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The internet of things (IOT) is a game-changing strategy to future technological advancement: An assessment

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Abstract
The Iot technology, often known as IoT, is a revolutionary technology that has transformed the conventional quality of thinking into a high-tech way of existence. The Internet of Things is responsible for such developments as the modern city, smart homes, prevention of pollution, energy conservation, infrastructure, and smart industries. In order to improve technology by means of the IoT, a significant amount of important science investigations and examinations have been carried out. In spite of this, there are still a number of obstacles and problems that need to be fixed before the Internet of Things can live up to its full promise. These concerns and challenges need to be evaluated from a variety of perspectives regarding the Internet of Things, including applications, difficulties, robotics and automation, human and ecological implications, and so on. The primary aim of this systematic review is to offer a thorough summary from both a technical and a social point of view. In this article, several difficulties and fundamental problems with the Internet of Things, as well as essential application sectors, are covered. Additionally, the paper brings to light the previously published literature and illustrates how it has contributed to various parts of the Internet of Things. In addition, the significance of big data and the analysis of this data in relation to the Internet of Things has been highlighted. The Internet of Things (IoT) and how it may be applied to the real environment are topics that are covered in this paper, which will be helpful to current researchers.

Keywords: Internet of Things (IoT), IoT architecture, IoT challenges, IoT applications etc.

1. Introduction
A developing paradigm known as the Internet of Things, or IoT, makes it possible for electronic gadgets and sensors to communicate with one another and with us via the use of the web in order to make our lives easier. IoT uses connected devices and the network to deliver new solutions to numerous difficulties and concerns associated to various businesses, governmental organizations, and governmental and non - governmental sectors all over the globe [1]. The Internet of Things is rapidly becoming into an essential component of our everyday lives, and its presence can be felt almost wherever we go. The Internet of Things (IoT) is an invention that, in its whole, brings together a wide range of different kinds of smart technologies, platforms, and systems (Fig. 1). In addition to this, it makes use of quantum and nanostructures to improve storage, sensors, and processing speed in ways that were previously inconceivable. Detailed research investigations have been performed and are now present in the form of science papers, newspaper reports both on the web and in the form of written materials to demonstrate the potential efficacy and relevance of IoT transitions. These publications and reports can be found in both online and offline formats. It is possible to use it as a kind of preparation work prior to the creation of fresh and inventive business concepts, all the while keeping security, reliability, and portability in mind.
The rising presence of Internet of Things (IoT) technological devices has brought about a significant shift in the way we go about our typical day-to-day activities. One innovation brought about by the Internet of Things is the idea of "Smart Home Systems" (SHS) and items. These solutions and equipment are made up of internet-connected gadgets, home security systems, and dependable power management. In addition, an additional significant accomplishment brought about by IoT is the "Smart Health Sensing system (SHSS)". Small, smart equipment and gadgets are included into SHSS in order to assist with the maintenance of an individual's health. The many health problems and fitness levels, as well as the number of calories burnt in the fitness facility, among other things, may be checked and monitored

