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Review Paper on IoT Based Smart Applications, Home Automation

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ABSTRACT

This paper discusses internet of things and their applications in various domains such as healthcare, manufacturing, retail, transportation, etc. It highlights the importance of IoT technology in enabling devices and sensors to communicate and exchange data, leading to more efficient and connected systems. The paper explores different applications of IoT, including smart agriculture, smart cities, smart energy, and smart traffic monitoring systems, smart environment, and smart home automation. It also addresses the challenges and problems associated with IoT, such as privacy and security issues, handling big data, connectivity, data transmission, and compatibility. The literature review section examines the development of IoT in smart homes, identifies challenges and hindrances to widespread adoption, and discusses intelligent home automation systems. The survey analysis focuses on the gaps in IoT implementation, including security, interoperability, scalability, data management, ethical concerns, edge computing, and legal/regulatory frameworks. Overall, the paper provides an overview of IoT-based smart applications, their benefits, challenges, and future prospects.

Keywords: Internet of Things (IoT), Applications, Home Automation.

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INTRODUCTION

SMART applications based on the Internet of Things (IoT) represent a pattern in the area of software programs, using the power of the Internet of Things (IoT) to build seamless connection among devices and sensors, facilitating the inter- change of vital data. These applications aim to take benefit from the potential of cutting-edge analytical and machine learning techniques, enabling comprehensive examination of data produced by Internet of Things gadgets and sensors. The fundamental goal is to extract useful insights that can be used to make educated decisions.

These applications are applicable across a wide range of businesses and domains, resulting in substantial breakthroughs in industries such as healthcare, manufacturing, retail, and transportation. For example, in the healthcare industry, IoT- based smart apps can provide remote patient monitoring, prompt data analysis, and rapid response to emergency situations. These applications in manufacturing help to create intelligent and efficient production processes by maximizing resource use and decreasing downtime. IoT applications in retail improve the consumer experience by providing tailored services and real-time inventory management. Similarly, in transportation, these

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applications help to construct smart, connected systems that improve traffic management and vehicle economy

The ability of IoT-based smart applications to revolutionize the way we live and work is its distinguishing feature. These applications empower both individuals and enterprises by developing more systematic, connected, and insightful systems. They pave the way for a future in which our surrounding are not only connected but also intelligent, giving us the tools we need to manage an increasingly complicated and data-driven environment. The potential for innovation and advancement across multiple industries remains significant as the development of IoT-based smart applications continues to evolve, promising a future distinguished by enhanced efficiency, connectivity, and overall progress. [1]

Applications of Internet of Things:

Smart Agriculture

Smart Agriculture is one of the important domain of Internet of Things consists of greenhouse controls and micro climate which involves the use of smart technologies including automated machines, sensors, drones and actuators to escalate the quality and quantity of agricultural goods. This new advancement in the agricultural field have reduced the wastage of food, enabled productivity and manage a number of resources via remote sensing.

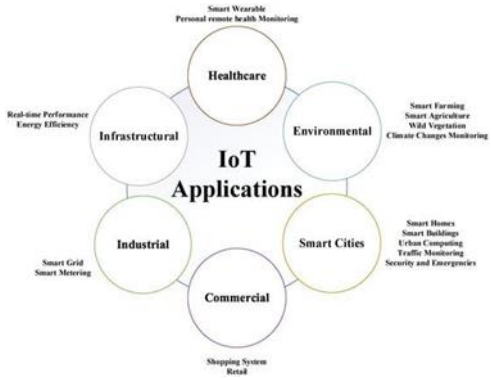

Fig. 1. Applications of internet of things (IOT)

Smart Cities

IoT based-smart cities are block out to grasp the data and technology to enhance the standards of the life for citizens, amplify sustainability and modernize the delivery of crucial services. In general, it depends on the Information and Communication Technologies (ICT) that put action into sustainable development programmers to address the issues driven by rising urbanization. Smart cities use IoT based-smart applications such as connected sensors, meters and lights to accumulate and inspect data, now in this era citizens can use smartphones, smart connected vehicles, smart home applications and wireless smart technology for connecting to a modern and smart city suspension. [13]

Smart Energy Meter

In smart energy, smart grids are used to pathway and dominance how much energy is consumed by various sectors. Observing the energy flow through powerhouses and wind turbines is concluded using

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winds powerhouses, then a smart energy meter is applied which accommodate a meter for measuring wind units. IoT is used as a main gate to connect this device to the primary server. [14]

