application programming interfaces (APIs), DataStream and DataSet, enable the processing of data in both stream and batch formats. The underlying stream processing engine offers support for multiple application programming interfaces[18].

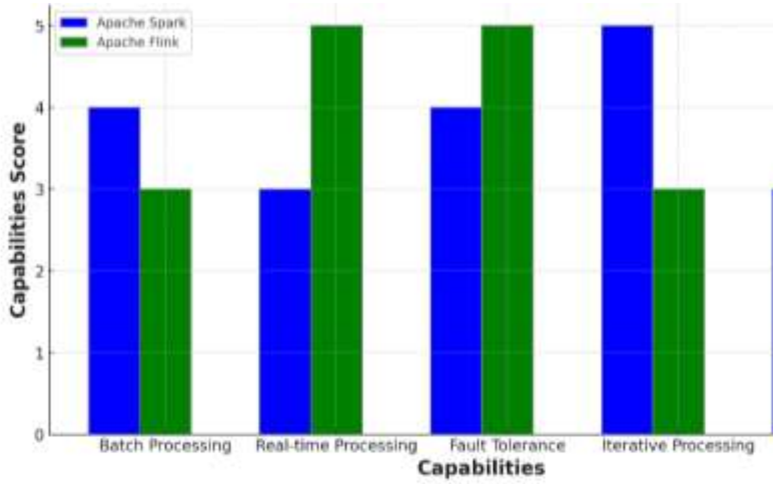

Figure 2: comparative analysis bar graph of Apache Spark and Apache Flink capabilities.

The capabilities that are provided by Apache Spark and Apache Flink are compared and contrasted against one another in this bar chart. Batch processing, real-time processing, fault tolerance processing, iterative processing, and data streaming processing are the five processing capabilities that we rank per technology. Certain skills are required in order to successfully manage very large amounts of data.

3.1.3 Spark vs. Flink:

The next section present a comprehensive comparison of the main similarities and distinctions between the engines of each platform. This enabled you to assess whether platform[19] is more suitable for a specific task. Subsequently, we analyse the resemblances and disparities of three machine learning algorithms—DITFS, SVM, and LR—that are employed in both systems, with a specific focus on the primary distinctions among them[20].

3.1.4 An Engine Comparison

The distinguishing feature between the two engines is in the manner in which they manage data streams. Conversely, Spark was primarily created to handle stationary data using its RDDs, while Flink is a streaming processing framework that is specifically designed[21] to handle continuous input. Spark utilises a method known as micro-batching for processing streams. This methodology employs a method of partitioning the incoming data into smaller units and subsequently handling each of these units individually[22]. To fulfil its primary objective, Spark utilises a direct sequence of RDDs as its framework, known as DStream. This method allows users to seamlessly transition between batch and streaming processes due to the shared application programming interface (API) of both methods[23]. In the context of systems that demand very low latency, micro-batching may not be capable of delivering the required level of performance. Flink is well-suited for such systems since it effectively utilises streams for any application workload.

