



A Survey on IoT Solutions Concerning Healthcare

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Abstract -The Internet of things is an omnipresent technology that has been around for almost three decades. The usage of IoT technologies is a boon to the modern Healthcare environment. Since Internet of Things is the next stage of technological revolution, it has become a necessity to incorporate it in the medical field for the convenience it provides. IoT promises immense potential for improving the quality of life in healthcare domain. This paper describes the current growth of IoT in the improvement of healthcare systems.

Keywords —Internet of Things, Cloud Computing, Healthcare

I. INTRODUCTION

Internet of things also known as IoT has become a popular technology these days. The main ideology behind the globally accepted technology is the simple and effective notion to connect things to the Internet. Connecting things or devices to the Internet allows users to access and control these devices remotely via the Internet. It is also possible to run these devices under the guidance of a computer, which allows the users to program the device. The devices can perform a set of actions under a specific set of conditions. These devices employ sensors, microcontrollers and Transmitters receivers to establish communication. Nowadays, Internet has an impact in day-to-day life in several aspects. Applications are developed based on IoT where physical objects are connected to the Internet by employing sensors. Healthcare is the process of taking preventative measures or necessary medical procedures to improve a person's well being. Healthcare has evolved over the ages and with the advancements in healthcare the inception of new diseases has also seen a significant increase. The global threat to life expectancy has encouraged mankind to discover effective treatments. An efficient healthcare service should deal with early pathology detection, prevention and homecare instead of the high-priced clinical care. Dependency of healthcare on IoT is increasing day by day, to better the quality of care, make healthcare more accessible and reduce its cost. IoT helps to improve healthcare by creating a digital identity for each patient. The sensors used in IoT save the readings on cloud and these readings can be accessed whenever needed. This allows for constant monitoring of the patient's symptoms in a continuous and extensive manner.

II. BACKGROUND

A. Internet of Things

The term Internet of things is a decade old, but the concept of connecting devices has been around since the 70s. Peter T Lewis coined the term Internet of things in 1985^[1]. The year 1999 has been a consequential year for the growth of IoT [2]. The network of smart devices was conceptualized way back in the 1980s. The first ever Internet connected appliance was a vending machine. It is a growing technology, which not only connects devices but also makes them smarter to assist human beings in their daily activities. Device to device communication is also the future of next generation cellular networks. This technology provides the much-needed leverage to IoT using intelligent device-to-device communication.

B. Healthcare in IoT

The healthcare applications using IoT are rapidly increasing day by day and the reason being the development of sensor devices. One of the first connected medical devices was the pacemaker, which used electrical impulses made available by the electrodes contracting the heart muscles to regulate heartbeat. IoT devices are employed in remote health monitoring and emergency notification systems. The health monitoring devices range from blood pressure and heart rate monitors to advance devices capable of monitoring specialized implants such as pacemakers, fit bit electronic, risk bands or advanced hearing aids. Figure 1 demonstrates how remote health monitoring is boon to patients who require constant monitoring. From the figure it can be observed that the real-time sensors connected to the patient's body sends the parameter readings to the concerned specialists and family members. IoT uses Internet to enable the transmission of real-time data of the critical parameters of the patient. In case of a substantial change in the critical parameters, an emergency alert is sent.

III. NEED FOR IOT IN HEALTHCARE

With the risk of decreasing life expectancy due to the rise in unascertained diseases and the advent of IoT revolutionizing healthcare the collaboration seems almost natural. The delay in accurate treatment being rendered to the patients in case of emergency being a major criterion for the need of IoT in healthcare. Since healthcare is becoming expensive by the day, the poor need a new approach and this is where IoT steps in.

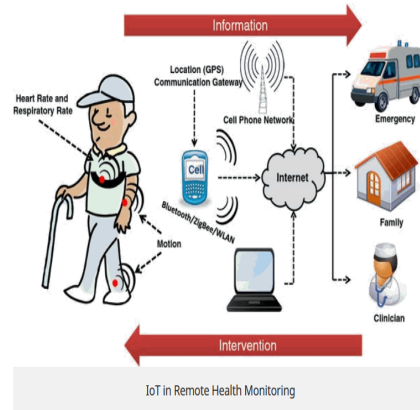


Fig. 1 IoT remote health monitoring

In developing countries the death rates due to lack of timely available medical treatments are high as compared to other developed countries. The majority of these deaths are preventable through quality care. IoT enabled healthcare applications allow patients to schedule their appointments without the need to call a doctor's office and wait for a receptionist. Healthcare information technology allows doctors to carry information with them anywhere they go through apps on their smart phones.