Smart Traffic Monitoring System

Astute traffic monitoring frolic a crucial part for contemporary transportation and urban traffic. Intuitive traffic monitoring system has a great possibility to discharge with internet of things based on EPC and RFID. EPC assigns a unique technological system to each traffic instrument, ensuring that each traffic tool has an identifiable identity similar to a vehicle's license plate, and RFID technology is a non-automatic recognition method that uses radio waves to autonomously identify out traffic tools and collect associated data using radio frequency signals, guaranteeing that the effectiveness of monitoring systems according to RIFD is unaffected by bad weather. In general, IoT-based insightful traffic monitoring system provides a wide range extension potential and development. [2]

Smart Environment

Internet of Things used in smart environment allows people to use a variety of linked devices for better understanding of technologies to develop comprehensive, fully covered, and multi-level monitoring ecological network. Smart-environmental applications need to analyze high-speed data streams in real time to call for effective, quick and extensive data streaming analysis. Although IoT has made great progress in the field of smart environment, but still it can be strenuous to acquire, store, process and analyze the enormous volumes of data computational intelligence approaches. [15]

Smart Home Automation

IoT-based home automation is the ability to control and direct household appliances with the help of internet connected hardware. Preprogrammed entangled heating and lightning settings, security attributes, and alarms are all attached to a single hub or gateway and are controlled remotely through smartphone apps. Smart homes become more efficient and viable option for people as a number of less priced smart home technologies pop up. The first internet of things home automation system, the Echo IV was developed in 1966. Which provide people the ability to adjust their home temperature, make grocery lists, turn appliances on and off, and control the opening and closing of their house doors, controlling the home appliances become day by day useful by people as new technology is developing day by day. In general, home automation is regarded as a benefit that enables self-proving configurations in which everything is formatted with an internet protocol (IP) address, which can be detect, control and approach remotely with web technology. [4]

Current Challenges and problems of Internet of Things

Privacy and Security

Privacy and Security in IoT is a crucial issue, researchers in industry and academia should allocate their entire attention to the critical security and privacy issue. To handle these issues of privacy it is way too imperative to develop management and protocol structures. IoT is becoming a pivotal component in many applications, including which smart parking, smart traffic monitoring, smart energy control, smart environment and smart healthcare. Users of all of these applications need protection for their personal data and information which is related to their routines, interactions and movements with other people. [16]

Big Data or Large Data Sets

Many of the vital current IoT challenges are related to big data. Such that, how can we handle the data stream of countless numbers of transactions? What are the issues with processing, analyzing and exploring the data and information those processors have provided? How can we make sure that our data is still safe and useful? [3]

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Connectivity

One of the major difficulties of IoT is connecting to so many devices and gadget and it challenges both the underlying technologies and primary structure of the contemporary communication models. Currently IoT ecosystem can connect tens, hundreds or even thousands of devices, but when it comes to connect million or even billions of devices the centralized system of IoT becomes gridlock.

Fig. 3. Challenges in internet of things (IOT).

In such systems, the whole cloud goes shut down if any of the server gets down, to maintain such systems it requires substantial expenditures and spending to run cloud servers capable of managing such vast amounts of data, which arises from billions of devices. [17]

Data Transmission

There is lack of guarantee in IoT that the data of people is transferred securely through a shared medium without hiding that data from anyone and thereby avoid unauthorized data and information gathering about people and things. [6]

Compatibility and Longevity: This problem is generated from fragmented cloud services, absence of systemized M2M protocols, differences in operating systems and firmware among IoT devices. Many IoT-based devices that does not provide compatibility and longevity are becoming useless as new technology is increasing, but few IoT appliances including, smart fridge and smart TVs tends to give survives to people for longer period. [17]

Background

With the facilitation of more organized, interconnected, and perceptive systems, these applications are essential in revolutionizing our lifestyle and workplace. IoT applications, for instance, improve healthcare delivery and provide remote patient monitoring, immediate time monitoring and control, they help industrial processes run more smoothly. IoT-based solutions help retail organizations by improving customer satisfaction and streamlining inventory management. In addition, these applications aid in the growth of intelligent modes of transport and smart tracking of traffic in the transportation sector. The creation of IoT-based smart applications is a huge step forward in boosting connection and effectiveness through- out multiple industries. Such applications have the ability to transform enterprises by providing imaginative alternatives and creating an increasingly linked and smart future as they progress. These applications pave the door for an additional intelligent and data-

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driven strategy for addressing challenging obstacles and increasing overall system performance with the seamless incorporation of IoT technologies. Furthermore, the widespread use of IoT applications not only improves efficiency and connectivity, but also lays the groundwork for a more resilient and environmentally friendly future, as smart technologies allow greater use of resources and control of energy across a wide range of industries.

