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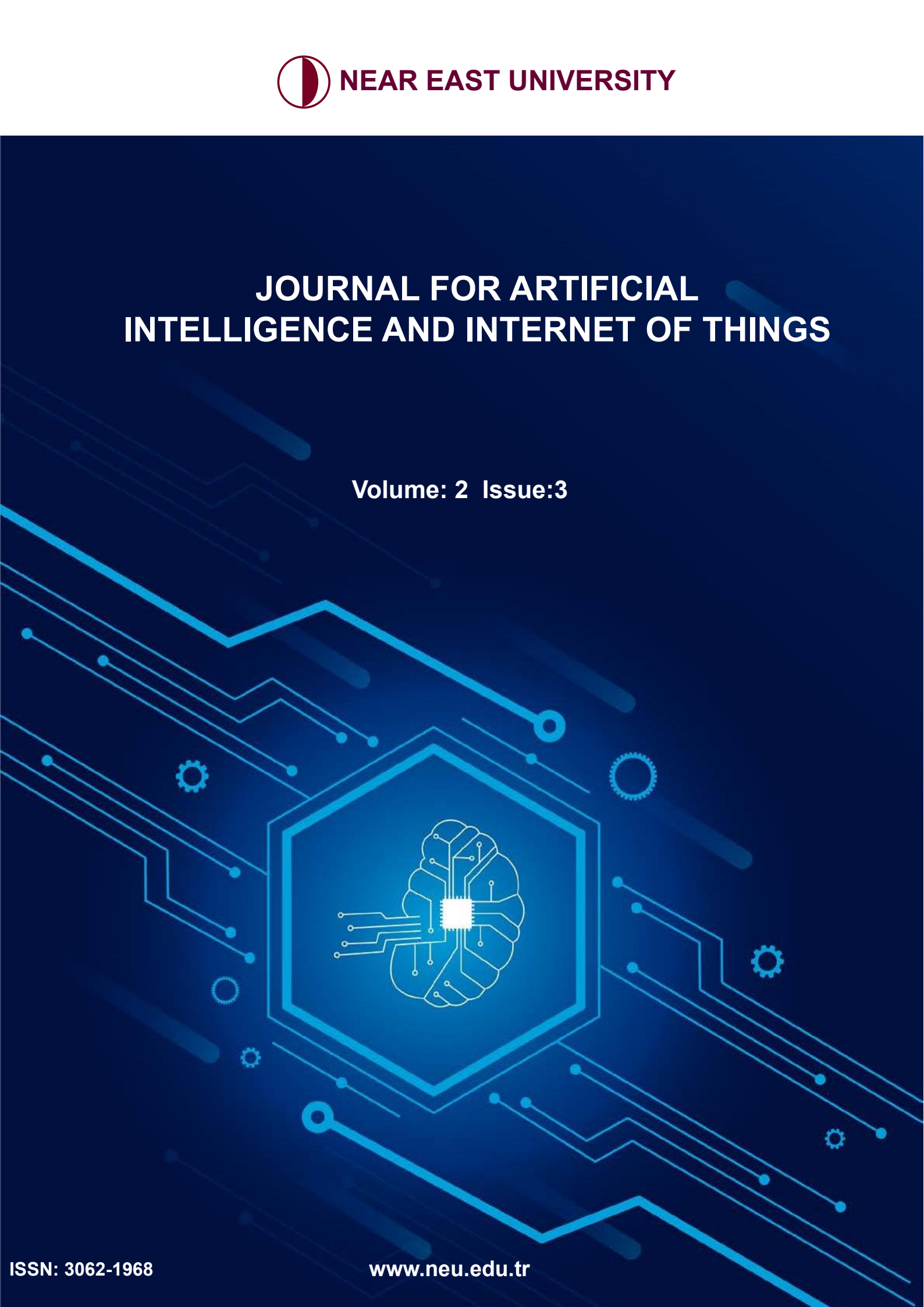

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CONTENTS

AN OVERVIEW OF THE INTERNET OF THINGS (IOT) AND MACHINE TO MACHINE (M2M) COMMUNICATIONS

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ABSTRACT: The Internet will grow when sensors and intelligence are attached to physical objects like assets or consumer products, which are then connected to the Internet. This procedure is referred to as machine-to-machine (M2M) communications and the Internet of Things (IoT). The concept and paradigm have been around for a while, but there has been an increase in the quantity and variety of connected devices as well as in technology for information gathering, processing, and sharing. Over the past decade, attacks on flexible architectures have increased. Malware, staged attacks, and coercion have all been added. While M2M increases the number of devices using distant structures for Internet connection, the Internet of Things (IoT) presents another attack vector. Between the existing methods for system structure improvement and the understanding of how these new improvements are unusual and how they are comparable, there is a gap in evaluation. Executions of countermeasures are hampered since current frameworks do not properly take the use of technological developments into account. These frameworks fall short when it comes to a strategy for identifying network issues that are occurring right now and when it comes to tools for examining, classifying, and analyzing non-human device countermeasures. With phones, smart cars, smart coffee makers, and an unlimited number of other smart appliances gradually gaining access to our lives and starting to have an impact on the future, the Internet of Things, which may be the phenomenon with the quickest growth in the whole IT sector, has already established itself as a fully-fledged partner in our everyday routines. Understanding the differences between the Internet of Things (IoT) and Machine-To-Machine (M2M) communication, which is the fundamental concept that gave rise to the IoT as we know it, seems to be essential to comprehending the present IoT environment. The study examines some of the most important M2M and IoT applications, and it offers a response to the novel structures based on an assessment of M2M devices that extend the lifespan of the whole IoT natural framework.

Keywords: Internet of Things, M2M Communication, Connectivity, Devices, Mobile Computing, Cloud Computing

1.INTRODUCTION

Thanks to the Internet of Things (IoT) and machine-to-machine (M2M) communication, linked gadgets will undoubtedly improve. According to the researchers, by the year 2035, a network of intelligent products would connect over 50 billion objects throughout the universe. The number of digital vulnerabilities increases together with the amount of organized content. The fifth anticipated generation of portable communication will include all wired and remote systems management administrations and advancements. The heterogeneous systems administration strategy gives rise to many threats. Building solid data innovation solutions

for such a wide range of systems with cutting-edge technology is a challenging challenge. Different combinations of intelligent things/objects and sensor network technologies are possible in the Internet of Things industry. People who use a variety of interoperable communication protocols are aware that a dynamic heterogeneous/multimodal network can be deployed in remote or inaccessible locations, such as mines, oil platforms, forests, pipes, tunnels, etc., or in times of emergencies like earthquakes, floods, fires, radiation areas, and others. These "things" or "objects" in the IoT infrastructure will become aware of one another, interact with one another, and learn how to benefit from one another's data by pooling resources and radically expanding the range and reliability of the ensuing services.

The Internet of Things market offers various combinations of cutting-edge objects/items and sensor development advancements. People who use various and interoperable communication mediums understand that a remarkable heterogeneous/multimodal framework may be conveyed in distant or inaccessible places (mines, oil stages, forests, funnels, tunnels, etc.) or in instances of crises, such as earthquakes, floods, fire, radiation zones, and others. In an IoT system, these "things" or "objects" will identify and learn from one another, then figure out how to misuse each other's data by pooling resources and unquestionably revamping the quality and reliability of the subsequent organizations.

Machine-to-machine communications will be more centered on the terminals and data centers (for example, cloud computing, home data centers, and others) than the nodes, as in the existing networks. The majority of the information needed by people, things, or objects will be locally accessible as storage capacity expands at decreasing costs. Along with this, always-on connection and enhanced computing power are options. The importance of terminals in communications will rise as a result. Physical business benefits such as high-resolution resource and product management, greater corporate collaboration, and improved life-cycle management will be provided by the Internet of Things market and machine-to-machine interactions. Many of these advantages come about as a result of the exclusive identification of certain items or objects, which, by gradually compiling a life history of cooperation and activities, enable each other to collaborate autonomously[1-5]. Consumer electronics, manufacturing and supply chain, automotive and transportation, and consumer and residential verticals are anticipated to lead all industry verticals in terms of revenue, followed by industrial and commercial buildings, healthcare, government, and other verticals.

2. Advancement of Internet

The beginning of Internet affiliation, which became standard for military, governmental, and educational institutions in the United States, may be traced back to the Advanced Research Projects Agency Network (ARPANET), which was established in the late 1970s. Then, America Online (AOL) created its second stage, which introduced a fixed web that drew email and web separation in the 1990s. Current third stage, which is 2010's, is the era of cutting-edge cells with various Internet experiences that are faster and better. The dynamic fifth generation (5G) of profitable communication is currently being examined by the entire world. The core component of 5G is machine-to-machine (M2M) and web-of-things (IoT) communication. Therefore, the fourth phase of the Internet is known as the Internet of Things or articles, in which a significant portion of traffic will be sent by the interaction of hitting items from the physical world with the developed world. The graph illustrates the development of the Internet from the ARPANET to the IoT and M2M. According to the general assumption that each person has five devices that they consider to be planned, the total number of planned items may exceed fifty billion.

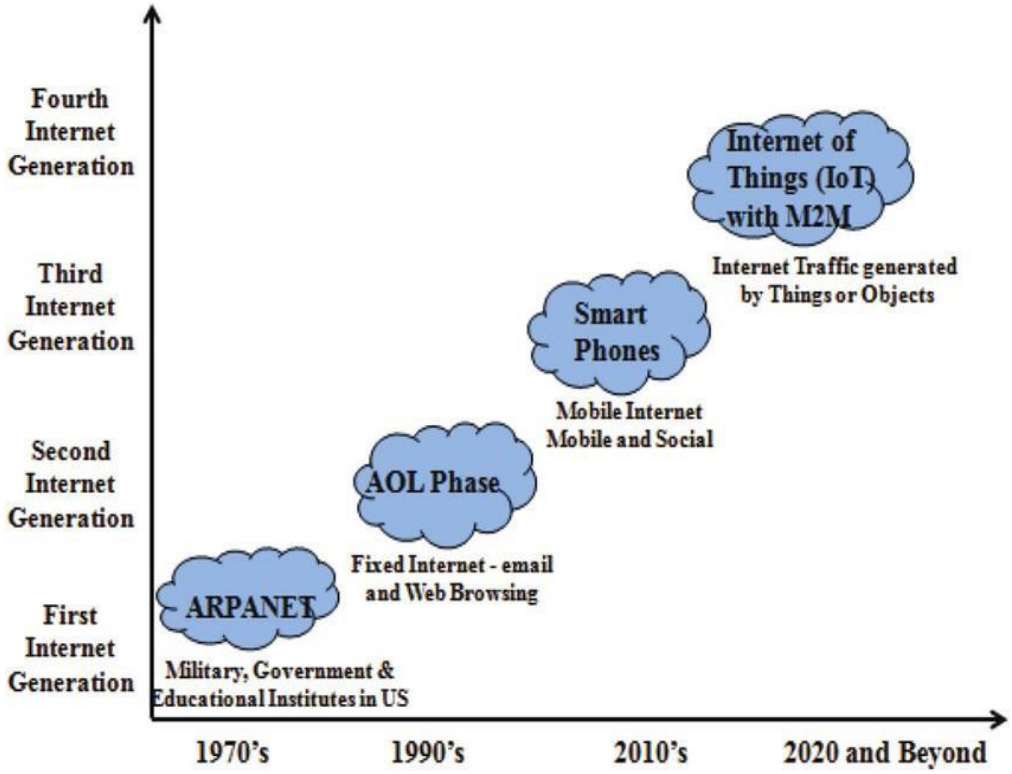

Figure1: *Advancement of Internet through ARPANET to IoT and M2M.*

3.What is Internet/Web of Things?

The term "Internet of Things" (IoT) is used to describe technology that collects data and uses the internet to share it with others. The Internet of Things is an enhancement of the present Internet relationship for every single item that exists in this planet or is expected to exist in the future. Examples of relatively advanced consumer IoT devices include wearable technology, smart meters, and remotely programmable thermostats.

Different frameworks from exchange viewpoints have been researched to advance the new twist of fate and notoriety of IoT as it has evolved into a working evaluating zone. One paradigm regards IoT as the Internet of Things, where open Web standards are maintained for data exchange and device interoperability. When incorporating sharp objects into the current web, the usual web relationships should have been upgraded and linked to the actual world. In the context of current far-off transfer transactions, the IoT is rapidly expanding an astounding portion of the concept. The main concept of the factors, including as Radio Frequency .

Identification (RFID) tags, sensors, actuators, phones, etc., which, via enticing tending to plans, may communicate with one another and aid their neighbors in achieving common goals. Before the Internet of Things concept is fully understood, several testing difficulties focused on both creative as well as social groups need to be resolved. By enticing them to change and engage in self-regulating behavior, focal concerns must work to support the theoretical interoperability of connected devices while providing trust, protection, and security.

The IoT concept also handles two or three fresh problems from the views of systems associations. To the extent that calculation and necessity permit, the factors influencing the IoT will in fact be depicted by a reduced base of favorable conditions. As necessary, the suggested plans must provide a noteworthy understanding of asset advantage in addition to

the unique challenges with adaptability. The security and safety of the included associates are impacted by the Internet of Things, a broadly speaking Internet-based explicit structure engaged in the trade of goods and experiences in generally speaking systems [6-10]. It is necessary to put in place safeguards that ensure the integrity of the information check, opportunity control, and customer security.

Figure2: *Internet of Things*

4. What is M2M?

M2M stands for machine-to-machine communication. There is no human contact involved in this direct system of communication between the devices via wired or wireless communications channels. Data is gathered and shared with other linked devices by the device. With the use of this technology, devices may connect to one another without the need for the internet. M2M communications are used in many applications, including military, monitoring and tracking, production, and facility management. The application of M2M technology is possible in a variety of settings, including homes, offices, and shopping centers. Controlling electrical appliances like fans and lighting through Bluetooth from a smartphone is a typical example of a machine to machine interaction. In this case, the two devices engaging with one another are the smartphone and electrical gadgets. The most popular interface for IoT in today's portable remote correspondence is M2M. Information is transmitted through link, remote, adaptable, and other developments, but there are serious security flaws and risks that might have negative impacts on M2M. M2M is widely used in many industries, including those related to electricity, transportation, mechanical control, retail, open administrations the executives, water, security, and other fields. M2M typically has to be small, affordable, and ready to function without human supervision over extended periods of time and transmit across the remote area network. It may do a variety of tasks like strategic planning, health monitoring, car transactions, mechanical assistance, and open vehicle the board. The affiliation and compatibility between machines, or M2M, is the most important aspect of IoT Internets. Security managements such information rebalancing, validation, and key basis are essential in M2M. There are countless potential results of IoT development and use that may be used to virtually every part of human existence, including biological monitoring, therapeutic treatment, general prosperity, Intelligent Transportation System (ITS), intelligent cross section, and different locations. The Internet of Things (IoT) is the key enabling factor for a hopeful future in the combination of a few technological

advancements and correspondences plans. The most important include clear evidence, differentiating and testing propels.

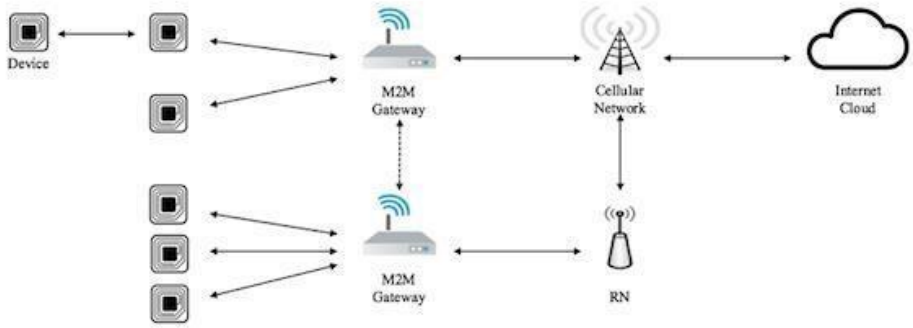

Figure3: *M2M Communication*

5. Technology System for M2M Smart Devices

Given that both types of devices raise similar privacy concerns, it is essential to understand the distinctions between machine-to-human and machine-to-machine technologies. We would benefit from understanding how much machine-to-human research can be used to address security concerns with M2M devices because machine-to-human development has seen a more pronounced significance of exploration than machine-to-machine development. Similar to how mobile phones use distant communication protocols, M2M devices also make use of brief channels and passageways for shared information. In order to do this, M2M device standards are also influenced by the same events and terminal demands that affect mobile phone reliability and technology.

Mobile devices with a conveyor interface, such as smartphones, are helpful for communication and the operation of software. However, computer devices are small and inexpensive, and they are designed for robotized (instead of human-focused) wired or remote communications. The two devices rely on comparable systems for communication, but M2M devices may provide more significant privacy, dependability, and usability vulnerabilities due to data transfer limitations, verification, get as far as feasible, and the demand for safe identifiable evidence endorsements. However, within the next ten years, M2M-conveyed devices will surpass mobile phones in size.

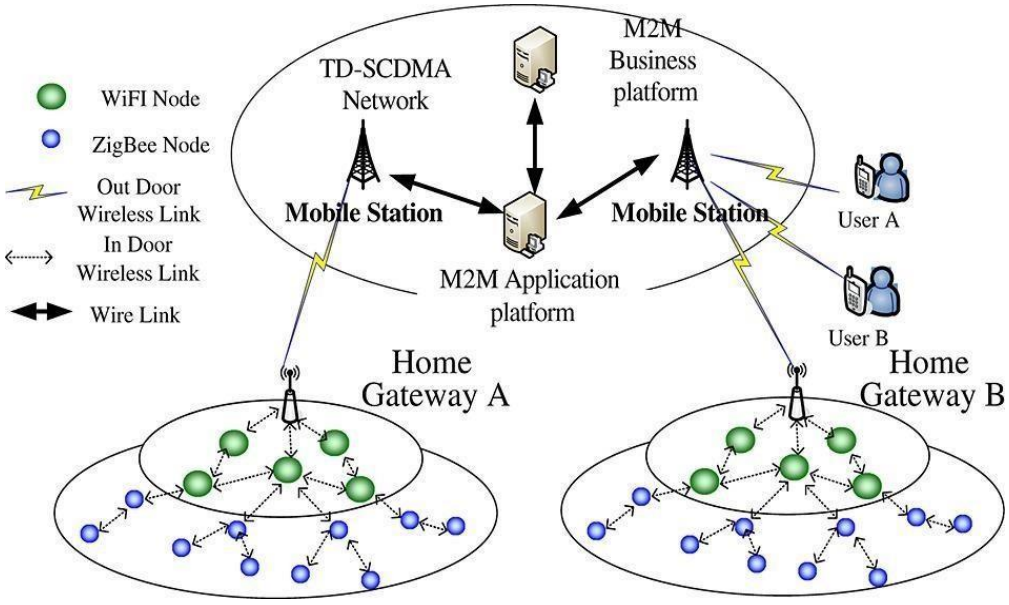

Figure4: *M2M Smart home and security system*

Globally, there were one billion mobile phone users in 2020; by the end of 2021, that number will rise to 2.5 billion; by the end of 2022, the number of related M2M devices may reach hundreds of billions of dollars. While mobile phones have certain uses and attributes from the perspective of the client's social interactions, M2M devices are made for specific tasks and industrial functions. However, many M2M devices automatically employ 2G and 3G introduced modules, which results in both old and new health difficulties and exposures that call for new monitoring tools for mitigation. Scientists have suggested several modifications to verification in light of these factors in order to provide intrinsic confirmation and security for easier arrangement and system enhancement. These progressions have not been tested or standardized, though. The utility of the two types of gadgets is essentially the same, despite the fact that mobile phones are capable of more amazing tasks than most M2M devices. Both make attractive targets for aggressors. The two types of devices need information security confirmation since they might be impacted by concerns with information honesty. Client security information is stored on mobile devices, and M2M devices transmit the same information. For instance, global positioning system (GPS) systems for mobile phones are increasingly integrated with web-based services while also being connected to standalone apps. Even if the customer is not aware of these practices, the locationbased programming for a customer's phone may be collecting and disseminating location data, and this data may also be connected to smart city M2M devices. In order to profile tourists as they go, GPS data might then be used to stamp location information onto digital images. This security breach would allow for the inspection of the client's developments throughout a city. The application of security controls to Devices and the remote framework parts that the devices operate over may be shown using information good practices. In the M2M organic architecture, on the other hand, automated judgments and practical reason set the criteria for data transit, necessitating the use of ever-higher levels of security.

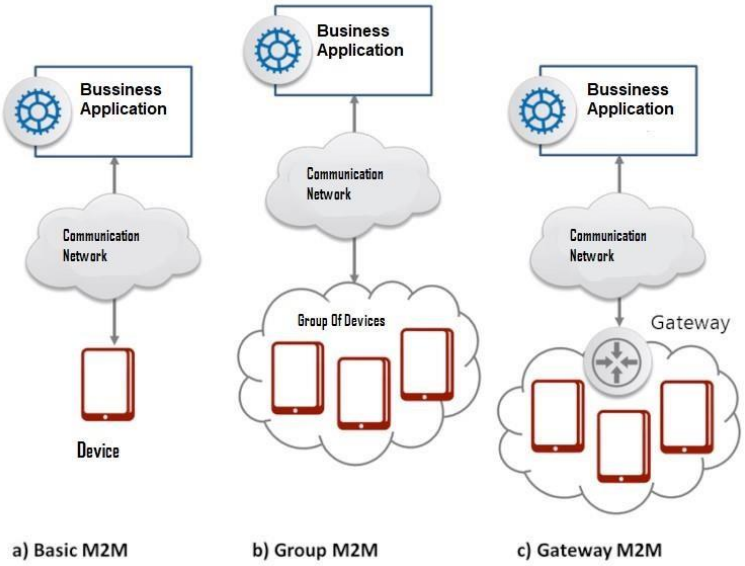

Figure5: *M2M organic architecture*

6. How M2M works?

Machine-to-machine technology's primary goal is to collect sensor data and send it via a network. M2M systems frequently leverage open networks and access techniques like cellular or Ethernet to make them more affordable than SCADA or other remote monitoring solutions. Sensors, RFID, a Wi-Fi or cellular communications link, and autonomic computing software designed to assist a network device in interpreting data and making choices are the core

elements of an M2M system. The data is translated by these M2M apps, which can start predefined, automatic activities. M2M and IoT are not the same, despite the fact that many people confuse the two phrases. M2M is necessary for IoT, but not vice versa. Both phrases refer to connectivity between linked devices, while M2M systems are frequently standalone, independent pieces of networked hardware. IoT solutions advance M2M by integrating many systems into a sizable,
interconnected ecosystem. IoT systems rely on IP-based networks to transmit data gathered from IoT-connected gadgets to portals, the cloud, or application systems, whereas M2M systems employ node connections between devices, instruments, and devices through cellular or wired networks.

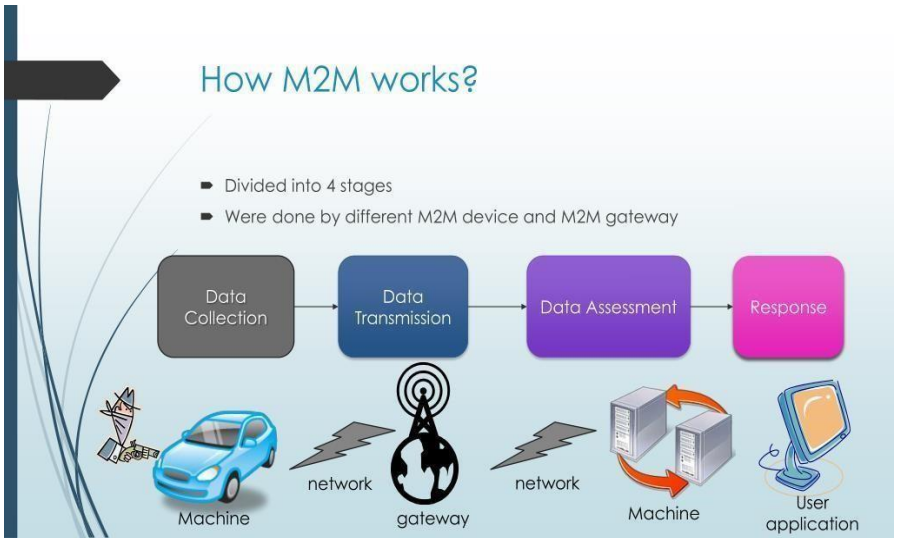

Figure6: *M2M works*

7. Who can provide M2M / IoT services?

In the scope of their current authorizations, DoT license holders, including Virtual Network Operators (VNOs) and ISPs like Vodafone Idea and TTBS, are permitted to offer M2M services, including on unlicensed bands, with the exception of M2M cellular services. In addition to being a telecom service provider, an IoT or M2M service provider like Vodafone-Idea, Tata, or Airtel may also offer services to both businesses and residential customers. TRAI wants M2M and IoT service providers to formally identify themselves as MSPs. Due to the fact that certain telecom providers may also offer telebanking, e-commerce, contact center hosting, vehicle monitoring, etc.; nonetheless, these services fall within the category of Other Service Providers (OSP). There should be specific rules for M2M Service Provider (MSP) Registration. MSPs should include information on the connectivity provider that will link their M2M application.