using these gadgets, which can be used either inside or outdoors. In addition to that, it is being utilized in clinics and trauma centers to track the critical health situations that patients are experiencing. As a result, it has fundamentally altered the whole landscape of the medical industry by providing it with access to sophisticated technologies and cutting-edge tools. In addition, Internet of Things developers and designers are actively engaged in efforts to improve the lifestyles of individuals who are handicapped or in the older age group. The Internet of Things has delivered an outstanding improvement in this domain and has opened the door to a fresh path for the everyday lives of individuals in these situations. The majority of people are taking use of these tools and technologies because they are highly cost effective in terms of the amount of money required to produce them and because they are readily accessible within a price range that is seen to be reasonable. They are able to lead a regular life as a result of the internet of things. Transportation is an additional crucial component of our everyday lives. The Internet of Things has enabled certain new technological developments that make it more effective, pleasant, and dependable. At various signalized crossroads spread across large cities, biosensors and drone-like machines are now in charge of managing the flow of traffic. In furthermore, vehicles are being sold to people with pre-installed detecting devices will be able to detect impending heavy congested roads on a chart and may recommend an alternate route to take that has less traffic congestion. These automobiles are being marketed with pre-installed wearable sensors. The Internet of Things thus has a lot of potential applications in many different fields of life and technology. We may reach the conclusion that IoT does have a lot of potential including both terms of advancing technology and helping people. This opens up a lot of doors. The Internet of Things has also demonstrated its significance and promise in the rapid industrialization of an area that is still in the process of growing. Additionally, it is being called a revolutionary move in the trade and stock exchange markets at the moment. Nevertheless, ensuring the safety of one's records/knowledge is a critical concern that is also very desired [5]. This is a significant obstacle that must be overcome. The Internet, which is responsible for the majority of security breaches and cyberattacks, has provided several entry points for cybercriminals, which has led to the insecurity of data and information. Despite this, IoT is dedicated to providing the most effective solutions that can be found to address concerns about the safety of records / knowledge. As a result, safety should be the primary priority with regard to the Internet of Things in business and the economy. IoT developers are putting a lot of effort into creating a safe way for cooperation across social media platforms and privacy issues since this is a problem that is now receiving a lot of attention in the IoT industry. The following sections of this article are structured as follows: The "Literature survey" section will give a state of the art report on significant research that explored a variety of topics and difficulties pertaining to the Internet of Things. In the section titled "IoT Architecture and Technologies," the IoT prerequisite for development and architecture were dissected in great depth. Important significant difficulties and challenges of the Internet of Things are explored in the section under "Major key issues and challenges of IoT." The "Major IoT applications" section presents new application fields related to the Internet of Things. The section titled "Importance of big data analytics in IoT" delves into the function of big data and analyzes its significance in the Internet of Things (IoT). The "Conclusions" paragraph was where the piece ended once everything was said and done.

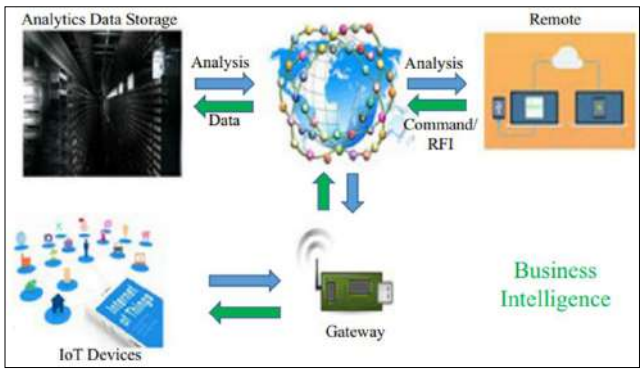

Fig 1: General architecture of IOP

Literature survey

The Internet of Things has an interdisciplinary vision to deliver its benefits to a variety of fields, including the environment, industry, public and private sectors, medicine, and transportation, amongst others. Different scholars have offered a variety of interpretations of the Internet of Things, each catering to a particular set of concerns and concerns. In a number of different application areas, both the possibility and power of the Internet of Things may be seen. Some of the IoT's possible application fields are shown in Figure 2, which may be found here. In the recent past, a number of significant Internet of Things initiatives have emerged to dominate the industry. Figure 3 presents a few of the most significant Internet of Things initiatives that have successfully cornered the majority of the industry. A worldwide spread of these Internet of Things initiatives is illustrated in Figure 3, broken down into the regions of the Americas, Europe, and Asia/Pacific. It is clear that the American continent is providing more in the areas of smart healthcare coverage and digital supply chain programs, whilst the European continent is providing more in the areas of smart city development [8].