LITERATURE REVIEW

Literature review provides a comprehensive overview of the past studies on the topic that is being studied. This section will give us a brief insight on the topic of this study in the light of previous studies from different authors and researchers.

Background Theory

The Internet of Things, or IoT for short, is an innovation that allows for remote monitoring and gadget connection. The concept of the Internet of Things (IoT) has evolved significantly in recent years and is now used in a variety of settings, such as smart homes, telemedicine, and factories. Sensor network wireless technologies that are IoT-integrated enable worldwide communication of smart devices with advanced features.

Previous Studies

A wireless home automation network, which is made up of actuators and sensors that share resources and are connected to one another, is the main tool for creating intelligent residences. The Internet of Things' "smart home" framework includes home automation. If your house appliances and other items are connected to the Internet, they can be tracked and operated remotely.

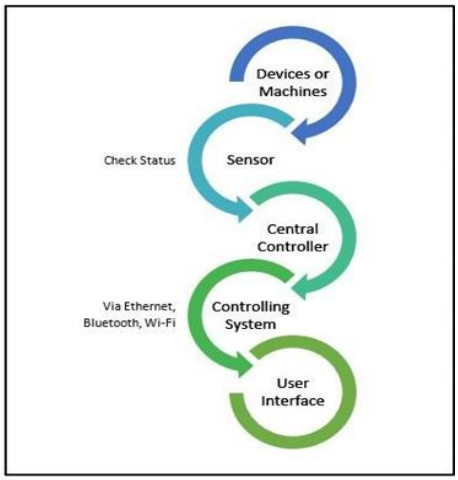

Fig. 4. Basic Block Diagram of Home Automation

These include lighting controls that turn on and off Controls that modify temperatures in the residence and produce consumption reports based on spoken instructions or applications for smartphones, and intelligent drip irrigation systems that begin at a particular moment of day on a customized monthly schedule help minimize wasted water. Innovative technologies for smart homes are now gaining popularity. [4]

The concept of smart homes has long piqued the interest of researchers, and significant work has been done to enable home automation. Despite being available for more than three decades, these

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technologies have not yet been widely used. To gain insight into this circumstance, we performed semi-structured home visits in 14 homes that had home automation. The long-term experiences—both successful and unsuccessful—of the families we spoke with reveal four challenges that must be overcome before home automation may become more generally used. High ownership costs, rigidity, subpar administration, and difficulties achieving security are some of these hindrances. Our findings also point to a number of areas that require further investigation, such as removing the need for structural modifications in order to install home automation, facilitating the composition of home devices and giving consumers basic security primitives they may set with confidence. [5]

Because of its numerous advantages, automation for homes is becoming increasingly popular. The controlled operation of residential features and gadgets through networked connections or remote control is referred to as ”home” automation. Artificial intelligence (AI) is the basis for the Internet of Things (IoT)’s immediate decision-making and automation. From a range of feature angles, the book discusses a number of intelligent home automation systems and technologies. The work revolves around the idea of house automation, in which smart devices incorporated into residential structures perform control and monitoring tasks. Techniques and technologies for heterogeneous home automation are examined. These include the internet, emails, Bluetooth connections, mobile, text messages, the ZigBee Dual Tone central controllers (Arduino or Raspberry Pi), Multi Frequency, cloud, and the Internet with performance. [6]

Recent advances in mobile phone technology and low-cost open source hardware frameworks have enabled the creation of low-cost structures for the “Internet of Things (IoT)-enabled home automation and safety systems.” Such systems frequently include an identifying and triggering layer made up of sensors such as sensors for temperature, detectors for smoke, inactive infrared radiation sensors, additionally referred to as movement sensors, and web cameras for security monitoring. A home gateway connects smart appliances, sensors, and other Internet of Things devices to the Internet. This paper explains the layout of an inexpensive smart entrance sensor that can notify an individual via a smartphone app when a door in their home or business opens. Several programming languages are used during the door sensor setup, as well as several applications and some of its drawbacks such as the possibility of interference from other radio frequency devices are looked at. [7]

According to the literary work, IoT is a network of “things” that are linked to a shared network path in order to interact, exchange data, or control each other. The proposed system, with or without the use of Android-based software, employs real-time monitoring, voice control to provide remote surveil- lance and control of power switches and devices. It employs a variety of sensors to monitor actual time device tracking and to keep your residence secure. To administer and observe it, a smartphone application connected to the internet or a corporate intranet is used. The project’s claimed advantages include lower household electricity costs, informing consumers about home security, and giving them the option to switch between devices using their voice or a simple toggle on their smartphone. Finally, yet importantly, and perhaps most significantly, the project will monitor usage to reduce electrical energy consumption and conserve the finite natural resources [8].