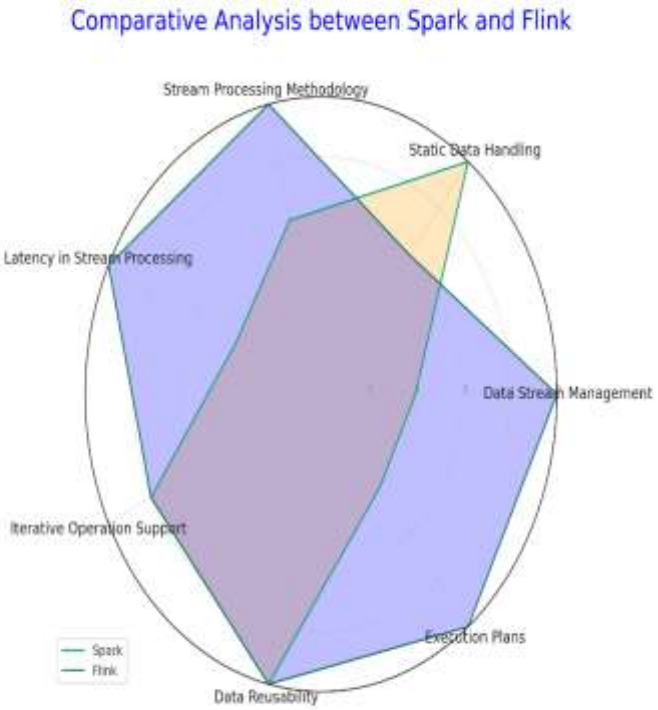

Figure 3: An Engine Comparison

Both Spark and Flink offer support[24] for iterative operations and the ability to reuse acquired data. Spark maintains data in memory throughout iterations by employing an explicit caching approach[25]. However, due to Spark's utilisation of acyclic graph plans for execution organisation, it is necessary to schedule and execute the identical set of instructions for each iteration. However, Flink's engine does comprehensive iterative processing by utilising cyclic data flows. By providing delta iterations, it becomes feasible to maximise the utilisation of processes that alter specific portions of data.

3.1.5 Application of distributed information

We have applied an information-theory-based feature selection strategy to both systems in order to streamline the comparison process. Multiple criteria can be accurately described as linear combinations of the Shannon entropy terms, namely conditional mutual information (CMI) and mutual information (MI). This is achieved by formulating precise assumptions on the independence of the variables. The framework includes the Minimum Redundancy Maximum Relevance algorithm and the Information Gain algorithm, both of which are relevant algorithms. The algorithm will initially assess the attributes by assigning them a basic score, and thereafter prioritise the features based on their significance[26].

3.2 Process Design:

By integrating Spark with Flink, you can create a versatile framework that excels at high-speed processing of vast quantities of data.It is necessary to include a comprehensive summary of the various elements involved, such as the data intake, processing, transformation, and analysis processes.It is crucial to examine how Spark's in-memory processing and Flink's stream processing characteristics complement each other and contribute to enhanced computational efficiency.

3.3 Data Ingestion:

Outline the steps involved in importing large amounts of data from several sources into the Spark-Flink system.It is crucial to explore the various methodologies for importing data in batches and streaming data in real time.

```
if Spark and Flink are available:
   initialize SparkSession
   initialize StreamExecutionEnvironment

   dataRDD = sparkSession.read().load("input_data_path")
   resultRDD = dataRDD.mapPartitions{ partition =>
   }.reduceByKey{...} // Aggregate results
      dataStream =
StreamExecutionEnvironment.getExecutionEnvironment()
.readTextFile("input_data_path")
   resultStream = dataStream.map{...}
                        .keyBy{...}
                        .timeWindow{...}
                        .reduce{...}
      resultRDD.saveAsTextFile("output_path_spark")
   resultStream.writeAsText("output_path_flink")
   else:
   print("Spark and Flink not available. Please install and
configure them.")
```

3.4 Data Processing and Transformation::

Specific information should be given on the processing and transformation pipelines that rely on the Spark and Flink frameworks.It is advisable to explore the batch processing options provided by Spark and DataFrames, as well as the real-time processing capabilities offered by the DataStream API in Flink.Caching, partitioning, and parallelization are optimisation techniques that can enhance the efficiency of the calculation process. Please examine them.

Table 2. Sumulation parameter

Datasets	Description
Large-Scale Sensor Data	High-frequency IoT sensor data from smart city weather, humidity, and pressure sensors.
Social Media Streams	Text, photos, and videos from social media networks in real time.
E-commerce Transaction Logs	Online retailer transaction data, including customer interactions, product purchases, and payment details.
Web Server Logs	Web server logs of user requests, access times, IP addresses, and HTTP response codes.
Scientific Research Datasets	Genomic, climate, and particle physics datasets.

