

Internet of Things Applications

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Abstract: *Internet of Things technology has become one of the most advanced technologies that will change and change many traditional things and add many advantages to many systems and environment and improve the level of services provided to many users, whether in the field of smart health care or smart homes or smart energy etc. In this paper, we will introduce the concept of the Internet of Things, its applications and components for a broader understanding of (IoT) and try to enable and support the Internet of Things and develop applications that support and improve the efficiency of services and other functions. And the importance of integrating Internet of Things with artificial intelligence and machine learning to assist in the analysis and processing of the enormous data collected by wireless sensors from all fields in order to provide sufficient information and help solve many problems such as the problem of energy consumption and the problem of traffic congestion and pollution, etc.*

Keywords: *Internet of Things, Smart Cities, Smart Energy, Cloud Computing*

I. INTRODUCTION

To understand the concept of the Internet of Things, it is important to study its small but eventful history. Although it is a relatively small concept that appeared in the late nineties, now the applications of Internet of Things are present everywhere and the number of Internet devices connected to the network has become in the billions, Internet of Things can be defined as a self-configurable, adaptive, and complex network that connects “physical objects” over the Internet through standard communication protocols [1]. The Internet of Things helped to improve the quality of life at the level of individuals and at the level of institutions and industries in order to manage resources more effectively and raise the operational efficiency of many industrial and commercial sectors with the spread of applications of Internet of Things in the industry and trade sector to the emergence of a new concept is Industrial Things Internet (IIoT) [2]. Internet of Things is one of the most critical technologies of the modern era, which contributed to the development of many sectors such as energy, health, transportation, etc. and also improved the many services provided to users as many governments and institutions are trying to enable the Internet of things (IoT) technology in almost half of all cities or buildings, New smart cities where all the services provided in such cities are entirely dedicated to the Internet of things in order to create an individual experience and highly efficient user. Many companies have integrated artificial intelligence with the Internet of Things to make things connected

Revised Manuscript Received on July 15, 2020.

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to the Internet and exchange information and create a kind of communication between the devices and each other and this is very important in the introduction of artificial intelligence to Internet of Things, which will allow the analyst to analyze the data and readings collected from the sensors And also help in giving some tips and decisions to the user in many topics such as the weather condition or the proportion of carbon in the room or temperature and many other applications and one of the most famous applications Internet of Things and artificial intelligence is a Voice Assistant Alexa of Amazon, where there are many users who rely on their nature in this kind of technology to accomplish a number of specific tasks such as sending an email to work or check the condition of the weather before going out or booking tickets for travel and many tasks [3]. Internet of Things can be considered a network that connects all the available objects in the environment, not just computers or smartphones. There are many practical and beneficial applications for the Internet of Things in practical life, such as health care, factories, nuclear reactors, and many other fields. But with the many benefits of Internet of Things there are also risks that can adversely affect any system that has Internet technology stuff because it is merely a time-consuming Internet of Things These devices become vulnerable to many threats and potential attacks and can lead to side effects on many sectors and infrastructure and also steal information and user data [4]. Although Internet of Things has provided many features to add to many areas and the excellent standard of living and services provided to many systems that have been integrated with the Internet of Things, but there are many challenges and problems faced by Internet of Things technology and a lot of ethical concerns and security that possible However, many enterprises need to find solutions to enable and consolidate the concept of safety and privacy in relation to the data of users in Internet of Things, While Internet technology deals with the massive amount of data that needs to be processed and analyzed, Another problem is that it is better to integrate artificial intelligence with the Internet of Things ,This integration can be a significant leap forward in dealing with computing problems with regard to massive data processing and analysis, It will save much effort, time and money, and in recent years many companies have developed a relationship between the Internet of Things technology and Cyber Physical Systems and systems because the physical devices surrounds almost in the environment surrounding any system, so this relationship is one of the most important relationships that constitute the central pillar In Internet of Things technology[5].