METHODOLOGY

Certainly! This paper’s methodology included a multi- faceted approach to thoroughly investigate the present state of IoT-based smart applications and their consequences. The survey was carried out using a mix of systematic literature review and qualitative analysis techniques. To begin, an extensive search was conducted across educational databases, scholarly articles, conferences, and reputable sources to gather a wide range of information on IoT applications across various domains. This entailed

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employing specific keywords and search queries pertaining to IoT, smart applications, home automation, security, scalability, and other relevant aspects. Articles and papers that provided in-depth insights, empirical data, case studies, and critical analyses of IoT applications were carefully chosen for inclusion in the review. Furthermore, to guarantee a robust survey analysis, global perspectives from scholars, practitioners, and professionals in the area of IoT were sought. This paper was critically evaluated in order to identify important themes, difficulties, and new developments related to IoT-based applications. This required categorizing and analyzing the gathered data in order to determine spaces, difficulties, and possible fields of future development in the IoT domain. The paper's design and simulation sections concentrated on combining the data collected into an in-depth analysis that stated the current state of IoT applications.

Table 1

Authors	Origin	Purpose	Source	Summary
Cristina Stolojescu-Crisan	Romania	Proposes qToggle, a flexible API for IoT-enabled home automation.	Article	Focuses on wireless networks, emphasizing IoT's rise in smart homes and industry.
A. J. Bernheim Brush, Bong- shin Lee, Ratul Mahajan	Canada	Identifies barriers, suggests improvements for home automation.	Research Paper	Addresses cost, inflexibility, manageability, and security concerns hindering adoption.
Vaishnavi S. Gunge, Pratibha S. Yalagi	India	Reviews intelligent home automation for residential buildings.	Review Paper	Explores approaches, enhancing understanding andimplementation of features.
Mohammad Asadul Hoque, Chad Davidson	USA	Explores IoT applications, designs an affordable smart door sensor.	Article	Focuses on applications in smart homes, healthcare, cities, and vehicles, addressing potential drawbacks.
Punit Gupta, Jasmeet Chhabra	India	Presents Ethernet- based Smart Home for real-time monitoring.	Review Paper	Highlights IoT for communi- cation, aiming to reduce costs, enhance security, and promote energy conservation.

This entailed dividing the paper into sections that covered various IoT application domains such as smart agriculture, smart cities, energy management, and home automation. Each section went into detail

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about the various applications, difficulties, and potential solutions. In addition, the paper included future prospects and areas for development in IoT by emphasizing emerging technologies such as AI integration, edge computing, 5G networks, blockchain security, and ethical considerations. The methodology aimed to provide researchers and practitioners in the field with an in-depth knowledge of applications for the Internet of Things, their challenges, and future directions.

DATA ANALYSIS AND RESULTS

Results

The paper provides an in-depth examination of IoT-based smart applications in a variety of domains such as healthcare, manufacturing, retail, transport, and others. It delves into the heart of the Internet of Things (IoT), highlighting its role in enabling device-to-device communication and data exchange. It brilliantly demonstrates IoT's transformative potential through the promotion of efficient and interrelated systems.

The paper meticulously investigates the impact of IoT in sectors such as smart agriculture, cities, energy management, traffic monitoring, environmental monitoring, and home automation by dissecting various applications. Each application domain is vividly described, highlighting the advances in technology and benefits realized in these industries as a result of IoT integration.

However, the paper isn't afraid to discuss the challenges of IoT implementation. It skillfully addresses concerns about privacy and security, handling massive amounts of data, connectivity issues, data transmission reliability, and compatibility between devices over time. These issues present significant barriers to the widespread adoption of IoT across industries, necessitating complex solutions and solid frameworks.

Analysis

The literature review section does an excellent job of tracing the history of IoT in smart homes, clarifying the barriers to widespread use, and discussing intelligent home automation systems. It provides insights into the challenges of incorporating home automation and identifies critical areas that require further investigation.

Moreover, the discussion section thoroughly identifies gaps in IoT implementation, focusing on critical aspects such as security, connectivity, scalability, data management, ethical concerns, edge computing, and legal frameworks. These identified gaps serve as a roadmap for future IoT advancements, indicating the need for complete solutions for creating a smoother and more secure IoT ecosystem.

The future works discussion provides a thrilling plan for IoT development. It highlights the potential of edge computing and 5G networks, blockchain for security and sustainability, AR/VR integration, and the critical focus on ethics and regulation. These future paths for IoT point to a transformative path that promises more intelligent, efficient, and secure systems.

