

A Survey of Internet of Things in HealthCare

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Abstract : Internet of things, as the name suggests it connects different devices over internet and allows them to communicate with one another to achieve certain tasks such as home automation, self driving car etc. It can also be termed as the network of devices such as vehicles, and home appliances that contain electronics, software, sensors, actuators, and connectivity which allows these things to connect, interact and exchange data. This will give immediate access to information about the physical world and the objects in it, leading to innovative services and increase in efficiency and productivity. Internet of things not only help in automating things, it also helps to improve the healthcare system and facilities. It makes them fast, secure, reliable and also provides remote access to the user. The objective of this paper is put together the advancements that are taking place in field of healthcare using IoT.

IndexTerms - Device to Device communication, HealthCare, Internet of Things, Well being

1. INTRODUCTION

Communication has changed a lot over the years. From being wired to wireless it has transformed drastically. Communication taking place among machines, people, machine and people have changed the way of how things used to work earlier. It has set a milestone in the world of technology. Internet of Things(IoT) is one such technology that has supported communication and has given upliftment to it. The term internet of things was contrived by Kevin Ashton in 1999. Internet of things allows various different devices, sensors, actuators to communicate with each other over the internet[1]. Right from our electronic appliances to the doors of our houses and garage, it has connected everything to internet and let us control them using our computers or mobile phones. There are a numerous applications of internet of things which finds its way in various fields(Figure 1). The applications can be classified based on various factors such as heterogeneity, network availability, coverage, scale and user involvement[2]. Figure 2 shows the basic blocks of internet of things.

Medical care or health care is one of the most fascinating applications of internet of things. Internet of things has changed the medical care scenario completely by enabling remote monitoring of patients, remote prescriptions, etc. An undecorated system of IoT includes a number of functional blocks which promote various functionalities of the system such as sensing, identification, automating, etc[3]. Figure 2 describes these functional blocks. The definition of the Internet of things has evolved due to convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems[4]. Internet of things provides suitable solutions for a wide range of applications such as smart cities, traffic congestion, waste management, health care, security, emergency services, logistics, retails, industrial control, and health care. Conventional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of things. The paper is further organised as section 2 explains about the architecture and technologies enabling IoT. Section 3 talks about the emerging and trends in health care. Section 4 concludes the paper.

Figure 1. Applications of Internet of things

Figure 2. Functional blocks of IoT

2. ARCHITECTURE AND TECHNOLOGIES

There is no single architecture for IoT which universally accepted. Different researchers have proposed various architectures.

2.1 THREE LAYERED ARCHITECTURE

Three layered architecture was introduced in the early of internet of things(Figure 3). It includes three layers namely application layer, network layer and perception layer[5].

(i) Perception layer : It is also known as physical layer and is the bottom most layer of the architecture. It interacts with physical devices and components such as sensors, actuators, etc[6].

(ii) Network layer : It is also known as transmission layer. It is responsible for connecting to other smart devices, servers, etc. It receives processed information from the perception layer and decides a route to transmit the data to various other devices[7].

(iii) Application layer : It is the top most layer of the three layered architecture. This layer receives the data transmitted from the network layer and uses that data to provide a specific application or operation[8].

2.2 FIVE LAYERED ARCHITECTURE

Five layered architecture consists of five layer namely(Figure 4) business layer, application layer, processing layer, transport layer and perception layer[9].

(i) Business layer : This layer is responsible for managing whole Iot system including applications, business model and profits[10].

(ii) Processing layer : It is also known as middleware layer. This layer is responsible for analysing and processing of huge amount of data that comes from the transport layer.

(iii) Transport layer : This layer transports the data from perception layer to the processing layer and vice versa.

Figure 4. Five layered Architecture

There are various technologies which support networking in internet of things. Figure 5 shows some of the major protocols that support or enable internet of things[11][12].

