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Study of Internet of Things Applications Supporting Technologies that are Used in the IT Sector

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ABSTRACT

The old, more primitive way of living has been replaced with a more contemporary and technologically advanced way of life now that the Internet of Things (IoT) paradigm has been implemented. There are many examples of improvements that have been brought about by the Internet of Things. Some examples include "smart cities," "smart homes," pollution management, energy efficiency, transportation, and industries. Numerous significant studies have been carried out in order to enhance technology through the Internet of Things (IoT). On the other hand, in order to fully achieve the promise that the Internet of Things has, there are a great number of challenges and issues that need to be handled. Several aspects of the Internet of Things (IoT), such as its applications, challenges, enabling technologies, social and environmental ramifications, and so on, need to be taken into consideration in order to ensure that these issues and challenges are effectively addressed. Providing a comprehensive analysis from a social and technological standpoint is the primary objective of this review essay. Important application domains, IoT architecture, and various problems are covered in the paper. Furthermore, the essay elucidates the present literature and demonstrates its contributions to several aspects of the Internet of Things. We also spoke about how analytics and big data are important for the IoT. Readers and researchers alike can gain valuable insights from this article's description of the IoT and its real-world uses.

Keywords: Information Technology, IoT, Supporting technologies.

INTRODUCTION

(IoT) is emerging with the aim of simplifying our lives. This paves the way for internet-based communication between various electrical equipment and sensors. Using internet connectivity and smart devices, the Internet of Things (IoT) finds new ways to solve problems in the public and private sectors, as well as in corporations and governments around the world [1]. The pervasiveness of the Internet of Things (IoT) in our daily lives is palpable. A vast array of intelligent frameworks, devices, sensors, and systems are brought together by the revolutionary Internet of Things (IoT) (Fig. 1). In addition, it uses quantum and nanotechnology to accomplish sensing, computation, and storage speeds that were previously unfathomable [2]. You can find a wealth of information about the potential benefits and efficiency of IoT transformations in books, articles, and news pieces. Take it as a jumping off point for further original business ideas that think about interoperability, security, and assurance.

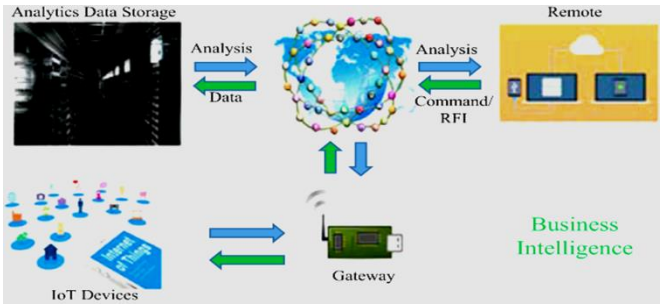

Fig. 1 *General architecture of IoT*

As IoT technology and electronic devices become more common, our daily lives have changed in big ways. One example of the expansion of the Internet of Things is the concept of Smart Home Systems (SHS) and appliances. An effective energy management system, home automation devices linked to the internet, and other internet-enabled devices make up a SHS [3-6]. Smart Health Sensing System (SHSS) is another important thing that IoT has done. Small, smart devices and tools are used in SHSS to help people stay healthy. In the outdoors or indoors, you may use these gadgets to track your vitals, fitness level, and calorie burn totals, among other things. Additionally, it is utilized to monitor patients in critical care units and hospitals. In short, it has revolutionized healthcare by facilitating the use of cutting-edge technology and intelligent devices [7-9]. Additionally, specialists and developers in the field of the internet of things are making great strides to enhance the lives of the elderly and those with disabilities. IoT has done amazingly well in this area and has changed the way these people live their everyday lives. The development costs of these gadgets and equipment are very low, and they are easy to find at a normal price, so most people are using them [10-12]. They can live a normal life because of IoT. Transportation is another important part of our lives. Some new improvements have been made to IoT that make it more useful, easy, and dependable. At many signalized intersections in big towns, smart sensors and drones are now controlling the traffic. A new generation of in-car sensors can predict when heavy traffic is on the way and provide an alternative route with less congestion [13-15]. This exemplifies the breadth of IoT's applications across numerous domains. We can state that the Internet of Things (IoT) has great promise for enhancing technology and simplifying people's lives.

The benefits of IoT to organizations?

Organizations can get multiple benefits from the IoT. Some advantages are sector-specific, while others are universal. Some of the most common advantages for businesses are:

- Keeps tabs on the company's major operations.
- Boosts satisfaction among buyers.
- Cuts costs and saves time.
- Raises output from staff members.
- Adaptable business models and integration are provided.
- Facilitates more informed company choices.
- Increases earnings.