Overall, the paper effectively captures the breadth and depth of IoT-based smart applications, emphasizing their benefits, addressing challenges, and painting a vivid picture of the exciting future possibilities.

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This section consists of critical discussion on the findings, explanation of the novelty of the results of the study, justifications of the results, and discussions how do the results differ or equate to other related studies.

Gaps and Limitation of IoT

This survey analysis examines the gaps in IoT implementation, addressing security, interoperability, scalability, data management, ethical concerns, edge computing, and legal/regulatory frameworks. It explores the challenges hindering the seamless integration and widespread adoption of IoT, including the need for robust security measures, standardized interoperability, scalable infrastructure, efficient data management practices, ethical considerations, effective edge computing implementations, and comprehensive legal and regulatory frameworks. By identifying these gaps, the analysis provides valuable insights for future improvements and advancements in the field of IoT.

Security and Privacy

Because of the large number of connected gadgets and the possibility of vulnerabilities they present, safety is an important issue in IoT. Many IoT devices have lax security, making them prime targets for cyberattacks. Furthermore, privacy concerns arise as a result of the enormous quantity of data generated by IoT gadgets, raising issues of data ownership, consent, and protection. [9]

Interoperability and Standards

The lack of interoperability and common standards is a significant challenge in the IoT ecosystem. Different devices, platforms, and protocols often operate in isolation, hindering seamless communication and integration. The absence of unified standards makes it difficult for devices from different manufacturers to work together and limits the scalability and potential of IoT deployments. [10]

Scalability and Complexity

IoT involves managing an enormous number of devices, generating massive amounts of data. The sheer scale and complexity of IoT systems pose challenges in terms of device management, data processing, connectivity, and infrastructure requirements. Scaling up IoT deployments while maintaining reliability, performance, and manageability is an ongoing challenge. [11]

Power and Energy Efficiency

Many IoT devices run on batteries or in environments with limited resources. Power consumption and efficiency of energy are critical worries for IoT devices because they have to function for extended periods of time without frequent battery replacements or recharging. Power consumption optimization while preserving capabilities and efficiency remains a challenge, particularly for gadgets used in remote or inaccessible locations. [12]

Data Management and Analytics

IoT generates a vast volume of data from numerous sources, including sensors, devices, and applications. Managing and analyzing this data efficiently is a challenge, as it requires robust storage, process- ing, and analytics capabilities. Extracting valuable insights, ensuring data quality, and implementing real-time analytics are crucial to realizing the full potential of IoT. [18]

Ethical and Social Implications

The rapid proliferation of IoT raises ethical and social concerns. Issues such as data privacy, consent, and surveillance come to the forefront. IoT applications in critical sectors like healthcare and infrastructure bring additional challenges related to data integrity, reliability, and accountability.

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Balancing innovation and convenience with ethical and societal considerations is a key challenge in IoT. [20]

Infrastructure and Connectivity

IoT relies on a robust and reliable infrastructure for seamless connectivity. How- ever, many regions still lack adequate network infrastructure, hindering IoT adoption. In remote areas or industrial environments with limited connectivity, deploying IoT solutions becomes challenging. Expanding network coverage, improving connectivity options, and addressing infrastructure gaps are crucial for widespread IoT implementation. [17]

Cost and Return on Investment (ROI)

While the potential benefits of IoT are significant, the upfront costs of deploying IoT solutions can be substantial. This cost factor can be a barrier to entry for smaller organizations or limit the scale of IoT. [24]

Edge Computing

The increasing volume of data produced by IoT devices establishes difficulties in transferring and analyzing that data in an effective and timely way. Edge computing, which involves analyzing information closer to its source (at the network's edge), can assist in addressing this issue.

Table 2

Aspect	Advantages	Disadvantages
Convenience	Home automation simplifies everyday duties, minimizing effort.	Reliance on technology may cause disruptions
Energy Efficiency	Smart devices maximize usage of energy, de- creasing bills.	Expensive initial device buy and costs for installation.
Security	Enhanced home security by means of remote monitoring.	Fears of computer hacking and potential privacy violations.
Comfort	Customizable environments for personalized comfort.	A learning curve for users who are new to technological advances.
Accessibility	Improved control for people with disabilities.	Problems with device/platform compatibility.
Cost Savings	Energy-efficient gadgets give to reduced utility bills.	Expensive initial investments; regular upkeep fees.