II. INTERNET OF THINGS COMPONENTS

Internet of Things has contributed to the development and change of many of the many applications created by those who have existed before and have helped change many areas and improve them from smart homes, smart energy, smart healthcare etc. But there are determinants of possible obstacle in the development or implementation of Any system or device supports Internet of Things. These parameters include to the storage and data processing, communication and the network, protection and privacy, so Internet of Things technology Therefore, Internet technology consists of the main components of any system or applications of Internet of Things (IoT) [6]. It is necessary that these elements exist in any application being developed or any system that is integrated with Internet of Things to ensure the success of such applications and the figure 1 shows the major components for Internet of Things.

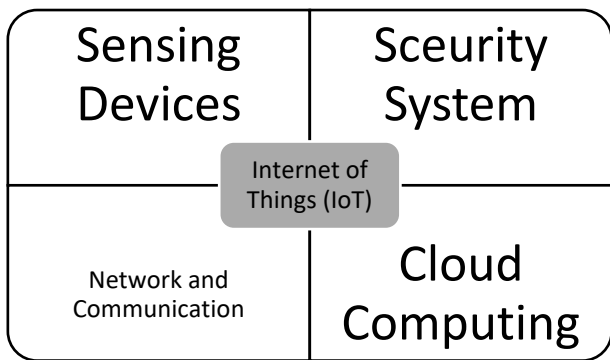


Fig. 1: Internet of Things Components

Sensing Devices

One of the most critical components of the Internet system of things is the tools of the sensor capable of making any device or system works with Internet technology can interact with the environment or with users and also interact with other systems and systems This layer of the system is the most critical thing because its mission is to collect information and send to The data processing layer and its analysis in order to obtain results and send them to the user and the decision-making sound and examples of the tools used in this layer responsible for the sensor (temperature sensor and humidity ratio, hydrogen ratio in the atmosphere, wind speed, and many other sensors that we can not mention [7]. The wireless sensor devices are one of the main components of the Internet of Things. It collects data and gives the Internet of Things systems and devices the ability to interact with the surrounding environment, device, and other similar systems. Such a network must exist within any Internet of Things system. It must be reliable, efficient, and durable. High in order to ensure the accuracy of the data collected from the sensors and the integrity of the data from the penetration and protection while sending them to the cloud to be processed [8]. Wireless sensors are made up of a wide range of categories. The first category is responsible for observing the surrounding environment, such as weather, wind speed, etc. The second category is responsible for sensing and controlling any outside influences that may affect the system such as carbon emissions, vibrations, The third category focuses its mission in the field of smart health care by

collecting and analyzing data related to human health such as heart rate, temperature, etc. [9].

A. Security System

Security concerns are one of the most critical problems is facing all the technology that has emerged since the advent of the Internet. Many security companies, institutions, and governments are still trying to reduce the attacks on their systems of saboteurs and always seek to protect these systems and all user data which are always the main target of an attack. It is essential that any system that is important and sensitive has a powerful protection system because any damage to this system can have side effects on the surrounding environment or the human life of nuclear power systems, health care systems or systems. Traffic and air navigation systems etc. Cybersecurity is still the most troublesome and troubling concern of many users and IT providers. Since the emergence of the Internet of Things technology, there have been many difficulties and security challenges that are very important to consider in order to protect the users of this technology and to reach the security of technology internet of Things and also gain the satisfaction of users whether they are individuals or institutions. The most important things for users are their statements where they can be a lot of concern for them for fear of stealing this information and their manipulation or control of the devices. This is also a reason why the user is concerned about the privacy of his information and his data. Therefore, all organizations and organizations must endeavor to develop and ensure that Internet of Things technology and other technologies coming on has enough safety and protection and respect the privacy of users in order to push the community to adopt this technology to a great that will provide many services and improve the standard of living of the individual and the community as a whole [10]. Privacy is one of the biggest challenges facing all Internet of Things applications. IoT technology is highly dependent on the collection and processing of data. The privacy of user data should be preserved, especially if it is of high value, such as smart health care. Many applications of IoT that contain data is critical, so you must apply a reliable and highly efficient protection system on all components of the Internet system to protect the data and privacy [11].