8. Some differences between IoT and M2M

A subset of M2M technology is IoT. The M2M communication system is a component of the Internet of Things (IoT) where two machines communicate without human intervention. The primary distinction between M2M and IoT technologies is point-to-point connectivity. An IoT system, on the other hand, often places its devices into a worldwide cloud network that enables more automation and more complex applications. Scalability is another significant distinction between IoT and M2M. Because devices may easily be added to the network and incorporated into already-existing networks, IoT is made to be extremely scalable. As new

point-to-point connections must be created for each system, M2M network setup and maintenance may be more labor-intensive.

Table1. *Differences between IoT and M2M*

M2M	IOT
• Point-to-point connectivity frequently includes customer-site gear.	• A network consists of both remote and local devices that transmit information via IP.
• Many devices connect to networks via cellular or cable connections.	• The data delivered is through a cloud-based intermediary layer.
• Designed for small scale projects	• Can usually be scaled for large projects
• M2M devices do not always need to be connected to the internet	• In most circumstances, devices need continuous internet access.
• Because devices must adhere to the same communication protocols, integration choices are limited.	• There are endless integration possibilities, but you'll need a platform that can handle all of your communications.

9. Applications of IoT

The IoT has many potential uses, which makes it feasible to create a wide range of applications based on it. However, only a small number of these applications have already been implemented. Future intelligent applications will be available for smarter workplaces, homes, hospitals, road networks, businesses, and industries [11-15]. Several significant examples of IoT applications include:

1. Aerospace and Aviation Industry

By accurately recognizing fake goods and components, the Internet of Things can contribute to improving the safety and security of goods and services. For instance, the aviation sector is susceptible to the issue of allegedly authorized parts (SUP). An SUP is an airplane component that isn't guaranteed to adhere to the standards of an approved airplane part (such as a knockoff that doesn't adhere to the high quality standards of the aviation industry).

2. Automotive Industries

Bicycles, trains, buses, and automobiles are all getting more sophisticated sensors and actuators with more computing power. Applications for smart objects in the automobile sector include the monitoring and reporting of numerous characteristics, including tire pressure and the proximity of other cars. Technology based on radio frequency identification has already been applied to expedite the manufacture of vehicles, enhance logistics, tighten up quality control, and enhance customer service.

3. Telecommunications Industry

The Internet of Things will make it possible to combine several telecommunications technologies and produce new services. The integration of SIM-card technology with

GSM, NFC (Near Field Communication), low power Bluetooth, WLAN, multi-hop networks, GPS, and sensor networks is an example.

These apps share a SIM card between several applications, and the reader (also known as the tag) is a component of the mobile phone. By placing items adjacent to one another, NFC enables quick and secure communication between them.

4. Medical and Healthcare Industry

IoT will have various uses in the healthcare industry, with the potential to use mobile devices with RFID sensors as a platform for medical parameter tracking and medication administration. The benefit achieved is in illness prevention and convenient patient monitoring, ad hoc diagnosis, and giving quick medical assistance in the event of an accident. Particularly for persons with diabetes, cancer, cardiovascular disease, stroke, respiratory disease, brain disorders, seizure disorders, and Alzheimer's disease, implantable and identifiable wireless devices can be used to save health information that could save a patient's life in an emergency.

5. Independent Living

IoT apps and services will have a significant impact on transitional housing by supporting an aging population by sensing daily activities with wearable and ambient sensors, observing social relationships with wearable and soundscapes detectors, and keeping an eye on chronic diseases with wearable heart rhythm scanners and in-body sensing.

6. Pharmaceutical Industry

Safety and reliability are the highest priorities for pharmaceutical items. The IoT paradigm offers several potential advantages for adding smart labels on medications, monitoring them through the supply chain, and checking their status with sensors. Items that require certain storage circumstances, such as the upkeep of a cold chain, can be watched continually and rejected, for instance, if the criteria weren't met during travel.

7. Retail, Logistics and Supply Chain Management

Supply chain management (SCM) and retail businesses can benefit from IoT in a number of ways. A merchant may improve various applications, for instance, by using RFIDequipped objects and given the practical that track the current items in real time.

8. Manufacturing Industries

Production processes may be improved or the full lifespan of products, from creation to disposal, can be tracked by connecting objects with information systems, whether through integrated smart devices or by the use of identification tags and data transmitters that can communicate with an intelligent supporting core router and telecommunications equipment.

9. Process Industry

Scalable architectures are being employed in many oil and gas facilities that take into account the potential for connector new ID techniques combined with sensing/actuating connected with the Information systems and incorporate the mobile monitoring of petroleum people in crucial onshore and offshore activities, container monitoring, tracking of drilling process components pipelines, monitoring and controlling of stationary equipment, etc.

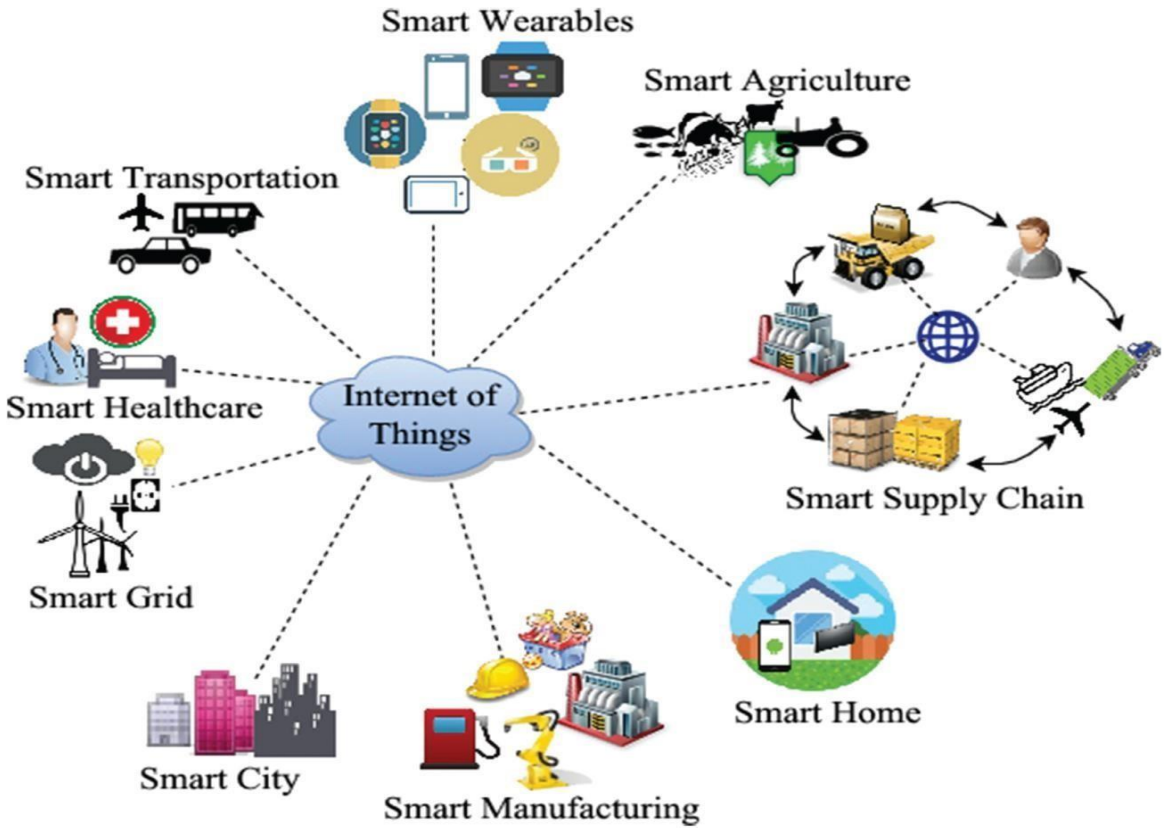

Figure8: *Applications of IoT*

10. Enabling building blocks of IoT

The development of the IoT will benefit from advancements in the following fields:

- *Interfaces between machines and digital information systems* provide the ground rules for interaction between two or more network units.

- Computer chips known as *microcontrollers* are made to be incorporated into noncomputer-related products.

- Most individuals in affluent countries are accustomed to *wireless communication*. Shortrange, long-range, bidirectional, and unidirectional channels, among many other wireless technologies, have the potential to play significant roles in the Internet of Things (IoT). The majority of wireless Internet devices, including all mobile phones and Wi-Fi clients, really have their own unique identities.

- An *RFID reader device* can scan an electronic barcode similar to one using line of sight. Several RFID readers allow for simultaneous item identification. Additionally, certain RFID tag-reader systems enable security measures that call for human input of a challenge code prior to ID decoding. The size, power needs, operating frequencies, rewriteable and non-volatile storage capacities, and software intelligence of RFID vary; their ranges range from a few centimeters to hundreds of meters. In contrast, smaller devices with no internal power supply (RF engineers claim they are lighted by the reader device, much like radar lights a target) tend to work at shorter ranges. Larger devices with an internal power source, on the other hand, tend to run at greater ranges. Additionally, more complex designs tend to cost more than simpler architectures since they offer greater storage, rewrite ability, and computation.

- *Technologies for energy harvesting* extract little but useful amounts of electrical energy from the environment. The focus of current research and development in energy harvesting is on acoustic, vibrational, and RF acoustics, as well as accidental temperature changes. An energy-harvesting transducer generates electrical power that powers a microcontroller, sensor, and/or network interface entirely or in part, in contrast to passive RFIDs, which simply echo when lighted. According to technical standards, energy collecting transducers can react to purposeful power transfers, such as those sent by RF and acoustic channels, in addition to accidental power sources.

- *Sensor networks* seek to take use of the advantages of sensing at several locations. Sensors monitor the environment and record any changes in environmental variables. In order to transmit information with an acceptable error rate, sensors, a particular class of transducer, must generate the minuscule amount of power necessary. Sensor designers are free to use any environmental signal, including sound, light, atmospheric conditions, vibrations, and others.

- When an *actuator* detects an incoming signal, the environment is altered as a result. Relays, for instance, are actuators that flip mechanical switches. As a result, they may activate a variety of reactions, including lighting, warmth, auditory alarms, and more. Objects may be moved and fluids can be pumped using actuators like motors, pneumatics, and hydraulics.

- *Location technology* aids in finding items and determining their physical locations for both humans and robots. The use of wireless techniques such as GPS (which is frequently supplemented by other signals) and cellular towers has resulted from the fact that sensors play a part in dead reckoning but that method does not meet practical demands for localization. There are known sites for fixator orbiting transmitters. Receiving equipment triangulates by figuring out how much each transmitter's delay contributed to the time signals they broadcast. Depending on the objects' electromagnetic, optical, and acoustic qualities, radar, LIDAR, and sonar can determine their relative positions. And some things emit their own radio waves, lights, or sounds that people and machines can use to determine where they are.

- A wide range of development activities fall under the heading of software. The IoT's development will depend on a variety of software characteristics, such as distributed execution and self-describing data structures, among others. Software that mimics human reasoning and completes tasks on behalf of people has been the subject of speculation because there is no theoretical framework to define the boundaries of software development. Whatever the merits of long-awaited artificial intelligence, software will undoubtedly aid future users in making sense of massive data sets acquired through networks of ordinary devices and sensors.

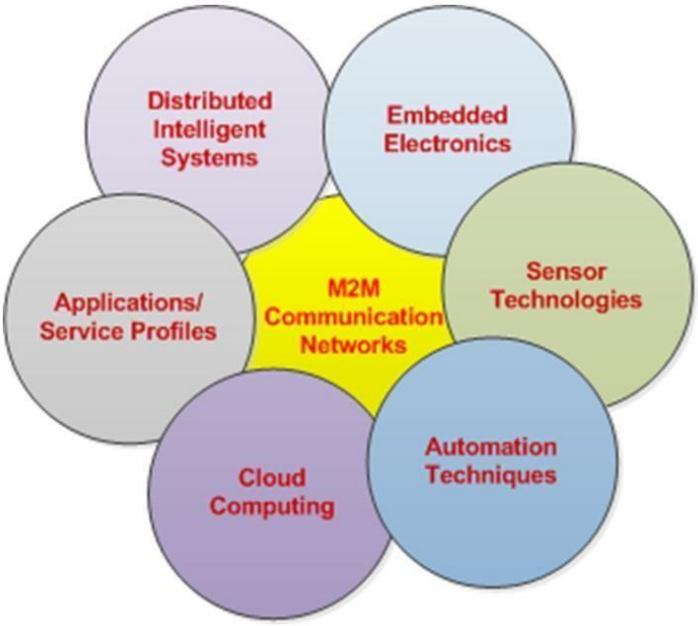

Figure9: *Enabling Technologies for Effective Deployment of IoT*

11.Factors for adoption of IoT

1. Hardware costs are falling

As demand has grown, the price of Internet of Things components including microchips, GPS sensors, and accelerometers has decreased. And it's not just about saving money; small microchips can now run more sophisticated software than before.

2. More machines are talking to each other

Machine-to-machine (M2M) technologies are becoming more widely used. By 2025, according to Vodafone, half of businesses will have implemented M2M communications solutions.

3. Software is more advanced than ever

Companies all over the world now have access to advanced data analysis capabilities thanks to today's rich, dynamic business software.

4. Connectivity is proliferating

Prior until now, IoT solutions could only connect to local area networks through wired or wireless connections since M2M connections were too expensive for mobile providers to support. No more. Mobile carriers are embracing the Internet of Things, in part because of the increased capacity that modern cellular networks offer.

5. Cloud solutions offer lower costs, scale, and flexibility

Large volumes of data may now be analyzed more easily because to the expansion of services like Microsoft Azure, which has made cloud storage and computing capacity more accessible and accessible. The extra benefits of scalability and flexibility—two things that organizations require when launching or growing an IoT solution—are provided by Internet of Things scenarios that make use of cloud-based analysis, storage, and other capabilities.

12. Smartphone Challenges Announce Explicit Risks to M2M Devices

It has been demonstrated that M2M devices' information security vulnerabilities are similar to those of cell phone devices. The following three methods are used by organizations to collect and use the various portable information types:

1. Compile personal data about each person and make it available to the public, internal usage, or both.
2. Gather personal data, retaining it inside the system while allowing advertisers to specify a certain range of traits for target advertising.
3. Gather personal data on people with the intent to sell it to third parties, occasionally including explicit profiles or identities.

Customers might not be aware of the times and means by which this information is obtained via mobile phones and M2M devices, or of the circumstances under which it might be disclosed to third parties. This is because the majority of customers don't read the privacy and client agreements they sign when they purchase or download software. In any event, purchasers are unaware of the connection between various types of data and their use, especially in an M2M setting where there is unlikely to be any customer knowledge.

Owners of M2M networks need to become increasingly aware of how and why users choose to provide them access to their personal data, as well as if a true choice is being made. This is especially important given that many information mining techniques are hidden from users' daily views. Therefore, if the M2M or mobile phone infrastructure is compromised, the totality of this information might potentially be made available to outside scrutiny. Security researchers have identified methods for getting around device restrictions and introducing changed firmware that creates dangerous flaws inside mobile devices. These same kind of attacks might cause harm or even the death of an emergency room patient if they took place on a medical M2M device rather than a cell phone. Because the devices' memory must be required, M2M devices that transmit healthcare data are not secure. To ensure the data and the device, new authorization and secure transfers are needed. Given these elements, M2M security is a key concern for both the potentially critical nature of the enterprises needed and the anticipated hazards to property and human prosperity. What's more, since these devices are continually connected to a system, malware that has been put on programs poses the most threat to mobile phones. The development of versatile applications has exploded, but so has the capacity to transmit portable malware to devices. The ability of malware to spread itself to many devices, especially M2M devices, has enabled it to infect remote-enabled devices. The distant industry is generally ill-equipped to handle the problem.

Attacks from one device on another have also become more common. These tools are capable of acting as both the attacker and the victim in an attack. Such attacks can be motivated by anything, including simple vandalism, data theft, mobile phone spam, and attacks on the administration. Versatile bots function as proliferating programs in this form of malware that increase costs for customers unnecessarily, reduce advantages, and even create advertising blunders. The attacks don't have to be random; they may be used to launch a validation attack on the operational frameworks, dodging get-to-control devices and triggering a restart of the systems. An attack that considered access to information and system connections and used the cell phone as the vector. Open data that is relevant on several levels will be traded using the M2M device as a vector. There will be additional opportunities for using devices as vectors as a result of the sheer growth in M2M device numbers and their widespread distribution. As the environment becomes more powerless to negotiate due to the lack of security measures inside M2M, there is a risk that this may unintentionally have an adverse

effect on the complex organism. There is a significantly larger opportunity for negotiation of validation, permission, and confirmation when M2M frameworks are organized, including feathery networks that use many interaction standards.

Figure10: *M2M communication common vulnerabilities and challenges*

13. Security and Privacy Issues in IoT

Customers will be connected and tracked by many sharp items because to the IoT's proximity. The client's security and approval are of the utmost importance. Other problems associated with these restrictions include information requests and trust transactions, which are discussed below [20] – [27]:

Dynamicity and Heterogeneity: IoT is the most unusual platform that will allow numerous devices to be connected and swept away from the building in a flood. It will be a glorious test to see how well the assurance and security plan works for such an amazing and diverse framework. Control aircraft haven't considered security measures up to now. Security for Integrated Operational World with Digital World. In any event, the trade-off between the openness of the internetwork and the physical and mobile world demands protection.

Information Safety with Equipment Security: Numerous investigations have been conducted to improve device security. The current open doorway for information security and device security is great. Since IoT and M2M rely on communication between items, information security is required.

Data Source Information: It is vital to understand where the knowledge has come from on a very basic level. Information regarding information sources is essential for managing, controlling, and, finally, securing IoT and M2M communication.

Information Confidentiality: In IoT environments, information puzzle looks out for a crucial issue, showing the confirmation that one person with control over the situation may access and modify the information. In the context of a firm, where information may address a supported prerequisite for being guaranteed to safeguard honesty and market respects, this is very significant. Clients may access information in the IoT environment, but only what is inescapably supported. This calls for giving particular attention to two important

considerations: first, the centrality of a portion control component, and second, the significance of a thing check procedure (with a related character the authorities structure).
Trust arrangement: In a plethora of situations and with constantly changing recommendations, trust is used. Despite the fact that it has been widely observed, trust is a strange concept for which there is no comprehension in the computer and information science industry. According to the viewpoint used, many meanings are available. The failure of many approaches to construct estimates and assessment processes is a common problem.

Most often employed security techniques are for limiting access to the resources and capabilities needed to fulfill such requirements. When a party needs assistance or a favored position from another party, the trust course of action refers to the process of accreditation exchanges that enables that party to provide the necessary resources in exchange for the affiliation or the favorable position. For safe communication, it is customary for the chairmen of the various structures to exchange accreditations before sharing information.
It is on this basis that we evaluate the problems with IoT trust. The establishment of shared trust depends on allocated cooperative endeavors and incorporates the iterative revelation of updated capabilities that are geared toward articulations supported by specific segments. Access to assets is possible in such a system primarily when a successful trust exchange has been established.

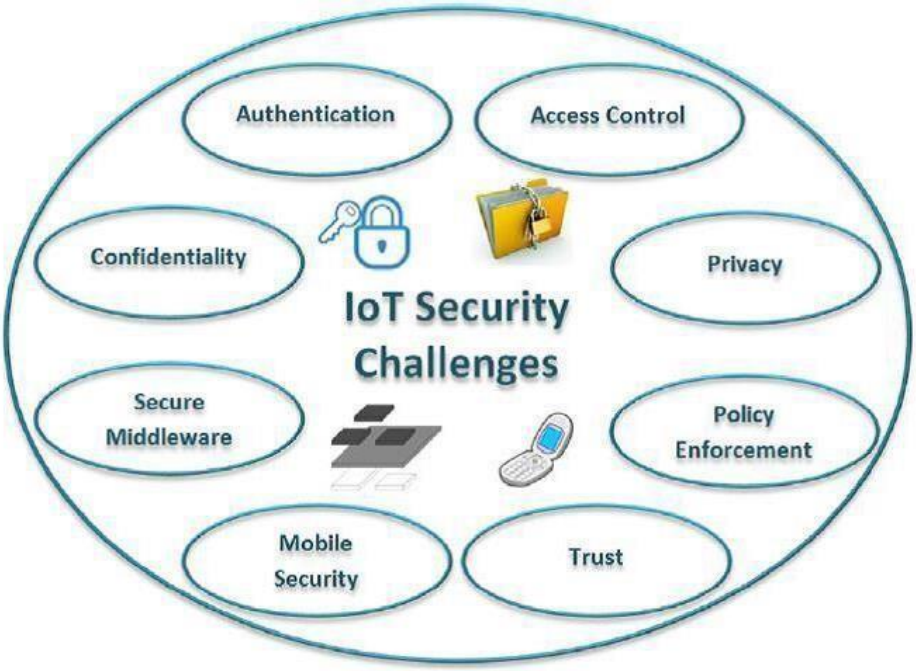

Figure11: *Vital IoT security strategies*

CONCLUSION

An enormous potential exists with the Internet of Your Things. Consider the potential of the data and insights in the examples below:

- For stock-management efficiency that propels the industry, store scanners on a store floor are linked to back room systems and analysis software at the office.
- For unparalleled reliability and uptime, robots on the ground of a production facility convey production and maintenance data lawfully to the people who need it.

- For better patient evaluation, radiologists from a diverse medical office and the family physician share diagnostic images from a CT scanner in close proximity.
- There is no pause among other business visionaries. In order to assist customers increase production efficiency, develop technology, and enable the creation of new plans, Microsoft is now delivering mobile and cloud services for the IoT. By starting with your present resources and discovering new things, we can alter your company by working together.
- Microsoft is interested in seeing the IoT-related products that we can help you create. As limitless as our capacity for imagination and as unique as our company, the potential is limitless.

The synchronization of numerous wired and distant communication businesses will be witnessed through bleeding edge easy correspondence. IoT and M2M will account for the most portion of all these wired and remote communication systems because they have practically tapped into every communication-related industry. For IoT and M2M communication, security displays are available, but new computerized attacks are developing daily. Advanced security strategies should thus develop appropriately, and this will continue to be a strong technique. Instruments for network security that are based on a person's job will be essential to the success of these firms' digitized safety process development. It is possible to accomplish the fantastic and secure communication using trust clustering check tools.

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A SURVEY OF MACHINE LEARNING (ML) IN SUSTAINABLE SYSTEMS

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Abstract: Machine learning has the ability to greatly improve sustainable systems by anticipating and maximizing the use of resources, boosting productivity, and reducing waste. Along with a review of earlier research on the incorporation of machine learning into sustainable systems, a case study of how machine learning was used to lower energy use in a residential structure is presented. The results show that machine learning can be used to generate significant cost reductions and energy efficiency. Wearable technology has added a completely new dimension to the already broad category of personal electronics. The mobile phone gave technology real individuality. Because so many services are designed around mobile phones, the market has opened up for a brand-new personalized experience utilizing wearable technologies. Fabric sensors may now be combined with wearable microcontrollers like the flora and lily pad to monitor stretch, pressure, bend, and even the direction that the body is being braced. The connections between them are based on conductive threads that follow the curve of the fabric. We'll examine how different teams used their in-depth understanding of wearable technologies to accomplish their goals in this study.

Keywords: Sustainable Systems, Difficulties, Machine Learning.

