Internet of Healthcare Things- Emerging trends, Issues, and Challenges

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Abstract— **IoT or Internet of Things has a primary intention and goal is to "connect the unconnected" which T means that the nodes or devices that are not connected to a computer network will be connected so that they can broadcast and connect with people and other objects. In today's world, IoT (Internet of Thing) is an emerging concept that aims to communicate and associate with billions, millions and trillions devices or things with each other. Internet of Things (IoT) is a network of network that associated with smart devices and their applications using sensors and clouds or Big data. They can able to sense, collect and sends data or messages from their encompassing and start networking. There are lots of practical applications we have used in our daily life where health care industry plays a major role. In health care, IoT provides better medical facilities to the patients that create a huge impact in medical field. In this chapter, we are going to discuss different technologies used in health care, security and its different challenging issues, several healthcare services and applications where we can use IoT.**

INTRODUCTION

A new technology has been developed from wireless communication where devices are communicated to each other and connected to Internet, called as Internet of Things (IoT). It is a new and innovative technology or process that used to collect information between different things and share among each other for better communication. IoT technology includes things which are nothing but IoT devices and physical objects. Things and data are the early point and the era is what an IoT device allows to do. The term "Internet of Things" is developed by the author Kevin Ashton, he said in late of 1990's a technology that permits and allows small RFID tags that means Radio Frequency Tab which is used in various objects contained information and readable at a distance. Being a small sticker or a special label in a plastic case, it allows, for example, tracking the movement of goods, improving the supply management system, and even preventing theft. Such RFID tags have become widely used in the trade industry. Moreover, Kevin Ashton explaining the basic idea of his invention used the term "Internet of Things". He once suggested that every single thing, in the real physical world, in IoT would have a digital counterpart as its virtual representation [4]. We can use IoE (Internet of Everything) in place of IoT because both contained the same meaning. In IoT, a process has been used that is "Machine to Machine" where each machine means smart devices or things can able to communicate to each other just like human can interact with each other. Humans can communicate or associate with different electronic gadgets by setting them and incorporate some instructions to them and then access the data but in IoT (Internet of Things), smart devices or machines can communicate between each other without any human intervention which is become now an huge demand for professionals and as well as normal people because it makes things alive. The internet of things (IoT) is the internetworking of physical devices, vehicles, buildings and other items—embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data [7]. There are some primary characteristics of IoT (Internet of Things) are listed as below:

a. A instantaneous explanation or solution in a world-wide global environment;

b. Indoor and outdoor wireless solutions for environments;
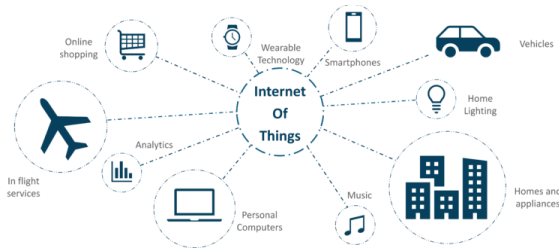c. Ability to distantly monitoring the environment and tracking objects.

Fig 1: Internet of Things (IoT) & its applications [11]

1.1.1: History of IoT:

- In 1990, John Romkey connected a toaster to the Internet with a TCP/IP protocol and after one year, few scientists from Cambridge University came up with the idea to use a web camera to monitor the amount of coffee available in their local computer lab's coffee pot by doing some programming.
- In the year 1999, Kevin Ashton has developed "the internet of things" and he described that this is a technology that connect several devices where it uses RFID tags.
- While his idea of RFID based device, Ashton's idea plays an essential role in the Internet of Things history.
- At the beginning of 21st century, the term IoT" came into widespread use by the media with outlets like The Guardian, Forbes and the Boston Globe making mention of it. As per increasing interest in the IoT technology, the 1st International Conference on the IoT was held in Switzerland in 2008. After one year, Cambridge University came up with the idea to use the web camera in their computer lab for measuring the amount of coffee in coffee pot.