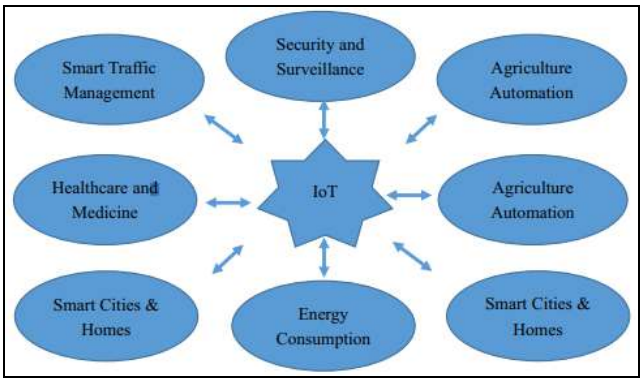

Fig 2: Sone of the potential application domains od IoT

[8] The international markets share of IoT projects is shown in figure 4, which can be found here. When compared to other types of Internet of Things initiatives, those centered on industries such as smart cities, smart energy, and smart vehicles clearly have a larger market share. One of the hottest trends in Internet of Things applications is the smart city concept, which also includes smart houses. A smart

home is one that has Internet of Things (IoT) enabled consumer electronics, an air conditioning and heat source, a t.v, audio/video media players, and security systems that are all interacting with one another in order to ensure the highest level of comfort, the greatest level of security, and the lowest level of energy usage. All of this connectivity is handled by an Internet of Things (IoT)-based central command unit, which utilizes the internet. The idea of a smart city has seen a rise in popularity over the past decade, which has resulted in an increase in the number of research projects [9]. The home automation business sector is on the verge of passing the 100 billion dollar mark by the year 2022 [10]. A smart home not only makes life more comfortable inside, but it also helps the homeowner save money in a number of different ways; for example, since it uses less energy, the homeowner's monthly power bill will be cheaper than it would be otherwise. Another segment that falls under the umbrella of a smart city is that of smart automobiles, in addition to smart residences [11]. Almost all of the features of contemporary automobiles, from the headlamps to the engines, are controlled by very sophisticated electronics and sensors that are installed in the vehicle. Te IoT is dedicated to the development of new technologies for smart cars that include wireless connection between vehicles and between vehicles and drivers [12]. This will allow for preventative maintenance as well as a pleasant and risk-free driving experience. A study was conducted by Khajenasiri et al. [10] on the Internet of Things (IoT) technologies for intelligent power control to benefit the implementations of smart cities. According to Tey, the IoT has only been used in a small number of application areas at this point to serve both the public and the technology. The Internet of Things has a very broad reach, and it has the potential to include almost all possible applications in the near future. Tey said that conserving energy is one of the major parts of life, and that IoT may help in the development of a smart energy management system that would save both resources and money. Tey gave an overview of the Internet of Things architecture in relation to the smart city idea. The authors indicate the infancy of IoT equipment and software as another one of the arduous tasks that must be accomplished in order to achieve this. Tey made the suggestion that these problems need to be fixed in order to guarantee a dependable, effective, and user-friendly IoT system. The problem of urbanization was investigated by Alavi et al. [13] [Citations needed] The migration of people away from rural areas and into urban settings, which has led to an increase in the city's overall population. Because of this, it is essential to provide intelligent solutions for the problems of transportation, energy, medical, and infrastructures. One of the most significant application areas for Internet of Things programmers is the planned city. It investigates a variety of topics, including traffic management, management of air pollutants, solutions for public safety concerns, intelligent parking, intelligent lighting, and intelligent trash collection (Fig. 5). Tey said that significant efforts are being made by IoT to address these difficult problems. As a result of the increased need for enhanced smart cities brought on by increasing urbanization, new business opportunities in the field of smart city technology have become available. The authors came to the conclusion that innovation that is enabled by the internet of things is very important to the growth of sustainable and liveable cities. Confidentiality are yet another significant concern raised by the Internet of Things that calls for a great deal of investigation. Weber [14] concentrated on these problems and recommended that a private institution that avails itself of IoT must incorporate authentication methods, security systems, adaptability to threats, and client confidentiality into their economic activities. If they did so, they would have an extra edge over its competitors.