B. Network and Communication

The system of communication and network is the most critical element in the technology Internet of things and is the nervous system of the system, responsible for many of the most important tasks and most important is the transfer of data from sensors and sent to the clock or systems and data analysis and storage and also responsible for the process of communication between Internet of Things hardware and whether the user wants to check his data and read the devices connected to his networks such as the application of health care or home monitoring systems and many applications of IoT which we will mention later. Internet of Things collects many data while collecting data and sending it across the network for processing and processing.



The network and communications system are one of the fastest and most advanced systems. There are now many techniques and tools that help make networks and Internet systems easy. Bluetooth, NFC, WIFI, WiMax, and PLC are one of the most critical technologies that help to access the network and send and receive data. It is also necessary that the Internet of Things devices that support communication protocols and send and receive. This is to increase the capabilities and efficiency of the Internet of Things systems. Table 1 shows all protocols responsible for communications and the protocols that It is responsible for sending data in the Internet of Things Applications [12].

Table 1: Internet of Things (IoT) Main Protocols.

IoT Network Protocols	IoT Data Protocols.
HTTP	MQTT
LoRaWan	CoAP
BLE	AMQP
ZigBee	XMPP
WiFi	
RFID	

C. Cloud Computing

the Internet of Things devices are collecting a lot of data and information especially that (IoT) depends directly on direct communication with millions of other devices and this leads to the production of vast amounts of data needed to store, processing and analysis in order to obtain many of the results that lead to Achieving the goal of Internet of Things is to improve the efficiency of any system. Therefore, there must be a system that meets the needs of the Internet of Things technology. Here is the importance of cloud computing. This is one of the most critical technologies of the modern era because of its services that help solve many problems. Therefore, it is crucial to have a cloud computing system and connect it with any device that supports the Internet of Things technology. So that the system is able to send and store data in the cloud safely and effectively and also perform many operations on this data, especially that the cloud computing system has the ability to operate and perform complex operations and processing large amounts of extensive data, unlike the Internet of Things In a different perspective, we can be tremendously leveraged by the process of integrating Internet of Things and cloud computing, because Internet of Things is rife and widespread in all fields, but it faces problems such as limited storage capacity and modest processing capabilities. Security and privacy, but thanks to integration with cloud computing, which has a massive equipment of unlimited storage capacities and the enormous capacity to handle many complex processes and also the safety and privacy, high reliability and many other features J is characterized by cloud computing system and can through the integration of the Internet of Things and cloud computing to deal with many problems and even open up new areas for business, economic and scientific research [13].

III. INTERNET OF THINGS APPLICATIONS

Since the advent of the Internet of Things technology in the early nineties, many new ambitions, ideas, and concepts have emerged to improve human life and make life smarter and simpler. These concepts include smart cities, smart networks, etc. The possibility of machine interaction with the environment and communication with users, With each other M2M. Internet of Things helps to make the environment more intuitive, smart, and straight forward, especially with all sectors such as energy, transportation, industry, healthcare, and other fields[14]. There is a growing demand for modern solutions by using our latest technologies and technologies to manage all infrastructure resources, especially with the problems of population inflation and lack of financial resources. Since the emergence of Internet of Things technology, many thanks and institutions have adopted this technique that will change the standard of living of the individual and solve most of the problems that have been and still are suffering the world because of the (IoT) of the flexibility and high prevalence in all areas where it is possible The use of anything and intelligent rendering capable of interacting with the user and with other connected devices in the same network This development in our environment as users will lead to the improvement of all life services such as traffic and financial services that protect the environment, reduce the consumption of energy and increase the capacity of very large and enable the concept of energy conservation and conservation by replacing traditional energy systems Renewable energy systems [15].

IV. SMART CITIES

Smart cities are among the most critical factors that have contributed to and are still contributing to the development of Internet of Things applications. There are many definitions of the concept of cities. The most common of these concepts is "cities that link physical infrastructure with the IT infrastructure, Trade, and economy in order to improve and enhance the standard of living of individuals and increase intelligence in the city and all areas." Smart cities can also be considered as one of the largest centers equipped with the latest technologies that collect and transmit data in order to provide a better level of services suitable for the future. Smart cities consist of six main components, as shown in Figure 3 [16]. Smart cities and the Internet of Things rely on the provision of an infrastructure made up of various sensors, data collection, and provision of services. Smart cities have become one of the most important directions for governments to develop their cities in order to improve all areas such as water and waste management and other services. Available in cities and homes [17].