Connected Devices by 2022	Year 2003	Year 2010	Year 2015	Year 2022
World Population	6.3 billion	6.8 billion	7.2 billion	8 billion
Connected devices	500 million	12.5 billion	25 billion	52 billion
Devices per person	0.08	1.84	3.47	7.5

Table: Evolution of IoT in different year [12]

In the near future, IoT manufacturers will focus on designing solutions for particular industries and industry segments rather than for general needs. There is a growing demand for specific use cases that help to resolve industry-specific challenges. For example, IoT solutions for remote patient monitoring aimed at reducing costs and improving the quality of patient care. The global remote patient monitoring market is expected to reach $1.8 billion by 2026, according to Grand View Research [12].

IoT technology has some fundamental characteristics. They are described below:

- Things or Devices: As I have discussed earlier in the introduction part, that things are the smarter devices that helps to access the data and shared with each others. Example: Intelligent Objects, Smart Objects, IoT Devices.
- Data: Data is the first step toward IoT operation. It is an information which contained by Things or Devices.
- Connectivity: It is a process that is used to connect between two IoT end points or IoT Things for communication purpose.
- Intelligence: It is the Key to unlock IoT potentials because of its ability to extract insights from IoT data.[13]
- Action: Actions are the consequences of intelligence.
- Heterogeneity: IoT (internet of things) is made up of heterogeneous devices that work or operate on different platforms on different networks, so all the components should be interoperable.

1.1.2: Applications of IoT: There are lots of new areas that appear at the intersections between interconnected technologies and various industries.

- Internet of medical thing
- Industrial internet of things
- Automotive internet of things
- Smart cities and smart buildings
- Smart agriculture
- Smart retail

In this chapter every section is going to study the different aspects of healthcare research in associated with Internet of Things or IoT technology. This chapter aims to look at the basis of IoT in the health system, importance of applying IoT technologies for the newly developing personalized health data. IoT-based healthcare systems are committed to use in reduce costs and increment the customers happiness and increase the client's participation. In Internet of Things, Smart Health care providers are used to make good utilization of such pioneering health systems

and supplies the correct and proper information about the proper patients at the proper time and consequently and there after these healthcare providers are able to manage the medical conditions of that particular patients promptly and efficiently. There are a lot of applications in the healthcare field, including the possibility of using smart phone capabilities as a platform for monitoring of medical parameters that advise patients of medical issues.

1.2 IoT in Healthcare: One of the major applications of IoT is in Healthcare application. Through IoT systems or technology, doctors and healthcare providers can help people throughout the Internet. The Internet of Things (IoT) system use data by bringing together the major technical and business trends of mobility and automation. The data collected from these devices can then be interpreted by the organization for the following parameters:

- Improve patient care-To offer new or enhanced care delivery and services that help differentiate a data-driven healthcare organization.
  - •Optimize processes-To develop new services and solutions that increase efficiency and reduce operating costs.
- Make hospital networks smarter-To monitor critical infrastructure and automating the deployment and management of the IT infrastructure.
- Connected medical devices-such as MRI and CT scanners, which generate vast flows of data that network with computing infrastructures providing analysis and visualization.
- Wearable medical devices and remote patient monitoring devices- To offer safer and more effective healthcare through real-time patient monitoring of vital signs, post procedure recovery, and adherence to treatment, both in hospital and remotely. With wearable sensors, doctors remotely track and respond to a patients' health status in real time.
- Video security cameras and electronic ID-enabled security doors- To increase security and prevent threats and unauthorized entry and departure.
- Medical asset tracking- To use Bluetooth Low Energy (BLE) tags to monitor location of medical devices, medicines and supplies.

- Preventative maintenance solutions- To reduce unplanned repair of essential medical tools, devices and systems for medical purpose.

