Internet of Things is a revolutionary approach for future technology enhancement

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Abstract

Traditional ways of life have been completely transformed by the Internet of Things (IoT), which has made it possible to implement high-tech innovations like smart homes, smart cities, and industries that are able to reduce pollution and save energy. The potential of IoT technology has been improved through extensive research, However, there are still a number of issues that need to be resolved. These difficultie cover a range of IoT-related topics, technical obstacles, social and environmental effects, as well as enabling technologies. This review article seeks to provide a comprehensive analysis of IoT from both a technological and social standpoint. It examines the various challenges and important issues that the IoT faces, considers architectural issues, identifies key application domains, and conducts a literature review to highlight the contributions of the earlier works to various IoT-related topics. Additionally, the article emphasizes the importance of big data analysis in relation to the Internet of Things. Overall, this article is a helpful resource for readers and researchers looking to learn more about IoT and its practical applications.

I. Introduction

The Internet of Things (IoT), a revolutionary paradigm facilitating internet-based communication among electronic devices and sensors, has the potential to enhance numerous aspects of our daily lives. Through the use of smart devices and internet connectivity, IoT offers innovative solutions to issues faced by organizations, governments, and public/private sectors around the world. Our daily lives and environment are being increasingly impacted by IoT. It includes a broad range of smart systems, sensors, devices, and frameworks (Fig. 1)[1]. The usefulness and application of IoT innovations have been well researched and recorded in academic studies and news stories, both online and in print. These sources offer both individuals and organizations useful references and a basis for creative business plans that give priority to security, dependability, and interoperability issues[2].

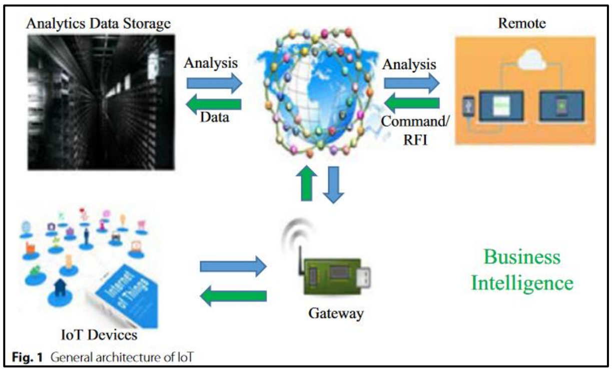


Fig. 1 General architecture of IoT

Significant changes to our daily lives have been brought about by the growing integration of device and technology. One notable advancement in the realm of IoT is the emergence of Smart Home Systems (SHS) and appliances, encompassing internet-connected devices, home automation systems, and efficient energy management systems. Furthermore, the development of Smart SHS has ushered in substantial progress in the healthcare domain, marking significant strides in the application of IoT.[3] Fitness levels, calorie consumption, and serious health conditions are just a few of the health indicators that are tracked and monitored by smart health sensing systems (SHSS), which employs intelligent devices and equipment. This advancement has revolutionized by fusing advanced technology and intelligent devices into the medical field. IoT researchers and developers have also made a concerted effort to improve the lives of the elderly and disabled. By providing these groups with affordable tools and equipment that help them live more independent lives, IoT has significantly improved their quality of life[4]. Transportation is another crucial aspect of our lives that has benefited from IoT advancements. At signalized intersections in large cities, automated sensors and drones are now used to manage traffic. Additionally, vehicles with built-in sensing devices can spot and foresee heavy traffic congestion, offering drivers alternate routes for a more comfortable commute. Therefore, IoT has contributed significantly to enhancing transportation efficiency, comfort, and reliability. Overall, IoT has vast potential to revolutionize various aspects of life and technology. Its applications extend to areas such as smart homes, healthcare, accessibility for the disabled and elderly, and transportation. The scope for technological advancements and its ability to facilitate humankind is extensive in the IoT domain[5].

IoT has proven to be important and has the potential to advance industry and economic growth, particularly in underdeveloped areas. It has also had a significant effect on trade and the stock market, signaling a revolutionary advancement. The security of data and information, however, continues to be a major concern and a difficult problem to solve. Due to the internet's prevalence of security risks and cyberattacks, vulnerabilities have been exposed, making information and data insecure. However, the Internet of Things is dedicated to providing trustworthy solutions to issues with data and information security. Security is taking the lead as the main worry for IoT in business and the economy. [6]. As a result, IoT developers are working hard to solve the problem of developing a secure framework for social network cooperation and privacy concerns.