1. INTRODUCTION

The fast growing science of machine learning has the potential to alter how sustainability is viewed. The power of artificial intelligence can be used by machine learning algorithms to sift through vast volumes of data and spot patterns and trends that would be difficult or impossible for people to notice. Machine learning is a tool that may be used to support sustainable systems in the energy production and consumption sectors. For example, machine learning algorithms can be used to improve the performance of solar and wind power installations. By examining data on weather patterns, energy demand, and system performance, machine learning algorithms can forecast how much energy will be needed at any given time and modify the output of renewable energy sources accordingly. This can increase the effectiveness of the energy system and decrease waste. Another sector where machine learning can be utilized to advance sustainability is the transportation sector. Machine learning algorithms can be used to analyze data on traffic patterns, vehicle usage, and fuel efficiency to determine solutions to reduce emissions and fuel use. For example, delivery truck or public transportation system routes could be improved using machine learning algorithms to reduce fuel use and overall distance traveled. Aside from the production of energy and the movement of people, AI may be used to solve a wide range of other supportabilityrelated problems, such as asset preservation, waste management, and environmental insurance. By examining data on resource

consumption and waste generation, machine learning algorithms can identify opportunities for more efficient resource use and ways to cut waste. In a similar vein, machine learning algorithms can be used to examine data on environmental aspects like air and water quality to uncover trends and patterns that might guide environmental protection laws and practices [1–5]. In general, applying machine learning to sustainable systems could be quite advantageous. By evaluating data and spotting patterns and trends that humans would find challenging or impossible to notice, machine learning algorithms can assist us in making better educated and efficient decisions about how to manage our resources and safeguard the environment. Reasonable frameworks are designed to deal with the problems of the present without compromising the ability of people to deal with their own problems in the future. However, the failure of sustainable systems to accomplish their goals is typically due to inefficiencies, waste, and wasteful resource utilization. Machine learning, a form of artificial intelligence that enables computers to learn and improve from data, has the potential to dramatically improve sustainable systems by anticipating and optimizing resource usage, raising efficiency, and reducing waste.

2. AMOUNT OF PREVIOUS WORK

A variety of industries, including healthcare, finance, transportation, and energy production, are being transformed by machine learning, a discipline that is quickly expanding. Machine learning is fundamentally an artificial intelligence technique that allows computers to learn from data rather than being explicitly programmed. One major benefit of machine learning is that it enables computers to continuously improve their performance on a given task without the assistance of a human. Algorithms that analyze data, spot patterns and trends, and base predictions or judgments on those findings are used to do this. Machine learning algorithms come in a variety of forms, such as supervised learning, unsupervised learning, and reinforcement learning. On a labeled dataset with the right output provided for each training example, supervised learning algorithms are taught. On the other hand, unsupervised learning algorithms are trained on unlabeled datasets and are tasked with discovering patterns and relationships in the data without the aid of a predetermined output. Algorithms that use reinforcement learning gain knowledge by interacting with their surroundings and getting feedback in the form of benefits or drawbacks.

Numerous industries have already seen a big impact from machine learning, and the possibilities for its use are almost endless. Machine learning algorithms are being utilized in the healthcare industry to assess patient data and forecast the propensity of specific diseases or ailments, assisting in the improvement of diagnosis and treatment. Machine learning is being utilized in the finance industry to evaluate market trends and make trading decisions, resulting in more effective and efficient investing methods. Additionally, machine learning is being utilized in the transportation sector to optimize routes and boost fuel efficiency, thereby lowering emissions and fostering sustainability. Machine learning has a wide range of potential uses in additional sectors, such as manufacturing, agriculture, and retail. It is conceivable that in the years to come, machine learning will be used in even more revolutionary ways as the field expands and changes. Numerous studies have been done on the use of machine learning in sustainable systems, such as resource optimization, waste reduction, and energy management. For instance, machine learning has been applied to optimize the use of energy in buildings, forecast and avoid equipment breakdowns, and improve travel routes to save gasoline. Machine learning has been applied in agriculture to forecast crop yields and optimize irrigation. Machine learning has been applied to waste management to increase recycling rates, optimize waste collection routes, and forecast and prevent equipment breakdowns.

Machine learning applications have been particularly well-liked in the field of renewable energy systems. To maximize the performance of photovoltaic systems, neural networks have been employed, for instance, to forecast solar radiation levels. For wind farm optimization, decision tree algorithms have been used to optimize energy production while reducing

expenses. Support vector machines and evolutionary algorithms have also been employed in the optimization of renewable energy systems. Another area where machine learning has been used in sustainable systems is resource management. For instance, clustering algorithms have been used to categorize various waste types in order to promote recycling and reduce the need for landfill space. In order to maximize resource allocation and reduce water waste, regression approaches have been used to forecast water demand in irrigation systems. Additionally, the distribution of resources in transportation systems, such as electric vehicle charging networks, has been optimized using machine learning. Machine learning has been used in a range of other sustainable systems in addition to renewable energy and resource management. For instance, social media data analysis using natural language processing has been used to track and forecast environmental disasters [6– 10]. Deep learning has been used to identify and categorize various forms of pollution, including oil spills. The design of sustainable buildings has also been optimized using machine learning to lower energy use and increase occupant comfort. Overall, the application of machine learning in sustainable systems has produced encouraging outcomes and has great promise for enhancing resource management and environmental effect. There are, however, obstacles and restrictions to take into account, such as the requirement for sizable and varied datasets, the complexity of some machine learning models, and the potential for moral and privacy concerns. We will go into more detail about the tools and techniques employed in these investigations, as well as the outcomes and ramifications of the most important discoveries, in the sections that follow.

3. Sustainable Systems utilizing Machine Learning (ML)

This analysis focused on a case study on how to apply machine learning to lower energy usage in a residential structure. Sensors were installed throughout the building to record data on occupancy, temperature, and energy use. The information was used to train a machine learning model that could forecast how much energy would be consumed and how to conserve it by turning off unnecessary appliances and regulating the thermostat according to occupancy. In today's technology, the phrase "machine learning" is gaining popularity. We utilize machine learning every day in programs like Google Maps, the Google Assistant, Alexa, and others, even if we are ignorant of it. Some of the most well-liked applications of machine learning in real-world settings are as follows [11–15]:

1. Image Recognition:

Image recognition is one of the most popular applications of machine learning.
It is used to identify objects, people, places, and other items in digital photos. The most popular application for face and image recognition is automatic friend tagging recommendation, and we have access to Facebook's auto-tagging feature. The automated tagging recommendation we get whenever we upload a photo of one of our Facebook friends is made possible by the face detection and identification algorithm of machine learning. It is based on the Facebook initiative "Deep Face," which is tasked with identifying faces and persons in pictures.

2. Speech Recognition:

Google gives us the option to "Search by voice." This is a well-known machine learning program that uses speech recognition technology. "Speech to text" or "Computer speech recognition," among other titles, are terms used to describe the process of turning spoken commands into written ones. Many voice recognition applications currently use machine learning algorithms extensively. Google Assistant, Siri, Cortana, and Alexa all use speech recognition technologies to carry out voice instructions.

3. Traffic forecast:

We use Google Maps to find the shortest and best route to new locations as well as information on traffic conditions. To forecast traffic conditions, such as whether it is clear, moving slowly, or severely crowded, it employs two techniques: The real-time location of the car as determined by sensors and the Google Maps app. The time it typically took in the days before, at the same time. Every person who uses Google Map makes a contribution to its development. It receives data from the user and delivers it back to its database to improve performance.

4. Product suggestions:

Machine learning is frequently used by Amazon, Netflix, and other e-commerce and entertainment companies to suggest products to customers. As a result of machine learning, anytime we look up a product on Amazon, we now see an advertisement for it while using the same browser to explore the web. Google uses a number of machine learning algorithms to understand consumer interest and then generates product recommendations based on it. Machine learning is also used for this, much as how we use Netflix to get recommendations for entertainment series, movies, etc.

5. Autonomous cars:

One of the most interesting applications of machine learning is self-driving cars. Machine learning is a key component of self-driving vehicles. Tesla, the most well-known automaker, is working on a self-driving car. Unsupervised learning is being used to train the automobile models to distinguish people and objects while they are moving.

6. Spam and malware filters for email:

Every new email that we get is immediately categorized as spam, essential, or regular. We consistently receive essential messages in our inbox marked with the important symbol and spam messages in our spam folder thanks to machine learning technologies. The following are some of Gmail's spam filters: General blacklist Content filter Header filter Filter based on rules Filters for Filter Permission Multi-Layer Perceptron, Decision Tree, and Naive Bayes classifier are a few machine learning techniques for email spam filtering and malware detection.

7. Personal Assistant Online:

Siri, Alexa, Google Assistant, and Cortana are just a few of the virtual personal assistants we have available. As their name implies, they help us find the information by providing voice guidance. These assistants can help us in a number of ways only by listening to our voice instructions, such as playing music, making calls, opening emails, setting up appointments, and more. Machine learning algorithms are a crucial part of these virtual assistants. These assistants capture our voice commands, transmit them via a cloud server, decipher them using machine learning algorithms, and then take the appropriate action.

8. Detection of Online Fraud:

Machine learning improves the security and safety of our online transactions by recognizing fraudulent transactions. Every time we execute an online transaction, a fraudulent transaction is conceivable due to phony accounts, bogus identification, and the theft of money mid-transaction. Therefore, by identifying whether the transaction is legitimate or fraudulent, the Feed Forward Neural network helps us spot this. Each valid transaction's output is converted into a set of hash values, which are then utilized as the next round's input. It helps identify fraudulent transactions and increases the security of our online transactions because every valid transaction has a distinct pattern that differs for fraudulent ones.

9. Trading on the stock market:
Machine learning is often used in stock market trading. Because there is always a chance that stock prices will fluctuate, the long short-term memory neural network is utilized to forecast stock market movements.

10. Diagnostic Procedure:
In the field of medicine, machine learning is used to identify disorders. Because of this, medical technology is advancing quickly and is now able to produce 3D models that can precisely detect the site of brain lesions. It facilitates the detection of brain cancers and other brain-related illnesses.

11. Automated Translation of Languages:
These days, it doesn't matter if we travel to a foreign country and don't speak the local tongue because machine learning can convert the content into the languages we find most appealing. This function, called automated translation, uses neural machine learning to translate text into our local tongue and is offered by Google's GNMT (Google Neural Machine Translation). The automatic translation is made possible by a sequence-to-sequence learning method that combines image recognition with text translation from one language to another.

4. RESULT AND DISCUSSION

The case study shows that machine learning considerably decreased the energy usage of the residential building. The model's ability to precisely estimate and optimize use led to a 15% reduction in energy consumption. The model improved energy efficiency and further decreased energy use by regulating the thermostat in response to occupancy.

Using machine learning has certain challenges [16–21]:

- Insufficient data: One of the major barriers to employing machine learning is the requirement for a large amount of data to train algorithms. If the data are insufficient or not representative, building machine learning models that are accurate and efficient might be difficult.
- Data quality: It's crucial for the machine learning algorithms to be trained on high-quality data. Data that is inaccurate or unclean may reduce the model's accuracy and effectiveness.
- Data labeling: In order to learn, machine learning algorithms typically need labeled data. This can be a time-consuming and labor-intensive operation when the dataset is vast.
- Lack of domain knowledge: A detailed understanding of the application sector is crucial for the proper development and implementation of the machine learning model. Without this knowledge, it can be difficult to pick the right characteristics and build a useful model.
- Selecting a model: There are many different machine learning algorithms available, making it challenging to choose the best one for a given task. The poor algorithm choice can lead to underwhelming performance and resource waste.
- Overfitting: A machine learning model won't be able to adapt to fresh data well if it is very complex and closely matches the training set of data. This could be a concern if the model is unable to correctly anticipate outcomes from unseen data.
- Under fitting, on the other hand, happens when a model is too straightforward and misses the underlying relationships in the data. This may result in a poor performance on the practice test and a limited ability to assimilate new material.

- Lack of capacity to interpret: Two machine learning techniques that are simple to understand and interpret are decision trees and random forests. For instance, neural networks are far more complex and might be difficult to understand. This can be difficult when understanding how a model produces its predictions is crucial.
- Bias: Machine learning algorithms may take into account biases in the training data they employ. It is important to identify and eliminate these predispositions since they may lead to irrational or wrong expectations or decisions.
- Ethical concerns: As machine learning becomes more prevalent, ethical concerns must be taken into consideration. For instance, it's possible that current discrimination or inequities will be amplified or maintained by machine learning algorithms. It's critical to consider the potential effects of machine learning and to make sure it's applied ethically and responsibly [22].

5. CONCLUSION

The findings of this study show how machine learning has the ability to greatly enhance sustainable systems. The residential building's usage of machine learning led to a decrease in energy use and an increase in energy efficiency. In order to maximize resource consumption and minimize waste, future study should concentrate on the extension of machine learning in sustainable systems. In the branch of artificial intelligence known as machine learning, algorithms are created that can learn from data and make predictions about it. It has numerous uses in a variety of industries, such as predictive modeling, audio and picture recognition, natural language processing, anomaly detection, and decision-making. Large datasets can be used to train machine learning algorithms, which can then make predictions or choices without having to be explicitly programmed to do so. Numerous sectors could be completely changed by the technology, which could also increase decision-making's efficacy and efficiency.

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COMBINING CLOUD COMPUTING WITH ARTIFICIAL INTELLIGENCE AND ITS IMPACT ON TELECOM SECTOR

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Abstract- The combination of artificial intelligence (AI) and cloud computing has been an emerging trend in recent years. This trend has substantial ramifications for a variety of different businesses, including the sector of the economy that deals with telecommunications. The cloud computing model offers a platform that is both scalable and costeffective, making it ideal for storing and processing massive volumes of data. The application of AI algorithms to this data can result in the extraction of important insights and the improvement of decision-making procedures. Telecommunications firms stand to gain improved capabilities such as real-time data processing, predictive maintenance, and automated network management as a result of the combination of these two technologies. In addition, firms that provide telecommunication services can benefit from optimization of their operations, cost reduction, and increased efficiency when they use AI and cloud computing. For instance, predictive maintenance algorithms can detect impending faults in equipment before they happen, which paves the way for preventative maintenance and cuts downtime significantly. [1] Artificial intelligence (AI) and cloud computing (CC) are two business-oriented technologies that are very much on the horizon as smart transformation technologies for businesses to be smarter once in order to render their services to their customers in a smart way, which means promptly, efficiently, and affordably that best satisfy the customers. Artificial intelligence (AI) and cloud computing (CC) are two business-oriented technologies that are very much on the horizon as smart transformation technologies for businesses to be smarter. This research investigates the ways in which CC and AI are utilized by MGA-MENA, the most prominent telecom operator in the Middle East. When applied together, the technologies of cloud computing and artificial intelligence will result in an improvement for a smart MGA-MENA business in the areas of operational services, product efficiency, better products, and more customer-satisfying services [2]. There is only one conclusion that can be drawn from this line of reasoning, and that is that gigantic telecom firms like MGA-MENA, with their massive customer bases, high number of transactions per minute, cloud computing, and artificial intelligence, offer a brand new and innovative economic potential. Therefore, it is imperative for the telecoms industry to maintain an active and contemporary technological presence.

Key words: Telecom Industry, Technology, Artificial Intelligence (AI), Cloud Computing (CC)

1. Introduction

Computing in the cloud and artificial intelligence (AI) have both emerged in recent years as two of the most disruptive technologies in the world of telecommunications. Integration of these technologies has opened up new opportunities for telecommunications companies to improve their operational efficiency, enhance the experience of their consumers, and boost their revenue [1]. This case study will analyse the usage of cloud computing and artificial intelligence in the telecoms industry. A particular emphasis will be placed on the influence that this combination has on the quality of the customer experience as well as the operational

efficiency of the business. We are going to look into a specific telecom business that has already implemented these technologies and assess the results of doing so. At the conclusion of this case study, it is our aim that you will have a greater knowledge of how cloud computing and AI may be utilized to promote innovation and success in the telecommunications industry. Across the Middle East, Asia, and Africa, a wellknown telecommunications firm known as MGA-MENA, which is presently present in 16 countries, has made the concepts of cloud computing a reality, which has resulted in a substantial improvement to the company's goods. At the same time, the company is currently present in 16 countries. It incorporates artificial intelligence as a part of its ambition to become the intelligent corporation of the future. This allows it to manage its business operations and keep control over the experience that its customers have with the company. Today's organizations face a number of challenges that prevent them from achieving sustainable growth through the application of innovation and development strategies, which is the only viable path forward. Companies in the telecommunications industry, such as MGA-MENA, operate in complex environments and are heavily dependent on technology for both their growth and the supply of services to their consumers. This is true for both the growth of the company as well as the delivery of services. They need to make efficient and cost-effective use of the most modern cloud computing and artificial intelligence technologies, which represent improvements above human calculation and intellect or, at the very least, a first step on the road to becoming such advancements.
These technologies are represented by the phrases "cloud computing" and "artificial intelligence," respectively. Robotics is yet another branch of technology that is making significant headway. They are not competing "technologies," but rather technologies that complement one another.[3] Telecoms firms stand out in the highly competitive current business environment, which is controlled by extremely large corporations and cutting-edge technologies. This is due to the fact that telecom companies have a vast geographic and client reach, in addition to the volume and complexity of their activities. MGA-MENA, which is one of the major telecommunications companies in the world, conducts business on a significant scale in all three of these regions: the Middle East, Asia, and Africa.

2. Literature review

To begin, a ground-breaking study on cloud computing in relation to telecommunications companies highlights numerous benefits of cloud computing that accrue to telecommunications in terms of capital, cost, time, marketing, customer relations, service delivery, customer satisfaction, and profits, to name a few of these advantages. Cloud computing is beneficial to telecommunications in a variety of other ways as well. Since they are not hampered by computing issues, which are essentially instruments for commercial goals, they are free to concentrate on offering services at the highest possible level of happiness for their customers. In conclusion, utilizing cloud computing is a preferable method for accomplishing the goals set forth by a corporation [1]. According to the findings of yet another study, the advent of new digital technologies is fundamentally transforming the nature of the modern business environment, rendering the traditional strategy process increasingly insufficient. The approaches for the development of strategies need to be modernized so that they can continue to be useful in this day and age of artificial intelligence, digital reengineering, and cognitive computing. The success of Dubai's electronic government can be attributed to a number of factors, including its first-rate IT infrastructure, the support that the government provides for innovative ideas, the availability of sufficient financing, and the high levels of electronic engagement from both individuals and businesses.[2]
Reports suggest that artificial intelligence is essential to the success of firms in the telecommunications industry since it assists in the creation of consumer profiles and tailors services to the requirements and interests of individual customers.

In addition to this, AI assists the operation team by predicting when a system will break down and providing prompt action to fix the problem. AI can also help improve customer support. For example, Vodafone has developed a chatbot called TOBI that assists customers with online questions and problem-solving. The satisfaction of the customers will increase as a result. [3] According to him, there has been an increase in the number of people using CC and AI, in addition to the expansion of the size of the communications network.

The sector has witnessed a variety of user desires and preferences during the course of its existence. Because of the increased demand for specialized networks (AI), this sector's operations simply cannot function without the assistance of artificial intelligence. Cloud robotics is a rapidly developing field of research that is made feasible by today's widespread internet connection and the rising array of powerful cloud computing services. This access and these services have made cloud robotics a discipline that is now possible to study. Humanoid, industrial, mobile, and other classes of robots, as well as other types of robots, have all benefited from successful implementations of the technology, which frequently occurred as a direct result of partnerships formed between prominent IT businesses and robot makers. [4]
As a result of the fact that the communication industry is currently facing a number of operational challenges, such as designing, maintaining, and managing, the industry stands to benefit from AI in a number of different ways. Businesses in the communication industry need to be able to make sound decisions in order to successfully manage their intricate and ever-changing operations. Using deep learning and the training data that is currently accessible in business, machines are able to analyse the huge amounts of data that have been obtained as a result of data mining. As AI grows more proficient at managing data such as traffic, the precision of judgments made in this industry will also increase. [5] AI and cloud computing are beneficial to the telecom business because they allow for a greater focus on security, which is especially important given the surge in security problems caused by downed networks and losses. Because of AI, there has been an increase in the security of systems, and machine learning is being used to automatically identify any attacks. As a direct consequence of this, there have been fewer attacks, which is to the advantage of both users and businesses. [7] Due to the rapidly growing number of customers served by the telecom business, it is now impossible for humans to evaluate the enormous amounts of data that are available for usage in the sector. while making predictions about the future. It is now possible, with the use of artificial intelligence and cloud computing, to analyse huge volumes of data in order to classify traffic, produce more accurate forecasts, discover anomalies, and eventually optimize networks for enhanced performance.

Because of this, the telecommunications industry is now better managed and more efficient, which eventually contributes to an increase in the value of the services that are offered to consumers. Artificial intelligence (AI) and cloud computing are the only technologies that will make it possible for users in the future to have specialized networks and packages that are suited to their requirements using AI. [6] Algorithms that monitor networks these days seek out unexpected build-ups of activity that could be the cause of undesirable occurrences such as distributed denialof-service (DDoS) assaults and attempted hacks. [7] These undesirable events include things like attempted hacks and DDoS assaults.

AI and CC are both faster and more reliable techniques to anticipate potential threats to a network. There are still challenges to overcome, despite the fact that the implementation of AI in the cloud is an inevitability. The greatest challenge is finding enough people with the right skill sets to work on artificial intelligence in the cloud. The telecommunications businesses that

make use of that system will need to be prepared to invest a sizeable amount of money in their workforce in order to provide their workers with the knowledge and skills that are essential to the sector's continued success. [9] Conducting research on the use of AI technologies in predictive analytics is another challenging endeavour. They employ cloud services to develop and train machine learning models, which enables them to gain access to insights that are both relevant and practically applicable. However, the usefulness of these models is contingent on their being provided with an adequate quantity of data.

Before employing a cloud-based artificial intelligence service, businesses need to ensure that they have adequate security measures in place to protect their private data and that they are complying with all applicable compliance rules. [15] According to a survey that was conducted by Accenture to analyse the potential economic influence that artificial intelligence could have on 16 different industries, businesses in every industry need to consider artificial intelligence as a prospective change agent in their strategies for investment, innovation, and human capital development. Artificial intelligence has the potential to increase labour productivity by taking over low-valueadded or supporting responsibilities, freeing up human workers to focus on higher-value tasks. [14] Interface technologies illustrate how difficult it is to govern issues that cut across disciplinary boundaries, and technology that is based on artificial intelligence may require adaptations to be made in a variety of legal fields. Recently, technologies such as artificial intelligence and cloud computing have been applied to the telecommunications industry in an effort to enhance both performance and customer happiness. It is not easy to implement and train these CC and AI technologies in the telecom industry because of the complexity involved.

However, the usage of CC and AI will raise productivity and effectiveness across a wide range of areas while also lowering costs, promoting sustainability, and ultimately boosting customer happiness, retention, and loyalty. It is possible that new threats, such as those to security, privacy, and reputation if they are misused, will need to be taken into consideration in the future. [16]

3. Data collection

The primary objective of the data collection, which consisted of interviews, observations, discussions with staff or groups, and documentation of activities in the engineering department, was to investigate the application of CC and AI in the most successful telecommunications firm in the Middle East, MGA-MENA. These methods ultimately proved to be trustworthy sources of information regarding the subject of the study. The cumulative impact of all of this is that MGAMENA Company will eventually decide to use this strategy in order to eradicate the possibility of human error and advance toward operational excellence, cost savings, and a quicker reaction time to network disruptions, all of which will ultimately result in an improved experience for the company's customers. It is common knowledge that the telecommunications industry is making important contributions to the ongoing revolution in the field of artificial intelligence. MGAMENA is widely regarded as the most successful information and communications technology company in the United Arab Emirates as a direct result of its use of cloud computing and artificial intelligence. The MGA-MENA engineers now have access to a comprehensive database that contains all of the network, customer connection, and data traffic logs. This is made possible by cloud computing. As a consequence of this, engineering was able to transform into a proactive organization rather than a reactive one, with AI playing a significant role that is anticipated to continue to expand over the course of the next few years. MGA-MENA Company is also constructing two cutting-edge Points of Presence (POP) to assist EXPO 2020 in Dubai. This is being done in order to provide a cutting-edge digital experience for the 25 million tourists that are projected to attend. These POPs, which stand for

the telecommunications network of the future, are completely dependent on the cloud and AI for coordination.

Different criteria were considered to select appropriate studies for this research and the studies that met the criteria were selected. This is depicted in Table 1.

Inclusion criteria	**Exclusion criteria**
Already published articles	Articles not in English Language
Open access available online	Not open access articles
Research articles and conference papers	Not research articles
English language only	Studies that do not match the keywords
Peer-reviewed Journal articles	Duplicate articles within the databases

Table 1: research criteria

4. Strategy for Digital Transformation

MGA-MENA The company has mapped out a detailed plan to follow in order to realize its objective of undergoing a digital transformation that is fuelled by AI. In order to provide clients with intelligent and faster service, enhance operational procedures, and enable speedy deployment of network technologies, the architecture of the telecom network was transformed from the legacy architecture to the telecom cloud architecture. The deployment of data centres, software-defined networking (SDN), and the virtualization of network functions were all involved. When implementing a comprehensive AI-driven solution, there are some features that an aging telecom network cannot supply or is prohibited from delivering. These functionalities are required for the solution to be successful. Because there is now less hardware, greater vendor freedom, and a separation of hardware and software, which was previously a typical network constraint, the engineering and information technology architecture have been made simpler. This suggests that the telecommunications industry is moving toward a model that relies more heavily on software, with centralized management (which is referred to as an orchestrator in the telecommunications industry) acting as the brain and making use of contemporary Application Programming Interface APIs to support MGA-MENA's transition from hardware to software and accountability for service resilience.