In Healthcare system, IoT system used to collect health data that has numeral number benefits in healthcare collaboration, while most of the research focuses on the personal fitness plan and has a lack of unity and resilience between a large number of devices and their business models.
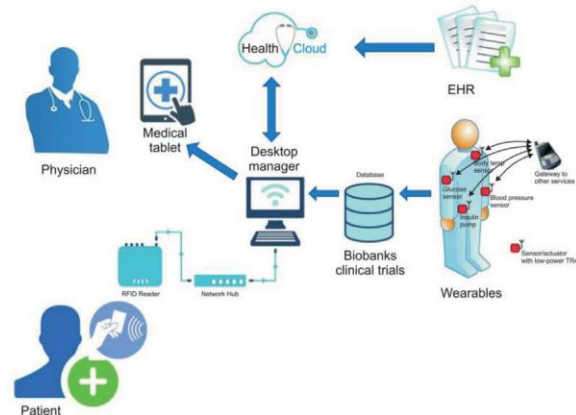

Fig 2: IoT in Healthcare applications [14]

Figure 2 depicts how this IoT in healthcare operates. There are lots of advantages of IoT for health applications like remote health monitoring, fitness programs, chronic diseases, children care and elderly care and many more. This e-Health monitoring system using IoT application or technology will decrease the number of appointment to a doctor and also it will be a great opportunity for the doctors to check their patient's health condition by sitting in anywhere. As this is a technology not so feasible now, but in coming years, this technology will meet the physical world definitely. The result from Healthcare applications using IoT technology will be accurate in the emerging IoT business that serves various opportunities and challenges to an industry. The IoT normally acts as a middleware which can be utilized in many ways to implement projects with ease. In IoT Healthcare architecture, the patient and doctor works as the middleware of the whole system which ensures that the communicating devices is used to create a conjunction between the medical service and the patients. In today's era, medical professionals or healthcare providers are used to collect a huge amount of data and then need to analyze and interpreted that data and finally doctors are making a decision based on that analyzed data. With these technologies, it is possible to handle a

much greater volume of information to store and analyze it in order to closely follow the progress of a particular disease or process. We have used many more health monitoring devices that can use for measuring blood pressure and heart rate and many more. In monitors to advanced devices capable of monitoring specialized implants, such as pacemakers, Fit bit electronic wristbands or advanced hearing aids. Specialized sensors can also be equipped within living spaces to monitor the health and general well-being of senior citizens, while also ensuring that proper treatment is being administered and assisting people regain lost mobility via therapy as well. IoT technology in Healthcare system as depicted in fig 2 is a heterogeneous computing and wirelessly communicating system that joins patients and health providers to diagnose, monitor, track and store vital statistics and medical information. Two important phases of IoT applications in Healthcare IoT Healthcare solutions can remotely monitor patients suffering from cardiac, diabetes, arrhythmia and chronic diseases, GPS tracking of dementia and Alzheimer's sufferers. Put life-saving data, such as CT scans, test results and patient records, into the hands of medical staff, almost anytime. [7].

1.3 Architecture of IoT in Healthcare:

Fig 3: Architecture of Healthcare system in IoT [15]

Now we are going to discuss the three layer architecture of IoT technology in healthcare system. It has three layers, to be specific, the perception, network, and application layers.

a. Perception Layer: It is the physical layer for IoT application. The function of this layer is used to detect and sense the data using different sensors. It also able to sense different physical parameters in the environment.

b. Network Layer: Network Layer has a function of connecting to other smart things, devices

and others. It also used to transfer data taking from perception layer and transferred to application layer.

c. Application Layer: Application layer has a responsibility of communicating application specific services to the user. It defines various applications in which the Internet of Things (IoT) can be deployed, like smart homes, smart cities, and smart health.
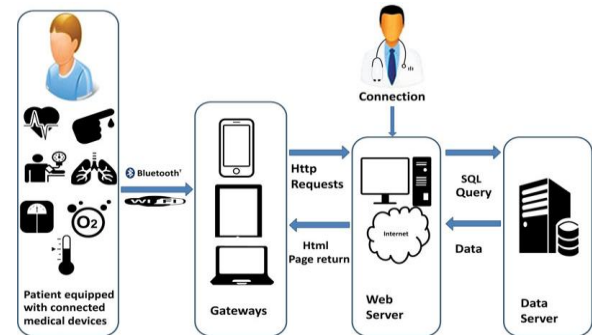

Fig 4: General architecture of IoT e-Healthcare system [16]

Normally IoT e-Healthcare system is a three layer architecture through which patient can be monitored with their doctor sitting in their home. As depicted in the fig 4, the general architecture where doctor can communicating and diagnosed their patients by maintains few steps.

Level 1: Architecture followed by the patient or the user.