3.5 Integration of Machine Learning and Analytics:

By incorporating analytics and machine learning into the Spark-Flink pipeline, it will be possible to conduct more sophisticated data analysis.Explore the MLlib and Flink libraries in Spark, and examine their potential applications in the field of machine learning.Examine multiple strategies for training and inferring models in a distributed fashion to effectively handle vast quantities of data.

3.6 Performance Optimization:

Identify techniques to enhance efficiency and resolve any issues impeding the speed of computing.Explore various strategies for improving Spark and Flink workloads, including data segmentation, resource allocation, and cluster optimisation.By comparing the proposed method with conventional frameworks used for handling enormous volumes of data, one may illustrate its effectiveness.

3.7 Scalability and Fault Tolerance:

Analyse the fault tolerance and scalability features of Spark and Flink technologies.It is crucial to analyse the different ways in which the suggested solution tackles the problems and shortcomings linked to dispersed settings.It is crucial to remember that Spark originated from RDD, and that Flink has the capability to perform fault tolerance checkpointing.

4 Results analysis

Metrics for Comparison

1 The time it takes to finish batch and real-time job processing should be taken into account as the initial performance metric.

2. Fault Tolerance: Assesses the system's ability to withstand errors in data or node failures that result in execution-level faults.

3. Scalability tests, which indicate whether or not the system can accommodate growing data volumes or node counts without compromising speed.

4 usability assesses the degree of community support as well as the learning curve.

5. Resource Efficiency: Estimates the memory and processing power needed for similar tasks.

Table 3. Results analysis

Metric	Apache Spark	Apache Flink
Processing Speed	High latency in batch processing	Lower latency, real-time stream processing
Throughput	High throughput for complex batch jobs	High throughput with slightly better performance
Fault Tolerance	Resilient across nodes with RDDs	Robust, slightly faster state recovery
Scalability	Excellent in batch mode	Superior for stateful operations at scale
API Usability	Rich API support, well-documented	Comparable API but with a steeper learning curve
Data Management	Strong in iterative batch processing	Better for windowing and state management
Resource Management	Efficient in resource management for batch jobs	More fine-tuned control over streaming jobs
Community and Support	Large community, extensive resources	Growing community, less extensive than Spark
Cost Efficiency	Generally cost-effective for large-scale batches	Potentially more cost-efficient in streaming

Table 4. Comparison of Apache Spark and Apache Flink across different metrics

Metric	Apache Spark	Apache Flink
Batch Processing	200 sec	220 sec
Stream Processing	180 sec	160 sec

Fault Tolerance	High	Very High
Scalability	Excellent	Good
Resource Efficiency	Medium	High
Ease of Use	Very Easy	Moderate