With the help of the Internet of Things (IoT), businesses can improve their plans and reevaluate their present approaches.

Companies in the transportation, utility, and manufacturing sectors make heavy use of IoT sensors and other devices; however, businesses in the agricultural, infrastructure, and home automation sectors can also benefit from IoT, and some of these sectors are even undergoing digital transformation as a result.

Simply said, farmers can enjoy a more effortless lifestyle thanks to the Internet of Things (IoT). Sensors and the Internet of Things (IoT) can automate farming by gathering data on rain, humidity, temperature, and soil composition, among other meteorological variables.

Infrastructure-related operations can also be better monitored with the help of IoT. To provide just one example, sensors can keep an eye out for anything that could jeopardize the safety of buildings, bridges, and other infrastructure. As a result, you get better service quality, lower operational expenses, and better issue management and response.

Through the use of IoT, a home automation firm may monitor the mechanical and electrical systems of a structure. Smart cities can assist residents in decreasing energy usage and trash production on a larger scale.

All sectors are impacted by the Internet of Things (IoT), including manufacturing, retail, healthcare, and banking.

The pros and cons of IoT?

Here are a few benefits of the Internet of Things:

- Makes data accessible whenever and wherever needed using any device.
- Makes it easier for electronic gadgets to talk to each other.
- Makes it possible to send data packets across an existing network, which may save expenses and improve efficiency.
- Advantages both companies and customers through the collection of large amounts of data from many sources.
- Runs analytics locally, reducing cloud data transfer.
- Automates tasks to raise the quality of a business's services and decreases the necessity for human involvement.
- Patient care may be improved and maintained continuously.

Among the many drawbacks of the Internet of Things are:

- The attack surface becomes larger in proportion to the number of linked devices. Hackers have a better chance of stealing sensitive data when more data is transferred between devices.
- Device management is getting more complicated as the amount of internet-connected gadgets increases. It might be challenging for enterprises to collect and handle data from a multitude of Internet of Things (IoT) devices that they might encounter down the road.
- Contains the ability to corrupt other linked devices in the event of a system bug.

Since there is currently no universally accepted standard for interoperability in the IoT, device compatibility becomes an even more pressing issue. Because of this, it becomes more challenging for devices made by various companies to exchange data with one another.

CONSUMER AND ENTERPRISE IOT APPLICATIONS

Practical applications of the internet of things range from those aimed at consumers and businesses to those aimed at institutions and industries. Transportation, communications, and power generation are just a few of the numerous possible applications of the Internet of Things (IoT).

From a consumer perspective, one example is the rise of "smart homes," which allow for remote control of various electronic devices, including heating, lighting, and thermostats, through the use of computers and smartphones.

The goal of developing wearable devices with sensors and software is to create technologies that enhance users' lives by collecting and analyzing data about them and communicating that information to other devices. Optimal paths to a scene of an accident or the monitoring of the vital signs of construction workers or firefighters on dangerous job sites are two examples of how wearable technology is boosting public safety.

The internet of things (IoT) allows medical professionals to keep a closer eye on their patients by collecting and analyzing data in real time. Inventory management for drugs and medical devices are two common activities that hospitals accomplish with the help of IoT technology.

By installing occupancy sensors, for example, smart buildings can cut down on energy consumption. Automated temperature control allows for things like turning on the air conditioner when a meeting room is full or lowering the heat when no one is in the office.

Internet of Things (IoT) sensors in smart farming systems for agriculture may monitor a variety of environmental variables, such as soil moisture, temperature, humidity, and light intensity. An additional critical component of irrigation system automation is the Internet of Things.

A smart city can manage traffic, conserve energy, monitor and enforce environmental regulations, and improve sanitation with the help of Internet of Things (IoT) sensors and deployments like smart streetlights and smart meters.

ORGANIZATION OF THE IoT APPLICATIONS

In the early 1990s, Weiser's (1993) Theory of Computing Everywhere came to light, and from that evolved the Internet of Things (IoT). A member of the RFID research group at MIT, Ashton, was the pioneer in using the phrase "Internet of Things" [17].

A web of interconnected devices and services known as the Internet of Things (IoT) now connects nearly every part of human life. These days, it's hard to fathom a world devoid of smart applications, sensors, and gadgets because technology is so ingrained in our daily lives.