Level 2: Architecture of the Network

Level 3: Architecture followed by the doctors or medical professionals and the hospitals.

Architecture followed by the patient or the user where the patients' current health statistics is the important aspect. The patient communicates with their doctor or other medical personnel indirectly because all types of interaction will be possible using a third party that is IoT. In general, patients will have a sensor on their body which is used to measure some important parameters of health and if they will find any abnormalities then at next stage patient will login to the application provided

from that hospital or that doctor and then create a profile so that the medical personnel on the other side can see the biodata of the patient. All updated information is kept on the cloud server as well as in physical storage. At next stage or level 2 which are network architecture that acts as a middleware between the systems. It is used to establish or develop a connection between the doctor and the patient. Network architecture algorithms are varying

for different systems based on their architecture. Finally at level 3, architecture followed by the medical personnel is fully depending on their patient need. In short, the full system helps removes stresses from society to ensure a healthy generation [3].

1.4 Healthcare Technologies: There are many applications of the smart devices and products that communicate to the Internet of Things (IoT) to have revolutionary changes in the healthcare industry. Healthcare personnel, Doctors and Patients all are getting advantage from IoT (Internet of Things) e-Healthcare system. There are several uses of e-healthcare IoT systems like mobile medical applications, wearable devices that permit patients to calculate their health parameters and the doctors and other medical personnel form corresponding hospitals will use IoT applications to keep eyes on the position of medical devices, personnel and patients. Here some key technologies have been discussed for IoT-e healthcare system.

• Cloud Computing: Cloud computing is a big transformation from the traditional way how a business's think about their IT resources.

• Cloud computing is on-demand access, through the internet for computing resources—

• applications, physical and virtual servers data, storage, development tools, networking capabilities, and more which are hosted at a remote data center managed by a cloud services provider (or CSP). The IoT and Cloud Computing complement one another, often being branded together when discussing technical services and working together to provide an overall better IoT service [17].

Grid Computing: Grid computing has a distributed architecture where multiple computers connected by networks to accomplish a joint work. These types of work are compute-intensive and little bit difficult for a single machine for handling. Multiple devices on a single network communicate under a common protocol and work as a single virtual machine to get complex tasks done. Grid Computing can be applied to IoT system due to non-invasive sensing and low-power wireless communication technologies which has enabled continuous monitoring and processing for patients those who are using biomedical sensor nodes. These small wearable devices - limited in memory, energy, and computation and

communication capabilities - are capable of continuously monitoring vital signs such as blood pressure, temperature, Electrocardiogram (ECG), Electromyogram (EMG), oxygen saturation. For more information about grid computing and IoT we recommend the reading of paper [18].

Big Data: Big data refers to a huge set of data which cannot be controlled by normal data management tool. So, Big Data is used to access to huge databases in real time applications. It has three main features:
a.   Speed at which data has been processed;
b.   Different types of stored data.
c.   Volume of data listed.
It has a primary objectives to improve a company's or system's responsiveness to a large amount of data collected, increase the output and enhance the knowledge of customer attitude then it can offer modified offers or announcement and create new technology. Different techniques are used to collect and store data. One of the major sources to collect huge amount of data is IoT devices. These devices have in-built sensors which are used to collect data from the environment they are in. The collected valuable data is transferred to the cloud through the internet.

Networks: For supporting the physical infrastructure on the IoT based e-Healthcare we need to define few short-range communications, such as WPANs, WBANs, WLANs, 6LoWPANs and WSNs to long-range communications, e.g., any type of cellular network. For low-power medical sensor devices ultra-wideband (UWB), BLE, NFC and RFID technologies can be applied and used for communications protocols.

Augmented Reality: Augmented reality has brought about a significant change in the healthcare industry. There are different applications of this technology in the medical sector. Right from providing assistance during surgeries to improving medical training, augmented reality is all set to make a bigger impact in the coming years. Apart from saving patients' lives, existing processes in healthcare organizations can be made more efficient and precise with augmented reality. We will have a look at the numerous uses of this amazing technology in the healthcare industry [19].