It is of the utmost importance to ascertain whether or not the chosen vendor satisfies the prerequisites imposed by the cloud intelligence architecture and provides support for the MGAMENA business. [16] As an illustration, a number of mobile core systems, such as Evolved Packet Core (EPC), are transitioning from an architecture that is based on hardware to one that is based on software.

Table 2: sample threat and mitigation table for AI &CC Its Impact on Telecom Sector

Type	Description	Impact on Telecom Sector	Explanation	References
Cloud-based AI	AI algorithms and models are hosted on cloud platforms, allowing telecom companies to access them remotely.	Improved network performance, reduced costs, and enhanced customer experience.	Cloud-based AI enables telecom companies to optimize network performance, reduce costs, and provide personalized services to customers.	[1], [3] [4]
AI-powered Network Management	AI algorithms are used to manage and optimize telecom networks, improving efficiency and reducing downtime.	Improved network performance, reduced costs, and enhanced customer experience.	AI-powered network management enables telecom companies to optimize network performance, reduce costs, and provide personalized services to customers.	[2], [7]
Predictive Maintenance	AI algorithms are used to predict equipment failures and schedule maintenance, reducing downtime and improving network reliability.	Improved network reliability, reduced costs, and enhanced customer experience.	Predictive maintenance enables telecom companies to reduce downtime, improve network reliability, and provide better services to customers.	[5], [10]
Chatbots and Virtual Assistants	AI-powered chatbots and virtual assistants are used to provide customer support and automate routine tasks.	Improved customer experience, reduced costs, and increased efficiency.	Chatbots and virtual assistants enable telecom companies to provide personalized customer support, reduce costs, and improve efficiency.	[13], [16]
Fraud Detection	AI algorithms are used to detect and prevent fraud in telecom networks, reducing losses and improving security.	Improved security, reduced losses, and enhanced customer experience.	Fraud detection enables telecom companies to prevent losses, improve security, and provide better services to customers.	[9], [10] [11]

Because these solutions make use of NFV infrastructure and open the door to intelligent operation that is supported by AI and machine learning, engineering in MGA-MENA may be able to profit from high optimization, effective resource usage, and decreased CAPX costs as a result of implementing these solutions. It is essential to keep in mind that MGA-MENA migrated their access network to a fibre architecture utilizing GPON, the coverage of which came close to 92% in inhabited areas. Virtual Customer Premises Equipment (vCPE), a technology that enables the relocation of certain router tasks to the cloud, is currently being integrated into the network in order to further improve it and assist MGA-MENA Company in streamlining and accelerating service delivery while also offering new prospects. MGA-MENA Corporation will be able to place artificial intelligence (AI) or machine learning at the top of this solution as part of Phase One of this particular service or solution. This will allow the company to improve service management, supply new products more quickly, and improve the customer experience. The mobile access network can be moved from its silo site structure to the cloud and virtual radio access network (vRAN) by pooling baseband units (BBUs) in central exchanges and front-hauling connections from POP to the last mile. This enables the provision

of intelligent customer service in terms of bandwidth requirements, traffic streaming, and mobile connections.

5. Operating Excellence

The combination of cloud computing and artificial intelligence enables engineering to utilize cloud services with network function virtualization (NFV) to capture all network events and start machine learning powered by integration with an orchestrator based on APIs and multiple sources of database, virtual network, and software-defined networking (SDN). This would lead to continuously improving customer experiences, providing innovative self-care portals to customers, and maintaining networks in top condition by implementing self-healing. Additionally, by utilizing an artificial intelligence-powered NFV network, an automated network with the use of machine learning, optimization may be accomplished by utilizing the data analysis performed by AI engines from a variety of sources and knowledge databases. This will improve support for resource relocation, traffic optimization, failure prediction, and network continuous assurance. Moreover, by utilizing an automated network with the use of machine learning, an artificial intelligence-powered NFV network may be utilized [17] [18].

As a result of this, the operation personnel are now able to focus on areas that require their expertise, which will assist MGA-MENA in lowering its OPEX, better rectifying auto errors, and resolving network issues. Even though the usage rate is low at the moment, the goal is to employ AI for more than twenty percent of operational activities. This is something that is only conceivable for services or networks that use cloud or NFV technologies. Motiv, an automatic self-healing system, and autonomous capacity planning on the access network side are three examples of the benefits that have been investigated by MGA-MENA. The self-service site, which is called "Motiv," is another. A customer who has Motiv can utilize the MGA-MENA App to troubleshoot any issues he may be having with his e-Life line services. The system will do a comprehensive analysis of the client's issue before deciding whether or not to make the necessary adjustments and corrections without first notifying the MGA-MENA Company. This strategy has the potential to resolve in excess of a million different situations.

A network that is too old would be unable to sustain such a solution. Second, artificial intelligence is used in network self-healing to do a comprehensive verification of the network. This verification includes detecting whether there will be a scheduled outage in order to carry out the most effective traffic rerouting and allot the required resources. Continuous monitoring and analysis of millions of data points, including network behaviour, network traffic, and NMS warning indications, are performed in order to forecast the occurrence of any probable breakdown.

It is important to keep in mind that a ticket is always available to record any event- or performancerelated data, since this information serves as the foundation for machine learning. The degree of adaptation is not where it ought to be and is only in the beginning stages at this point. Self-healing networks have an exciting and promising future. Third, the manual auto capacity planning that is still part of the development process for the auto capacity planning software Data must be examined from a wide variety of sources, including customer relationship management (CRM) software, system connections, inventory, and projections. The last step, but certainly not the least, is formulating a plan for the extension of the access network system on an annual (and, more recently, every six-month) basis. Due to the length of time involved, careful preparation is required. However, AI will function as a system that will routinely evaluate data from all sources in order to generate robust tactics and decrease

inaccuracies caused by existing practice. will learn from CRM about the rate of demand in a particular region and the resources that are available, and it will expand with updated forecasts so that a strategy can be put into place for when to do expansion, the number of connections that are necessary, the types of customers, and the load on each system based on requested services in order to avoid any system uplink congestion.

6. Product Management or strategy

Through the utilization of machine learning and a service orchestrator, the MGA-MENA Corporation has developed a system that, in response to the requirements of customers, may either make rapid selections or offer suggestions. This is also reinforced by the MGA-MENA Company's plan to utilize vCPE, which was previously announced and would boost customer happiness and revenue growth. vCPE was previously indicated. At this stage in the vCPE process, only the services that are required by the targeted business customers will be provided to those customers. After it is finished, the system allocation, the optimal path, and the virtual resources will be set up. The service will then be available, and it will be able to adjust more quickly than it would be able to with a normal lock. services under contract Certain components are installed manually with the assistance of a person. A certain kind of mobile phone data traffic, like that which is generated by Instagram or one of the many other programs that are used for social media, should be directed through the optimal international route in order to provide the best possible experience for customers. The digital store is another example of how MGA-MENA benefits from the transition from IPTV as part of the e-life package to NFV and SDN. The digital store uses AI to empower each customer with an engaging and personalized experience based on AI analytics of data related to customer usage, interest, and favourites. These insights are gleaned from customer data that is stored in the digital store [19].

All of these data captures make it possible to recommend and customize VoD on the main screen, as well as to recommend utilizing VoD as soon as it is practically possible. In addition, the MGAMENA Company has been recognized for their ground-breaking e-Life TV interface as well as the improvements they have made to the way that telecommunications companies operate services such as these as engine providers. These modifications ensure that each customer has a one-of-akind experience and that the services are presented to him in a manner that is appealing to him depending on his profile. in addition to a differentiation between adults and children.

7. Using SME and Case Support

The MGA-MENA Corporation created the Lab with a network-like environment and a variety of tools so that employees could test and confirm the required strategy and increase the benefit of this correlation by including the staff in this transformation. To enhance the number of use cases and make use of SME in the team domain, an expert team will analyse concepts for ideas presented in order to migrate work to the AI Cloud [20] [21].

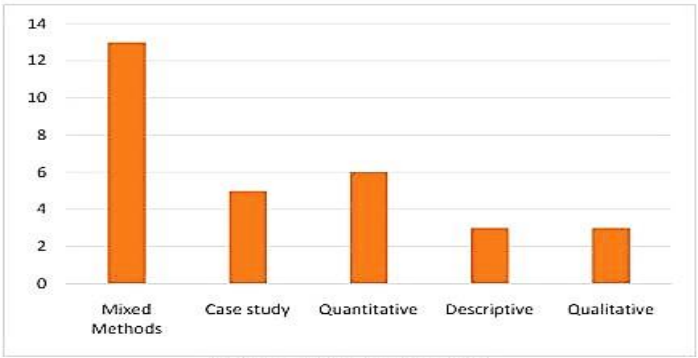

Figure 1. Research approaches

Analysis

Coding the qualitative data based on the primary conceptual work allowed for the determination of the advantages of cloud computing with respect to artificial intelligence. Computing in the cloud and artificial intelligence are two technologies that work together to help the telecommunications industry become more adaptable, speed up the deployment of services, and run more intelligently. As a result of this correlation, it became abundantly evident that the service provider could also offer automatically optimized networks, self-healing systems, and intelligent capacity planning in addition to continuously improving the customer experience. The alliance is beneficial to the telecommunications industry since it facilitates the shift from hardware to software in the delivery of services. switches to software-defined networking and the use of artificial intelligence-powered virtualized network functions, where high processing power enables telecom to layer logic on top of these, boosting their capabilities and demonstrating a direct relationship with the notion that we confirmed. shifts to software-defined networking and the use of artificial intelligence-powered virtualized network functions. This transition away from traditional telecom networks and toward customized networks is essential because it makes it more difficult for businesses to function without the assistance of artificial intelligence. In addition to the benefits that were illustrated by the manner in which MGAMENA adjusted its infrastructure, carried out its operations, provided services, and responded to the experiences of its customers, the conclusion of this link is In addition, the awareness that archaic systems networks cannot be used to access intelligence fuelled an effort to update its infrastructure. The potential competitive gains that MGA-MENA may obtain from this partnership are highlighted by a number of use cases that have already been implemented and by a number of projects that are now being developed in order to carry out MGA's plan for MENA to become a smarter company.

The achievement of success will be contingent on a wide range of criteria, such as a concern for security and compliance, suitable legislation to manage this technology, and effective data storage to generate intelligent reasoning. In addition, the telecom industry needs to take into consideration the large number of computations that are necessary for deep learning and machine learning techniques to be carried out rapidly.

This implies that these techniques require significant processing resources. Combine effective logic and algorithms with actual use cases in order to prevent excessive use of the cloud's resources.

Table of advantage

Scalability	Cloud computing provides a scalable infrastructure that can handle large amounts of data and support multiple users simultaneously
Cost Reduction	Cloud computing and AI can help telecom companies reduce costs by optimizing network performance and resource allocation.
Improved Network Performance	With real-time analysis of network traffic and usage patterns, cloud computing and AI can help improve network performance, reduce downtime, and deliver a better customer experience.
Enhanced Security	Cloud computing and AI can provide advanced security features such as anomaly detection, threat prevention, and real-time data monitoring
Personalization	By analyzing customer data and usage patterns, operators can provide targeted services that meet the specific needs of each customer.

New Revenue Streams	By examining client data and use habits, cloud computing and AI can assist in locating new sources of income. This may result in the creation of fresh products and services that can be profitable, boosting profitability.

8. Challenges & open search issues:

Combining cloud computing with artificial intelligence (AI) has the potential to revolutionize the telecom sector, but it also presents several challenges and open research issues. Here are some of the challenges and open research issues associated with this combination:

Data Privacy and Security: Cloud computing and AI rely heavily on data, which raises concerns about data privacy and security. Telecom companies must ensure that customer data is protected and secure, especially when it is stored in the cloud.

Integration and Interoperability: Integrating cloud computing and AI into existing telecom infrastructure can be challenging, especially when it comes to interoperability between different systems and platforms. Telecom companies must ensure that their systems can work together seamlessly to provide a unified experience for customers. Scalability and Performance: Cloud computing and AI require significant computational resources, which can impact scalability and performance. Telecom companies must ensure that their systems can handle the increased workload and provide fast and reliable service to customers.

Ethical and Social Implications: The use of AI in telecom raises ethical and social implications, such as bias in decision-making and job displacement. Telecom companies must ensure that their use of AI is ethical and socially responsible. Open Research Issues: There are several open research issues associated with combining cloud computing and AI in the telecom sector, such as developing new algorithms and models for AI, improving data privacy and security, and addressing ethical and social implications.

Overall, combining cloud computing and AI has the potential to transform the telecom sector, but it also presents several challenges and open research issues that must be addressed. Telecom companies must carefully consider these issues and work to develop solutions that ensure the safe and effective use of these technologies. The combination of artificial intelligence and cloud computing in the telecommunications industry will result in an improvement in network efficiency, an improvement in user experience, improved network security, increased automation and efficiency, and the creation of new revenue streams.

It is possible that AI will have a substantial impact on the operations of MGA-MENA, including planned or successful initiatives, repercussions on operational excellence, and customer experience. This might help MGA-MENA maintain its status as an ICT provider in the MENA region and rank higher. AI-powered solutions have the potential to boost operational efficiency in a number of ways, including through the automation of processes and the delivery of insights in real time. Through the provision of personalized services and help, AI may contribute to an increase in customer satisfaction. If MGA-MENA's AI projects are successful, it will be easier for the company to stay ahead of its competitors and keep its position as the leading ICT provider in the region. MGA-MENA may focus on the following areas to continue exploiting cloud computing and artificial intelligence technology to boost innovation and growth in the region:

1. Make an investment in AI-driven analytics and insights to improve decision-making and obtain a deeper understanding of your customers.
2. Create chatbots and virtual assistants powered by artificial intelligence in order to improve customer care and assistance.
3. Leverage the capabilities of cloud computing to make their network infrastructure more scalable and flexible.
4. In order to improve the operational efficiency of your business and lower your costs, implement AI-powered predictive maintenance and network optimization.
5. Look into new ways to conduct business and make money by offering cloud computing and artificial intelligence-enabled solutions and services.

Integrating AI into customer service operations may have a positive effect on customer satisfaction and retention rates in general. This might be achieved by providing assistance around the clock, decreasing response times, and personalizing customer experiences. Virtual assistants and chatbots that are driven by AI can provide answers to simple questions and full fill requests for assistance, freeing up human customer service representatives to address more complex issues. It is possible that higher levels of customer satisfaction and retention will result from providing customers with service that is both faster and more effective.

Cloud computing solutions have the potential to improve operational efficiency by enabling the scalability and flexibility of network infrastructure, lowering the amount of human workload through automation, and offering real-time insights and analytics for improved decision-making. Security solutions that are hosted in the cloud have the potential to offer superior protection against cyberattacks. The precise cloud computing solutions that the telecommunications company chooses to employ and how those solutions will affect the firm's operational efficiency will be determined by the company's unique business needs and goals.

9. Conclusion

With the majority of telecommunications companies aiming to modernize legacy networks dependent on network function virtualization with software-defined networking in order to compete and survive in the pressure of a rapidly changing environment, the transition to cloud computing has advanced significantly. MGA-MENA Corporation has improved its network throughout the course of several years of operation. Due to the impossibility of people processing such a large volume of data, moving to the cloud alone is insufficient to manage complicated and dynamic processes. In order to enhance the value of the cloud, AI is crucial. This will lead to better traffic categorization, more accurate network problem forecasts, time optimization, and better customer services. Therefore, it is thought that cloud computing and AI are the best business models. The AI and cloud computing strategy, however, works well for telecom companies with a large clientele and several concurrent activities. The study adds just a little to our knowledge of how large corporations like the telecoms may become more effective by using managerial tactics and cutting-edge technological innovations like cloud computing and artificial intelligence.

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OVERVIEW OF IOT SOLUTIONS FOR SUSTAINABLE TRANSPORTATION SYSTEMS

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ABSTRACT : While big data analytics aids in the analysis of vast data sets, the Internet of Things is all about data, devices, and connectivity. The Internet of Things (IoT) involves attaching real world things to the Web in order to build sophisticated frameworks and offer global mobility. This is accomplished by innovative initiatives like the Smart Transportation Framework (ITS). IoT solutions greatly enable the global IoT in the creation of Intelligent Transportation Systems. Istio introduces a new era of communication based on the Internet of Things for automobiles by integrating data analytics with the storing, processing, and computation of sensor data in order to efficiently manage the Traffic system. Roads, trains, airports, and ships are automated by an Internet of Things-based intelligent transportation system (IoT-ITS) to improve how customers perceive how things are moved, tracked, and delivered. A case study of an intelligent traffic management system that is based on big data and the Internet of Things and will be used to improve traffic solutions for cities. The ITS-IoT system is made up of an eco-system of sensor, monitoring, and display systems. This case study will also discuss a few of the system's hardware and software components. There will also be a focus on how concepts like conjoint analysis, cluster analysis, multiple regression analysis, multiple discriminant analysis, logistic regression, and other big data analytics approaches may be combined with IoT and support the growth of IoT-ITS. Additionally, the case study will show some outcomes of big data analytics and how they relate to smart transportation systems. Due to the huge number of drivers of private automobiles, transportation has developed into one of the most common aspects of daily life. Additionally, this has made city traffic very difficult to navigate. This is due to the numerous negative effects of the severe congestion, such as a rise in the consumption of fossil fuels, pollution, unforeseen collisions, and lost downtime. Because technology is capable of handling a wide range of features, including organizing, monitoring, trying to identify, and informatics, it has quickly put in place an adequate and effective traffic management system, particularly for road transportation. The smart management tools that have emerged to aid in IoT-based traffic congestion reduction are highlighted in this article.

Keywords: Internet of things, data analytics, smart traffic, IoT, traffic management.

1. **Introduction**

The complexity and congestion of the world's road infrastructure have grown along with the popularity and adoption of personal mobility among civilian populations. An efficient traffic management system is needed to lessen accidents, pollution, and lost time because of the extreme traffic congestion caused during peak hours (Almalki et al.,2021). Apparently, the Web of Things is expanding quickly. Through the use of the cloud and a variety of machine learning techniques, the Internet of Things (IoT), a vital and quickly developing technology, has contributed in effective traffic control. The significant role and expanding significance of

intelligent transportation systems (ITS), particularly with regard to vehicle-to-vehicle (V2V) communication, have changed every industry, from business to healthcare**.** Mixed media content is now well known to be present in autos, and this change in perspective has further improved how each scenario is presented. The rising mobility of automobiles has harmed the quality of service (QoS) for multimedia products over smart cell phones and portable IoT devices, despite the fact that technological advancements have improved the lives of the typical person. In reality, increased portability lowers sustainability (high power consumption), manageability (short battery life), and accessibility, making it a significant challenge that must be successfully overcome. The wireless link's received signal strength indicator (RSSI) at the base station also varies more (i.e., has less coverage). Because portable devices at the edge of Internet of Things (IoT)-based computer networks (i.e., ambulances) are resource-constrained, it is particularly difficult to satisfy user demands while viewing video content of emergency patients in cars. Greater vehicle mobility actually has a significant impact on network performance (i.e., quality of service), user perception, and degree of satisfaction while transferring sensitive and important data. The general public will have access to the mechanism's grievance remedies. The Internet of Things (IoT) enables continuous and digital connectivity for everything with an ON/OFF switch. It describes a scenario in which physical items and living things can communicate with digital data and settings. Making commonplace items like watches, vehicles, refrigerators, and railroad tracks sentient is one of the objectives of the Internet of Things. A lot of data is generated as more devices are connected to the internet. This enormous amount of data must be managed and converted into useful information in order to create efficient systems. Big data analytics significantly speeds up the process of extracting useful information from the created data. The term "big data" was in use before the Internet of Things (IoT) was used for analytics. Massive information is characterized as data that exhibits precision, speed, variety, and quantity. Both structured and unstructured data are abundant in this instance. Accordingly, the terms "velocity" and "veracity" refer to the degree of data uncertainty and the pace at which data are processed. The data from IoT devices is contrasted with the big data that comprises this information. Manufacturing, transportation, consumer electronics like smartphones and wearables, as well as smart homes (IoT), will soon be impacted by the Internet of Things. In accordance with WSNs, the idea of the web of things (IoT) was established. The term "internet of things" was coined by Kevin Ashton to describe digital representations of separately identifiable objects housed within a "internet-like" framework. They could be massive buildings, machines, products of any type, businesses, or even the physical remains of people, animals, or plants. Mathuramalingam is one among the remaining 280. WSNs and the Internet of Things will be used in this study to create an intelligent transportation system. Transportation is changing as a result of the Internet of Things (IoT). The development of people and goods as well as the economy, public safety, and the environment will all be enhanced by modern, intelligent transportation networks. Smart transportation systems will revolutionize passenger experiences, change how cargo and goods are tracked and delivered, and automate our roads, railways, and skies. System integrators, independent software vendors (ISVs), service providers, and other solution providers will greatly benefit from the significant business opportunities presented by smart transportation systems. In today's big cities, there are numerous transportation-related issues due to the overburdened urban transportation infrastructure, including issues with energy waste, noise pollution, and air pollution. Urban traffic congestion and clogging have increased as a result of urbanization, motorization, modernism, the urban population, and the increasing speeds of vehicles. Due to the current trend toward information technology development and globalization, as well as the fact that conventional means of transportation technology no longer meet the requirements of economic and social development, intelligent transportation is

the only viable option for the development of urban transportation. It represents a revolution in methods used to move people throughout cities. The "Internet of things," smart transportation, and intelligent transportation for modern urban transportation appear to have outstanding opportunities to grow as a result of developments in the intelligent transportation industry. The "new generation of intelligent transportation" technologies have a significant positive impact on networking technology, the Internet of Things, and the attainment of real-time, accurate, safe, and energy-saving intelligent transportation goals. Today's population growth in metropolitan areas necessitates the need for more advanced transportation systems. IoT-capable devices in the millions are required to develop smart and intelligent transportation. The Toronto Intelligent Transportation Systems Centre and Testbed created a system called MARLIN-ATSC (Multi-agent Reinforcement Learning for Integrated Network of Adaptive Traffic Signal Controllers) to use smart signals that locally analyze traffic information to optimize traffic flow. When the framework was tested at 60 busy midtown Toronto crossing points, deferrals decreased by up to 40%. The test also revealed a 26% reduction in travel times. Singapore has implemented a smart transportation strategy and system. It has one of the least crowded large cities, with an average vehicle speed of 27 kph on major roads, compared to 16 kph in London and 11 kph in Tokyo. The Electronic Road Pricing system in the city adjusts the tolls based on the volume of traffic. Drivers are alerted to severe road events by an Expressway Monitoring and Advisory System [1–5]. Additionally, GPS tracking and reporting capabilities are included in city taxis. The Intelligent Transport System's Operations Control Center combines data from each of these systems to give the general public access to realtime traffic data.

2. Related Works

The analysis environment for ITS (Intelligent Transport System) analysis and optimization systems is covered in this work. This situation makes use of co-simulation, which is advantageous for modeling flexible systems. The potential for virtual ITS is realized by picking components that can be used at various stages. These components are replicated using existing bundles that each use the shortest time stamp possible or objects with the same time stamp. The recommended method is brilliant since it avoids the need for continual computing. The proposed integrated system analysis environment helps ITS in the seamless integration of many models, and it performs substantially better than the models currently in use. Additionally, it completes the present framework. The simplified system integration procedure makes it simple to construct ITS infrastructure across the nation. Time can be taken into account in the recommended co-simulation application for ITS, making it a time-based simulation. The best possible transportation system is suggested, and a genetic algorithm is used to evaluate the stochastic data in order to develop an effective traffic light system. Computing the aggregate for each route after each traffic signal has been programmed, handled, and the information processed determines the ideal state. The simulation makes use of the vehicle's average speed and the distance covered. The simulation aids in determining where the suggested traffic lights should be placed in order to accommodate the most vehicles. The simultaneous study of numerous things using a statistical measure is possible with multivariate analysis. Multiple variables can be analyzed simultaneously using this methodology. Various approaches to multivariate analysis can be used, depending on the circumstance. This study suggests a prototype car that can communicate with both the car's internal electrical devices and other vehicles parked along the route. The projected on-board device's numerous components are also covered in detail in the model. Numerous applications could use this technique to guarantee effective operation. The suggested article provides a summary of the several requirements for developing a successful ITS system. The recommended framework's accuracy is assessed using MATLAB-based replicas in light of the current situation. The observations demonstrate that the suggested environment is useful for finding the car in various settings.

When evaluating the algorithm, execution time and finding accuracy are taken into account. In order to improve mobility, the study develops a ground-breaking system that combines the Internet of Things with intelligent transportation systems [6–10]. The gadget tracks the weather using its sensors, and the observing system uses this data to advise drivers of the device's location and other details. Therefore, passengers are informed of the bus's present route. When evaluating the effectiveness of the suggested method, this system takes the number of tickets collected into account.