The use of radio frequency identification tags on bulk materials used in manufacturing processes greatly simplifies process management. In a data network setting, information hidden by RFID readers can trigger a separate process that in turn activates still another smart system. The Internet of Things (IoT) makes use of smart sensor devices that can authenticate, set up a network, and upload the data they gather to storage and analysis clouds [18-20].

Large-scale and industrial aspects of the Internet of Things (IoT) coexist with smaller ones in areas such as healthcare, lifestyle, and personal electronics (smartwatches and cellphones). These services are accessible through user-friendly web services, allowing users to acquire the desired analytical findings.

Businesses are keeping an eye on the Internet of Things (IoT) due to its rapid development, as they aim to improve manufacturing efficiency and quality. In production, programmable digital control devices (PLCs), embedded systems, and sensor units interacting over wired networks are utilized. Distributed control systems (DCS) and supervisory control and data acquisition (SCADA) provide for centralized control of these systems. Most of the time, they don't even need a connection to a local network or the Internet to get things done.

A must-have in today's interconnected world, the Internet of Things (IoT) has made global data, process, item, and person exchange lightning fast.

Direct communication between two machines over a channel, whether wirelessly or wired, forms a Machine-to-Machine (M2M) network. About half of the 8.5 billion M2M networks expected by 2022 will originate from automation equipment, tracking apps, and security monitoring [21-23].

Many people's lives have been improved by the Internet of Things (IoT), particularly in the fields of smart cities, smart industries, smart environments, healthcare, and education. Important data is gathered by the smart sensors in these applications and stored as big data in cloud computing environments. Using machine learning techniques, they are examined and added to notable patterns.

Internet of Things (IoT) applications that use artificial intelligence have the potential to outperform human intelligence in terms of processing speed and accuracy by retrieving previously stored data and assessing the process of change under complex situations. So, the IoT application services are available 24/7/365, allowing users

to do anything, from anywhere, with lightning-fast speeds and top-notch quality. There are various types of services, and we delve deeper into each of them.

Smart City

By utilizing a wide range of digital and ICT infrastructure, "smart cities" aim to improve the living conditions of its inhabitants. Additionally, it has the potential to influence our daily routines. The challenges of achieving the prospects and the development of a smart city are addressed in this study [23]. Figure 2 shows a number of parts that make up smart cities.

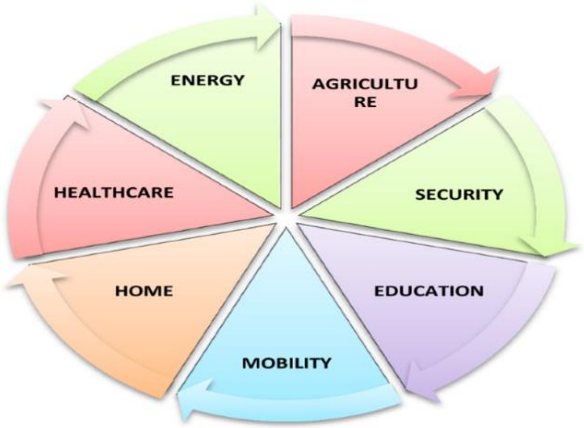

Fig. 2 *Smart cities components of IoT*

Smart city applications mostly include:

● Cities have smart parking systems that can find open spots.
Devices that track the state of materials and vibration in bridges and other historic structures.
● Central locations, including bars and city centers, can have their noise levels mapped in real time.
● A smart traffic software can identify when there is heavy traffic due to weather or accidents and then suggest alternate routes for drivers and pedestrians.
● Intelligent road and street lighting that changes its brightness and intensity based on the weather.
● Detecting garbage levels and optimizing garbage roads are waste management systems.

A number of "smart cities" have emerged in recent years. Some find distribution solutions using municipal access networks for all data-dependent city management and maintenance services. It provides a concrete example of how the IoT can facilitate the integration of electronic engineering, unified optimization, data access networks, geographic information systems, and GIS in the development of management systems for municipalities.

Environmental, health, and traffic monitoring services generate a disproportionate share of the massive amounts of data generated daily by wireless sensor networks used in smart city infrastructures. Thus, innovative approaches to data management are required for the generation and analysis of data to aid in the administration of intelligent and ever-changing resources. The Shatter-Dempster A multi-level intelligent home architecture and semantic web technologies are presented by Uncertainty Theory. Scenarios that take into account all of the features and the current state of affairs illustrate and clarify the suggested design.

This study [24] proposed a communication-based trash can system that reads and collects data on garbage volume over the Internet using an embedded IoT prototype with sensors. To learn more about the advantages of this technique, including financial considerations, compared to more conventional methods of garbage collection, trials were carried out. These experiments gave third parties a realistic environment to work with and laid the groundwork for smart city solution development by using open-source data from Copenhagen city.