Wearable: As per our knowledge till now, we can conclude that we need some wearable medical devices for measuring different parameters of health like pressure, heartbeat etc. These types of wearable devices have three major advantages like information connected with the devices, target-oriented healthcare communities. In healthcare, the Wearable IoT (WIoT) is a network of patient-worn smart devices (e.g., electronic skin patches, ECG monitors, etc.), with sensors, actuators and software connected to the cloud that enable collection, analysis and transmitting of personal health data in real time. Wearable technology is widely used in healthcare to enable patient condition monitoring, therapy delivery, and more. In 2021, the wearable medical devices market was estimated at $16.2 billion, and it is expected to reach $30.1 billion by 2026 at a CAGR of 13.2 % [20]. Wearable devices are used to measure health data like calories intake, walking steps, heart bit, blood pressure; time spent exercising, and many more. There are lots of advantages of using these types of devices and also it looks after our health. I have discussed some wearable devices as given below:

Wearable Fitness Trackers: Some of the simplest and most unique forms of wearable technology are fitness trackers which looks like a wristbands operated with different sensors to keep track of the patients or users physical activity like steps, calorie and heart rate. They provide users health and fitness recommendations by synchronizing to various smart phone apps.

Wearable ECG Monitors: Wearable ECG monitors are on the new edge technology for the consumer electronics. These are sets to monitors and measure electrocardiograms, or ECGs. Mobile ECE monitors are able to measure an electrocardiogram and send the reading to the corresponding patient's doctor for detecting any abnormalities and also able to track pace, distance, and elevation and monitor automatic tracking for walking, running, swimming, and biking.

Wearable Blood Pressure Monitors: Omron Healthcare launched Heart Guide in 2019, the first wearable blood pressure monitor. Though it might look like a typical smart watch, Heart Guide is an oscillometric blood pressure monitor that can measure blood pressure and daily activity - like steps taken, distance traveled, and calories burned[21].

Biosensors: It is a completely different wearable device from other wearable devices that has discussed above. The Philips' wearable biosensor is a self-adhesive patch that allows patients to move around while collecting data on their movement, heart rate, respiratory rate, and temperature.

1.5 IoT Healthcare-Services and Application: IoT e-Healthcare services and applications has a range of fields that include: managing the private health and fitness data, proper handling and care for pediatric, supervision of chronic diseases, intensive take care of elderly patients. Here I have discussed different types of services maintained using IoT in Healthcare system.

1.5.1 Different Healthcare Services:
Ambient Assisted Living: Ambient assisted living is a beginning trend where artificial intelligence (AI) enables the use of new products, services, and processes which help to provide safe, high-quality, and independent lives. Due to causal health issues, everyday living aspects can become physically and mentally challenging for them. Ambient Assisted Living (AAL) provides technical systems to support elderly people in their daily routine to allow an independent and safe lifestyle as long as possible. The personal interaction between elderly people and their environment with hospitals is an important aspect in AAL. Ambient-assisted living (AAL) provides a better quality by monitoring daily routines to provide immediate healthcare services as and when required. Internet of things (IoT) maintains a great role for developing technologies for ambient-assisted living. The AAL systems offer an ecosystem of medical sensors, computers, wireless networks and software applications for healthcare monitoring.