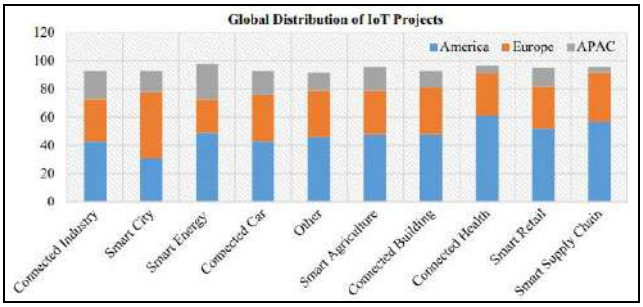

Fig 3: Global distribution of IoT projects among America (USA, South America and Canada), Europe and APAC (Asia and Pacific region) [8]

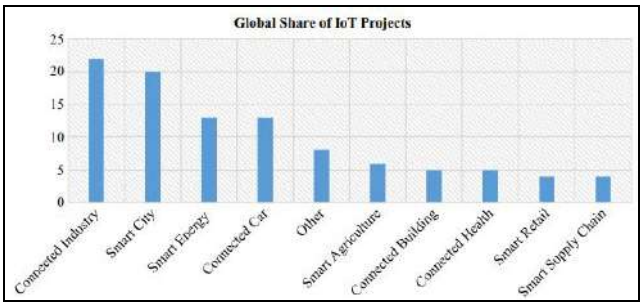

Fig 4: Global share of IoT projects across the world [8]

Fig 5: Potential IoT application areas for smart cities

Weber proposed that in order to describe worldwide security and privacy concerns, inventors of IoT technologies should take into consideration the geographical limits of the various nations. To meet the requirements of the whole worldwide in terms of privacy and safety, a standard architecture has to be developed. Prior to the development of a fully functional Iot platform, it is strongly suggested to do research and become aware of the problems and obstacles that exist in the areas of privacy and safety. After some time had passed, Heer *et al*. Discovered a security flaw in an IP-based Iot networks. Tey said that internet connectivity is required for users to communicate amongst the many components that make up an IoT system. Therefore, concerns about the safety of IP-based Internet of Things systems are quite relevant. In particular, the life span and characteristics of

every item included in the IoT system must be taken into consideration while designing the security infrastructure for the network. In addition to that, it involves the participation of a reliable third - party provider and the use of several security mechanisms. It is extremely desired to have a security infrastructure that has the capability for scalability to service both small-scale and large-scale items in the Internet of Things. According to the findings of the research, the Internet of Items (IoT) has given birth to a new method of communication between several things located across the networks; as a result, conventional end-to-end internet protocols are unable to offer the support necessary for this interaction. Therefore, in order to provide complete end-to-end privacy, new procedures need to be established taking into consideration the transformations that occur at the portals. In addition, each layer that is useful for interacting has its own set of needs and concerns about security. Therefore, ensuring security for all of the levels is necessary, since meeting the criteria for just one of the layers would leave the region in a vulnerable situation.