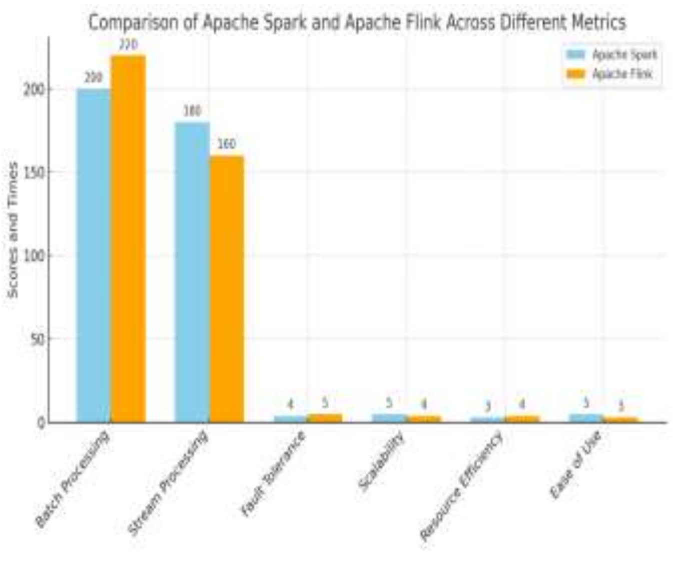

Figure 4: Comparison of apache spark and apache flink across different metrics

5 Conclusion

Both Apache Spark and Apache Flink are open-source frameworks that are able to do calculations on enormous amounts of data using their respective capabilities. These frameworks are extremely reliable. The fact that both are capable of fault-tolerant computing and distributed computing does not change the reality that they excel in distinct ways:Because it is the solution that is the least resource-intensive, Spark is the best choice for applications that need to perform iterative and batch processing. It is the user-friendliness of the system as well as the well-established ecosystem that it has built that are the two variables that contribute to the adaptability of the system.Real-time stream processing is made possible due to Flink's exceptionally low latency, which makes it possible to do stream processing. As a result of its built-in streaming capabilities and its lightning-fast state management, it is an excellent option for managing contexts that call for the processing of data in real time.The particular requirements that you have outlined will be the decision-making aspect that will finally determine which choice is the most suitable alternative. In the event that you are required to carry out processes that involve repetitive analysis or batch processing, Spark is a wonderful alternative that you should examine being a potential solution. For circumstances in which it is vital to have minimal delay and speedy data analysis, the Flink option is the one that is best fit for the case than any other alternative. With the adoption of hybrid big data processing pipelines, which incorporate both frameworks, an increasing number of enterprises are adopting this approach. It is anticipated that this pattern will endure in the not too distant future.

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Security Issues & Challenges of Data Sharing in Cloud Computing

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ABSTRACT
The digital ecosystem and improvements in industries like healthcare, banking, and science have made data sharing essential. However, there are serious security and privacy dangers associated with the quick expansion of data interchange. The research presented here examines the security issues surrounding data sharing and provides approaches to reduce the risks. We look at the danger landscape, focusing typical attack methods such insider threats, leaks of information, and illegal access.

Keywords— Data Security, Cloud Computing, Data Protection, Encryption, Privacy, Risks and threats

1. INTRODUCTION

A newer form of utility computing that has replaced its space in various data centers is the cloud computing system. Through the Internet, consumers can access a wide range of information technology capabilities and facilities, which has led to a remarkable variance in the IT sectors' processes. In addition to maintenance, it benefited the IT sectors by requiring less investment in infrastructure [1].

It is becoming popular as virtualization power, distributed computing with server cluster and rise in the availability of broadband internet assessing is increasing. The IT world is looking forward to the services delivered and consequently enhancing the growth of cloud computing [2].

Sharing knowledge through others turns out to be correspondingly more beneficial when cost-effective improvements in computer technology and large-scale networks are used. Furthermore, cloud computing makes it easier to obtain digital resources in addition to storage. Cloud data sharing, on the other hand, requires off-premises infrastructure that certain organizations jointly own, and distant storage somehow threatens data owners' confidentiality. As a result, ensuring personal security [3].

In practically every technologically advanced industry that uses computer systems, computer security is essential. Providing a cryptographic system that is computationally impossible for attackers to have access to is the primary goal of security. When it comes to computer system design, security is one of the most important considerations, while there are many other variables as well. For example, one technique used in RSA is the problem of integer factorization. Elliptic curve cryptography, digital signature algorithms, DH key exchange, and other applications support the discrete algorithm. Hard AI issues serve as the foundation for these primitives [4,5].

The problem of instantaneously attaining fine-grained Ness, high efficiency on the data owner's side, and standard data confidentiality of cloud data sharing remain vague. There is no constituency among the data synchronization besides data storage. Essential to enhance the system security mechanism.

The suggested Decisional Bilinear Prime Elliptic Curve Hellman Diffie-Factorial The purpose of Cryptographic Data Sharing in Cloud Computing (DBECC) is to secure cloud data sharing. Additionally, it should concentrate on all forms of attacks in the cloud computing space. Additionally, it is utilized to protect the data from side channel, dictionary, SQL injection, collusion, and brute force attacks.