There are applications for the IoT platform in modern farming as well [13]. Some of these methods include farming without soil, monitoring soil moisture and stem diameter to control sugar content and fruit plant health, conducting studies to optimize greenhouse microclimate conditions for fruit and vegetable production, controlling temperature and moisture for hay and straw, selective irrigation in dry regions to save water, weather forecasting (including changes in wind, rain, and snow), and so on.

Smart Home

Most Internet of Things (IoT) applications for home automation focus on energy and water consumption research. In addition, museum burglar detection systems are set up, and remote control apps are mainly used for attacks. There are hazards associated with deploying these systems. The two most important concerns with home automation systems are their security and the privacy of their users. The research identified 32 potential dangers, four of which were considered very serious. These serious threats stem from areas including risk analysis, security,

privacy, security design, and human behavior as it relates to software components. To eradicate these dangers, security and privacy must be considered throughout the design process.

Through wireless networks or sensor networks, every component of the home automation system is able to converse with every other component. To facilitate these exchanges, a smart home and security system based on machine-to-machine (M2M) applications can be established [14].

The home's environment sensors and gadgets, including those in service on the Internet, can be centralized and controlled through a communication medium. Next, you can use this data for a variety of purposes, such as enhancing home security or managing energy more efficiently. [15].

Infrastructure for the Internet of Things (IoT) objects can benefit from smart building and cloud computing-based technologies by better coordinating and utilizing a wide range of sensing devices. The massive quantity of energy that smart buildings use can only be decreased with the help of building management systems. Files and resources on computers decide which device feature is most suitable for the cloud-based building management system.

Smart Shopping Area

Technology advancements in cellphones, such as e-Wallet and Near Field Communication (NFC), have accelerated the expansion of the Internet of Things (IoT) into the retail industry. Installed Internet of Things devices (IoT) from 2015 to 2025, in billions, are shown in Figure 3.

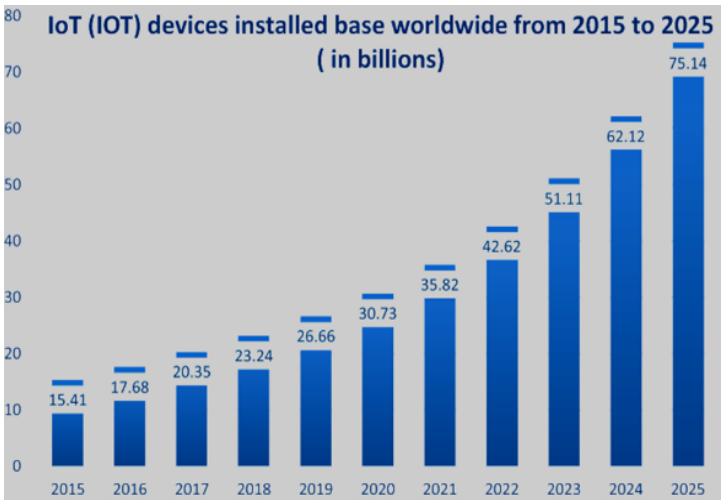

Fig. 3 *Internet of Things (IoT) devices deployed globally between 2015 and 2025, in billions*.

There will be an increase of 37% in the budget for Global Industry Marketing from $87 million in 2019 to $310 million in 2023, according to the research. This data is illustrated in Figure 4.

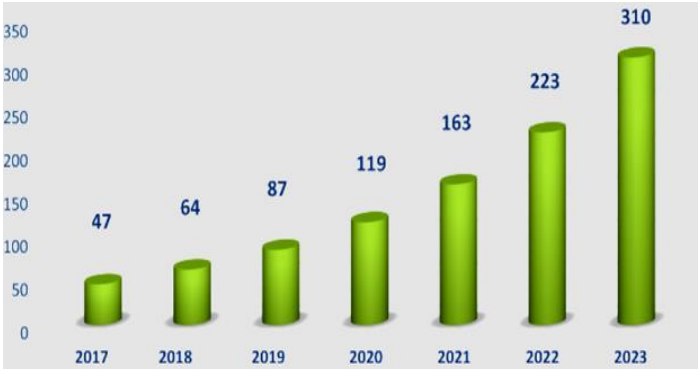

Fig. 4 *Industry forecast for the world, 2017–2023.*

Vehicles used for public transportation, arenas for athletic events, theme parks, etc., are commonplace in commercial districts. Consequently, near-field communication (NFC) payment transactions in areas focused on activities include:

● Consumers can rely on smart shopping programs that take into account their interests, habits, and any allergies they may have when making recommendations.