IoT architecture and technologies

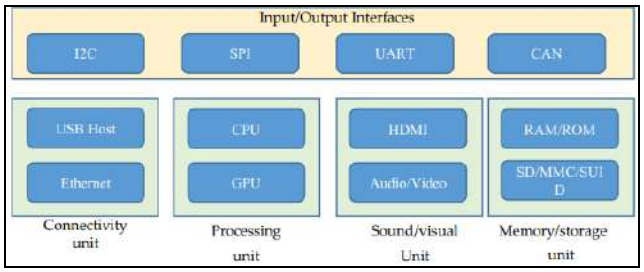

Fig 6: A generic function module of IoT system

The Internet of Things architecture is composed of five significant levels, which together define all of the capabilities that may be accomplished by IoT devices. The sensing device, the internet layer, the middleware layer, the application layer, and the business layer make up these layers. The Internet of Things architecture has a panels that sits at the very bottom. This layer is made up of various hardware objects, such as sensors, RFID chips, scanners, and so on, as well as other physical items that are linked to the Iot environment. These devices are responsible for the collection of data, which is then sent along to the network level. The data is sent from the network layers to the processing system through the network level, which functions as a transmission channel. This data may be sent through any wire and wireless means, including 3G/4G, Wi-Fi, Bluetooth, and other similar technologies. The layer that comes after the next one is called the intermediary layer. The primary responsibility of this layer is to analyze the data that has been sent down from the network level and to arrive at conclusions and recommendations of the study of pervasive computing. After that, the information that has been collected is used by the application level for global remote access. There is a corporate layer at the very top of the design, and it is responsible for controlling the Internet of Things as a whole, together with all of its software and systems. The data and information obtained from the web application are visualized by the business logic, and this data is then utilized to create future objectives and plans. In addition, the architectures of the Internet of Things may be altered to suit the requirements of a particular application [19, 20, 37]. In addition to the layered architecture, the Internet of Things consists of multiple functional units that enable the many activities associated with the Internet of Things [38]. These functional blocks include a sensing mechanism, identification and identification, control and administration. These kinds of functional building pieces of the IoT architecture are shown in Figure 6. There are various essential functionality blocks that are involved for I/O activities, connection difficulties, computation, audio/video surveillance, and data storage. These blocks may be found spread across the system. Incorporating an effective Internet of Things (IoT) system is critical to achieving maximum performance, and all of these functional units work together to do so. Despite the fact that there have been a number of reference designs presented along with the technical requirements, they are still a very long way from the standard platform that is appropriate for the IoT on a global scale [39]. Consequently, it is imperative that an appropriate architecture that is capable of satisfying the requirements of the global IoT market be created. The overall operational architecture of the IoT system is depicted in figure 7. Figure 7 illustrates how the Internet of Things is dependent on certain application factors. IoT ports play an essential part in IoT communication because they make it possible to establish a connection among IoT administrators and IoT associated devices to a range of applications [40].

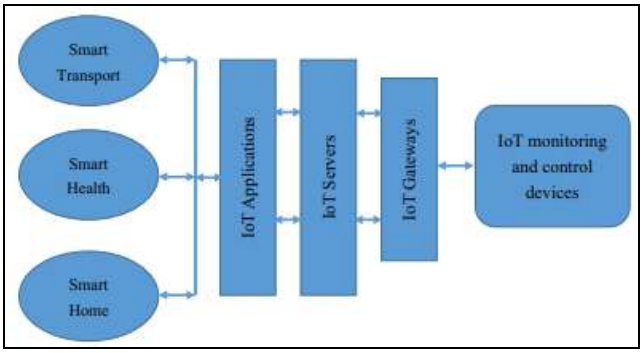

Fig 7: Working structure of IoT

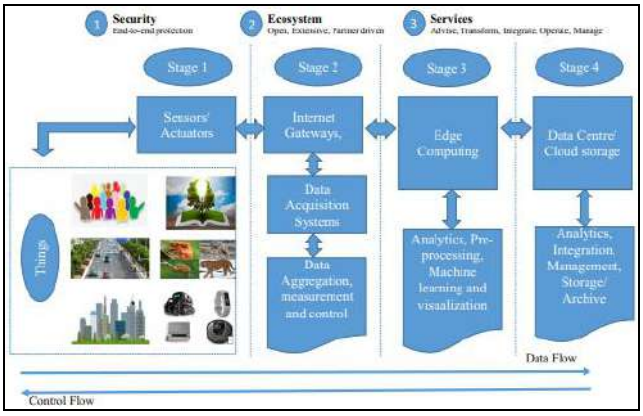

Fig 8: Four stage IoT architecture to deal with massive data

"Scalability, modularity, interoperability, and openness are some of the most important design considerations to consider while developing an effective Internet of Things architecture to work in a heterogeneous setting. The architecture of the Internet of Things needs to be designed with the goal of satisfying the requirements of cross-domain interactions, multisystem integration with the potential for simple and scalable management functionalities, user-