This Paper has VI Section, Section I Discuss the introduction, Literature Review is presented in section II. Risk and security concerns are discussed in section III. Section IV explicitly presents the concept of Protecting Data using encryption. At the end conclusion is sum up in section V followed by reference in section VI

2. LITERATURE REVIEW

The purpose of this section is to provide an overview of the body of research on safe cloud data exchange. The papers in this part focus more on the essential requirements that will enable secure data sharing in the cloud than they do on the specifics of that topic. Secure data sharing in the cloud is a relatively new field of study that has grown in importance as a result of the cloud's advancements and growing popularity as well as the growing need for data exchange amongst individuals.

We divided the current articles into two categories: cloud security and data sharing. Journals about cloud security and privacy have been published. Confidentiality, integrity, availability, accountability, and privacy are the five issues that cloud computing raises. Xiao and Xiao [6] identified these issues and carefully examined the risks to each of them as well as defense mechanisms.

Chen and Zhao [7] succinctly summed up the requirements for safe data exchange in the cloud and described the requirements for achieving privacy and security in the cloud. Shawish [8] recommended a review of cloud security and privacy, focusing on how privacy regulations need to be taken into consideration. Cloud computing and the steps that could be taken to prevent privacy violations as well as security lapses involving personal data stored in the cloud. Issues that impact cloud computing information security management were examined by Wang et al. [8]. It made clear the fundamental security needs that businesses must meet in order to understand the dynamics of cloud information security.

The impact of the Internet on data sharing among a wide range of organizations, including corporations and government bodies, was examined by Saradhy and Muralidhar [9]. They divided information sharing into three categories: record matching, query restriction, and data transmission. They also provided a framework for effective and safe online information sharing. Butler [3] outlined the issues with data sharing on the Internet that allow people to draw conclusions about specific users. It is advantageous because it makes organizations more aware that the information they decide to make public may still raise privacy issues and does not guarantee user confidentiality. Pagano [10] highlighted the privacy issues that continue to impact data sharing while outlining the advantages of doing so from a banking standpoint.

Athena et al. (2018) used efficient techniques. In particular, elliptic curve D-H for the creation of secret keys and ID attribute-based encryption to improve cloud data security [11]. A novel ID-based public auditing protocol with improved structure, privacy preservation, and effective aggregation authentication was proposed by Kang et al. (2018) for cloud data integrity verification. shown that, on the presumption that the D-H problem was difficult, the proposed protocol could withstand forgery attacks. Furthermore, additional ID-based auditing techniques have already been compared with the proposed methodology [12].

An inventive security architecture was technologically enhanced by Santhi et al. (2018) to enhance cloud security. Prior to the Third-Party Auditor (TPA) authenticating the generated secret information, the CSP, data owner, and data user created the secret key for the data using the DH algorithm [13]. A secure data group sharing and dissemination strategy based on attribute-based and timed-release conditional ID-based broadcast PRE was proposed by Huang et al. (2018) in the public cloud [14].

Some of the most important necessities of secure data sharing in the Cloud are as follows. Initially, the data owner must be talented to state a user group which is permitted to view his or her information. Any member of the group must be capable of gaining access to the data anytime, wherever without the data owner's involvement. No-one, except the data owner and the group members, must achieve access to the information, including the CSP. The data owner must be capable of adding new users to the group. The data owner must also be talented to cancel access rights against any group member over his or her shared information. No group member must be permitted to cancel rights or else join new users to the group.

Encoding the data owner's previously stored information in the cloud is a small step towards achieving safe information sharing. This way, the data is theoretically shielded from both the cloud provider and other malicious users. The data owner gives each group member the key used for data encryption when he has to share his information with others.

Any group member can then acquire the encoded information from the Cloud and decrypt the information with the key and later doesn't want the involvement of the data owner. However, the issue with this method is that it is computationally useless and places too much load on the data owner while allowing for factors such as user revocation.