However, edge computing execution in IoT systems is still evolving, and standardized approaches and frameworks are required for successfully utilizing the benefits of computing at the edge. [19]

Legal and Regulatory Frameworks

IoT operates in a complex legal and regulatory landscape. As IoT expands into various sectors such as healthcare, transportation, and smart cities, there is a need for clear and comprehensive legal frameworks that address issues like data protection, liability, and compliance. Developing appropriate regulations and standards is crucial to ensuring the responsible and ethical use of IoT technology while safeguarding the rights and privacy of individuals and organizations. [20]

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CONCLUSION AND RECOMMENDATIONS

Finally, this in-depth examination of Internet of Things (IoT) applications, difficulties, and prospects sheds light on this technology's revolutionary potential and complex land- scape. The paper delves into a variety of domains, including healthcare, manufacturing, retail, transportation, smart agriculture, and home automation, demonstrating IoT's broad reach for creating interconnected and automated systems.

Conclusion

The authors expertly navigate the past development of IoT in smart homes, emphasizing the obstacles to widespread implementation. The extensive literature review offers helpful insights into the many facets of home automation, determining barriers such as elevated ownership costs, inflexibility, ineffective management, and security concerns. Furthermore, real-world experiences of households with home automation through semi-structured home visits are highlighted and the importance of tackling challenges to home automation are also discussed. The results and discussion part thoroughly examines IoT's impact across various fields, emphasizing its role in promoting effective and connected systems. However, the paper discusses major obstacles to the seamless integration of IoT. Among the issues discussed are security and privacy problems, data management and transmission challenges, device compatibility and longevity, and the need for a strong legal and regulatory framework. If these issues remain unresolved, they will create significant barriers to widespread IoT adoption across industries. Identifying absences and constraints in IoT implementation creates a road map for future enhancements. Security, connectivity, scaling, handling of data, moral issues, edge computing, and legal regulations are highlighted as critical areas that require complete solutions for a more seamless and secure Internet of Things environment. Looking ahead, the section on future works highlights exciting possibilities for the advancement of the IoT. Key areas of focus include the incorporation of artificial intelligence (AI) for intelligent decision-making models, the widespread use of edge computing and 5G networks are being developed to improve interaction, and study on blockchain is being conducted to improve security. Furthermore, this article highlights a creative approach by highlighting the long-term sustainability link between augmented reality (AR) and virtual reality, or VR, as well as the importance of ethics, rules, and regulations. In essence, this paper serves as a comprehensive guide for both IoT practitioners and researchers. It additionally looks at the present state of applications for the Internet of Things, but it also provides a vision for the future, which includes technological innovations, moral quandaries, and regulatory frameworks. This paper is an invaluable asset as the Internet of Things evolves, offering expertise, gets closer, and a frame- work for managing the complex and dynamic environment of IoT technologies.

Recommendation

The Internet of Things (IoT) future spaces has tremendous opportunities for growth and innovation. The incorporation of Artificial Intelligence (AI) into the Internet of Things (IoT) frameworks is one of the key concerns that will determine this future path. The role of AI in allowing autonomous choices throughout IoT systems shall be critical. AI will enable IoT devices to not only gather and analyze data, but additionally to make intelligent, responsive decisions, by leveraging deep learning and statistical analysis. The integration of AI with IoT brings in a new era in which machines can learn, improve, and detect demands, resulting in increasingly intelligent and flexible systems across multiple domains. Further, the growth of IoT is positioned to capitalize on the integrated potential of edge computers and the emerging 5G networks. Edge computing minimizes latencies and improves immediate processing by analyzing information closer to its source, which is critical for applications in the Internet of Things that require quick answers. With the emergence of 5G wireless networks, IoT devices will be able to

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link together effortlessly on a scale. This combination of edge computing with 5G networks will be disruptive, opening up new opportunities in areas such as autonomous cars, smart cities, and industrial automation, in which instant data transfer and high bandwidth are required Discovering the possibilities of blockchain technology is another essential path in the future of IoT. Blockchain has the potential to improve trust and security inside IoT ecosystems. Its randomized and secure nature can improve the security of IoT network interactions, data, and device verification. Blockchain innovation tackles concerns about integrity of data, privacy, and identification by enabling secure peer-to-peer connection and data sharing, hence increasing the trustworthiness of connected devices Furthermore, the Internet of Things (IoT) future path demonstrates long-term viability augmented reality (AR) and virtual reality (VR) insertion, and ethical considerations. In the Internet of Things, long- term viability entails reducing the use of energy, utilizing energy from renewable sources, and reducing the impact on the environment. AR/VR incorporation with IoT is set to trans- form experiences by providing fully immersive connections and applications in fields such as video games, healthcare, and remote cooperation. These innovations will use real-time data from internet of things devices to enhance experiences through offering context and increasing engagement among users. Additionally, as IoT expands its influence, ethical considerations and durable regulatory frameworks becomes more and more crucial. Government officials as well as industry consumers must ensure ethical installation while protecting individual rights, secrecy, and information security while encouraging invention and convenience. The growing focus on moral principles and regulatory frameworks shall be critical in guiding the ethical and accountable expansion of the Internet of Things throughout enterprises and societal areas.