Table1: A cutting-edge transportation system that incorporates IoT and the Internet of Things.

Ref. No.	Publication year	Proposed technique	Traffic safety	Energy efficient	Merits
1	20019	Pollution-free transportation	No	Yes	Handles traffic in an efficient manner
2	2018	Pollutionavoidance transportation	Yes	Yes	Reduction in emission of CO_2 by using electric vehicles
3	2017	Green transportation	No	Yes	Traffic handling with sustainability is given importance
4	2019	Safe and sustainable transportation	Yes	Yes	Traffic congestion is handled efficiently
5	2018	Green transportation	Yes	No	Proposes a pollution free technique which helps in vehicular movement
6	2019	Collision-free transportation	Yes	No	Determination of braking response time and steering response time
7	2020	Collision-free transportation	Yes	Yes	Safe system design with collision warning
8	2021	Congestion avoidance transportation	Yes	Yes	Time of arrival (TOA) based localization, using automatic braking for collision avoidance

3. The Internet of Things (IOT)

The Internet of Things (IoT) is a system in which linked items, such as actuators or computing units, interact with one another to perform activities. The authors claim that 85% of networks are fragmented, which prevents data from communicating with other networks or the cloud. On the other hand, the term "Internet of things" refers to an endeavor to establish connection by connecting physical objects online in order to collect and analyze data as well as a strategy for promoting connectivity. Devices designed for the Internet of Things should be independent and able to access information from a Web server. Almost everything today has the pervasive Web of Things (IoT), which is essentially a form of dynamic inclusion (Joo et al., 2013) [11–15]. Figure 1b illustrates how IoT technologies make use of processing units, sensor nodes, and actuators to connect the real and virtual worlds.

IoT and smart cities

Intelligent urban communities use a range of innovations to raise the comfort levels of its residents in the areas of water, energy, transportation, education, and health. This entails reducing costs, conserving resources, and engaging with their community more successfully and actively. Big data analytics is one of the newest technologies with a lot of potential to improve smart city services. Data collection has generated enormous volumes of data that can be applied in a variety of valuable application sectors as digitalization has invaded every part of daily life. Smarter infrastructure, which is the foundation of smarter cities, can assist governments in creating smarter cities in a number of ways. Enhancing transportation-related services, such as parking, transit, and traffic management, is one tactic. Information and communication technology (ICT)-enabled smart cities have improved control over and insight into the many systems that affect residents' daily lives. However, there isn't a single, agreed-upon definition of what a smart city is. "Smart transportation," which refers to the incorporation of cutting-edge technologies and management practices into transportation networks, is one of the most significant vertical uses of the internet of things. Users will be better able to use transportation networks in a safer and "smarter" manner as a result of these technologies' mission to supply cutting-edge services connected to various modes of transportation and traffic management.

Intelligent transportation systems are made possible by the Internet of Things, which increases capacity, improves traveler experiences, and makes moving anything safer, more effective, and more secure. The employment of intelligent traffic management with these sensor networks enables the city's police, emergency services, and other governmental entities to respond to crises quickly and ease congestion. The Smart City concept, which aims to integrate cutting-edge and potent communication technology for municipal management and residents, is served by IoTbased intelligent transmission networks. There are several issues that cities must address, and outmoded traditional planning for transportation, environmental pollution, financial management, and security observations is insufficient for smart cities. Modern technology and dependable infrastructure are essential for the development of the smart city framework. Globalization and urbanization have put pressure on contemporary cities to raise the living standards of its residents. The advancement of Internet of Things (IoT) technologies and the rise of big data have both contributed significantly to the success of smart city initiatives. The Internet of Things (IoT) facilitates the integration of sensors, radiofrequency identification, and Bluetooth into the physical environment by utilizing highly networked services. Big data gives communities the opportunity to learn valuable lessons from a wealth of data obtained from different sources. Big data and the Internet of Things have provided new and fascinating challenges for the realization of the vision of future smart cities. These new challenges typically focus on business and technology issues that assist cities realize the core characteristics of a smart environment in order to achieve the vision, principles, and objectives of smart city applications. In the context of smart cities, this study makes use of the most cutting-edge communication technology and smart-based applications. By focusing on how big data may significantly impact urban populations at different levels, the principles of big data analytics to support smart cities are investigated. A summary of the technological and commercial research challenges is also provided, along with a proposed big data business model for smart cities. In the context of big data, this study can serve as a starting point for future enhancement and development of smart cities. Innovative applications called intelligent transportation systems are designed to provide special services for different types of transportation and traffic

management. They also give diverse users the information they need to use transportation networks in a way that is safer, more efficient, and intelligent. Expiry combines cutting-edge analytics to a variety of Intelligent Transport System technologies, such as automatic license plate recognition, message-variable signs, container management systems, traffic signal control systems, and speed traps. Expiry's analytics are especially helpful for complex applications that integrate data from a variety of various sources with real-time data, like parking guidance and information systems, weather forecasts, and bridge de-icing systems The Intelligent Transportation Systems (ITS) are defined by the European Union as "where information and communication technologies are applied in the field of road transport, including infrastructure, vehicles, and users, as well as in traffic management and mobility management, as well as for interfaces with other modes of transport" in 2010. Smart transportation uses a range of technologies, from screen applications like security CCTV systems to more sophisticated applications that include real-time data and input from numerous other sources. Car navigation, traffic signal control systems, container management systems, programmed number plate recognition, and speed cameras are examples of fundamental artificial intelligence systems utilized in smart transportation. Users are able to use the transportation network more efficiently as a result of ITS technologies. In order to satisfy future demands, these technologies also pave the way for the creation of smarter infrastructure. Thanks to the advancement of intelligent transportation systems, transportation managers now have access to a wider range of technology options that can be used to operate and maintain the systems more effectively and boost performance.

The Intelligent Transportation Society of America claims that ITS technology enables:

- To determine the optimal course given the circumstances, use a navigation system.
- Quickly warn other drivers of potentially hazardous conditions to prevent collisions.
- Use a smart sign to find a parking spot that is unoccupied.
- Step onto a bus as soon as the incoming traffic signal turns green.
- Recognize traffic incidents and act quickly.
- Reroute traffic when bad weather or deteriorating road conditions are present.
- For travelers, real-time traffic and weather updates.
- Enable drivers to control their fuel usage.
- Consider the situation at hand while adjusting speed restrictions and signal timing.
- Improve efficiency and safety while increasing tracking and inspection of freight.
- Promote and enhance the use of public transportation.
- Keep an eye on the stability of the infrastructure, including bridges.

Austria's Autobahn and Highway Financial Stock Company (ASFiNAG) leveraged Cisco's Connected Roadways solutions to integrate the "internet of things" with its roadside sensors, showcasing the benefits of implementing smart transportation technologies. The end result is a road that can navigate itself, inform users, and anticipate traffic to maintain clear lanes.
Big Data and the Internet of Things (IoT) seem to provide huge possibilities for cost reduction and new revenue generation across a variety of businesses. In the first two briefings of the IoT series, researchers provided an introduction to IoT and discussed how it affects the industrial sector. The usage of IoT to provide intelligent citations will be highlighted in this short. The Internet of Things is a system in which actual physical objects and their sensors are connected to the Internet using wired and wireless network connections. The Internet of Things will

connect both living and inanimate objects. The Internet of Things (IoT) will connect everything, including automobiles, utility meters, medical devices, and everyday objects.

A Brief history of car IoT components

According to SAE's vehicle levels, connected and autonomous vehicles—which include those that are "vehicle to everything," including "vehicle to cloud," "vehicle to infrastructure," "vehicle to device," "vehicle to network," "vehicle to pedestrian," and "vehicle to vehicle"—are currently a representation of the technological age of the twenty-first century. They acquire entry to participating in a larger system. Vehicles communicate with one another, their environment, and other drivers. Smart automobile applications (assistance for steering, velocity, and brakes) have gradually lessened a variety of infrastructural issues by assisting with driving. 2019). Because there are fewer concerns about traffic congestion and more modern automobiles, the International Society of Automotive Engineers (SAE) contributed to the definition of vehicle innovation by utilizing the levels in Fig. 3.

IoT is changing logistics in many different ways.
The Internet of Things (IoT) is transforming our lives on a constant basis. Two uses for the Internet of Things are environmental preservation and transportation networks. For the automotive industry, which has produced some of the most important inventions, this is especially true (Belli et al., 2020). The automotive industry and our roads are being impacted by the Internet of Things in the following significant ways: According to Dheena et al., driving reduces traffic congestion, enhances highway safety, and reduces pollution and trash production. 2017). improved roads, transportation and environmental apps, and spending

Intelligent traffic management system
Intelligent traffic control solutions based on the Internet of Things come in three varieties. This phrase refers to a collection of resources, including software, hardware, and communications technology,that can be used to improve the effectiveness and security of the transportation system (Mohamad et al., 2020).

1. The Smart Traffic Data System's defining features are its agent technology, IR ray sensor, RFID, and WSN. This study outlines a communication and interaction architecture for a sizable number of different, geographically dispersed, autonomous IoT devices. Agency technologies are integrated with IoT.

Intelligent traffic management system obstruction

1) A flexible traffic control system is being developed. LabVIEW, Thing Talk, the Arduino board, HTTP, and MQTT protocols were used to conduct efficiency testing. The Raspberry Pi, the Arduino board, and cameras are among the more simple devices (Diorite et al., 2021). The importance of lane markings is emphasized by the HW model. MATLAB support is already implemented on Thing Talk.

2) The Internet of Things (IoT), an active radio-frequency identification (RFID) system, and WSN enable the following applications: The Internet of Things and agent technologies were combined to build the IoT in order to handle clear communication and interactions among a great number of diverse, strongly dispersed, and distributed devices. (2012) (Xiang et al.).

3) IoT-based smart traffic signal system and smart road congestion control scheme for urgent vehicles are being implemented on the right: Wi-Fi sensor node using ultrasound (Lalit et al., 2020).

The traffic density monitoring module was used to fulfill the following tasks: determines the operation time of the signal using measures of traffic congestion.

4) According to Ejaz and Anpalagan (2019), the performance characteristics of smart traffic and vehicle monitoring include ATMEGA, GPS, IoT, traffic management, Ublox-Neo 6 M, Zigbee, RFID, and blue tooth. The tracking module is run by a NodeMCU, while the attention to detail is handled by an ATMEGA series microcontroller. Additionally, they have opened up the data to the general public via a cloud data stream known as "MTech track."

5) An IoT-VANET-based ambulance traffic control system in a smart city; performance criteria based on an algorithm due to the system's Internet connection; Lane monitoring is possible at any time (Batrachia et al., 2018). Information from different lanes is gathered and tracked centrally by the traffic control office.

6) The GPS Neo 6 M, Arduino UNO, and Ambulance Traffic Management System were all Internet of Things-based devices. the conditions for success Jiawei et al., IoT-based Ambulance Traffic Management System with SIM 900A, Arduino UNO, and GPS Neo 6 M to make a path to one or more ambulances. 2019). A GSM 900A installed into the ambulances was powered by 12 V, 1 A, and a 10 V Arduino board was integrated into the fuse board to create an Arduino-based traffic control system.

7) A Case Study of an IoT-based Smart Traffic Signal Framework in Bangladesh: Advanced Traffic Monitoring Granular and pervasive computing, the OWL Urban Traffic System (UTS), and the Zigbee protocol are used to calculate traffic density. Highway details and traffic light clusters are integrated using Web 2.0 features (Singh et al., 2021). Smart intelligent transportation systems/Internet of Things based on cognition and traffic control systems/IoT Network Cognition and Performance Parameters include eight sensors, CCTV, fuzzy logic, and pedestrian sensors. (2018) (Hassan). The Traffic Light Framework for Savvy City Traffic Light is a fluffy-based solution for intelligent intersection steering at traffic light intersections.

8) Self-driving automobiles, Arduino, an ESP8266 Wi-Fi module, and ultrasonic sensors are used in conjunction with the Internet of Things (IoT) and an ultrasonic sensor (Jitendra et al.,2021). The ESP8266 module, which works with any opensource Internet of Things platform (Ramji et al., 2021; Tirumala and others, 2019), uses Wi-Fi to send sensor data. For accessing information, HTTP is used.

9) KNN algorithm-based traffic monitoring system In an IoT model using the KNN algorithm, TMS extensively makes use of IRs in three key areas:

1) Android software;
2) interaction with the user;
3) communication between the server and the client (Kaur and Malhotra, 2018).

4. Challenges of Big Data

The emergence of a brand-new phenomenon known as "Big data" was prompted by the massive amounts of data that must be managed at specific rates and periods. Massive information advancements capture, store, analyze, and decode the information in a distributed environment. The subsequent Social Information base Administration Framework constraints were what sparked the beginning of huge information [16–20].

- When the volume of data increased rapidly, RDBMS found it difficult to handle such a large amount of data.

- RDBMS increased the number of processors and memory to meet this demand, which increased the cost.
- In addition, the RDBMS cannot process about 80% of the unstructured and semi-structured data.

Big data has unique characteristics with many dimensions. The next paragraphs provide an explanation of the four big data dimensions. The size of the data is the first dimension. Big data jargon refers to this concept as volume. The amount of data being produced and processed keeps rising dramatically. The main data sources include social media, internet banking, and automobile sensors. Given the rising data volume, a highly scalable and dependable storage system is needed. The Internet of Things will be impacted by the processing of this data because of the enormous increase in the number of cars. Variety describes the range of data types that big data may accommodate. Structured, semi-structured, and unstructured formats of data are examples. Data that is set out as lines and sections in tables is referred to as "organized information". Semistructured information is information that is both arranged and disorganized. Data that is semistructured cannot be stored in tables. Additionally, it contains tags for classifying data fields. Unstructured data lacks a clear framework, including data from automotive sensors. The analysis of vehicle data in terms of velocity and various parametric structures simplifies the setup and use of intelligent transportation. The rate at which data is generated also rises as data volume does. The big data era makes it challenging to collect and interpret data due to its frequent arrival. For instance, Facebook sends 3.3 million posts and 3.1 million searches to Google in a single minute. Determined by the data's velocity in vehicle systems. Veracity implies that the data are atypical and unclear. This is due to the contradictory data. To produce precise findings from analysis, data must be trustworthy [28].

Problems with Big Data Technology

- Managing a large amount of data might be difficult since some of it—such unstructured material like movies and photos—cannot be stored in standard tables. Even though these data may be managed effectively when handled separately, merging data from several sources presents significant challenges. The greatest difficulties are listed below:
- Data must first be formatted because it is heterogeneous and comes from a variety of sources. • Issues can arise if data that are gathered for analysis is incomplete or lacking. In these cases, it is necessary to replace the missing values with null values to prevent them from impacting the rest of the data and to guarantee a successful outcome. • In the age of big data, managing a sizable amount of data is the most pressing issue. The processing will take longer as there is more data present.
- Real-time data processing at a faster rate of arrival is challenging because of the higher velocity of big data.

Big data storage should be designed to be scalable in the event that the volume of the data grows at an exponential rate. In addition to being scalable, the data must also be trustworthy and faulttolerant. • As data volume increases, data privacy becomes a more pressing concern. Strong access control measures must therefore be implemented across the whole life cycle of huge data. To ensure that the accessible data can be used to collect the necessary business knowledge, data sharing should be restricted to a minimal. Even though the data will be used for analysis, sensitive information should be protected before processing.

The Central Server, RFID device, sensors, lighting control unit, and EBOX II are necessary components for an effective intelligent transportation system. In the event of a system failure, the Central Server dramatically improves resilience. EBOX Ditags, data-transmitting antennae,

and data-decoding scanners make up this RFID device. RFID enhances data flow and information exchange between vehicles.

Design specifications for an ITS system

- The RFID tag operates at a certain frequency. Future ITS systems will require ultra-high frequency.
- The power required for the RFID device and lighting control unit to operate is supplied by additional chargers. This aids in identifying data at a reasonable distance of 4-6 meters.

Design Objectives

When developing a new ITS system, the following elements are taken into account. The s-ITS system needs to keep up with the rapidly growing bigdata industry. The settings must be easy to access from a distance and the data must be portable.

5 . Intelligent transport system proposed model

• Dependable

Because the smart transportation system is intended to function independently, dependability is essential. Additionally, it should be structured to effectively handle any unanticipated circumstances.

• Easily navigable

The user is not required to understand every detail of the implementation. Instead, the administrator should have control over server-side issues and the user should be able to access the initialization with only one click.

Laboratory Design

The intelligent design of an intelligent transportation system that can address issues in real time is at the heart of the smart intelligent transport system (SITS) that has been proposed.
The following modules are addressed by the intelligent system:
(a) Tracking the location of vehicles
(a) An automated parking system for vehicles (c) Internal communication in a VANET (d) Mining big data from vehicles.

Localization of the s-ITS vehicle flow

The recommended methodology aids in selecting the most precise routes. The benchmark for evaluating the model's performance is the lower bound accuracy value. Since there are now enough effective paths and all less linked paths have been deleted, the model has succeeded in obtaining the target accuracy larger than the lower bound. The proposed paths are insufficient, though, if the lower bound is higher than the anticipated accuracy rate. The collection is further expanded to incorporate the required paths for efficient vehicle localization. The vehicle restriction computation predicts the area of the vehicle at time l. This also includes storing the set and producing an estimate later, if the projected set's count is more than 5. It is then decided what Fisher value is. If it is less than 5, the fisher value is not computed, and additional

connections are built to make sure they are included. The lower bound accuracy derived from the Fisher matrix in line with the flow is then used to compare the anticipated value to. More connections may be lost if the projected accuracy value rises. As a result, the suggested method has the advantages of simplifying location estimation and accelerating vehicle path selection.

(b) Intelligent parking system for vehicles

In this module, sensors play a significant role. They assist in gathering information on the location of the vehicle, parking lot availability, specifications of the vehicle, information from prior reservations, parking location, and current traffic statistics. Big data is essential in this situation due to its real-time uses and capacity to build an intelligent transportation system.

Outcome factors, such as the occupied or free factor, determine where to park an automobile. The location is designated as such if there is free parking there. However, if there are any cars there, the location is marked as occupied. The application of the result value, which will be updated over time by sensors, serves as the foundation for the parking decision. The server then updates the decision. In order to come to a final determination regarding the parking space, the attributes are contrasted with the specified threshold value.

3 Openness within a VANET

The sensors monitor the current location and condition of the car in the traffic flow with the aid of the vehicle's device and previous registration. Data is exchanged and shared between automobiles via IoT sensor systems, assisting in traffic avoidance and ensuring a safe ride.

Big-Data Mining for Vehicles (c)

The building is designed to offer view of traffic patterns and potentially dangerous street conditions. It should also be equipped with information to manage unforeseen incidents and scenarios so that moving cars can be forewarned in advance for safe driving. A vast amount of previously similar data must be used as a foundation for the signals, which must be given to the vehicles, as well as the current traffic scenario.

Implementation

As part of the implementation of s-ITS, the proposed system must carry out transportation intelligence through localization and traffic avoidance using big data techniques. Using Chennai as an example, different highways' traffic volumes are shown on the map using different colors. Here are some illustrations of various big data applications and how they relate to ITS.

6. ITS's use of big data techniques

By simultaneously examining more than two variables, multivariate analysis produces useful conclusions more quickly. Univariate is used to accommodate additional parameters for analysis. Multivariate structure uses a large number of predictor variables in contrast to linear regression, which only takes into account two variables.

Multivariate Techniques Classification

The variable's ability to be divided into dependent and interdependent versions serves as the basis for classification. The form is considered to be dependent when a variable is designated as a dependent variable and is anticipated to be predicted by independent variables. There are no independent or dependent variables in an interdependent form. A few instances of multivariate methods are displayed in the flowchart that follows.

- ***Analysis of multiple regression:***

Forecasting how a dependent variable will change in response to changes in an independent variable is the goal of multiple regression. When one dependent variable is connected to two or more independent variables, this strategy has been shown to be effective. The least squares method is used to achieve this.

With the use of this multiple regression method applied to ITS, it is feasible to predict the time (Dependent variable) at which the vehicle will arrive at its destination while also accounting for other factors like the flow of traffic along the route and the vehicle's speed.

As seen in the equation, this condenses the prediction and can be expressed in both metric and nonmetric formats.

- ***Analysis Using Multiple Discriminants***

When it is possible to divide the entire population into various groups based on a dependent variable with multiple pertinent classes, this strategy is appropriate. The major objectives are to understand the differences between the different groups and to forecast the tendency of an object to belong to one of the groups using the independent variable.

- ***Multivariate method classification relevant to s-ITS***

The quickest, most efficient routes that get you to your destination faster and avoid traffic are discovered when this method is applied to ITS. This makes use of both the time factor and the location-based route map.

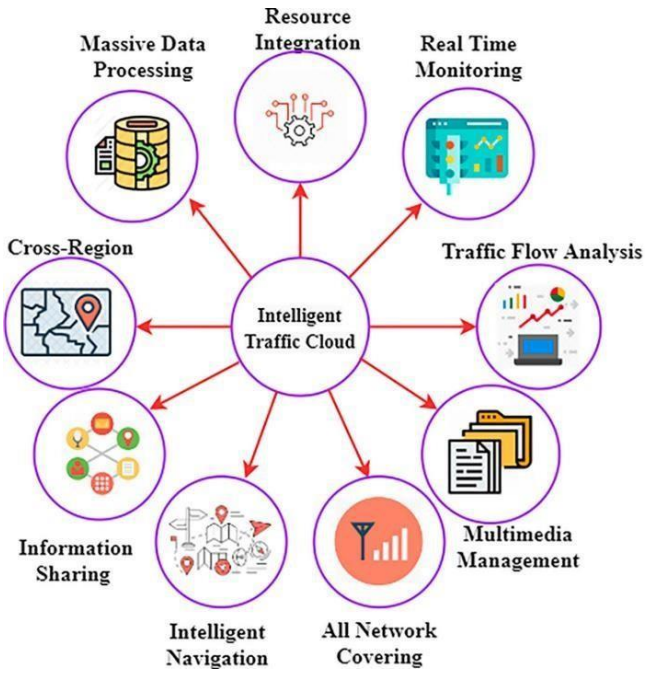
Analogous Regression: Multiple regression and multiple discriminant analysis are combined in the logistic regression model. When compared to multiple regression,

Combination Analysis: Both product researchers and buyers will benefit from this analysis. Customers only focus on a subset of a product's attributes and specifications throughout design; the remainder are disregarded because they are boring to customers. Product researchers pay close attention to every aspect of a product's marketing, yet users of s-ITS in car systems are solely focused on going safely and avoiding collisions. They want to learn the procedures and tricks that will let them travel safely and without being stuck in traffic. However, it is envisaged that the framework would take into account a number of factors related to the evolution of vehicles and borders that choose continuous movement at a steady speed. the following illustration shows ***Crowd Analysis:*** The process of grouping values into predetermined groups or clusters in order to identify differences among the data points is known as cluster analysis. The most frequent way of grouping many components is through determining the comparability of the comparable elements. The elements are then put into the appropriate clusters once the similarity has been determined. The profile of the final variable is the final step. According to how important they are in identifying the numerous components that ensure vehicle motion for efficient and accident-free transportation, the variables that affect vehicle motion in sITS are divided into different categories.

7. Intelligent Transportation System (CIoT-ITS) powered by the cloud

This study focused on an IoT and cloud-based smart city's intelligent transportation system. The intelligent transportation system (ITS), a vital component of a smart city that takes into account fuel consumption and traffic quality, is the key to the long-term evolution of intelligent smart city transportation. A smart sensor and the transportation network should be connected in order to create a sustainable IT'S. The recent success of IT'S exemplifies the growing usage of autonomous vehicles on roads to build sustainable transportation networks. The Internet of Things (IoT) and cloud computing will make transportation more efficient and use less fuel, similar to autonomous vehicles. This study suggests CIoT-ITS as a method for predicting traffic flow and reducing congestion in a smart city.