Once the data owner cancels the accessing rights to a group member, that particular member must not have permission to access the consistent data. Meanwhile, the member currently possesses the data access key; the data owner has to re-encrypt the data using a new key, rendering the revoked member's key unusable. Once the data is re-encrypted, he needs to distribute the innovative key to the remaining group users, and this is computationally ineffective and places too much burden on the data owner once allowing for huge group sizes that could be more than millions of users. Therefore, this solution is impossible to be deployed in the real world for very critical data such as business, government, and related medical data.

Therefore, if these security concerns are not properly addressed, they will prevent cloud computing's wide-ranging applications in the future.

A one-to-many cryptographic primitive, attribute-based encryption provides fine-grained access control on the ciphertexts that are outsourced. Through the use of access strategies and attributes assigned to private keys and ciphertexts, it has a method that allows access control over encoded data. Data confidentiality and access control can be guaranteed by using Ciphertext-Policy Attribute-Based Encryption (CP-ABE), which enables the data owner to specify the access policy over a universe of attributes that the user wishes to possess in order to decode the ciphertext [15].

On the other hand, current solutions mostly concentrate on the way to afford secure data read for users, none of these works deliberates that several users may also write the encrypted data collaboratively in cloud computing.

3. RISKS AND SECURITY CONCERNS OF DATA SHARING IN CLOUD COMPUTING

There are numerous security problems and challenges in cloud computing technology. The security problems in cloud computing are specified in [5]. Safe and secure network connectivity is essential for the cloud network that connects the systems. Additionally, it features virtualization patterns that lead to numerous security issues. High security is therefore necessary in order to translate virtual computers onto physical machines. Data security measures include data encryption and the implementation of pertinent policies required for data sharing.

The allocation of resources and the memory managing algorithms should be highly protected and safe. One of the major problems in cloud computing is that it implicitly consists of the business-critical data and complex processes and also outsources sensitive data securely. The data stored on a cloud service is the responsibility of the cloud provider who controls and protects those data. When the data is organized on the cloud through IaaS or PaaS, then the complete control is possessed by the cloud provider.

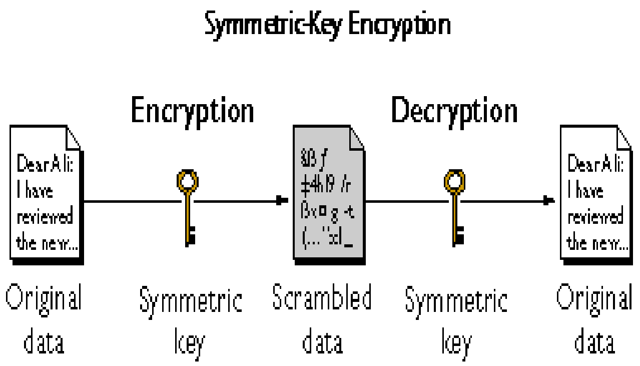
Because of this, a reliable relationship between cloud users and Cloud Service Providers (CSPs) is necessary, and many kinds of research are conducted to achieve this. Cloud computing technology faces the same security risks as the majority of computing systems. One of the main concerns is protecting confidentiality and sensitive files that are outsourced; these days, this is relevant to mobile devices for data misuse or integrity violations. By using attribute-based encryption to restrict the admission of the encrypted files by the Data Owners, the processed data stored in cloud storage are protected from unauthorized users.

4. PROTECTING DATA USING ENCRYPTION

By creating cryptographic techniques, one can achieve cryptography, which is the science of encrypting and decrypting communications to be safeguarded when transmitting over an untrusted and insecure network. Cryptoanalysis, on the other hand, is the art. Alternatively, it is the science of researching and evaluating cryptographic methods in order to crack them. Mustafa, it's evident that cryptanalysis and cryptography are related. After D-H presented a paper titled "new directions in cryptography" [6] in 1976, which demonstrated the public key concept and the various key exchange protocol techniques, cryptography saw a significant advancement.