Artificial Intelligence (AI) Integration

AI technologies, such as machine learning and predictive analytics, will play a vital role in IoT. AI can enhance IoT systems by enabling intelligent decision-making, improving automation, and enabling predictive maintenance. The integration of AI with IoT will enable smarter and more efficient systems that can learn and adapt to changing environments. [25]

Edge Computing and Fog Computing

Edge and fog computing will continue to gain prominence in the IoT landscape. By processing and analyzing data closer to the source, these computing paradigms can reduce latency, enhance real-time processing capabilities, and reduce the burden on centralized cloud infrastructure. Edge and fog computing enable faster and more efficient decision-making in IoT applications. [19]

Networks

The deployment of 5G networks will revolutionize IoT by providing faster and more reliable connectivity. 5G's low latency, high bandwidth, and ability to connect a massive number of devices will unlock new possibilities in sectors like autonomous vehicles, smart cities, and industrial automation. 5G will enable the seamless and robust connectivity required for widespread IoT adoption. [23]

Blockchain for IoT Security

Block chain technology can enhance the security and trustworthiness of IoT systems. By providing decentralized and tamper-proof record keeping, block chain can secure transactions, ensure data integrity, and authenticate devices in IoT networks. Block chain can also enable secure peer-to-peer communication and data sharing between IoT devices. [23]

Sustainability and Energy Efficiency

As environmental concerns grow, there will be a greater emphasis on sustainable and energy-efficient IoT solutions. IoT devices and networks will focus on optimizing energy consumption, utilizing

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renewable energy sources, and minimizing environmental impact. Smart energy management, resource monitoring, and waste reduction will be key areas of focus, Sustainability and Energy Efficiency. [21]

Integration with (AR) and (VR)

The integration of IoT with AR and VR technologies will create immersive and interactive experiences. IoT-enabled AR/VR applications can enhance fields like gaming, remote collaboration, training, and healthcare. Real-time data from IoT devices can be visualized and overlaid onto the physical world, adding contextual information and enhancing user experiences. [22]

Ethics, Privacy, and Regulation

As IoT expands, there will be increased focus on ethical considerations, data privacy, and regulatory frameworks. Policymakers will work towards establishing comprehensive regulations to ensure the responsible and ethical use of IoT. Striking a balance between innovation, convenience, and protecting individual rights and privacy will be crucial for IoT's future growth. [20]

REFERENCES

[1] Sathish and S. Smys, "A Survey on Internet of Things (IoT) based Smart Systems," Journal of ISMAC the Journal of IoT in Social, Mobile, Analytics, and Cloud, vol. 2, no. 4, pp. 181–189, Sep. 2020, doi: 10.36548/jismac.2020.4.001.
[2] L. Xiao and Z. Wang, "Internet of Things: a New Application for Intelligent Traffic Monitoring System," Journal of Networks, vol. 6, no. 6, Jun. 2011, doi: 10.4304/jnw.6.6.887-894.
[3] R. Th. Hasan, "Internet of things and Big Data Analytic: A State of the Art Review," Journal of Applied Science and Technology Trends, vol. 3, no. 02, pp. 39–46, Dec. 2022, doi: 10.38094/jastt302135.
[4] C. Stolojescu-Crisan, C. Crisan, and B.-P. Butunoi, "An IoT-Based Smart Home Automation System," Sensors, vol. 21, no. 11, p. 3784, May 2021, doi: 10.3390/s21113784.
[5] A. J. B. Brush, B. Lee, R. Mahajan, S. Agarwal, S. Saroiu, and C. Dixon, Home automation in the wild. 2011. doi: 10.1145/1978942.1979249
[6] V. S. Gunge and P. S. Yalagi, "Smart Home Automation: A Lit- erature Review," International Journal of Computer Applications (0975 – 8887), no. 1, pp. 6–10, Apr. 2016, [Online]. Available: https://research.ijcaonline.org/rtdm2016/number1/rtdm2568.pdf
[7] M. O. Hoque and C. Davidson, "Design and Implementation of an IoTBased Smart Home Security System," International Journal of Net- worked and Distributed Computing, vol. 7, no. 2, p. 85, Jan. 2019, doi: 10.2991/ijndc.k.190326.004.
[8] P. Gupta and J. Chhabra, IoT based Smart Home design using power and security management. 2016. doi: 10.1109/icicct.2016.7542317.
[9] A. Jacobsson, M. Boldt, and B. Carlsson, "A risk analysis of a smart home automation system," Future Generation Computer Systems, vol. 56, pp. 719–733, Mar. 2016, doi: 10.1016/j.future.2015.09.003.
[10] T. Chakraborty and S. K. Datta, Home automation using edge computing and Internet of Things. 2017. doi: 10.1109/isce.2017.8355544.
[11] M. Vucinic, B. Tourancheau, and A. Duda, Performance comparison of the RPL and LOADng routing protocols in a Home Automation scenario. 2013. doi: 10.1109/wcnc.2013.6554867.
[12] R. K. Kodali and S. Yerroju, Energy Efficient Home Automation Using IoT. 2018. doi: 10.1109/ic3iot.2018.8668155.
[13] G. Sushanth and S. Sujatha, IOT Based Smart Agriculture System. 2018. doi: 10.1109/wispnet.2018.8538702.
[14] B. K. Barman, S. P. Yadav, S. Kumar, and S. Gope, IOT Based Smart Energy Meter for Efficient Energy Utilization in Smart Grid. 2018. doi: 10.1109/epetsg.2018.8658501
[15] Y. Hajjaji, W. Boulila, I. R. Farah, I. Romdhani, and A. Hussain, "Big data and IoT-based