Figure 5. Technologies supporting IoT

3. INTERNET OF THINGS IN HEALTH CARE

Internet of things in health is also popularly known as internet of medical things[13]. The reliance of healthcare on internet of things is increasing day by day. In light of a person's interesting natural, conduct, social and social qualities, the incorporated routine with regards to prosperity, medicinal services and patient help is named as customized human services. This engages every single individual by following the fundamental human services guideline of "the correct consideration for the ideal individual at the ideal time", which prompts better results and improvement in fulfillment in this manner making medicinal services practical. A reasonable administration centers around the counteractive action, early pathology location, and homecare rather than the costly clinical one, and checks the general prosperity to foresee needs and guarantee consistency to human services plans. Internet of Things guarantees to deal with the personalization of consideration benefits and can keep up an advanced character for each individual. Diverse hardware is utilized in social insurance, to convey and to make the universal arrangement of framework[14].

According to a new report by Grand View Research Inc., IoT in the healthcare market is expected to reach nearly USD 409.9 billion by 2022. Internet of things healthcare network is one the imperative elements of IoT in healthcare(Figure 6). It bolsters

Figure 3. Three layered Architecture

access to the IoT backbone, encourages the transmission and gathering of medicinal information, and empowers the utilization of healthcare-tailored communications[15][16][17]. IoT is accelerating at a great pace when it comes to developing solutions in healthcare, it allows easy collection of data, analysis for research , monitoring and much more. Some of the major IoT healthcare solutions(Figure 7) are explained below.

3.1 SMART SENSORS AND HEALTH DEVICES

Innovative healthcare solutions are becoming widely introduced in medical organizations enabling healthcare providers to reduce costs, improve patient treatment, and enhance the workflow. These solutions guarantee to significantly transform the health industry. One of such innovations is smart devices or wearables. They allow to get the accurate readings and provide an helping hand in interpreting the data. Gradually, they are replacing the heavy machineries which take up large space and would cost high. These devices can be easily worn by the patients and it would sense the data using sensors embedded inside the devices. Some hospitals have also implemented smart beds which adjusts automatically as per the patient's posture or position[18].

3.2 BIOSENSORS

Biosensors are one of the most element of IoT in healthcare. As the name suggests, these are a type of sensors which sense the biological information of the body.It consists of three parts (i) a component that recognises the analyte and produces signal (ii) signal transducer (iii) a reader device.A biosensor is an analytical device, used for the detection of a chemical substance, that combines a biological component with a physicochemical detector[19]. The transducer which converts one signal into another works in a physicochemical way.The biosensor reader device with the associated electronics or signal processors that are primarily responsible for the display of the results in a user-friendly way.

3.3 PATIENT HEALTH PORTAL

The importance of health portal is rapidly rising these days. It is providing improved and enhanced services in request processing and scheduling appointments. It also remote assistance to patients in case of emergencies. Health portals facilitate both the lives of doctors and patients. Other functionalities of the health portals include checking laboratory results, making payments , consulting doctor, providing health tips, food recipes etc. Future holds a lot more applications of the health portal.

3.4 REMOTE MONITORING SYSTEMS

Monitoring patients is getting difficult in this modern day life, especially old aged patients who need to be monitored at short intervals. Sometimes due lack of proper monitoring some diseases go undetected, which a major problem faced all over the world. Monitoring system is usually a collection of sensors connected to a microcontroller or microprocessor and complex algorithms. If the system detects some abrupt changes in the heartbeat, body temperature, blood pressure,etc it will either trigger alarm or notify

the assigned doctor about the patients' health. Patients' health data can be securely captured using these solutions. These systems allow medical professionals to make appropriate health recommendations remotely[20].



Figure 7. Applications of IoT in healthcare

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Figure 6. Internet of things health network

4. CONCLUSION

Internet of things will definitely change our society and will uplift the technology trends in the near future by providing effortless anytime, anywhere solutions, the examples given in the paper makes it very clear. Internet of things is emerging at a very high pace in the field of the health care and will continue to grow in the near future. This paper gives clear insights about the architecture and general applications of internet of things. The main focus of the paper is to put together emerging as well as existing trends of internet of things in the field of medical health care. In sum, the results of this survey are expected to be useful for researchers, engineers, health professionals, and policymakers working in the area of the IoT and healthcare technologies.

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