Mobile Health Things (m-IoT): Mobile IoT is a innovative healthcare application which connects with 6LoWPAN with evolving 4G networks. Although the characteristics of m-IoT represents the IoT for healthcare services which is worth mentioning that exist some particular features inherent to the global mobility of participating entities.
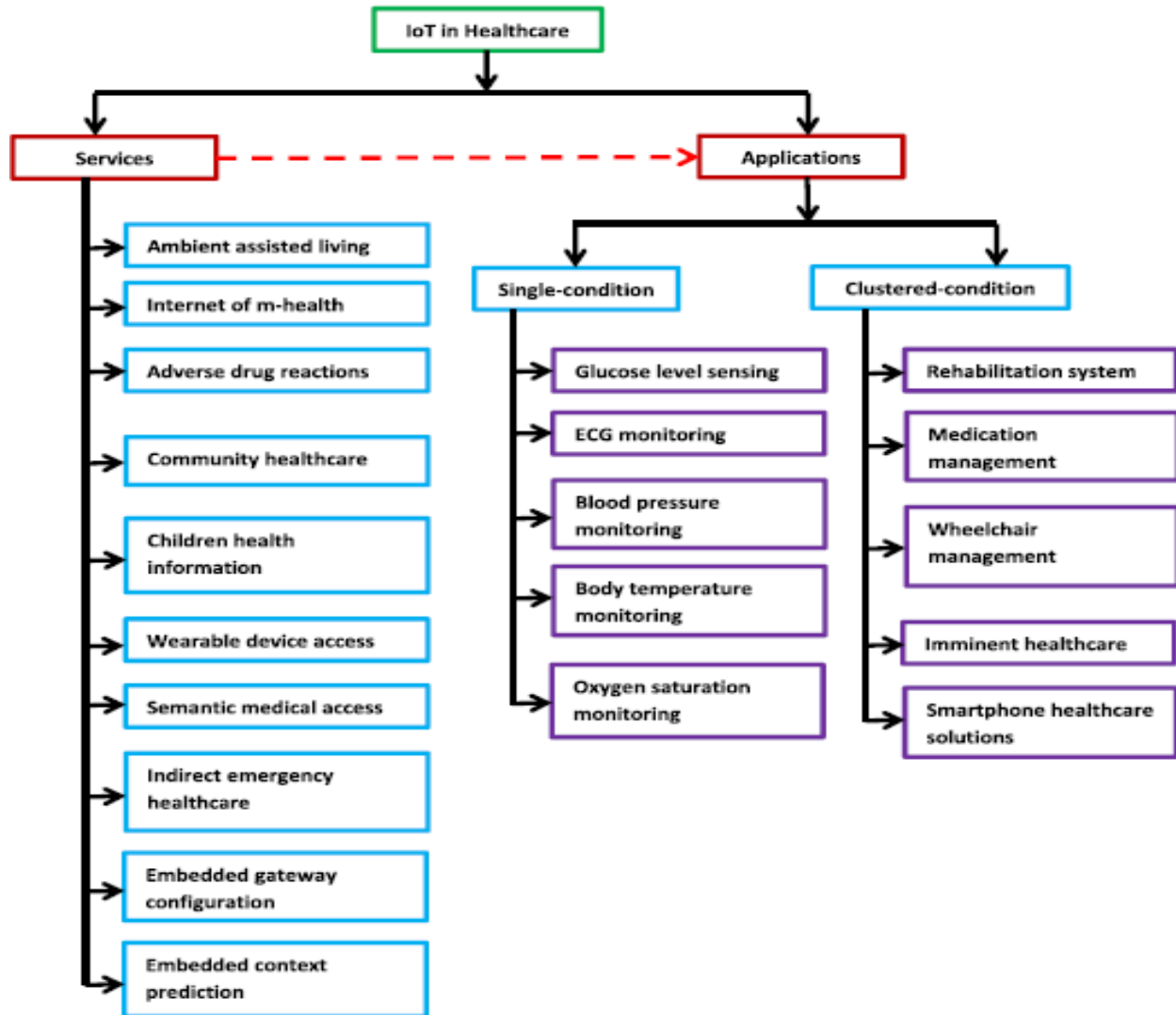
Fig 5: IoT in Healthcare-Services and Application (Islam, Kwak, Kabir, Hossan, & Kwak, 2015)

Adverse Drug Reaction: Adverse drug reactions (ADRs) become a challenge in modern healthcare specifically in an ageing population. An adverse drug reaction (ADR) can be defined as 'an appreciably harmful or unpleasant reaction resulting from an intervention related to the use of a medicinal product; adverse effects usually predict hazard from future administration and warrant prevention, or specific treatment, or alteration of the dosage regimen, or withdrawal of the product' [22].The effect of ADR can be reduced by using wearable devices of IoT. They can identify the drug by means of barcode or Near-Field Communication (NFC). adverse drugs reaction (ADR) and harmful effects of pharmaceutical excipients imply severe incidences, due to incompatibilities of the drug with the medical

history. The rate of ADR appearance is extremely high in worldwide hospitals dverse drugs reaction (ADR) and harmful effects of pharmaceutical excipients imply severe incidences, due to incompatibilities of the drug with the medical history. The rate of ADR appearance is extremely high in worldwide hospitals

• Community Healthcare: It comprises of network of local community where services offered by IoT like municipal hospital, residential area, rural community.