● Intelligent product management systems automate the process of restocking inventory by controlling the rotation of products on shelves and in warehouses.

● Applications for supply chain control make it possible to track products in the supply chain.

Computers, PDAs, and cellphones may share information with one another thanks to near field communication (NFC) technology, which uses contactless, short-range radio transmission. The security of the technology is compromised since third parties in the NFC ecosystem can access sensitive consumer data like bank account numbers due to the absence of a universal standard [16-17].

Everyone involved in an NFC transaction is familiar with each other thanks to the dynamic relationships that allow them to exchange access permissions in the service environment's applications. However, these parties are completely unaware of each other's rights and permissions to access places; they can only access their own. Managing and owning the NFC ecosystem becomes more complicated due to the stakeholders' lack of knowledge. In response to this concern, Secure Element (SE), a security module, was created to underpin the security of near field communication (NFC).

One technology that helps keep near-field communication (NFC) operations safe is cloud computing. Compared to SE, which is exclusive to mobile phones, cloud computing offers a lot of benefits and makes NFC safer overall. More so, when it comes to managing NFC applications, cloud computing can fix a lot of issues.

Smart Industry

"Smart industry" refers to the evolution of manufacturing. With the advent of fully automated production came the digital revolution, which completely automated electronic systems and information technology. Industry4.0, also known as the Fourth Industrial Revolution, is swiftly approaching, and it will usher in an era of smart production made possible by the combination of internet technology and the fast-spreading trend of industrial automation [24-32].

"Industrial IoT" refers to the combination of the Internet of Things with control systems used in manufacturing. IIoT allows for real-time data analysis by integrating big data, the IoT, machine-to-machine communication, cloud computing, and networked sensors.

Here is a way to organize IIoT applications: Whether you're in a chemical plant, an industrial setting, a hospital, or any other kind of facility concerned with worker or product safety, an indoor air quality measurement and improvement system can help you keep an eye on levels of oxygen and harmful gases. Radio frequency identification (RFID) and near field communication (NFC) tags, such as Zigbee, are examples of wearable technology that can detect indoor locations and monitor ozone levels in meat drying facilities.

Robotic systems that are able to connect to the Internet of Things (IoT) will soon be the standard, given the IoT's ongoing revolution in many areas of our life. Because of this need, innovative, high-tech services for robot-object interaction have been developed. Nevertheless, in order to expand the robotics applications made possible by the IoT, a number of crucial concerns, security concerns, design methodologies, and strong architectural components must be taken into account. Robots mostly engaged in the Internet of Things (IoT) sector, technical implications, and outstanding issues constitute the entire scope of this research.

The concept of the "smart industry," which incorporates Internet of Things (IoT) sensors into preexisting industrial infrastructure, aims to automate various Internet-based processes. The smart sector also makes use of data collected through the IoT system to adjust the manual system. For instance, a paradigm for direct evaluation of industry personnel can be found in business intelligence. An intelligent industrial system's sensors feed this model, which then uses that data to recommend various manufacturing procedures to employees.

CONCLUSION

Academics and programmers from all around the world are very interested in the latest advancements in the Internet of Things. Researchers and developers involved in the Internet of Things are collaborating to expand the technology to a massive scale for the benefit of society. But we can only address the many problems with the current technical approaches if we take their deficiencies into account. We laid forth a number of concerns and difficulties that IoT developers need to think about in order to create a better model in this survey piece. We also cover important aspects of Internet of Things applications when discussing its academic and developer communities. Just as the Internet of Things (IoT) delivers services, it also generates massive amounts of data. This article analyzes the possible uses of the Internet of Things in a variety of contexts, including healthcare, home automation, smart agriculture, smart cities, industrial control, smart environment, security, and emergencies. Technology, particularly the commoditization and simplification of sensor technologies in particular, have made it imperative that we maintain constant contact with all the things we rely on.

It is the next big thing in the Internet of Things (IoT), computers, and communication, and it's built on rapid advancement in a number of crucial fields like nanotechnology and wireless sensors. Management, power, industrial control, retail, utilities, healthcare, and a host of other sectors are potential users. A new age has dawned with the advent of the Internet of Things (IoT), in which tiny "smart" objects that are always online will be able to detect their environment, share data, and carry out online commands. Some see the Internet of Things (IoT) as the third major wave of international business, following in the wake of the Internet and personal computers.

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