Cryptography algorithms differentiate into two main categories:

(i) Symmetric cryptography
(ii) Asymmetric cryptography



It has only one key to encrypt or decrypt the information over insure channel.

Because it deals with a wide range of clients, devices, and measurements, secured cloud is a crucial study topic. Since many mobile devices may reach the clouds, smaller security keys will be favored. Therefore, security with a small key size is the crucial factor that immediately springs to mind [16]. In the modern era, cryptography has emerged as one of the important sciences. We frequently conduct intensive digital communications on the internet in addition to other communication channels, which is why cryptography is important. Symmetric Cryptography also prov-ides a degree of authentication Because data encrypted with one symmetric key cannot be decoded with any other symmetric key, symmetric cryptography also offers a certain level of authentication. Therefore, as long as the decrypted messages continue to make sense, each party employing a symmetric key to encrypt communications can be certain that it is speaking with the other as long as the key is kept secret. You can trade the key with another reliable participant in a symmetric key. Typically, you create a key for every participant pair.

Asymmetric cryptography

Asymmetric cryptography is of 3 Types-

1) Elliptic curve Cryptography.

2) Diffie-Hellman Cryptography.

3) Prime Factorization in Cryptography.

Elliptic curve cryptography

Since ECC employs a single key for encryption and a separate key for decryption, it falls under the category of asymmetric cryptography. It is protected against non-repudiation, authentication, and key-exchange. The approach to PKC that is based on the mathematical structure of elliptic curves over finite fields is clearly characterized. Elliptical curves have the advantage of requiring very small keys while maintaining the highest level of security [4]. The elliptical curves can be used for a variety of activities, including encryption and digital signatures. The capacity to calculate a point multiplication will determine how secure ECC is. The problem's complexity is indicated by the size of the elliptic curves. A plane curve over a finite field that contains the points that satisfy an equation is called an elliptic curve:

$$y2 = x3 + ax + b$$

The equation of a curve may be quite challenging if the coordinates from the beyond equation are not chosen from a finite field of characters that are not equal to 2 or 3. The field in ECC is well-defined using a pair of m and f in the binary case and p in the prime case. "A" and "b," which are utilized to define the equation, are the constants in the curve. Numerous integer factorization algorithms, such as Lenstra curve factorization, have numerous uses in the field of cryptography[10].

Diffie-Hellman Algorithm

Asymmetric cryptography also includes Diffie-Hellman (D-H). It is an important method for two parties to exchange keys. It is one of the simplest instances of key exchange used in the field of cryptography. A symmetric key cypher can be used to encrypt the data using that shared secret key. The public key is generated using the D-H method. Without any prior knowledge, the symmetric public key algorithm exchanges the secret key between two users across an unprotected channel. Only key exchange is possible with the D-H feature. The D-H key exchange algorithm lacks two-party verification and cannot be used for both encryption and decryption. One of the main challenges with the D-H algorithm is that it is vulnerable to man-in-the-middle attacks [11].