• Wearable Device Access: Different types of wearable devices available in market that helps to track and monitor the health parameters of patients or users. Wearable devices come with a complete set of suitable characteristics for the IoT architecture.

• Semantic Medical Access: Semantic Medical access is designed for the semantization of the Internet of things in the medical and healthcare field. The solutions proposed for the interoperability issues of medical devices need to integrate of huge and heterogeneous amount of data. It also gives services, like: Multi-type functional communication service, the significant exploitation of the localization feature provided by the connected objects, the simplification of medical texts for the patients and the effective integration of the social media technology. The wide potential of medical semantics and ontology has received close attention from designers of IoT-based healthcare applications.

• Indirect Emergency Healthcare: In some cases we need indirect healthcare system as an emergency situation like bad condition of weather, accident occur in road, earthquake etc. These indirect emergency healthcare services are used to provide different available data information.

• Embedded Gateway Configuration: The IoT e-healthcare application use hub module which can handle different connections from other devices that have an identity with the same IoT hub. An embedded gateway configuration is used to connect patient with internet with all the medical components.

• Embedded Context Prediction: One of the main issues is the frameworks that all third-party developers may have to build with suitable mechanisms, that we called suitable mechanisms (ECP) service [23]. Such a framework is developed in [15] in the context of ubiquitous health care.

• Early intervention/prevention: If a patient will diagnosed with any type of disease in initial level then, healthcare services will be revolutionary for all of us.

1.5.2: Different Healthcare application:

Diabetes Prevention: The term "diabetes" is a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia along with some disorder of carbohydrate, fat and protein. It has a long term effect and able to damage various type of body organs also. By wearing wearable devices incorporated with IoT can help to monitor the glucose level of the body and prevents any kind of damage.

• Electrocardiogram Monitoring: According to report [24], 30% of all deaths are related to circulatory systems problems, like arrhythmias, myocardial ischemia, or prolonged QT intervals. So to prevent from all these harmful disease, we need to monitor our vital signals by a electrocardiogram (ECG) also can be measured and monitored using IoT enabled devices.

• Blood Pressure Monitoring: It is a great application of IoT. To prevent Heart attack, we need to control the blood pressure. To make it possible, IoT uses wearable sensors that constantly monitor blood pressure of the patients and in case of any abnormalities, it will inform to hospital.

• Body Temperature Monitoring: Different IoT sensors incorporated in Telos B is used to find the temperature of body. In case of fever, it will inform to the hospital associated with it.

• Oxygen Saturation Monitoring: Oxygen saturation level can be measured using pulse oximetry, a non-invasive monitoring system.

• Rehabilitation System: In [25], an ontology-based automating design method for IoT-based smart rehabilitation systems is proposed to mitigate the problems previously described.

• Medication Management: There is a huge issue for financial load for medication poses. IoT enables a new technology that will resolve the issue.

• Wheelchair Management: A new application developed from IoT e healthcare system that in case of elderly people they can easily take the help of mobile wheel chair facility. This facility helps the elderly people for travelling purpose.

• Imminent healthcare: This is an immediate service that can possible by the help of IoT application. In case of any emergency, patient need not to travel to doctor, just click the phone and have the services or medication.

• Smartphone Healthcare Solutions. As till now we have discussed all the application and the services, all will be possible using Smartphone application using IoT.

1.6: Security and Challenges and its Solutions: Huge amount of experiment has been done on various applications of IoT and its application in Healthcare service but there are lots of challenges which need to be addressed. Here I have discussed several numbers of challenges faced by IoT e-Healthcare system. IoT system use some different types of sensor for collecting health

parameters and then store the data into the cloud and when required then transfer the data to the hospital for any types of clinical emergency. So, we need to focus on following security requirements or challenges faced by IoT for achieving secure and safe healthcare services.

• Confidentiality: To maintain a secure and confidential property of medical parameters for accessing unauthorized users.