The cloud-based Intelligent Traffic Monitoring System is depicted in Figure 1. Massive real-time data collection from intelligent traffic systems is required for increased traffic. Controlling traffic infractions, preventing collisions, identifying potentially risky drivers, and simulating offline traffic conditions are the goals of a thorough traffic management system. The term "resource integrating" describes the method by which individuals, including clients, combine and use resources to produce value. In order to organize and optimize traffic on the route, find out which way the cars are moving. The traffic infrastructure manager can use this information to estimate the volume of traffic that will flow from one control point to the next and re-establish paths that will optimize traffic. Media management is a business subject that covers the description and portrayal of strategic and operational phenomena as well as management difficulties in media businesses. Through the carrier's network, wireless communication will be determined in this hightraffic location. Users of navigation systems can examine one or more charts in manual, graphical, or text format. the use of sensors and camera sources to locate a vehicle Data sharing is a defining characteristic of information communication between various businesses, individuals, and innovations. . The addition of IP addresses from different locations to different address pools and strength evaluations are encouraged by global traffic management. Address pools A and B can be used as the default IP address and address pools, respectively, in cloud access control settings. As a result, the application resources' primary and secondary instances crash. Figure 2 shows how the CIoT-ITS is supposed to work. Working with automatic driving is easier because the driver takes on the role of a passenger. As autonomous vehicles follow the same lanes in traffic flows, little space between vehicles is maintained; this cooperative driving application lowers fuel consumption and gas emissions while maintaining safe and efficient transportation. The end result is similar to a wirelessly connected car in that the following vehicle will automatically slow down, turn, and accelerate in response to the first one's action. The neighborhood is informed by the vehicle's sensors of the data they have gathered.



The roadside unit (RSU) subsequently transmits a data summary to the cloud server for processing. Traffic control systems and a centralized traffic control center receive static sensing data from the road via the roadside unit (RSU). For cluster nodes that operate as agents, acquire traffic data from all node platforms, and guide it to a base station where data can be collected and processed, the cloud architecture is utilized to effectively track data movements, vehicle densities, flow times, and waiting times [21]. Smart cars can use these components as an

intelligence hub to gather data on possible traffic. Technically, an RSU consists of the Base Transmitting Station (BTS) and Base Station Controller (BSC) traffic control operations. The BTS of a cell is the equipment used for signal transmission and reception. In order to operate traffic signals, traffic sensors collect data on the movement of vehicles and transmit it to the Vehicle Information and Communication System Center [22] [23]. CCTV cameras are a crucial part in maintaining the road system. Congestion and traffic jams are typical when traffic lines are created at weak points in the network to aid in transport management. Through better server management of high volume traffic, such as load balancing, accessibility issues are avoided and load times are decreased. Businesses that appropriately distribute web and network traffic across several hosts will see an improvement in application response times and throughput. The device controller examines the sensor data before determining the timing of the traffic signal by means of a traffic management algorithm. The crossroads is likely to have a lot of traffic [24]. There are two prepositional models in the suggested model. 1) A speed estimation model and a traffic forecast model.

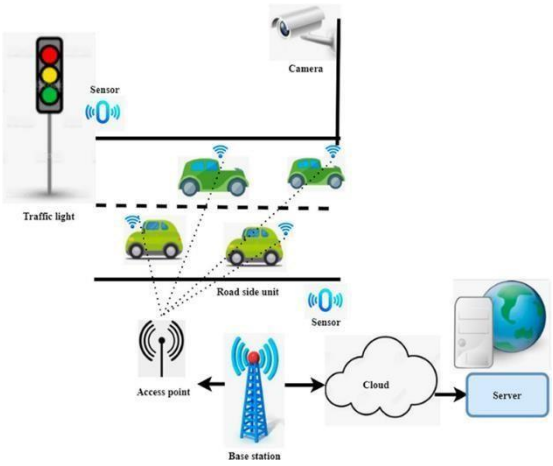


Fig.2. *Conceptual CIoT-ITS*

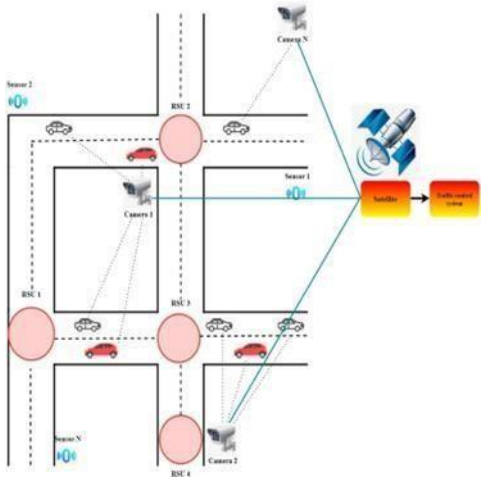


Fig 3. *Intelligent Transport System.*

The Intelligent Transportation System is depicted in Figure 3. Specialized on-board units (OBUs) that are connected into on-road vehicles make up an intelligent transportation system. These OBUs, which are controlled by a CPU, provide coverage for a wide range of mobility and infotainment functions. OBUs periodically send signals along the route telling the nearest RSU and other continuous vehicles of their current conditions, including speed, location, and direction. For on-road automobiles to connect, explore, and exchange messages with RSUs and other onroad vehicles that have irregular information about their connectivity restrictions, the vehicle network must be stable [25] –[27].

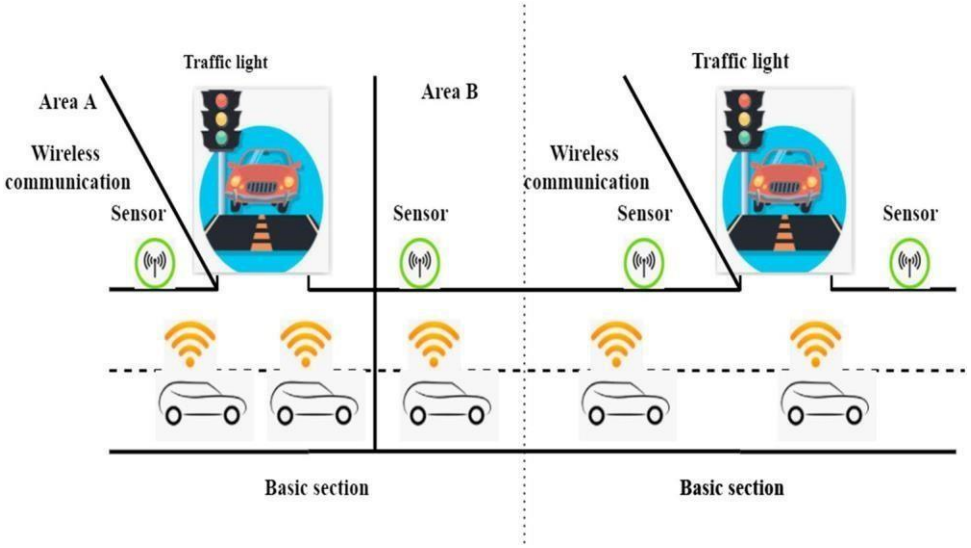


Fig 4. *A partial vehicle entry model*

8. Results of the experiment and discussion

The trial results show that the suggested framework performs better than the current ITS methods in terms of throughput and package transportation. When there is a delay or latency, it is extremely beneficial. the various elements and the weights given to them in relation to various network topologies for packet data transfer. The proposed approach shows how different network conditions affect delay. The network's most recent version, IEEE 802.11 p, has a lower latency and a higher packet delivery ratio.

The time and distance factor, along with the metrics RMSE and MAPE, are used to make the observations. To determine its effectiveness, the suggested s-ITS is compared to alternative approaches including fuzzy control rules and fuzzy rules based on genetic algorithms. To determine the most efficient path, the observation is typically conducted at peak hours and in busy areas. Because the vehicles are moved when there is traffic in a particular area, the recommended s-ITS offers both efficient traffic monitoring and simple parking.

9. Conclusion and Future Work

In the new paradigm, bigdata and IoT in particular are vital to everyday applications. Bigdata technology enables straightforward pre-processing, resulting in pre-processed data for additional processing. The s-ITS system and other big data and IoT operations are then given access to the processed traffic data. The provided framework can be used to develop effective transportation systems, intelligent parking, and vehicle position tracking. To estimate how much traffic is there in a particular area, the technology tracks the movement of the cars. The proposed s-ITS system outperforms currently in use conventional systems in terms of packet delivery and network delay. The MAPE and RMSE figures also demonstrate this. The ITS system could incorporate energysaving features and improve system performance to better manage the current condition of the roadways. This might be the next initiative aimed at energy efficiency for a dependable and intelligent transportation system. This article explores the sensor smart road network's potential path toward intelligent speed restrictions and vehicle alert systems, in addition to actual evaluations of traffic congestion, pedestrian crossings, and free route availability for fire engines in metropolitan locations.

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A SURVEY OF MACHINE LEARNING METHODS FOR NETWORK PLANNING

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ABSTRACT: In this chapter, machine learning, artificial intelligence, network planning, and the connection between these concepts are discussed in general terms. In order to generate new predictions, machine learning models attempt to exploit the fundamental relationships and patterns in your data. Image recognition serves as a common illustration. We are aware that the connections between image pixels and labels (such "dogs" or "cats") are intricate. It is highly challenging to find this intricate relationship using an equation that takes the image of a cat or a dog as input, and it constructs a new equation for each label, making it a scalable solution. Instead, machine learning techniques look for situations where the pixels and labels don't match. The goal of machine learning is to identify if an invisible image depicts a dog or a cat by removing probable patterns using a training set that includes several instances of any type of cat or dog. Similar to this, machine learning techniques may eliminate the relationship between chemical systems and properties when given sufficient examples, as well as the ability to otherwise dissolve extremely complex equations.

Keywords: Machine learning, artificial intelligence, networks, and network planning.

1. INTRODUCTION

Our lives now depend heavily on technology. Every day, it keeps evolving. It will continue to be very important to us in the future and will demonstrate changes. People lead more pleasant lives when technology is thus advanced. People are employed in this industry to preserve this comfort. Defining the technology of the future is another name for artificial intelligence, which is a technological capability. It is made up of the words "artificial," which is used to characterize human-made copies of natural things, and "intelligence," which refers to the capacity for understanding and thought, rather than being naturally occurring. Although it is a popular misconception, the idea of artificial intelligence is not a system. Systems now include artificial intelligence. In general, artificial intelligence is the study of human thought processes and the creation of artificial commands that are comparable to these processes; in other words, we can characterize computers as having the capacity to carry out human activities. It enables machines to tackle challenging issues in a manner akin to humans. Effectively uses computers to solve problems that call for intelligence and thinking. However, the roots of artificial intelligence were formally laid in 1956 at the "Dartmouth College Artificial Intelligence" conference, which was led by John McCarthy. At the Massachusetts Institute of Technology (Massachusetts Institute of Technology), John McCarty and Marvin Minsky established the first Artificial Intelligence Laboratory in 1959. You will be seriously mistaken if you think of machine learning as just another definition of the idea of artificial intelligence due to the connotation of

its name. Though essentially a subset of artificial intelligence, machine learning denotes a more specialized area of research.
Machine learning is an artificial intelligence application that enables the system to automatically learn from experiences and develop. It allows the machine to learn freely without programming and constant control. With some developments in artificial intelligence, machine learning has advanced. The initial innovation involved teaching computers how to learn and how to carry out any conceivable task once it was realized that providing the information required accomplishing the tasks. The development of the Internet ranks as the second-biggest innovation. The development of the Internet opened up a previously unheard-of potential for the storing of information. The machines could now access the data that was previously unavailable to them owing to storage constraints. It is now more effective to instruct computers to think for themselves rather of relying on them to perform tasks due to the growth in the amount of data they can handle. By enabling computers to learn, machine learning algorithms act as their brains, making them smarter. Classification enables big tasks to be completed in a variety of activities related to the study of the estimated modeling and the analysis of data. Regular exposure to new data and experiences of these algorithms. The introduction of instructional data, such as examples, firsthand experience, directions, and observations to look for patterns in the data, marks the beginning of the learning process. New input data is added to the machine learning algorithm to verify that it is functioning properly. The results and estimation are then verified. By feeding the computer more data, one can activate the algorithms that lead to "learning" and enhance the output.

The algorithm is repeatedly retrained until the intended output is discovered if the estimate is not what was anticipated. As a result, the machine learning algorithm is able to continuously learn on its own and produce the best response, which will progressively improve its accuracy over time [1–5]. After the algorithm has finished its learning phase, it can apply the knowledge to tackle related issues based on various data clusters.

2. EXTENT OF PAST WORK

Depending on your source, you may have heard a lot of positive or terrible things about machine learning (ML) and artificial intelligence (AI) in the modern day. The majority of us immediately think about artificial intelligence when it is brought up. 2001: Samantha in Her (the movie), C3PO, Data from Star Trek, or HAL from A Space Adventure. And many people have never even heard of machine learning as a distinct field. Although they are frequently presented in a fashion that allows for interchangeability, these expressions are not the same. We might claim that machine learning has evolved from AI in the broadest sense. Google trend graphs show that before machine education overtook AI in September 2015, searches for AI were more prevalent. Even if it was not an artificial intelligence practice, machine learning has become one of the key ones. Some people define machine learning as a means of obtaining a branch of artificial intelligence. It's shameful if you're still having dreams about killer robots that were sent to Earth from the future. The impact of AI and machine learning goes well beyond what is "just" the future of humanity.
A type of artificial intelligence known as machine learning enables computers to learn without the need for programming (Samuel, 1959).

Machine Learning History (Timeline)

1950s: Early machine learning research was carried out using straightforward techniques.
Bayes approaches for probability in machine learning were first introduced in the 1960s.
AI Winter in the 1970s was brought on by skepticism over the efficacy of machine learning.
Backpropagation was rediscovered in the 1980s, which led to a resurgence in machine learning research.

1990s - Machine learning work has switched from an information-oriented approach to a dataoriented approach [6–10].

Scientists start to develop computer systems that can process massive volumes of data, generate outcomes from results, or "learn" from data. Recurrent neural networks (RNNs) and support vector machines (SVMs) have gained popularity. Complexity fields were first calculated using neural networks and super Turing computation. Support-Shooter Clustering (SVC), other nuclear approaches (kernel), and erratic machine learning techniques gained popularity in the 2000s. 2010s - Deep learning is now feasible, which has made it a crucial component of the machine learning software services and applications that are extensively utilized.

3. Why Machine Learning

Machine learning has shown to be useful since it can solve issues at a speed and scale that the human intellect is unable to match. To recognize patterns and correlations between input data and to automate repetitive tasks, it is possible to train the massive computing power behind one or more specific tasks. As stated in the beginning, it is impossible to assign labels like "good" or "bad" to those who approach a system with malicious intent. The burden is decreased and scenarios that people cannot capture or detect can be solved without any issues if a model is constructed using a data set in which the genuine processes are real and fictitious transactions are labeled with a fictitious label [22] [23].

Application of machine learning and work environment

First and foremost, data science domains including data analysis, data processing, data visualization, and feature engineering should be well-known in order to apply machine learning approaches to any field. The environment in which the code will be written is another need. Jupyter notebooks are one of the most frequently utilized environments in this division.

Workflow for machine learning

The overall workflow for machine learning changes depending on the kind of problem you are attempting to address from the data set at hand:

- Discovery Modeling,
- Data Analysis,
- Data Cleaning,
- Data Processing

4. Network Planning Using Machine Learning Methods

Network design

Since the network is at the core of most contemporary businesses, network design may have a significant impact on the bottom line. It takes a special blend of project management and technical expertise to strike the correct balance between network performance, safety, backup, and cost. We will delve further to assist you with your next Network Design project, offer a fundamental framework you can use, and go over some best practices you should keep in mind as you proceed. The use of planning and designing communication networks is known as network design. Prior to network application (when you really distribute and configure what is created), network design begins with the identification of business and technical needs [11–15]. network planning, network analysis, hardware selection, IP addressing, and application planning. Network design is usually a straightforward process in households and small offices. The network design process is frequently extremely complicated in large business networks and involves numerous parties.

PPDIOO and other Network Life Cycle Models information

Let's review the network life cycle model before getting into how to create a network. Network life cycle models are useful in the context of network design because they help to clarify where and how the network architecture, network components, and overall structure fit into the larger life cycle.

The Cisco PPDIOO (Prepare, Plan, Design, Apply, Run and Optimize) model is one of the most widely used network life cycle models.

Prepare: Here is where high-level requirements and strategies are defined. Your contribution at this point can, for instance, contain specifications and fundamental research.

Plan: Based on the data gathered during the planning stage, this step deals with specific network requirements.

Design: The design phase involves developing a comprehensive network design using the data from the preceding two stages.

Apply: The distribution and setup of the network infrastructure take place at this point. Typically, the test is run at this point to validate the design.

Run: This is a phase in the network's life cycle for use in production. At this point, monitoring is crucial to ensuring that the network operates as intended and that issues can be fixed quickly.

Optimization: Most networks need to be adjusted and optimized at some point in their life cycles. The definition of the change occurs at this point. The loop begins at the beginning when planning and implementing significant changes.

Network Design - PPDIOO

Cisco's PBM (Plan, Create, Manage) and NDLC (Network Development Life Cycle) are two other network life cycle models. The general phases (information gathering, design, application, and improvement) and cycle structure are the same regardless of the model you select. Understanding any network life cycle and how the network architecture fits in is crucial.

Step -by- Step Network Design

Let's explore the procedure for constructing a network infrastructure now that we are familiar with the principles underlying the network life cycle model. Although the scale and complexity of your network design details vary, this fundamental framework can guide your decision-making.

1. Set the requirements

Any network design project should begin with information gathering and the development of network and technical requirements. The rest of the design falls apart in the absence of clearly stated goals.

Work requirements help you define what you need to do this means:

- Support the new office
- Improve the end user experience
- Cutting Costs
- Follow new regulations
- Improve business continuity

Business demands are compatible with the preparation stage when viewed through the lens of the PPDIOO life cycle model. To ascertain business requirements, you should collaborate extensively with stakeholders. It's time to talk about the technical/functional needs after outlining the job criteria. Sample requirements include:

- Band width
- Security Requirements
- Special protocols that need to apply the project
- RTO/RPO (Rescue Time Target/Recovery Point Target) Number
- Working Time SLA (Service Level Contract)

When establishing requirements, do not disregard the constraints. Budget constraints, for instance, will apply to business requirements. Technical specifications could contain restrictions, including the necessity to support legacy programs.

2. Evaluate the current status of the network

You generally won't start from scratch in the majority of networks. Making life simpler can occasionally be beneficial, but it can also make projects challenging. For instance, there is no need to be concerned if wiring is already there for all setups. However, the present cable is now a problem that needs to be fixed if you are just using Cat5 cable and require Cat6A to handle 10GBaset. It is crucial to know this at the start of the design process, regardless of the state of the network. You should assess the network's present state before recommending any special designs. You should know about network performance, data flow, applications and services on the network, network security, and physical and logical order by the time you complete this phase. Examining current network diagrams, policies, and monitoring tools can be done for this segment. In other situations, you need to employ safety browsers and automatic network mapping tools to get a complete view.

3. Design your network topology

You can begin blocking the operational network components after understanding your requirements and the present state of the network. You must take into account both the network's logical and physical elements in this stage.

Consider the following while designing a physical network:

- Operation of copper and fiber optic cables
- Required number of key port points
- WiFi Access Point Position
- Shelf layout
- Cooling and Power

The logical network design performs the following:

- IP addressing/sub -network
- VLAN
- Data flow

4. Network topology

You ought to be able to produce the static maps of the logical and physical networks you designed after completing this step.

5. Tip: Keep in mind cloud networks and workloads. Internal and cloud data streams must both be considered in your network design. Let's examine the idea of two fundamental network designs before going on to the next stage: hierarchical network layers and design from top to bottom and from bottom to top.

5. How are the core, distribution, and access layers organized in a hierarchical network design?

Three fundamental network layers are the foundation of the conventional hierarchical network design. Each layer controls a different area of the network's data flow. Layers [16–20] include:
Core layer: This layer controls traffic flow between various geographic areas. In other words,

it serves as the network's support system. High-performance, pricy core routers perform best in the core layer.

Distribution layer: Between the access layer and the core layer comes the distribution layer. It serves as a barrier and uses networking concepts to control or permit data flow between various sub-networks in the network. The distribution layer partners include less expensive routers and L3 switches.

Access layer: The layer comprising user computers, printers, and VOIP phones is known as the access layer. The packages in this layer are changed and traffic is directed by smaller "access switches". You might not always require three layers. For instance, numerous network distribution layers entirely exclude

From top to bottom and bottom to top design

From top to bottom and from bottom to top are the two methods used for network architecture. When developing your network from top to bottom, you begin with the application layer, build the model, and then reach the physical layer. The layout is reversed from bottom to top. The idea that working your way down from business requirements is preferable is frequently held. Though it typically takes longer from top to bottom. Starting with the physical components of the network and moving higher, the network design works from bottom to top. Because it locks you to particular results before getting to the application layer on the users, creating a network from bottom to top may be faster, but it also forces you to compromise on the missing needs or expected results.

Select hardware and software

You must specify the gear and software you'll be using in this phase. In some circumstances, this happens concurrently with step 3. In other circumstances, some software or hardware can be predetermined at the start of the project. After learning what the network should be able to achieve, choosing specific hardware and software to employ typically gives you the most freedom. At this point, specific cables, racks, network hardware, servers, apps, cloud services, etc. are needed to realize your concept. You'll decide. Think about any supply chain issues that could arise from large or customized orders. Your project's completion may be delayed if you don't have your access switches or structural cables in a timely manner.

Application plan and beyond

Now that you've chosen your gear and software and designed your network, you may plan the application and more. To complete this step, a distribution, configuration, and testing strategy must be developed. A small-scale test distribution may be included in some circumstances (often larger nets) in order to confirm the viability of the concept before scaling it up.

Rigorous The important components of creating a plan successfully are project management and communicating with stakeholders. Network distribution involves a lot of moving pieces, so your plan should consider project milestones, change management, and significant outputs. You will also require a transition strategy if the network is to be run by a different team from the one that created it. If you are in charge of managing an advanced network, it's critical that you have a strategy for monitoring and maintaining the network.

Network Design Application

Now that we have a framework to follow, let's look at some network design best practices to help us make more informed choices.

1. Integrate security early

The notion of "shifting security to the left" in the Devops community is well-liked for a reason: it is effective. You may lessen the likelihood of running across security vulnerabilities at your security position by prioritizing security from the start of a project. Additionally, because the majority of decisions are already made, security will not be applied inefficiently, increasing network performance is more likely. Prioritize and establish performance and security requirements at the project's outset. In theory, we should all understand that "security is

everyone's responsibility," but in reality, this isn't always the case. Stakeholders that care about safety are typically a good idea for projects.

2. Know when to use from top to bottom and from bottom to top

When you start from scratch, the design from top to bottom is typically a "better" choice. You can concentrate on company requirements and increase your chances of making the right decision by designing everything from top to bottom. Many network design initiatives, however, do not make financial sense to invest in from top to bottom. Efficiency is significantly more efficient, for instance, if you are already aware with the basic business requirements of your company and you merely need to grow your network or boost the bandwidth.**3. Standing everything**

If you can standardize, standardize. In the long run, troubleshooting, patch, care and asset management will greatly simplify. Some examples of what you can standardize and standardize: • Home computer name (for example, Printer 5. office2.lan3)

- Hardware model
- IP address scheme
- Cable color (eg. single color for VoIP, single color for data, etc.)
- Security strategy

4. Growth plan

After a year, the amount of network bandwidth used today will have changed. You should consider how much bandwidth demand is anticipated to increase over the network's lifetime and design for this scenario. The solution is simple: just add more bandwidth in accordance with your needs. However, it is more crucial to make sure the network is adaptable and modular enough to quickly accommodate growth. Even if you cannot predict your future needs, you can build your network with the possibility of having to scale it in mind.

5. Create and continue network documents

Missing, outdated, or missing network documents result in time loss, frustration, and significant technological debt. Make sure your network design and application output contain 1-3-layer network diagrams as a favor to you or your friendly neighborhood network administrator. After making them, make sure to move on with them.

Matters to be considered when designing computer networks

Some of the most crucial considerations in network design are copper and fiber, logical architecture, IP addressing, VLANs, capacity, and WiFi scope. In network design, a lot can happen, and it is simple to miss some details. Here are some crucial ideas to bear in mind when working on your next project.

Editorial request

Regulations that have an impact on the logical and physical design of the network should be taken into account while designing a network. Local construction codes, for instance, may have an impact on how you manage structural wires. The National Electricity Law in the United States includes specifications for the amount of power needed by your network hardware. Logically, agreements like HIPAA, PCI DSS, and GDPR impact both transfer data and still data. You should take into account these needs when designing a network in order to achieve harmony.

Cyber durability and backup

Corporate networks need some degree of error tolerance since network usability is crucial for business operations. Therefore, current network architecture typically includes n+1, 2n, or 2n+1 backup (or higher). Of course, extravagance and durability come at a financial expense. Your network architecture needs to strike a compromise between backup cost and durability. It

would be fantastic if you could consistently obtain five to five (99,999% of working time), but that is not inexpensive!A decent method to balance this is to consider the cost of the deduction time (i.e., how much money you would lose every minute/hour if the network fails) and compare it to the possibility that your present backup strategy won't work properly.