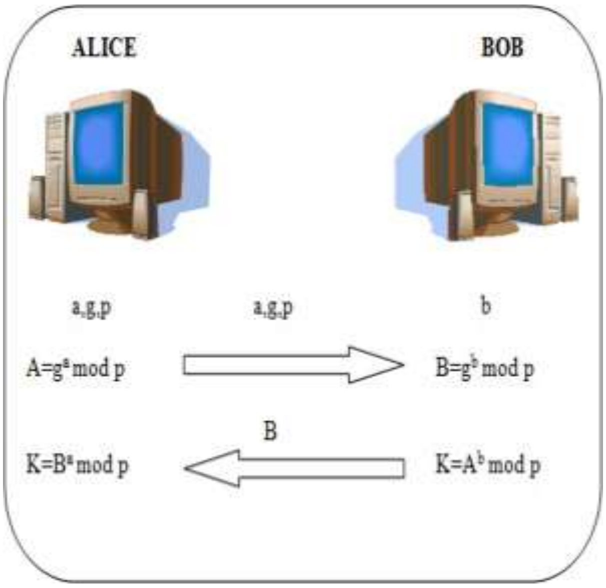


Figure 1 Basic Diagram of D-H Algorithm

Figure 2 shows the flow chart for the traditional D-H algorithm. It will explain the operation of the traditional D-H algorithm. A D-H key will be utilized for encryption and decryption using the suggested technique, and time complexity and analysis will be measured in the current algorithm. Public key encryption methods used for business purposes include the RSA and D-H key exchange protocols [12]. While both techniques use 1024-bit keys, encryption and decryption systems require a minimum key length of 128 bits. Both algorithms needed to be broken when they were first introduced in 1970.

Because the D-H key exchange does not offer authentication for both parties involved in the interchange process, it is vulnerable to man-in-the-middle (MITM) attacks. Additionally, Alice and Bob believe they are conversing with each other, but MITM pairs them up and obtains all of their messages. The D-H key exchange process lacks authentication because of an MITM attack[13].

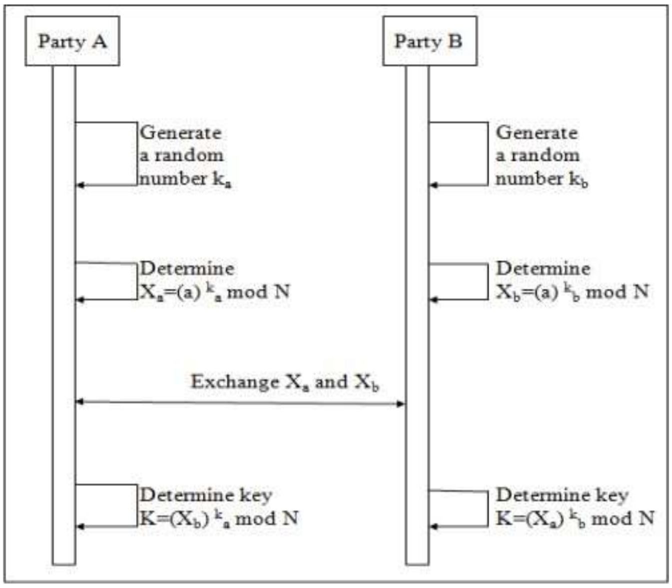


Figure 2 Flow chart of the Diffie-Hellman algorithm [2]

Prime Factorization in cryptography

The breakdown of a composite number into smaller, non-trivial divisors that, when multiplied collectively, equal the original integer is known as integer factorization or prime factorization in number theory. Because it employs mathematical modelling for public key encryption systems, it is often referred to as asymmetric cryptography. By knowing Euclid's geometric location, one can visualize a prime factor[15]. A full number, in his opinion, is a line segment with a least line segment larger than one that can split it evenly. Every positive integer has a distinct prime factorization according to the fundamental theorem of arithmetic. However, the fundamental theorem of arithmetic simply ensures the existence of an integer; it provides no information on how to determine its prime factorization. Fermat's method is the fundamental approach to prime factorization. Every other approach is a variation of this sophisticated fundamental method. The secret to a safe connection is the factorization of the huge semi-prime number [16].

5. CONCLUSION

The study on cloud data sharing security emphasizes how crucial it is to fix any potential weaknesses and make sure strong security measures are in place to protect private data. Implementing thorough security mechanisms must be given top priority as more and more businesses use cloud computing for data sharing and storage.

The results show that although cloud technology has many advantages, including scalability and accessibility, it also brings with it new data security issues. The confidentiality, availability, and integrity of shared data can be seriously jeopardized by elements like illegal access, data breaches, and insufficient encryption.

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