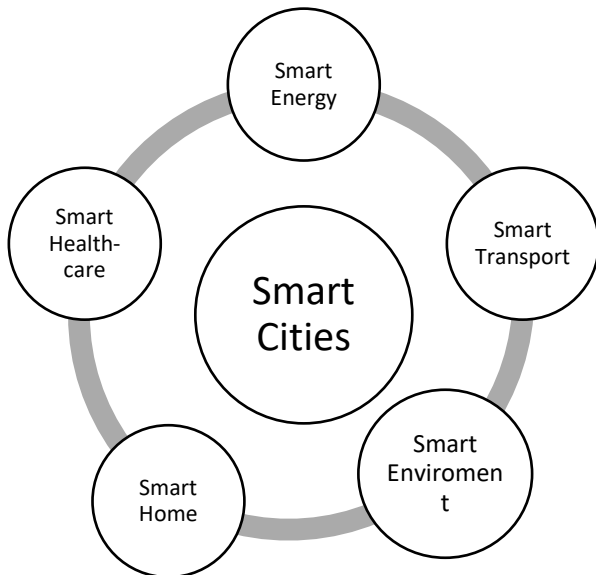


Fig. 2: Smart cities Components.

A. Smart Energy

In recent years, the demand for energy has increased significantly because of the increasing number of consumers. It was necessary to have a new system capable of controlling and controlling all the energy resources handled by the system in order to facilitate the transfer of energy and also the possibility of improving energy consumption better and facilitated, Internet of Things technology Many things that can be applied to existing power systems and make them smarter and efficient systems in energy management, The integration of energy systems with the Internet of Things has enabled the collection of information on the consumption and treatment of energy users and the results that help decision-makers make decisions to help reduce energy waste, apply more economical methods, save energy and money, and users can see the nature of their energy consumption from In order to increase awareness and understanding of the use of energy correctly and adequately and cleverly and also make room for the use of renewable energy such as solar energy, wind energy, etc [18]. One of the most essential services added by Internet of Things is the management, monitoring and intelligent load, where the energy system in any enterprise sweats to high load at peak hours and therefore it became necessary to find a system that monitors and control any overload on energy resources and even switch between them Renewable energy sources such as solar energy and wind energy to meet the demand for excess energy at peak hours, especially in the hot areas and also can combine the two systems of solar energy and wind to meet all the needs of consumers and the absence of any deficit or cut in energy and also the use of devices Sensing, The way Internet of Things and determine the amount of electricity consumed by any system in the case of a high demand for energy and try to reduce this load by converting some of the devices that consume high energy, such as systems adaptation to the solar cell system in order to reduce cost and reduce energy waste and Preserve the environment and make the system more intelligent and efficient energy [19].

B. Smart Health-Care

Health is one of the most pressing concerns for many institutions and government agencies where many companies are seeking to develop the health sector and one of the most critical factors that helped in the development of the field of health care is the Internet of Things as the development of new applications and systems to provide comprehensive health care and make necessary Monitoring the health status of any patient is a natural, quick and straightforward task where the doctor can find out all the information about any patient has such as heart rate, body temperature, oxygen saturation level and many information and all this through a web page that displays information collected from Equipment for inhalation Which is fitted to the patient, such as an Watch Apple, and therefore the possibility of monitoring the situation permanently has become more accessible and also create a record of a patient containing all the information related to his health status, which he and the doctor in charge to see it and make the necessary decisions and try to avoid any future diseases, Figure 4 illustrates the health care network using Internet of Things and the creation of health care systems to collect as much biological information about patients as possible and for all participants in the Intelligent Health Care Program. Data analysis and classification can help to understand and find solutions to many diseases Or preventive measures and the possibility of storing all data in the cloud and access at any time and place and this will contribute to the improvement and development of the health care sector and make it more intelligent and efficient [20].