friendly application design, and storage and analysis of large amounts of data. In addition to that, the architecture has to have the capacity to scale up the functionality, as well as add some intelligence and automation to the IoT devices that are part of the system. In addition, a whole new obstacle presents itself in the form of the ever-increasing volume of huge data that is produced by the connectivity between IoT sensors and devices. To effectively manage the huge amounts of streaming data produced by IoT systems, then, an efficient architecture is essential. Cloud computing and fog computing/edge computing are two common types of IoT system designs. These types of architectures help with the management, monitoring, and analysis of large amounts of data in IoT systems. As a result, a contemporary Internet of Things design may be defined as a four-stage architecture, as seen in Figure 8".

Importance of big data analytics in IoT

A large number of devices connected and sensors that are able to interact with one another make up an Internet of Things (IoT) system. The quantity of these sensing devices is continuously growing due to the fast development and extension of the IoT network. These gadgets are able to speak with one another and transport a substantial quantity of data via the web. Big data is a term that has been used to the collection of information that is both very large and constantly updated. The ongoing proliferation of connections based on the Internet of Things gives rise to complicated issues such as the administration and gathering of data, as well as storage and analysis and analyses. The IoT big data platform for building automation is particularly helpful for dealing with numerous challenges that are specific to building automation, such as regulating the oxygen level, measuring smoke and dangerous chemicals, and determining the degree of brightness [59]. This kind of architecture is able to execute data analyses for the purpose of decision making, as well as gather information from sensors that have been put in the structures themselves. In addition, an Internet of Things (IoT)-based cyber physical systems that is geared up with data analysis and reporting acquisition strategies may be used to facilitate enhancements in industrial output [60]. Congestion in public transportation is a significant challenge faced by smart cities. IoT wearable sensors may be put at traffic signals to collect real-time traffic information, which can then be processed in an IoT-based traffic control system [61]. This data can be retrieved and monitored in real time. In the field of healthcare research, the Internet of Things sensors that are implanted in patients continually provide a large amount of data regarding the patients' current conditions of health. Big data technology is the ideal answer for this work [62]. This vast quantity of information has to be combined into one computer, and that it must be monitored in real time to take rapid decisions with high precision. The Internet of Things, in conjunction with big data analysis, may also be able to aid in the transition of industrial sectors from their more conventional practices to more contemporary ones [63]. The sensing devices provide information that can be evaluated using big data methodologies, that might be of assistance in a variety of decision making endeavors. In addition, the use of cloud technology and analytics may be beneficial to the improvement and preservation of energy while simultaneously lowering costs and improving customer satisfaction [64]. The Internet of Things (IoT) generates a massive volume of streaming content, which must be stored efficiently and must undergo further processing before decisions can be made in real time. Machine learning is a highly effective method for dealing with such a big quantity of knowledge and is capable of providing findings that have a high level of accuracy [65]. For this reason, the Internet of Things, Big Data analytics, and Machine Learning all working together is highly vital for the development of a socialites.

Conclusions

Recent developments in Internet of Things technology have piqued the interest of developers and academics all around the globe. IoT programmers and academics are collaborating to advance the technology on a wide scale, with the goal of providing the greatest potential benefit to the community. Therefore, enhancements are only feasible if we take into account the many problems and deficiencies that are inherent in the technological techniques that are now in use. In this review post, we discussed a number of problems and obstacles that an Internet of Things developer has to be aware of in order to create a more effective model. In addition, significant application domains of the Internet of Things that are currently being worked on by IoT academics and programmers are covered. Because the Internet of Things not only delivers services but also produces a massive volume of data. As a result, the significance of big data analytics is also covered in this article. Big data analytics may provide precise conclusions, which can then be used to the process of developing an enhanced IoT system.

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