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applications in smart environments: A systematic review," Computer Science Review, vol. 39, p. 100318, Feb. 2021, doi: 10.1016/j.cosrev.2020.100318.
[16] M. Abdur, S. Habib, M. Ali, and S. Ullah, "Security Issues in the Internet of Things (IoT): A Comprehensive Study," International Journal of Advanced Computer Science and Applications, vol. 8, no. 6, Jan. 2017, doi: 10.14569/ijacsa.2017.080650.
[17] A. Banafa, "3 Major Challenges IoT is Fac- ing — OpenMind," OpenMind, Jul. 31, 2018. https://www.bbvaopenmind.com/en/technology/digital-world/3- major- challenges-facing-iot/
[18] S. Oh, J. Haberl, and J.-C. Baltazar, "Analysis methods for charac- terizing energy saving opportunities from home automation devices using smart meter data," Energy and Buildings, vol. 216, p. 109955, Jun. 2020, doi: 10.1016/j.enbuild.2020.109955.
[19] H. Yar, M. Imran, Z. A. Khan, M. Sajjad, and Z. Kastrati, "Towards Smart Home Automation Using IoT-Enabled Edge-Computing Paradigm," Sensors, vol. 21, no. 14, p. 4932, Jul. 2021, doi: 10.3390/s21144932.
[20] G. Kobayashi, "The Ethical Impact of the Internet of Things in Social Relationships: Technological mediation and mutual trust," IEEE Con- sumer Electronics Magazine, vol. 5, no. 3, pp. 85–89, Jul. 2016, doi: 10.1109/mce.2016.2556919.
[21] A. J. D. Rathnayaka, V. Potdar, and S. Kuruppu, Evaluation of wireless home automation technologies. 2011. doi: 10.1109/dest.2011.5936601.
[22] V. H. Bhide and S. Wagh, i-learning IoT: An intelligent self learning system for home automation using IoT. 2015. doi: 10.1109/iccsp.2015.7322825.
[23] I. Mistry, S. Tanwar, S. Tyagi, and N. Kumar, "Blockchain for 5Genabled IoT for industrial automation: A systematic review, solutions, and chal- lenges," Mechanical Systems and Signal Processing, vol. 135, p. 106382, Jan. 2020, doi: 10.1016/j.ymssp.2019.106382.
[24] G. Duwe and M. Rocque, "Effects of Automating Recidivism Risk Assessment on Reliability, Predictive Validity, and Return on Investment (ROI)," Criminology and Public Policy, vol. 16, no. 1, pp. 235–269, Feb. 2017, doi: 10.1111/1745-9133.12270.
[25] L. M. Gladence, V. M. Anu, R. Rathna, and E. Brumancia, "Recom- mender system for home automation using IoT and artificial intelligence," Journal of Ambient Intelligence and Humanized Computing, Apr. 2020, doi: 10.1007/s12652-020-01968-2.
[26] R. Hassan, F. Qamar, M. K. Hasan, A. H. Aman, and A. S. Ahmed, "In- ternet of things and its applications: A comprehensive survey," Symmetry, vol. 12, no. 10, p. 1674, 2020. doi:10.3390/sym12101674
[27] L. Farhan et al., "A survey on the challenges and opportunities of the internet of things (IOT)," 2017 Eleventh International Conference on Sensing Technology (ICST), 2017. doi:10.1109/icsenst.2017.8304465