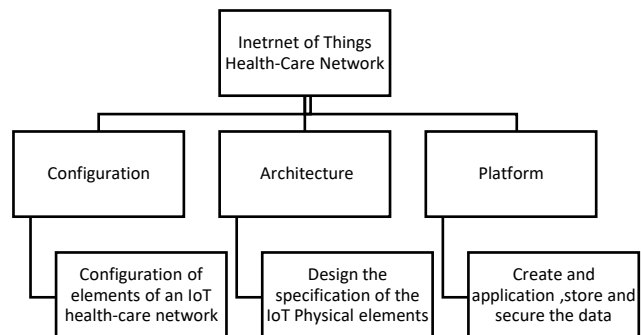


Fig. 3: Smart Health-Care Application Components.

Smart health care is one of the essential features that emerged with the introduction of the Internet of Things in the field of health. It has become possible to integrate the technology of communication and information with the health sciences, which helped in providing many solutions and adding more and better options in the health care sector which is one of the most critical sectors used by Individual or society in general and it is necessary to focus on the use of IoT In order to improve health services and reduce the material cost of patients and health institutions Smart healthcare encompasses many of the options that Internet of Things technology has added to improve the management, processing, and analysis of data in the health sector to provide support at all levels, both at management level and decision-making or operational level, which will lead to many benefits such as Improve the process of data



acquisition and management better, faster, and more secure. Provide better, more effective and efficient options for patients and help them choose the best health services they need [21].

C. Smart Transport

Internet of Things has helped to provide many additional services and improve the services provided in the transport sector, whether the transport of passengers or goods where we can provide vehicles with devices supporting the Internet of Things and send all information about the condition of the vehicle whether moving or static or if there is any technical failure etc. We can monitor the condition of any vehicle with high accuracy through the internet of Things. Some of the services provided by the transport sector are the transport of goods or logistics. In some cases it is necessary to know some information such as temperature and humidity or the amount of pollution in the air inside the truck and a lot of information that can help in maintaining the safety of the goods and also Internet of Things technology enabled the control, monitor, and direct some remote-controlled vehicles such as drones that use all areas of transport, whether by land, sea or air. Internet of Things has added many advantages to the transport sector, where the task of managing and monitoring the transport easier through a central control system connected to the network, which facilitated the currency management of the flow of materials and goods coming with vehicles, in addition to providing the necessary information on the status of parcels and goods and ensure the safety and Track its location using GPS and the IoT it can even help In monitoring and organizing traffic and providing advice to decision-makers in order to avoid any problem that could affect traffic or the transport sector [22]. The transport sector is one of the most critical elements of the infrastructure that helps in the life of the cities and the flow of goods and many services, so it is necessary to develop traditional transport systems and the addition of technology to improve the level of services and the development of new features of the system such as traffic control and flow control Shipments at the shipping terminals where some government agencies used the Internet of Things in the transport sector and helped them collect many information analysis in order to support any future decisions seeking to develop the field of transport, Through the Internet of Things can be controlled many things that were not available in the past, such as control of goods in real-time, to know full information about the condition of the vehicle, monitor the behavior of the driver during the driving and if committed to the speed prescribed. And the addition of sensors many options and information that can be obtained and therefore we are able to obtain specific information on any shipment at any time and the possibility of connecting the shipping and cargo platforms with intelligent transport system and send data on the location of cargo and weather conditions surrounding the goods and then processing data Collected to help make decisions and preventative actions. Here are some things added by integrating Internet of Things into the transport sector [23]:

- Tracking equipment in real-time.
- Communicate all elements of the system and take appropriate precautions such as report trains.

- Delays or accidents.
- Predictive maintenance.

D. Smart Home

The houses were the first target groups by the technology of the intranet of Things because the houses contain things and services that can be developed by IoT in order to improve the standard of living and make it more modern and straightforward. The things that can be developed in homes and integrated with the Internet and make them able to interact is Adaptive systems where we can add sensors to the adaptive home system, which enables us to obtain information on humidity, oxygen saturation at the home or level of carbon dioxide, and many information and homes still attract the interest of many companies that support Internet of Things technology for the development and the addition of possibilities and other characteristics did not exist before in our homes and increased the level of safety and control through the development of a system of control of the house [24]. The Smart Energy Meter is one of the smartest home applications. It is essential to provide a vital service and help improve the living standards of the individual and his environment by monitoring energy consumption and obtaining information and live readings of the actual consumption of the house of energy and the possibility of reducing energy consumption and What can increase the efficiency of smart home systems is to integrate them with a renewable energy component such as solar energy, wind energy, etc., which contributes significantly to free energy for homes without any pollution or additional costs. Make Homes smarter [25].