II. Literature survey

IoT encompasses a interdisciplinary perspective that aims to that deliver its benefits across many domain, including the public/private sectors, environmental, industrial, healthcare, transportation, and more. Based on their particular interests and focus areas, researchers have offered a variety of perspectives and interpretations of IoT. Numerous application domains demonstrate the impact and potential of IoT and its potential. A few of the application domains where IoT exhibits its potential are shown in Figure2.

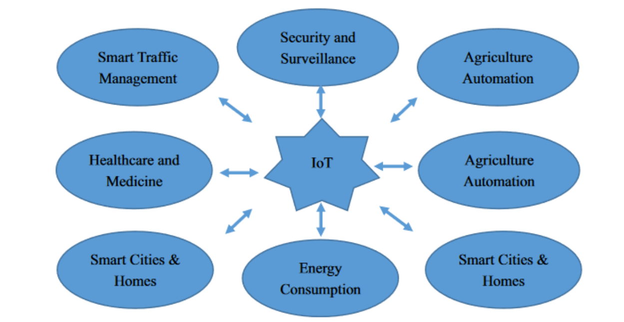


Fig. 2 Some of the potential application domains of IoT

In recent years, several significant IoT projects have emerged and made a considerable impact on the market[7]. Figure 3 highlights some of these noteworthy IoT projects, depicting their global distribution across the American, European, and Asia/Pacific regions. The graph shows that while the European continent has significantly contributed to smart city initiatives, the American continent has assumed a leading role in the health and smart supply chains project. This distribution demonstrates regional focus and depth of knowledge in various IoT application domains.

Fig. 3

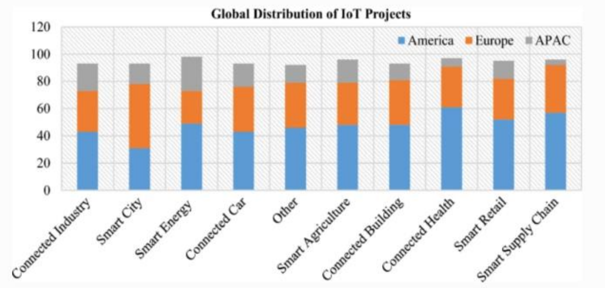
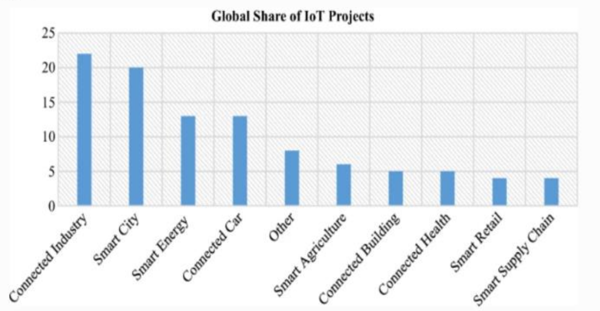


Figure 4 Chart the wide market share of IoT project in graphical style. The graph unequivocally shows that IoT project in the smart-city, business , smart energy, and smart-vehicle sectors holds a sizable market share in comparison of other domains. This observation emphasizes the significant impact and presence of IoT in these specific areas, highlighting their importance in the IoT landscape as whole[8].

Fig. 4



III. Technologies and IoT architecture.

Five fundamental layers that define IoT architecture is made up of IoT system features. Network, middleware, application, Perception and business layers are these layers. Sensors, RFID chips, and barcodes are examples of linked physical devices that are a component of the IoT network's perception layer, It forms the structure's foundation. "These cutting-edge devices effortlessly acquire and transmit data to the network layer. The smooth transfer of information from the perception layer to the information processing system relies heavily on the network layer, serving as an indispensable conduit for seamless transmission. Multiple wire or wireless transmission methods, such as Internet, Wi-Fi, Hotspot and Bluetooth, may be used[9]. Above the network layer, in the middleware layer, decisions are made based on the results of ubiquitous computing after processing the information that has been received. The application layer uses the information that has been processed to manage all devices globally. The management of the whole IoT system, including all of its services and applications, falls under the purview of the business layers, which are found at the top of the architecture. To determine its future goals and tactics, it visualizes the data and information it receives from the application layer. It's important to remember that IoT architectures can be tailored and changed depending on particular requirements and application domains. In addition to the layered architecture, the functional building elements that make up

IoT systems include sensing techniques, authentication and identity, control, and management.