Cloud and internal

The optimum location to perform a specific workload is no longer always locally. Once your job and technical requirements have been established, you should carefully assess if cloud networking is a solution in and of itself. However, when the cloud is more suited (and vice versa!), be sure to lock yourself into an internal solution. We won't revisit the entire cloud and internal topic here.

Cooling and Power

It is simple to ignore the network's cooling and power needs. Don't commit this error! Your power distribution system won't ever function properly if you don't supply for your power needs. Your new network equipment may overheat and break down before its time if you do not consider the overall cooling of the equipment. Observations on power and cooling

- Verify that the electrical boards and plugs you have are appropriate for your new appliance.
- Keep Power over Ethernet (Poe) loads in mind when sizing your UPS (battery backup) and other power sources.
- Check that the server room's cooling system can handle the extra heat generated by the new network hardware, or make cooling-related investments.

No one dimension can be used to describe the complete network design. But if you take the appropriate technique, you may produce a design that meets your company's requirements. Of course, as PPDIOO demonstrates, a network does not come to an end after the design phase, as the life cycle model demonstrates!

The creation and use of networks is just the beginning. The real business begins once the network is broadcast. Active network monitoring aids in network maintenance and records your choices for network upgrades or expansion.

6. RESULTS AND DISCUSSION Estimated maintenance with IoT and IIOT

Equipment maintenance is a difficult and time-consuming operation that consumes the majority of field workers' time and costs businesses money. The Internet of Things (IoT) and the Internet of Industrial Objects (IIOT) employ sensors to gather data about systems and machines, then transmit it to users across a network. In order to assess data like temperature and humidity, the system uses machine learning algorithms to estimate performance and anticipated outcomes. Caterpillar analyzes data from devices and equipment to find trends using machine learning and IoT. Caterpillar discovered a correlation between fuel meter values and the amount of power needed to cool the ship's containers.

Logistics planning

The proper individual receiving the appropriate amount of stuff at the appropriate location is ensured by logistics planning. The management of suppliers and the commodities they send to a company is the main emphasis of incoming logistics. The management of orders, delivery, storage, stock control, and use all involve a number of intricate operations. Businesses may predict and suggest future transactions by gathering information about current planning and fostering a machine learning model. Walmart employs machine learning to boost operational effectiveness. Real-time modifications can be performed and any deviations in the supply chain can be found with the help of the Retail Link 2.0 system.

Retail trade

Large amounts of data are being gathered by retailers and businesses who sell things online. It contains information on consumer demographics, spending patterns, and preferences. In this

regard, the main difficulty was to gather data both online and offline and to identify the trends that could have a favorable impact on data pricing, inventory, customer experience, and profitability. Retailers can use machine learning to find patterns in data so they can act on what they learn and improve their interactions with customer brands. Users of websites for shopping and browsing can submit data to e-commerce businesses, who can then utilize this information and market trends to offer customized product recommendations that will boost sales. One of the first businesses to use personalized product recommendations based on shopping and purchase history is retail behemoth Amazon. The strength of these features comes from machine learning. One of the businesses that makes use of Alexa to swiftly access information from its data is the upscale clothing retailer Rebecca Minkoff. In under one second, Minkoff was able to receive the correct answer when he asked Alexa which item from the spring collection was the most popular.

Autonomous vehicles

Future transportation will be safer and greener thanks to autonomous vehicles. The use of machine learning and deep learning by software engineers strengthens computer algorithms that enable a vehicle to make decisions that are comparable to those made by humans. For instance, Drive.ai, one of the industry's most potent software tools, employs the deep learning algorithms of autonomous vehicles to "build the brain." To ensure road safety, the study team adds definitions for features like pedestrians, traffic signals, and road signs to the software. By combining unedited photos with raw data, it evaluates how well an object will be recognized and how to maneuver around an obstruction while travelling on the road [24].

Teaching of writing

Even for seasoned academics, subjects like how to write an article and how to draft an essay might be difficult. Additionally, the supervisor-author relationship can be challenging and lessen motivational slumps. With the aid of machine learning techniques, the automatic writing assessment program ECREE can accelerate this procedure. For instance, the algorithm can swiftly point out the draft regulations to analyze when a student prepares and submits Ecree's review. The computer program evaluates student work based on 36 factors and may provide students feedback in under a minute. Any number of students may submit messages to Ecree. Each pupil may be examined fairly and according to the same standards thanks to the vehicle.

7. CONCLUSION

A area of computer science known as machine learning was created in 1959 as a result of artificial intelligence research on numerical learning and model recognition. A system called machine learning looks into the development of algorithms that can forecast data and learn as a structural function. Such algorithms work by creating a model from sample entries to make data-based estimations and judgments, as opposed to merely obeying static program instructions. Life has been revolutionized by artificial intelligence and machine learning. The application of machine education is strengthened by the historical evidence. New data mining, curation, and management strategies have also given recently developed modeling algorithms crucial support. In conclusion, machine learning offers a great potential for a relaxed and problem-solving lifestyle that will eventually effect humanity.

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A SURVEY OF THE ARCHITECTURES AND PROTOCOLS FOR WIRELESS SENSOR NETWORKS AND WIRELESS MULTIMEDIA SENSOR NETWORKS

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ABSTRACT: In this research, wireless sensor networks and wireless multimedia sensor networks are mentioned. Wireless sensor networks are a new technology that can be applied in many areas that have been quite on the agenda recently. By using wireless sensor networks, information can be collected interactively with the environment, this information can be evaluated collectively and changes can be made on the environment based on information if necessary. A sensor network allows you to easily access information at anytime, anywhere. This function fulfills the data by collecting, processing, analyzing and spreading. Thus, the network plays an effective role in the formation of a clever environment.
Keywords: Wireless Sensor Networks, Wireless Multimedia Sensor Network, Networks, Network architectures, Network Protocols.

1. INTRODUCTION

Developments in hardware and wireless systems have enabled the production of low -cost, low power consumption, multi -functional miniature detection devices. Hundreds and thousands of these devices can be created with the help of thousands. For example, these devices are distributed to a wide geography and a net-hoc network is formed. This distributed and the sensors that make up the network cooperate a detection network system. Wireless sensor networks; a wide range of revolutionary perception feature for different application areas offers capabilities. The reason for this is the sensor networks:

- Reliability
- Truth
- Flexibility
- Cost Efficiency
- It is the ease of installation.

Tilak etc. He stated that clever sensors could offer cautious surveillance and collect information about machine collapse, earthquakes, floods and even terrorist attacks.

- Sensor Networks
- Collection of information
- Information processing
- It makes it possible to monitor and observe various environments for civil and military applications.

With the developing technology, wireless networks have become widespread after wired networks. Wireless network technology has both ergonomic comforts and maximized the rate of use of systems. As a natural consequence of the widespread of this technology, wireless networks are mostly preferred in the field. Perceptions; Temperature, movement, heat, humidity, location, pressure, such as the perception of changes in many factors are equipment. These functions of the sensors are combined with wireless networks and communication and interaction between further distances were established. Wireless multimedia sensor systems in many civil and military areas are widely used systems. Successful results are obtained in physical events or in combination with media, and microphones. WMSN (wireless multimedia sensor networks) applications can be used alone, as well as in areas such as computer vision, signal processing, communication, and network technologies, robotic areas can be used in areas where online operations can be performed. Wireless sensor networks are wireless personal field networks consisting of many sensor nodes to collect data from the environment. IEEE 802.15.4 and Zigbee standards are used in the communication between the wireless sensor network nodes. With these standards, low power consuming, low cost, reliable and expandable networks can be created. In the thesis, it is aimed to reach the sensor network nodes from every point that can be communicated between wireless sensor network nodes and IP-based networks and access to the internet. In line with this goal, literature research was conducted on the standards used in wireless sensor network and IP -based networks. As a result of the literature research, it was concluded that data packaging, addressing, service discovery and security problems should be overcome in order to communicate between the two networks. After the detection of the problems, the methods used to overcome them were examined. With the examination of inter -network communication techniques, it was concluded that the most efficient method that protects the existing standards is a server -based method. Based on the results of the literature research, a server -based method was preferred for inter -network communication [5-10]. The server -based communication system created in the study consists of server, network gateway and wireless sensor network. The server used in the system is the unit that offers users on the internet side of the wireless sensor network. In the study, XMPP technology, a messaging protocol as a server system, was preferred. The reason why XMPP technology is preferred is to exemplify the usability of different technologies as a server instead of a classic web server as a server. It is unit agility in the system in which the interchangeable translation process is performed. The network gate is the only device that can communicate with both the internet and wireless sensor network. Network passages undertake data storage, service providing, packaging, addressing, service discovery and security procedures in the system. The wireless sensor network consists of sensor nodes and interacts with the environment in various ways. As a result, the integration of IP -based networks with a wireless sensor network was designed by designing a server -based system. With the designed system, the advantages of Zigbee standard in communication between networks were maintained by using the server -based method. In addition, in server -based systems, the usability of the XMPP server instead of the classic web server is tested with the application made within the scope of thesis.

2. EXTENT OF PAST WORK

2.1 Wireless sensor networks

Wireless sensor networks consist of spatially distributed autonomous devices, which use sensors aimed at monitoring the physical and environmental conditions of a particular position, including measures such as temperature, sound, vibration, pressure, movement, pollutants, and different locations. These devices communicate with each other through a wireless connection. These sensors may have limits in their resources related to memory, calculation power, energy, and bandwidth. They are presented in small physical dimensions and can be easily placed in

physical areas. They are also considered to be very seeking temporary networks that organize selforganizing. Considering the architectures, there are special address requirements due to local unique addresses and data-based technologies. A special benefit of these networks is that they are efficient in energy to solve impulse and overlap problems. A quick comparison can be made between WSNs and mobile temporary networks (MANET). MANETs are not as strict resources as they are working on a multi-by network and provide security through common key encryption. WSN uses a wireless connection and provides security through symmetrical key encryption [7,8]. While WSN supports private traffic models, it provides tighter resources with power processor speed and bandwidth. Some advantages and disadvantages of WSN are:

Advantages:

- Prevents excess wiring.
- It can accommodate new devices when requested.
- It is flexible enough to pass through physical sections.
- It can be used through a central monitor.

Disadvantages:

- It may have a lower speed compared to the wired network.
- When purchased in a high amount, the installation costs can be costly.
- Configuration can be very complex compared to cable networks.

2.2 Advantages and disadvantages of the wireless sensor network

Despite some disadvantages, WSN technologies are expected to be an important part of our daily operations and working systems shortly. A way to reduce obvious challenges related to technology is to partner with organizations such as Wipe lot and buy the optimized versions of technology directly. Wipelot wireless sensor technologies aim to increase telecommunication resolution, speed, and coverage and reduce energy consumption. Functionality IEEE 802.15.4 based "wireless sensor network" and 2.4 technology, as well as GHz radio frequency; these components are determined as the benefits of technology. This system and application, which works without the need for an interface, offers portable, flexible, and useful design items. Therefore, technology allows users to concentrate on tracking results by focusing on real-time situations. [8, 9]

2.3 How does it work?

The system produces the required power from the battery or natural energy source when transferring data communication to the desired location via the wireless connection. It has integrated small devices into the transformation process. These wireless receiver nets; It has proven benefits such as internal processing, independent organization, flexible contact with the environment, interconnected work, small physical dimensions, and comfort. It allows remote monitoring through controlled web applications that offer a wide range of wireless networks to create lower costs and power consumption. In the past, these procedures were performed through battery-powered telecommunications. In contrast, the receiver nets easily collect data for local control efficiency, event diagnostic, and monitoring. Therefore, these systems help to eliminate the inadequacy of worn systems and cable-based solutions and provide communication supported by low energy consumption.

2.4 Wireless multimedia sensor networks

Wireless multimedia sensor Networks (WMSN), sound and video, such as multimedia content of devices with the ability to detect the wireless connection with each other systems. These systems have a layer similar to the cable network layer structure. These systems are used effectively in many areas such as health, traffic, safety, and the industrial sector.

2.5 Scope of application

Application areas are expanded day by day but can be divided into major categories. WMSN can be used for surveillance purposes. This purpose is mostly used in the field of security. The determination of crime and terrorist attacks in advance, follow-up and control of public activities and the presence of missing persons are used effectively. In this application, moving/standing video images and audio recordings are examined. Criminal detection, loss search, identity detection, etc. Support to images obtained during the operations, vector machines (SVM), GAUSS (GPC), integer-numbered wave case transformation (ILWT) by applying classifications and images are classified. It was determined that the performance of the classifications together was increased in the investigations. WMSN can be used for traffic supervision. Theft, usurps, traffic accident, and traffic by relieving flow and identifying empty parking spaces are used in areas such as directing users. Studies are continuing for effective use in the field of traffic supervision. With the inclusion of the internet in these applications, the structure has expanded. While developing the design; the Technology to be used for the maximum package that can be passed through physical and Mac layers (IEEE 802.15.4) should be determined, the security algorithm to be used in the link layer should be selected, and scenarios such as transmission time, waiting time and time for communication should be carefully determined for the sensor nodes coming from different IP addresses. WMSN can also be used effectively in health services. With the spread of new generation 3G/4G technologies, it can be presented with the determination of emergency health status, as well as controlling the condition of patients from home and being able to perform imagecentered procedures such as ECG without going to the hospital. In addition, health services such as remote control of body temperature, blood pressure, heart rate, and respiratory frequency can be provided instantly.

2.6 Factors affecting the design

Wireless sensors generally consist of several basic structures. It is generally possible to divide the structure into two layers. In the first part, there is an analog-digital converter in the second part, while the processor, sensor system, memory, power unit, and control/control unit are in the second part. The general working logic of the system is as follows: Data is taken with the sensor with the user interface, network device, and transmission software. The data received is processed from the analog-digital converters and the CPU is also processed and certain results are obtained. These results are subjected to various synchronization in the coordination unit.

2.7 The main problems that should be resolved and considered when designing are:

- The needs of each sensor device such as processor, memory, and power supply can be limited.
- The quality requirements of each application (QOS) are different. For example, while it is important to provide safe transmission of data in a short period in multimedia applications sent to instant messages, in the data received in the form of flow, it has become important to ensure the continuity of this flow. This should be determined in advance according to each problem type.
- Since the data you send is multimedia data, it is necessary to provide a healthy transmission of high bandwidth.
- Depending on the location of the data and the delay in the transmission, the capacity required is not the same. Therefore, a variable channel capacity need occurs.

- Channel sharing in wireless communication is a necessary concept. Therefore, there may be interaction in the transmission layers between the data. To prevent this interaction from damaging the data, it should be taken into consideration.
- Since the multimedia data sent are large, several algorithms and transactions can be applied to minimize the resources and costs in their transmission, and can be subjected to sorting, compression, and encryption operations.

3. Wireless Sensor Network Architectures and Wireless Multimedia Sensor Network Protocols

3.1 Network Architecture

The transmission of wireless sensor networks is also among some layers. Before moving on to these layers, brief information about network architecture should be given [10-11]. According to

Ian F. Akyildiz, Tommaso Melodia, and Kaushik R. Chowdurry; •
Perceptions used may be audio/video and/or numerical sensors.

- Audio/video sensations (Video/Audio sensor) are perceivers who can capture sound and move/fixed/fixed images at low resolution.
  Numerical sensor (SCAR SENSOR), Pressure, Moisture, Temperature, such as perceivers. Storage capacity is low.
- Multimedia processor hubs are the relatively larger capacity hubs that provide data transmission between sensations with as little loss as possible.
- Storage Hub is the hub that allows this hub to keep real -time data long for a long time and even process with certain algorithms without being presented to the user.
- SINK is the area where users are directed to the user and transmit the multimedia currents from them to the user.
- Gateway is the part where Sink and the Internet and IP -based WMSN communicate with each other. There is a geographical area coverage area.
- Users are located in the last step of architecture. They are interested in the results of the WMSN within the geographical area they determine by using IP addresses and interfaces.

3.2 Network Layers

As in the standard network structure, there is a layered structure in WMSN. Transmission is made between layers [12-20]. These layers; Application layer, transmission layer, Network layer, Mac layer and physical layer.

3.2.1 Physical Layer

The physical layer is the layer where the network structures are materially. In this venture, which is resistant to initiative, multiple networks can be found together. As the number of networks in this layer on the bottom of the architecture increases and/or transmitters in the Mac layer, the possibility of parasites on the network increases. Equal methods are used to prevent these parasites on the network. One of them is UWB technology that offers high data rate transmission with low energy consumption. In this technology, information is transmitted as short-term blows such as radio frequency. However, this transmission may cause delays and efficiency in the transmission of multimedia data, which are continuous. For the solution of this issue, cross -layered transmission is seen as a light. Another technology is SDR-based MS technology. This technology makes different different wireless networks available in the same frequency band.

3.2.2 Mac Layer

The Mac layer is a layer in which the control and recovery functions of errors are fulfilled. The Mac layer used for WMSN differs from the presence of power savings, motion management and error recovery strategy and Mac used for wireless networks. Mac protocols used in cellular communication are time-compartment multiple access (TDMA), frequency compartment multiple access (FDMA), and code divided multiple access (CDMA) protocols. Although the method applied is different, the purpose is to reduce the initiative between the data. Mac protocols can be divided into 3 groups as planned, unplanned and hybrid Mac protocols. In the planned Mac protocols, communication between the sensories is made sequential. TDMA can be given as an example of this method. Synchronization is increased by reducing the collisions between the sensories. In unplanned Mac protocols, independent communication is allowed between the sensories. The complexity is low and energy saving is high. Hybrid Mac protocols are a protocol targeting energy saving. It has the ability to separate long and short packages. In this way, when planned Mac protocol methods were used for long packages, energy savings were obtained by using unplanned MAC protocol methods for short packages. While this structure adapts to rapid changes, its complexity is high. In addition to these three approaches, another Mac protocol that begins to attract attention is the cross-based Mac protocol. The main purpose of wireless communication is to minimize energy expenditure while performing communication at the maximum level. In order to ensure this, it was found that transmission with layer architecture was found to reduce the yield while saving energy. The cross -based Mac protocol is based on this structure. In the studies on this method, it has been observed that productivity increases, reliability, management and planning increases the controllability. From this point of view, the reduction of costs and increasing the yield will increase the effectiveness of the WMSN.

3.2.3 Network Layer

This layer is a layer of routing. The main applications performed in this layer can be shown as multiple errors tolerance, providing connection quality and energy optimization. The data coming from the sensors to this layer may be in different ways. For example, in a video sensor, multiple cameras can therefore come to multiple image data. In this case, the reduction of the data is performed in this layer and sent to SINK. The situation is slightly different in directing real -time data. In these data, the accuracy of time, speed and data is important. In this case, it can be checked by the guidance protocols whether the data pass between the Mac and the Network layer is healthy. One of these protocols is the Multi-Way and Multi-SPEED routing protocol (MMSpeed) approach. In this approach, while trying to balance between the two layers, delay measurements and feedback mechanisms are taken into consideration. In the same way, the incoming data may be subjected to a number of deterioration due to external factors, such as rain, snow and/or elements such as camera lens. In this case, some algorithms should be applied to correct the deterioration. Various methods can be applied to maximize the transmission in the network layer. For example, plan and friends increase this transmission
They worked on nodes. As it is known, the data move through the sensor nodes. When various optimsasions are applied on these nodes, the connection time, the power of spent and the quality of the transmitted data were affected.

3.2.4 Transmission layer

It is the layer where the relationship between the network layer and the application layer is established. Although the TCP protocol is preferred in the transmission layer, the UDP still maintains its place as a preferred protocol. The UDP protocol continues to be preferred instead of TCP in some applications. The real -time transmission protocol (RTP), which works with

UDP, is sent in formats such as real -time transmission control protocol (RTCP), which is adapted to dynamic timely conduction, and multimedia packages for KMAA in JPEG2000 and MPEG.

Because the content of the UDP and the multimedia package is not easy to distinguish. Instead of UDP, TCP is more successful in finding and relieving a tremor in data transmission and the obstruction in the network. However, UDP is more effective in safe transmission of data. However, TCP cannot distinguish the band on which this blockage is on. Factors such as excessive traffic density, congestion, high package recording rate, delays, excess energy consumption in the transmission layer are factors that adversely affect the performance of the transmission layer. In order to increase the performance layer performance, measures can be applied to increase the bandwidth, minimizing real -time delay and efficient use of energy.

3.2.5 Application Layer

Application layer is the layer where the user interfaces are located in the KMAA coding section. It is aimed to reach the best bandwidth in the coding phase by spending the least energy. Multimedia sensories also have Encoding processes should be preferred with the least complexity of these operations. As complexity increases, cost and energy will increase. But there is also a dilemma that needs attention here. As the computing complexity increases, the cost, time and energy consumption increases, and it may be difficult to solve in simple coding.

4. RESULTS AND DISCUSSION

4.1 Service Quality Concept

Service Quality (QOS) can be expressed as the service quality provided by the application for network applications or the quality of the application for the user. In terms of the user, QOS is the usability that the application provides itself, not the function and capacity quality of the application. In terms of application, it is based on the reliability, functionality and interaction between layers. QOS by the network perspective is to ensure the situation where network resource use is at the highest level. The main purpose of QOS is to increase the bandwidth to the highest level by using different algorithms or mechanisms in each layer for each data in the network structures where different multimedia data are available. Since the structures and QOS supports of different types of networks are different, limitation criteria and applicability can also be changed. For example, for mobile AD HOC, bandwidth restriction is a more challenging application than dynamic networks. In terms of the application layer, QOS can be expressed in general as the number of active senses and the low error rate of the data from the sensoria's. As a network layer, the QOS deals with the application of the data between layers, not the applicability of the application.

4.2 Procedures that can be applied in transmission of multimedia data

In the transmission of data such as sound and image, cost and time savings may need to be subjected to different procedures to protect the integrity of the data and to ensure safe transmission. These operations are compressed, encryption and so on. It could be. There are different algors that can be used for this purpose. F.Akyildiz and his friends, who work on the methods to be used for compression process, examined Entopy-based deviation measurement (EDM) and multiple cluster coding protocol (DMCP) methods. From these methods, EDM is a method based on coding the data received from different cameras and compressing and calculating the yield to be obtained. It is aimed to create a DMCP -based coding hierarchy by using EDM results. The compression efficiency obtained by coding using EDM according to the result obtained is higher than the classic coding. The transmission of sound data with a multimedia data is a more sensitive issue. The sound is a data that can be exposed to external

effects and deterioration due to its structure. Encryption of this data is a method that can be preferred to prevent the deterioration of data that may occur in the data and to protect the integrity of the data safely. Honggang Wang and his friends have worked on cross -layer architecture and resource efficiency and data safety for the transmission of sound by using WMSN. When the results of this study were evaluated, it was seen that the MDBT -based sound flow method was preferred. In this method, the data can be divided into packets according to the privacy of the sound information, and instead of encryption of all data, it is provided to encrypt the data package that only occurs privacy. Thus, while the safety of the data is provided, the energy is increased and the energy spent is reduced by equal resource allocation.

4.3 What to pay attention to security

WMSN applications are not only used to measure numerical values such as pressure, humidity and temperature, but also in analog data such as image and sound. Of course, this situation has brought about how to ensure the integrity and safety of these data and what should be considered.

- Effective management of experience quality (QOE) and service quality (QOS) is one of the biggest problems. Features such as limited welding capacities, computability and compression processes are complex, privacy/security management and dispersion of data should be considered for QOS.
- In these applications, indirect or direct data are obtained. Questions should be taken into consideration how much of this data is personalized, how much can be used and how to protect it.
- WMSN applications are also subjected to attacks as in every communication application. These attacks, called taxonomy, can be categorized as communication attacks, confidentiality violations, sensing knot attacks, crypto logical attacks. In order to prevent these attacks, many safety steps such as preventing the begging of the network, checking the integrity and accuracy of the data between the nodes, and authentication should be taken into consideration and applied.
- The platform used should be selected by taking into account security, privacy and technological restrictions. In different layers, different algorithms (compression, authentication, collection, etc.) should be a hierarch platform that allows applicable.
- In addition to these problems, there are certain controls that should be considered in the design stage since it is known that wireless networks are much more open to attacks.
- Since transmission is made between the sensor nodes, the positioning of the nodes is very important. The placement and association should be created in a way that allows an attack that may come to the other nodes to cause the least damage to other nodes.
- It should be taken into consideration that the collected data are special data of the individuals and it should be known that confidentiality tenders can be made through operations such as listening and playing the data. For this reason, it should be emphasized how to develop a model for the protection of privacy during the design phase.
- When transmitting the data between the nodes, it must be controlled and confirmed that the integrity and accuracy of the data is preserved.
- There are various studies in order to ensure that the designs are realized by taking these controls into consideration.