E. Smart Environments

Internet of things applications have emerged in the field of geographical risks to contribute to increasing the efficiency and accuracy of monitoring and early warning systems to prevent and reduce losses of geophysical disasters such as earthquakes, landslides and other risks that could pose a threat to the lives of citizens. As it became necessary to have a system for monitoring and early warning of geographical hazards based on Internet of Things technologies and to make use of sensors to obtain much essential information that helps in analyzing and preventing some geophysical hazards such as rain gauge, water sensors Subterranean to reduce landslides [26]. The smart environment is not limited to the applications mentioned. Still, it is one of the most essential and vital sectors to add additional services and capabilities to the environment around us and improve them through the Internet of Things are smooth and with the help of sensors to make the situation more secure and stable as some institutions In the use of devices to detect water pollution and know the level of acidity and through the possibility of monitoring forests through fire detection systems in the woods to try to control and preserve the environment from destruction and make it a life-enhancing climate and more intelligent and interactive with the surrounding elements [27].

V. ARTIFICIAL INTELLIGENCE AND INTEGRATION WITH IOT

Many companies are still trying to add and integrate the concept of artificial intelligence into computers or their applications, so to add many capabilities such as the ability to learn from the surrounding environment to try to imitate the human mind in learning and development. Data extraction, video games, natural language comprehension systems, and data analysis and classification systems. Artificial intelligence has developed several categories, including self-learning and natural language processing. One of the most important branches in the field of artificial intelligence is the self-blending, which depends on increasing the level of machines in self-learning and data analysis and analysis by applying some algorithms to help make decisions, so the most important goals of self-learning are to improve the process of data analysis intelligently better. One of the most commonly used self-learning algorithms is supervised self-learning and non-supervised self-learning, It is also possible to take advantage of the artificial intelligence algorithms, notably the supervised learning algorithm and the non-supervised learning, where they can be used in the Internet of things applications in the field of health care or energy consumption where the algorithms analyze the data and produce the necessary and necessary results to improve electricity consumption, for example, or Early detection of any disease can be cured and many other areas [28]. Artificial intelligence refers to the electronic environment that is sensitive and interacting with others around it. Internet of Things works together to provide support and help with daily services and other activities by using information collected from or obtained from the surrounding environment. Other systems connected to the same network. Systems with artificial intelligence must have the following characteristics [29]:

- Embedded: Many devices are added to the surrounding environment and connected to the network.
- Context of knowledge: the possibility of these devices in the interaction and with the user and the surrounding environment and recognition.
- Personal: The possibility of allocating systems and devices to suit the needs of users and the environment.
- Adaptive: The possibility of adaptation, adaptation, and response to any omer or do it can happen to the environment, system or user.
- Predictability: The possibility of the system and devices to anticipate user requests and issuing advice without external interference.

VI. CONCLUSION

Internet of Things has made everything adaptable and connected with the surrounding environment and other devices and enabled the concept of (M2M) where the devices can communicate with each other without human intervention and the processing and collection of vast amounts of data using cloud computing so it is necessary to further develop and contribute to Implementation of applications that help increase the level of efficiency, speed

and intelligence of any system or service provided with the need to pay attention to the integration of artificial intelligence algorithms and machine learning with the Internet of Things to strengthen with the need to protect these applications, especially the data collected from users or the surrounding environment of the data is of great importance so it is necessary to seek the development and study of Internet of Things for its technology To anything anywhere for anyone at any time.

ACKNOWLEDGMENT

Authors would like to express gratitude to the Centre of Research Excellence & Incubation Management (CREIM), UniSZA for sponsoring the publication of this research article.

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