IV. IoT's most important problems and difficulties.

A variety of challenges and issues have been brought about by the integration of IoT systems into numerous parts of human existence in addition to the complexity of the technologies utilized for data transfer between embedded devices. For IoT developers in the cutting-edge technology society, these issues present significant obstacles. The difficulties and needs for complex IoT systems grow as technology develops. To ensure the ongoing development and success of IoT technology, IoT developers must foresee emerging issues and address them, offering practical solutions[10].

A. Privacy and security concerns

One of the most crucial and challenging elements is maintaining privacy and security. of this market, given the multiple threats, hacks, dangers, and vulnerabilities in the IoT arena. Insufficient authorisation and authentication, risky software and firmware, inadequate transport layer encryption, and exposed web interfaces are the main causes of device-level privacy problems. Concerns about security and privacy play a significant role in developing confidence in IoT systems across a variety of industries. To reduce security threats and assaults, security methods must be incorporated into the IoT architecture at each tier. To ensure security and privacy in IoT systems, a sizable range of protocols have been created and put into use, spanning every layer of the communication channel. [11]. To ensure secure communication between devices, some IoT applications might need particular techniques. Furthermore, the use of wireless communication within IoT systems introduces increased vulnerabilities, necessitating the implementation of techniques for spotting malicious activity and enabling self-healing or recovery. Users can feel safe and at ease when using IoT solutions by focusing on privacy, which is another crucial issue. For communication between trusted parties, it is crucial to establish secure network connections with the proper authorization and authentication mechanisms. The existence of various privacy laws among various objects interacting inside an IoT system raises another problem[12].

B. difficulties with standards and interoperability.

Interoperability is the capacity of different IoT systems and devices to communicate data, regardless of the particular software and hardware implemented. Interoperability is difficult since there are so many different technologies and development methods employed in the Internet of Things. It is possible to research interoperability at the technological, semantic, syntactic, and organizational levels. A variety of features are offered by IoT systems to enhance interoperability and facilitating communication in situations with a variety of different objects. Additionally, based on their functions, many IoT platforms may be combined, offering options to a variety of IoT users. [13]. To solve this problem, researchers have proposed a range of interoperability handling strategies, including adapter, gateway based, virtuals network, and service oriented approaches. Although these methods minimize certain interoperability-related concerns, several problems still necessitate more study and development[14]..

C. law, morality, and regulatory rights.

IoT developers have serious concerns about ethics, law, and regulatory rights. To uphold moral principles, prevent violations, and maintain standards, they entail abiding by established rules and regulations. Laws are specific restrictions set by governing bodies, whereas ethics refers to the standards that people hold themselves to. In order to uphold standards, guarantee quality, and stop illegal activity, both ethics and laws are necessary[15]. While the development of the IOT has solved many practical issues, it has also raised moral and legal issues. These difficulties include safeguarding personal information, fostering trust and safety, and facilitating the use of data. Research shows that because they don't trust IoT devices, the majority of IoT users favor government standards and laws surrounding data protection, privacy, and safety. Therefore, resolving this issue is essential to fostering and improving public confidence in the use of IoT systems and devices.

D. flexibility, accessibility, and dependability.

An IoT system's ability to scale means that it can accept new services, tools, and gadgets without sacrificing performance. Supporting a massive number of devices with varied amounts of memory, computational power, storage space, and bandwidth is the core issue with the Internet of Things. [16]. Along with scalability, availability is a vital component that must be considered in the layered structure of the Internet of Things. With the use of cloud-based IoT solutions, which offer support for scalability, As more devices, storage, and processing power are added, the IoT network may grow.

However, as IoT networks become more commonplace, a new research paradigm for developing an integrated IoT framework that satisfies universal demands emerges. Another difficult task is ensuring that resources are available for authentic objects no matter where they are or when they are needed[17]. To access their resources and services, several small IoT networks link to large worldwide IoT platforms in a scattered way. Accessibility hence becomes a critical problem. The use of various data transmission methods, such as satellite communications, may lead to service disruptions and problems with resource availability. The continuous availability of resources and services is therefore dependent upon an independent and trustworthy data transmission channel[18].