5. CONCLUSION

Wireless multimedia sensor networks are one of the recent working areas. With the effect of technological developments, remote access and generally allowing system controllability has enabled it to attract more attention. It is thought that this technology, which is increasing in many areas from health sector to security sector, from industry to entertainment sector, will be used more effectively in the coming years. In particular, it is considered that the developments in the field of security and health are more interesting. Thanks to the new applications to be formed, it is vital to ensure that health services are provided more effectively and faster. New studies will be followed in this field. In addition, another interesting issue is the usage areas in security applications. It is thought that there may be practices such as determining the tendencies of the person by sound and video analysis among the following workspaces and the creation of the profile.

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THE IMPACT OF CLOUD COMPUTING ON THE DEVELOPMENT OF ARTIFICIAL INTELLIGENCE TECHNOLOGIES IN E-COMMERCE

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Abstract- The rapid advancement of technology has transformed the e-commerce landscape, with artificial intelligence (AI) emerging as a powerful tool for enhancing customer experiences and driving business growth. This study investigates the impact of cloud computing on the development and adoption of AI technologies in the e-commerce industry. Specifically, it explores how the availability and accessibility of cloud computing resources have influenced the development and adoption of AI technologies in e-commerce, identifies the key challenges associated with integrating cloud-based AI solutions into existing infrastructure and systems, and examines how cloud-based AI technologies can be customized and localized to meet the specific needs and preferences of users in the e-commerce domain. Through an extensive review of existing literature and analysis of case studies, this research sheds light on the benefits, challenges, and best practices related to the implementation of cloud-based AI solutions in the e-commerce sector.

Keywords: Cloud computing, Artificial intelligence, E-commerce, Artificial intelligence technologies

1. Introduction

In the course of human history, there have been a total of four industrial revolutions, the fourth industrial revolution profoundly changed humanity and increased interest in connecting physical items with people online, which had a significant impact on the retail sector. The Internet of Things, cloud computing, big data analytics, artificial intelligence, and augmented reality are all examples of fourth industrial revolution technology (Har et al., 2022). The opportunities that Artificial Intelligence (AI) produces lead to significant changes in the world's economic systems, it prompts the quick discovery of large data trends and enhanced product design to accommodate user preferences (Khrais, 2020). More people are paying attention to cloud computing, which is quickly emerging as one of the best resources for businesses, organizations, and users who need affordable, practical, adaptable, and scalable computing services for daily operations. Based on user needs for the resources, internet-based cloud computing enables the sharing of computer resources with other devices (Karagozlu et al., 2021). The use of AI techniques, systems, tools, or algorithms to enable online transactions for the purchase and sale of goods and services is known as AI in e-commerce. The convergence of cloud computing and AI presents a unique chance for businesses to gain a competitive advantage in the E-commerce industry by leveraging advanced technology (Petrović & Živković, 2019).

The aim of this study is to investigate the impact of cloud computing on the development and adoption of artificial intelligence technologies in E-commerce. Specifically, the study will explore how the availability and accessibility of cloud computing resources have impacted the development and adoption of AI technologies in E-commerce, identify the key challenges associated with integrating cloud-based AI solutions into existing infrastructure and systems

in Ecommerce, and examine how cloud-based AI technologies can be customized and localized to meet the specific needs and preferences of users in E-commerce.

The study will draw upon existing literature on cloud computing and AI technologies in Ecommerce to provide insights into the potential benefits and challenges of adopting cloud-based AI solutions. The study will also identify best practices and recommendations for businesses looking to implement cloud-based AI technologies in E-commerce.

The paper is organized in the following order: Section 2 reviews a few related studies, Section 3 describes the findings and discussions. Section 4 explains the summary and conclusion of the presented paper.

2. Relatedwork

This section reviews related studies and finding related to cloud computing's effects on the use of artificial intelligence technologies in e-commerce. Petrović and Živković (2019), stated that the advancements that cloud computing and artificial intelligence have brought to society have the potential to be quite significant. If it weren't for the analysis of enormous amounts of information, the corporate sector would not have access to a wide range of opportunities. Operations have been storing significant data, and sometimes even all of the data, in the cloud for some time but artificial intelligence has provided more relevance to the classification and arrangement techniques of this diverse storage.

In a study conducted by Bawack et al., (2022), the research focused on AI in E-commerce with more emphasis on China and USA. The study offers insightful information on current research trends and potential paths for AI in e-commerce. The report points up a number of research holes in the area. The paucity of research on the moral and social ramifications of AI in e-commerce is one of the major gaps in the field. More research on the effects of AI on employment, privacy, and consumer behavior is needed, the report contends. This discovery is significant because it emphasizes the need for a more comprehensive approach to AI research that considers the technology's broader societal ramifications.

Yathiraju, (2022) found out that the effectiveness and efficiency of decision-making processes can be greatly increased by integrating an Artificial Intelligence (AI) model in a cloud-based Enterprise Resource Planning (ERP) system. The study shows how the AI model can be used to quickly evaluate huge amounts of data, spot patterns and trends, and generate precise forecasts and suggestions for company operations. The research's conclusions are significant because they demonstrate how the incorporation of AI in ERP systems has the ability to change established business procedures and give companies a competitive edge.

Akter et al., (2022), the research showed that implementing digital innovations like artificial intelligence (AI), blockchain, cloud computing, and data analytics may greatly enhance corporate processes and provide businesses a competitive edge. The study demonstrates how these technologies can be utilized to streamline operations, cut expenses, increase decision-making, improve customer satisfaction, and spur innovation. The study also identifies the main obstacles that firms must overcome in adopting these technologies, such as a lack of technical experience, concerns about data privacy and security, and regulatory compliance. These obstacles include the desire to boost efficiency, revenue, and competitiveness.

3. Targeted Research Questions in this Article

3.1.How has the availability and accessibility of cloud computing resources impacted the development and adoption of artificial intelligence technologies in E-commerce? The fourth industrial revolution may be brought about by the development of many application domains such as Internet of Things (IoT), big data, and cloud computing, which can lead to increased automation and a high degree of connectivity between humans and machines (Kashyap et al., 2022).

Artificial intelligence

AI is fundamentally necessary for the improved performance of all technologies. It is a technology that spans several different technological advancements (Kashyap et al., 2022). Intelligent devices or software that can think like humans make up artificial intelligence technology (Castillo & Taherdoost, 2023). There are two ways to teach and develop artificial intelligence: supervised learning and unsupervised learning. In supervised learning, AIs are given training datasets that define the parameters of a successful output. Unsupervised learning differs from supervised learning in that training datasets and results are not predetermined. Their goal is to use binary logic and the provided data exclusively to tackle difficult issues. The system does not only classify returned values as correct or erroneous (Petrović & Živković, 2019). In 2017 there's an increasing rate of AI adoption in different sectors. In figure 1, it can be seen that in AI 2017, a majority of new businesses were focused on the core AI, healthcare, and business intelligence sectors.

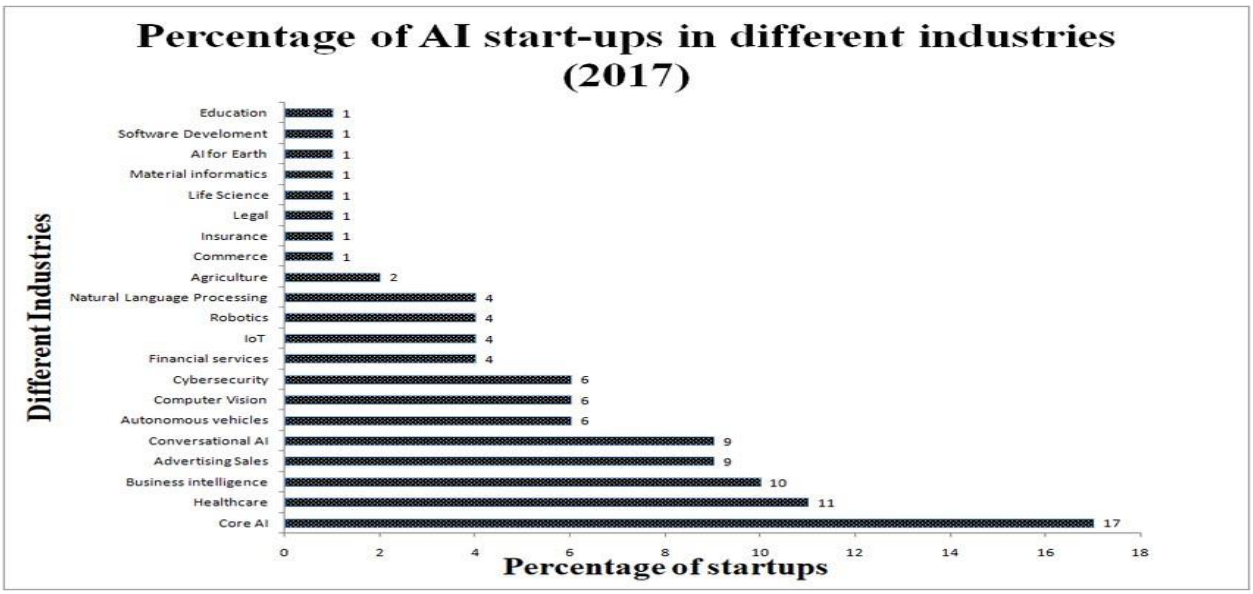

Figure 1: (2017) data on the percentage of AI start-ups in various industries (Soni et al., 2019).

Cloud computing

The phrase "cloud computing" refers to a consumption model of computing that is built on service level agreements between service providers and consumers (Yoo & Kim, 2018). Cloud computing, which uses the internet and centralized remote service providers to keep information or data and applications, is becoming or becoming more prevalent in computer technology. The purpose of cloud computing is to use more computer power to carry out millions of instructions per second. Numerous cloud networks with high-tech connections are utilized by cloud computing to speed up data processing between the servers (Karagozlu et al., 2021). Solutions for cloud computing have been created to cut the expenses associated

with creating specialized software to support company operations. A widely used but effective idea for allocating resources in the field of cloud storage, the idea makes it possible for organizations and other people to share complicated system architecture and execute the solutions they require (Xue et al., 2021).

E-commerce

Over time, e-commerce has evolved into a key economic force. Its capacity to help businesses reach a wider consumer base and to let customers purchase whenever it's convenient for them have both contributed to its development and importance (Taher, 2021). It refers to the use of the internet and electronic media to transact in products and services. E-commerce requires a business to use information technology (IT), such as electronic data interchange (EDI), as well as the internet. Ecommerce is the direct sale of goods or services to a customer via the internet through a vendor's website. The gateway accepts payments made with a credit card, debit card, or electronic funds transfer (EFT) via a wireless shopping cart or shopping basket (Jain et al., 2021).

AI and cloud computing in E-commerce

Cloud computing and artificial intelligence (AI) have become prominent technologies in the business world, offering companies the opportunity to enhance their services and cater to their customers in a prompt, efficient, and cost-effective manner. This transformation enables businesses to become smarter and provide the best possible customer satisfaction (El Khatib et al., 2019).

Researchers planned a variety of cloud computing and Internet of Things (IoT) apps to work together to produce and gather data as it benefits from cloud computing and storage (Mohammed Sadeeq et al., 2021), Figure 2 shows the cloud and IOT architecture.

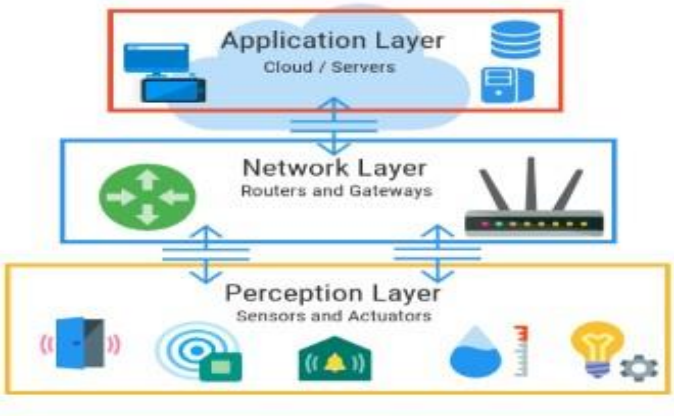

Figure 2 : Cloud- IOT architecture (Mohammed Sadeeq et al., 2021)

Cloud computing has facilitated the development of AI technologies by providing access to powerful tools and resources that are essential for training machine learning models. Cloud-based AI platforms, such as Google Cloud AI, Amazon Web Services (AWS), Microsoft Azure, and IBM (Watson AI group) have made it easier for businesses to leverage AI technologies without requiring significant investments in hardware and software ((Petrović & Živković, 2019).

Business intelligence (BI) is a technique combining cloud computing (CC) with AI (CCAI) that was put forth by Xue et al., (2021). The BI system offers solutions for data collection, storage, and analysis organization. The database platform is employed to transition BI to CC

methodologies. The created system is capable of numerous error detection, has lower computational costs, and improves performance, accuracy, flexibility, and programming. The experimental results as shown in Table 1, shows that CCAI can improve performance (98.46%), accuracy (99.75%), and efficiency (99.42%) for users while also improving user flexibility (99.42%).

Table 1: The analysis of accuracy, efficiency, performance and flexibility (Xue et al., 2021)

S. No.	Accuracy	Efficiency	Performance	Flexibility
1	99.35	98.23	97.82	88.92
2	99.68	98.76	98.32	94.65
3	98.68	98.82	99.36	96.94
4	98.52	99.62	99.12	98.62
5	99.75	99.42	98.46	99.42

3.2. What are the key challenges associated with integrating cloud-based artificial intelligence solutions into existing infrastructure and systems in e-commerce, and how can these challenges be overcome?

Cloud-based artificial intelligence (AI) solutions are becoming increasingly popular in ecommerce as businesses look to improve their efficiency and customer experience. However, integrating these solutions into existing infrastructure and systems can be challenging. Recent literature has identified several key challenges that businesses may face when integrating cloudbased AI solutions into their e-commerce operations.

One of the primary challenges is data privacy and security. With the increasing use of cloud-based solutions, businesses must ensure that sensitive customer information is protected. Belgaum et al. (2019), stated that the SDN flow tables only have a little amount of memory and can only store a few flow entries. And because smart devices are scalable, they are very vulnerable to attacks if these entries are changing dynamically and frequently. To make this integration more effective, an artificial intelligence technique is required to identify and stop all forms of threats at all stages. Another challenge is infrastructure issues. The preparation of datasets and making the task easier for humans can both be significantly impacted by AI. For finely calibrated outcomes, more robust infrastructure is needed, which is why computational power is a major barrier to both cloud computing and artificial intelligence. To provide the services they offer, both branches require extremely complex infrastructure, especially if these systems are created privately (Petrović & Živković, 2019).

Cost considerations can also be a challenge when integrating cloud-based AI solutions. Understanding total cost of ownership (TCO) is one of the main cost management issues of cloud migration. Managing variable expenses during a cloud migration is another problem in cost management. Organizations must take into account the cost of the cloud infrastructure, as well as the cost of transferring and managing applications and data, the cost of staff training as well as any other expenses related to the cloud migration process. Organizations risk spending more than they had planned if they don't have a good understanding of the TCO (Bandari, 2022). The lack of skilled personnel is also a challenge. Integrating cloud-based AI solutions may require specific technical expertise, which may not be available in-house. The increasing demand for AI also means a rise in demand for AI tech developers. Lari et al. (2022) suggest AI should be made a required subject in schools and colleges due to the growing role that digitization is playing in our daily lives. This will prevent future generations from being in a position where they have plenty of opportunity to advance digitization but insufficient knowledge to do so. Mohammed Sadeeq et al., (2021) discovered that Storage

and computational performance is another challenge. Plans that make use of IoT devices that are cloud-based must have strict performance objective requirements. Due to the widespread use of cloud-based IoT devices for various applications, such requirements may be challenging to achieve in all circumstances. There are various difficulties with integrating cloud-based AI into the systems and infrastructure that are already in place in e-commerce. However, by combining security protocols, spending on training and development, and a phased implementation strategy, these difficulties can be overcome. By overcoming these obstacles, businesses can benefit from the enhanced productivity, improved customer experience, and competitiveness in the e-commerce market that cloud-based AI solutions can provide. Belgaum et al. (2019), reported as shown in Table 2, that the possible challenges with cloud computing is ensuring dependability and supporting scalability, and AI can help solve these problems.

Table 2: challenges in Cloud computing and the solutions AI provide (Belgaum et al., 2021)

Challenges in cloud-computing	How AI provides solution
Infracture optimization	The classification of running state can be done using neural networks and fuzzy systems. Data can be extracted from earlier instances using machine language. Multi-objective optimization can be done using evolutionary computation.
Fault management and resilience	The tasks can be mapped to virtual machines using evolutionary computing, fuzzy systems, and neural networks. Machine learning, fuzzy systems, and neural networks can all be used to forecast errors.
Cloud service pricing	Machine learning, fuzzy systems, and neural networks can all be used to forecast market price trends and consumer demand. It is possible to map cost and demand for a price using neural networks. Multi-objective optimization can be done using evolutionary computation.
Load balancing	The detection of load imbalance, the mapping of virtual machines, and dependability problems can all be done using neural networks. To express preferences, constraints, and management policies, fuzzy systems can be employed. Multi-objective optimization can be done using evolutionary computation.

3.3.How can cloud-based artificial intelligence technologies be customized and localized to meet the specific needs and preferences of users in e-commerce?

E-commerce relies heavily on customization and localization, and cloud-based artificial intelligence (AI) solutions can help with these tasks. Recent research reveals that there are numerous ways to customize and localize cloud-based AI technology for e-commerce.

Beyond the simple "localization" of the website content, Singh & Pereira (2005) argued that websites now need to be culturally customized with design elements that take the user's cultural values into account. Website owners may overcome the significant difficulty of attracting users to the site and fostering trust and loyalty with them by taking into consideration the values of customers from particular nations and cultures.

Customization happens when the client proactively specifies one or more marketing mix components, as opposed to personalization, which occurs when the company determines,

typically based on previously gathered customer data, what marketing mix is ideal for the individual (Kumar et al., 2019).
One approach is to use machine learning algorithms (such as collaborative filtering, deep learning, unsupervised clustering, and k-nearest neighbors) as a preferred approach for creating applications that understand consumer preferences (based on their reviews, previous product purchases, and product usage) (Kumar et al., 2019).
Chen (2018) highlighted the importance of using big data analysis in the development of personalized recommendation systems for e-commerce. Web page extraction, feature analysis, behavior tracking, interest modeling, and information recommendation are some of the key features. Figure 3 illustrates the structure of a comprehensive electronic commerce system based on big data analysis.

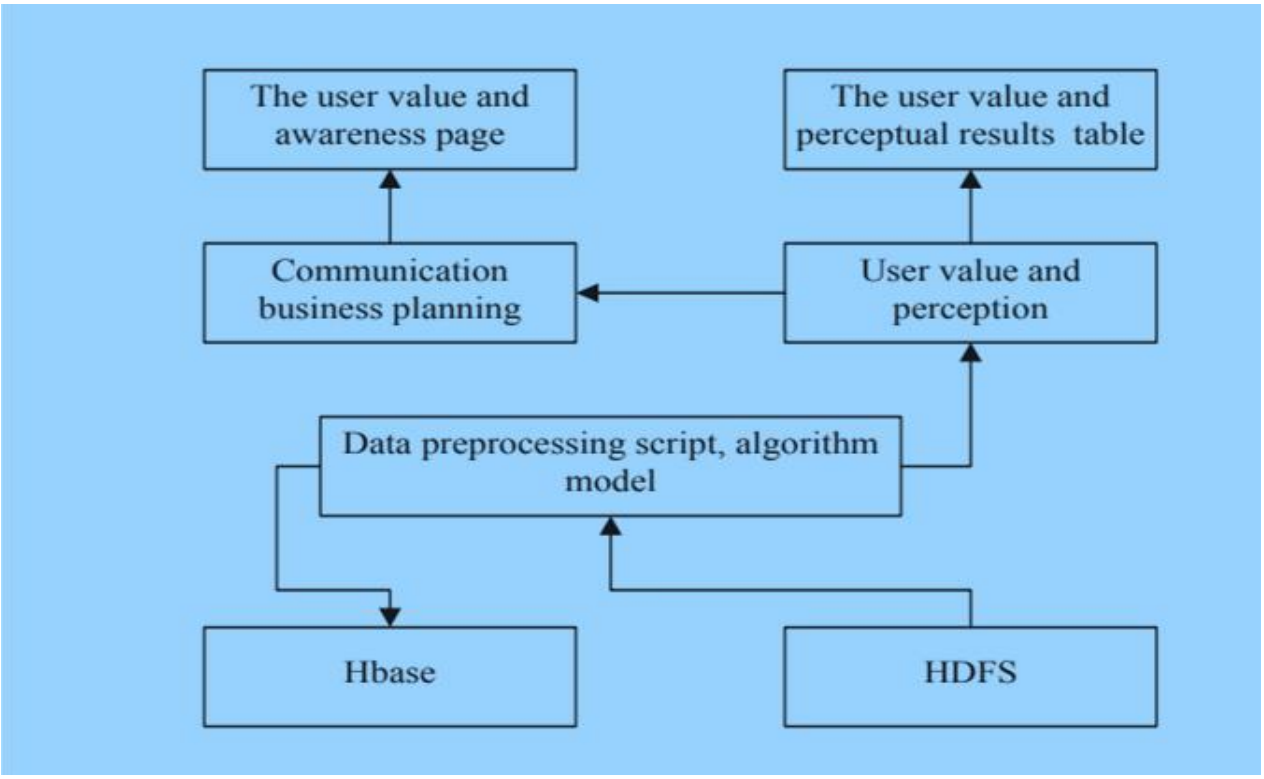

Figure 3: E-commerce system framework based on big data analysis (Chen, 2018).
The proposed model by Guo & Zhang, (2022) uses deep learning to improve the accuracy and efficiency of product customization and recommendation in cross-border e-commerce. The model involves collecting customer data and analyzing it using advanced algorithms to generate personalized recommendations that are tailored to the customer's preferences.

Another approach is to incorporate user feedback into the AI model to improve its accuracy and relevance to users. AI can be used to predict customer behavior and suggest personalized offers, promotions, and product recommendations based on their past purchases and browsing history. AI can be used to analyze customer feedback and reviews to identify areas where product customization can improve the customer experience. AI can also help in creating customized marketing messages that resonate with individual customers and their specific needs and preferences (Haleem et al., 2022)

Customer segmentation based on behavioral factors, such as past purchase history and product preferences, is effective in predicting customer behavior and providing decision support than traditional demographic or geographic segmentation. Using AI to create personalized

customer models can improve the accuracy and effectiveness of decision-making in online market (Pereira et al., 2022).

AI technologies in digital marketing can evaluate what content is most likely to keep users returning to the site based on historical data. AI analyzes which clients are most likely to cancel a particular service and which attributes are typical among those who unsubscribe. These statistics allow marketers to plan their upcoming campaigns and put in place measures that encourage people to stick around (Haleem et al., 2022).

4. Discussions and Recommendations

The study reveals that the availability and accessibility of cloud computing resources have significantly impacted the development and adoption of AI technologies in e-commerce. Cloud computing offers scalable and flexible infrastructure, allowing businesses to leverage sophisticated AI algorithms, machine learning models, and natural language processing capabilities without the need for extensive hardware investments. This has led to the proliferation of AI-driven functionalities in e-commerce platforms, such as personalized recommendations, chatbots, virtual assistants, and predictive analytics. However, integrating cloud-based AI solutions into existing ecommerce infrastructure poses challenges. These challenges include data privacy and security concerns, compatibility issues with legacy systems, and the need for specialized technical expertise. Overcoming these challenges requires implementing robust security measures, ensuring seamless integration with existing systems, and providing adequate training and support to users and developers.

The study also highlights the importance of customizing and localizing cloud-based AI technologies to meet user needs and preferences in the e-commerce industry. Tailoring AI solutions to specific markets and cultural contexts enhances user experience and increases adoption rates. Localization efforts involve adapting AI algorithms, language models, and recommendation systems to account for regional variations and cultural sensitivities, thus improving the accuracy and relevance of AI-driven features.

5. Conclusion

This study demonstrates that cloud computing has played a crucial role in the development and adoption of AI technologies in e-commerce. By leveraging cloud-based resources, businesses can harness the power of AI to enhance customer experiences, optimize operations, and drive revenue growth. However, challenges associated with integration and customization must be carefully addressed. To successfully implement cloud-based AI solutions in e-commerce, businesses should prioritize data security, ensure compatibility with existing infrastructure, and provide comprehensive training and support to users. Furthermore, localization efforts are essential to tailor AI technologies to the specific needs and preferences of diverse e-commerce markets. By understanding the impact of cloud computing on AI development and adoption, e-commerce businesses can make informed decisions and effectively leverage these technologies to gain a competitive advantage in an increasingly digital marketplace. Future research should focus on exploring emerging trends and technologies in cloud-based AI and their implications for the ecommerce industry.

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