• Authentication: To keep invalid users out of databases and network and from other resources by doing some verification and make the system secure.

• Availability: To provide guarantee reliable access of information from unauthorized personnel and protect from threats.

• Integrity: To maintain integrity towards health parameters of patient/user, we need to modify or deleted unauthorized users to ensure accurate data for further processing.

• Interoperability: To enable communication between heterogeneous devices or system and in order to achieve a secure system. It makes easier for medical service providers for communicating or transferring patient information with one another. The lack of interoperability prevents devices from connecting autonomously, discovering each other and collaboratively engaging with other smart devices and services which is a barrier for companies to build automated system [8].

• Fault-tolerance: To maintain secure services in presence of fault or glitch. When sensors are used to share data to cloud, security is the main and primary concern. One and only solution is to use back-up nodes which will keep the data secure in presence of fault.

• Latency: To maintain zero time for data transmission in the transport layer. Latency means the time taken by a data to pass from one point or network to another point or network.

• Energy efficiency: To provide low energy system for health care application. Specifically IoT use high amount of energy for operation purpose that makes the sensor to shut down or switch off and disrupting the working of the total system. So there is a need of making low energy efficient device and for that reason Green IoT has been used in industry application.

• Resiliency: To resist disturbance and agitation and not able to adapt constantly changing environment. It can be possible by maintaining a careful architecture and proper IoT designing.

• Secure booting: When the device is powered at the first time, the authenticity and integrity of the software on the device is verified using cryptographically generated digital signatures. For more information, please read the white paper [26].

• Memory limitation: One of the security aspects of IoT e-Healthcare system that smart devices have very low memory. They are activated using embedded operating system (OS), software and application. For this reason their memory is not proper for executing different types of security protocols.

• Mobility: In general IoT devices are not situated in a fixed position. Continuously they are moving from one place to another based on the need of the patient and the doctor. Due to mobility, applications that are connected to Internet should be properly syncing with the wearable device.

• Privacy: Special consideration to protect the information/data of individual patients to exposure in the IoT environment where almost any physical or logical object can be provided a unique identifier that has the ability to communicate autonomously over the Internet.

• Network Segmentation: To ensure security of the particular network where other users are connected.

• Hardware Protection: Each medical device that is potentially susceptible; anyone from anywhere could infect that device by using a malicious chip inherited into it. To protect hardware devices manufacturer make difficult port for accessing and lock them using digital electronic signature.

• Scalability: The number of IoT devices has increased gradually, and therefore more devices are getting connected to the global information network. Therefore, designing a highly scalable security scheme without compromising security requirements becomes a challenging task.

• Communications Media: Normally health devices are connected to both local and global networks using different wireless links such as Zigbee, Bluetooth, WiFi, GSM, WiMax, and 3G/4G etc. the characteristics of wireless channel of these

networks make the security aspects of the system less appropriate. So it needs to find a authenticated security protocol that can serve for both wired and wireless channel characteristics equally.

• EMI Shielding: By building a solid metal shield or frame around the device, an organization may protect the device from unwanted interference.

• Data encryption: Most of the embedded devices currently use asymmetric lightweight cryptography (LWCRYPT) for protecting channels between both the users.

• Access Control: IoT e-Healthcare system must have strong access management system for ensuring healthcare data security and privacy; this will led to decrease the chance of misuse of patient's healthcare related data and prohibited malicious attacks on it.

CONCLUSION

In this chapter I have discussed the impact of Internet of Things in Healthcare Industry and how patients and doctors also get advantage of using this e-Healthcare service. Meanwhile day by day, IoT has changed the healthcare industry from beginning level to intermediate level and increases the efficiency and also make the system chip. This chapter depicts all the related part of IoT e-Healthcare services, network architecture, services and application, different types of challenges and security issues. All these types of application require a large number of sensors that should be handled carefully to monitor. Cloud computing, the and Grid Computing will be a promising way to process a huge amount of data. Healthcare providers or doctors use internet application of Smartphone for managing the health related data of the patients which helps to protect the patient initially. IoT creates an innovative revolution to the society for helping the patients to detect their disease at initial level and also diagnose the same instantly using the application of IoT e-Healthcare app.

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