V. important IoT applications.

A. environmental protection, health care, and the emerging economy.

The Internet of Things is committed to delivering new financial and public benefits while advancing society. It entails a wide range of public services, including industrialization, preservation of water purity, growth of the economy, and wellness. The overarching objective of IoT is to assist in achieving the social, health, and economic goals listed in the sustainable development agenda of the United Nations. Environmental sustainability is a key factor in IoT development, and creators must take into account any potential adverse effects that IoT systems and devices may have on the environment[19]. A specific difficulty is the environmental effect of energy use by IoT devices. Due to the rising demand for internet-enabled services and cutting-edge technologies, energy consumption has gone up. devices that consume less energy, more research will be required. Adopting green technology can help create future Internet of Things gadgets that are energy-efficient, which is good for the environment and for people's health. IoT devices are being actively developed by researchers and engineers to monitor a range of health conditions, including diabetes, obesity, and depression. In the framework of IoT, several research have been conducted to solve issues with the environment, energy, and healthcare [20].

B. Transportation and vehicles in smart cities.

IoT will transform the existing social infrastructure by introducing concepts such as smart cities, smart homes and smart cars to build a high-tech base. A lot of progress is being made in understanding and addressing the technological needs of the home with the use of technologie like machine. The coupling of IoT servers with technologies like cloud-servers and wireless-sensor networks is the key to creating successful smart cities [21]. Environmental considerations are also important when designing and planning smart city infrastructure, which requires the use of green and energy-efficient technologies. In the automotive sector, smart devices are installed in vehicles to detect traffic jams and provide drivers with optimal alternative routes to reduce congestion in cities. In addition, affordable smart devices are designed for all types of vehicles to monitor engine activity and contribute to vehicle health. The introduction of self-driving cars that can communicate with other vehicles through smart sensors could significantly improve traffic flow compared to human-driven vehicles. However, it will take time for this technology to become widespread. Today's IoT devices can help by detecting traffic congestion and taking appropriate action. As a result, it is advantageous for vehicle manufacturers to serve the public good by integrating IoT devices into vehicles.

VI. The usage of big data in IoT

An IoT system consists of several connected devices and sensors. With the growth of the IoT network, these devices and sensors are spreading quickly. They communicate with one another and transfer huge volumes of data—known as "big data"—over the internet. Data management, collecting, storage, processing, and analytics face significant hurdles as a result of the expansion of IoT networks[22]. Monitoring oxygen levels, spotting harmful gases and smoke, and controlling lighting are just a few of the smart building management challenges that may be addressed by implementing an IoT big data platform. A framework of this kind may collect data from sensors installed in structures and perform data analytics to assist in decision-making.

By employing an IoT-enabled cyber-physical system integrated with tools for information analysis and knowledge acquisition, industrial output can be significantly enhanced. It is imperative to decrease congestion in smart citiesAn IoT-based traffic management system can gather real-time traffic data through IoT devices and sensors installed at traffic signals. Subsequently, this data can be analyzed to derive valuable insights [23]. Patients who utilize IoT sensors generate a plethora of real-time data on their health issues that may be analyzed in the healthcare industry. Big data technology is the good option for handle this enormous quantity of data in real-time and combining it into a centralized database to enable rapid and precise judgments. IoT and big data analytics have the potential to completely change how manufacturing is currently done. Sensing equipment generates data that can be analysed using big data techniques, supporting various decision-making processes in the manufacturing sector. The use of analytics and cloud computing can also lower costs and increase customer satisfaction while promoting the development and conservation of energy. IoT devices produce enormous quantities of streaming data, so effective data storage and real-time analysis are essential for making informed decisions. With the ability to process and analyze such a large amount of data, deep learning techniques are especially effective[24]. Therefore, the development of a high-tech society largely depends on IoT integrations. big data analytics, and deep learning.

Conclusions

Researchers and developers all over the world are paying close attention to recent developments in IoT. In order to maximize this technology's positive social effects, they are working cooperatively to expand it on a large scale. Recognizing the various problems and restrictions posed by the current technical approaches is necessary to actually achieving these improvements. This survey article highlights a number of difficulties and issues that IoT developers should take into account when creating improved models. It also looks at significant areas of application where IoT developers and researchers are engaged.

Big data analytics are important, which is further highlighted by the fact that IoT not only generates a lot of data but also offers services. An improved IoT system can be created by utilizing big data analytics, which allows for accurate decision-making. Researchers and developers can open the door for advancements and have a positive impact on society by addressing these problems and utilizing the potential of IoT and big data analytics.

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