IV. LITERATURE SURVEY

The body sensor network (BSN) technology is one of the vital technologies in the development of IoT concerning healthcare developments, where a patient can be monitored using a collection of tiny-powered and lightweight wireless sensor nodes. BSN is a collection of low-power and lightweight wireless sensor nodes that are used to monitor the human body parameters. The security and privacy issues that are commonly found in most healthcare applications are combated using body sensor networks [3]. The collaboration of IoT and cloud offers an efficient healthcare monitoring systems in which medical information can be transferred safely with the consent of the patient. A network is built among all the entities participating in healthcare, which improves communication among the entities in turn delivering better care and services. Object hyper linking is a new age technology that aims at extending Internet to objects and locations around the world. The huge data generated from various sources resides in the cloud, which requires greater processing power to retrieve information in a secure and reliable manner [4]. A pervasive surveillance system comprises of sensors, actuators, and cameras. Due to its myriad advantages mesh topology is used in this surveillance system. An application layer protocol like the Constrained Application Protocol (CoAP) is used for the data compression and transferring, and the Scalable High-Efficiency Video Coding (SHVC) is used for the video compression and transferring. The system constitutes three layers: the home environment, the router, which acts as a gateway and the remote environment. The home environment comprises of a home IPv6 over Low power Wireless Personal Area Network mesh network which incorporates sensors, actuators, cameras, an edge router and a local server, the gateway which consists of a router and a local database and the remote environment or cloud platform where data and video are stored and analysed. The real time data is stored in the cloud server. Any change detected in the data, automatically causes all data to be updated. This allows the concerned entities involved in providing the healthcare to give the necessary advice and instructions to the patients after studying the real time data [5]. Data analysis is of primary importance in the successful realization of IoT devices and services. The anomalous regions are the segments in sample health parameter data that are of practical interest to the medical professionals. This area of research is of substantial importance and is of profuse benefit to humanity.

To illustrate, when some individual's smart health monitoring device suddenly shows a considerable change in critical parameters at mid-night, an emergency alert is generated and that individual's data is appropriately elucidated. The healthcare analytics using a vigorous anomaly detection engine would facilitate early and prompt detection of dominant diseases. The prerequisites for IoT services like data privacy, sensor data compression, and security. A compelling factor is data quality, which is essential for real-time remote health monitoring. The main challenge of anomaly detection is to minimize the risk of the disease going undetected which is accomplished through IoT[6]. The IoT enabled healthcare systems have an upper hand over the conventional monitoring systems as the elderly are in constant need of care. The IoT enabled monitoring system employs a central unit for decision-making. This central decision making unit can detect dangerous and critical situations depending on the data generated by the sensor devices. Medical reports are generated on a regular basis based on constant monitoring. The primary server analyses data based on the reports generated. After the analysis is complete in case of an emergency situation the platform sends an alert to an emergency contact or it connects directly to the emergency control room[7]. The Internet of things is growing by the second and making life easier for patients and doctors. The devices such as smart meters and fitness bands and RFID based smart watches and smart video cameras assist in the process. Providers should be capable of handling large amounts of information and data, which is challenging. The potential of IoT for medical facilities are gathered by smart sensors, which are accurate and analyse a variety of health parameters. This includes the essential parameters such as pulse, heart rate, blood pressure and oxygen and glucose level in blood. Sensors can be incorporated in pill containers to generate alerts when the patient has taken the medication.

This solution compiles IoT-based healthcare in one complete kit [8]. As the risk of chronic diseases increases by the day there is an immediate need to discover solutions to enhance the quality of life. The focus is on how the internet of things is a suitable framework for e-healthcare applications making it possible to integrate heterogeneous hardware devices and services to smoothly interact with one another is the key to removing any operational barriers and making it possible to create a holistic health care that's available on the internet. The E-health applications comprise of services and software that relay, control and keep track of medical health information and rely on the Internet to transmit and store patient's information [9]. Vast amounts of sensor data generated from pervasive healthcare applications are managed by cloud computing to perform further processing and analysis. The presented system is a unique solution, dedicated for managing patient-related data on the cloud. The main components of the system are wearable sensors, sensor gateway, communication APIs, managing applications and cloud infrastructure. It deploys both open hardware and open software resources for establishing the hardware platform and the software platform. It allows direct communication of the sensor devices with the Cloud application [10].

V. FUTURE OF IOT IN HEALTHCARE

IoT is on a continuous path of progress to perform non-invasive and precise monitoring of health. The use of Internet enabled technologies like virtual reality can also prove to be highly beneficial for remote health monitoring. Experts firmly believe that a well-organized and methodical remote healthcare using IoT could substantially cut down the necessity for regular medical check-ups. It would drastically reduce the burden on patients and professionals since patients can be monitored from the comfort of their home and need not wait in the hospital for observations. In countries like UK, the collaboration of a number of charities, universities and technological giants and the healthcare society aspire to introduce IoT-enabled Tech to millions of people suffering from dementia, cancer and other terminal diseases. They aim to equip people with sensors, wearables, monitors and other IoT-enabled devices allowing patients' health parameters to be monitored remotely from the comfort of their home. Britain exploited IoT in healthcare by introducing the IoT-enabled Test Bed programme in 2015. The trial conducted provided connect tools to diabetic patients suffering from type 1 or type 2 enabling them to efficiently self-manage their conditions from the comfort of their home.

VI. CONCLUSION

IoT devices save and share information with each other, making it possible to collect, analyse/process and store the data more accurately. Therefore IoT is being used for patient monitoring and servicing. Across the world, researchers have started to explore various technological solutions to enhance healthcare provision in a manner that enriches the existing services by mobilizing the potential of the IoT. This paper surveys distinct aspects of IoT-based healthcare technologies. It presents distinct healthcare network architectures and platforms that deploy IoT as the backbone technology, to facilitate medical data transmission and reception. With the elevation of IoT enabled health care systems, there will be a revolution in health care that changes the current scenario.

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