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Internet of Things in Health Monitoring: A Review

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Abstract: Healthcare monitoring systems have emerged as one of the most vital systems and from the past decade have become technology-oriented. Human beings face an unexpected death problem due to various illnesses that is due to the patients' lack of medical care at the right time. Healthcare applications are most important among the applications that the Internet of Things (IoT) has facilitated for the world. Generally speaking, IoT has been widely used to connect advanced medical resources and provide people with smart and effective healthcare services. The advanced sensors can either be worn or integrated into the patients ' body to monitor their health on an ongoing basis. The information gathered in such a way can be analyzed, aggregated and extracted to make early disease prediction. The processing algorithms help the doctors personalize the treatment and, at the same time, it helps to make the health care cost-effective with improved results. We also highlight in this paper the challenges of implementing the real-world IoT health monitoring system.

Keywords: Health monitoring, Internet of Things (IoT), Medical devices, Sensors

INTRODUCTION

The increased use of health-related mobile developments and smart devices has had a major impact on the world. The benefits these technologies offer to health experts are rapidly taking advantage of, thereby producing a significant improvement in health care in clinical settings. Similarly, countless ordinary users are served with the benefits of M-Health (Mobile Health) applications and E-Health[1] (ICT-supported health care) to improve, assist and assist their health. The highest attainable standard of health is a fundamental right for an individual, according to the constitutions of the World Health Organization (WHO). Because we are truly inspired by this, we are trying to propose an innovative system that puts forward a smart patient health tracking system that uses sensors to track patient vital parameters and uses the internet to update the doctors so that they can help to prevent death rates in the event of any problems as soon as possible.

IoT-based patient health monitoring is a technology that allows patient monitoring beyond traditional clinical settings (e.g. at home) that can improve access to care and reduce health care costs. This can greatly improve a person's quality of life. This makes it possible for patients to remain independent, avoid complications, and reduce personal costs. The plan promotes these aims by providing care right to the home. In fact, patients and their family members feel comfortable being monitored and will be helped if a problem arises.

The Internet of Things (IoT)[2] offers an upward infrastructure to reach the next level of health care. That ensures that the patients are transported or embedded with inexpensive, low-cost, secure and

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useful tools, so that patients, medical devices and doctors can network seamlessly. The sensors will continuously record signals, then correlate with the essential physiological parameters and communicate over the wireless network[3]. With the existing health records, the resulting data are collected, processed and analyzed. The physician can make a better prognosis using the available data records and decision support systems to suggest early treatment. Even if the doctor is not available, this analysis allows the machines of today to predict health problems. Not only prediction, machines from the systematic study of medicinal databases can also come out with the medicines.

Progressive technology will have a transformative impact on the life and health monitoring of every human being; it will significantly reduce healthcare costs and a step forward in the accuracy of predictions of disease. In this paper, we present an idea of a service model for patient comfort in technological and economic views as well as the open challenges in implementing IoT in the medical field of the real world.

BACKGROUND

Several IoT systems for health monitoring systems have been developed in recent days. In a medical system called as a smart box, peer-to-peer (P2P) and IoT technologies were combined to keep patients in control. An Android application was created to record data such as SBP-Systolic Blood Pressure, DBP-Diastolic Blood Pressure and Heart Rate by enabling the electronic sphygmomanometer to communicate through Bluetooth. The framework made it easy to use any mobile device to send the recorded data, and such data is then recorded, abnormalities are identified and messages are transmitted to the people.

Real-time application was submitted for the IoT healthcare with distributed flow system. The data will be recorded in the local server and communicated later when the person under observation moves beyond range. A Galileo board is an IoT-based device with an embedded medical platform for signal analysis designed for electrocardiogram (ECG)[4] and heart function is monitored on the basis of an algorithm.

There have been few IoT Portable Medical Devices on the market that have improved the mobility of the patient. But there were also security threats and few disadvantages while using Portable Medical Devices. When we began to consider light-weight IoT devices, diseases were predicted using existing databases. But while predictions like that; issues were in storing and analyzing databases using those databases new fine-grained access control system for health information stored on the cloud was implemented to resolve the security challenges and the concerns of cloud reciprocity.

When the previous works are addressed, there is a limitation of database connectivity in monitoring the data in constant time intervals and analyzing data between the different cloud environments. In this paper, we present a cloud-based Internet of Things system that can be implemented in various health monitoring systems, taking into account this limitation.

SYSTEM ARCHITECTURE

This system consists of four-layer protocols such as the physical layer, network layer, middleware layer, and layer of operation. Next, the physical layer consists of sensor and transmitter-embedded devices. The network layer is responsible for transmitting signals from sensors to the cloudlets, while the middleware layer is responsible for storing the data in the cloud and making it available to the concerned people. Finally, analytics and diagnostic processes are performed in the application layer.

This review paper examines the IoT-based healthcare research trends and addresses different issues. They are providing in this paper;

- A survey of IoT-based healthcare services and applications
- Highlight various policies and strategies that can support researchers in developing innovative healthcare solutions

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- Useful insights into security, privacy issues and challenges

1. E-Health System:

E-Health

E-health is an emerging field in the intersection of medical information technology, public health and business, with reference to health services and information provided or enhanced by the Internet and related technologies. In a broader sense, the word characterizes not only a technical development, but also a state-of-mind, a way of thinking, a mindset, and a commitment to networked, global thought, using information and communication technology to improve health care locally, regionally, and worldwide.

The rising healthcare costs and the aging of the population have created many problems for governments, healthcare providers and the healthcare industry, which they are trying to overcome using e-health technologies; An emerging sector with the potential to improve the quality of healthcare services, patient monitoring, disease detection and related medical procedures. Using wireless technologies to monitor patients remotely unobtrusively attracts great interest as it can be done in a reliable and cost-effective manner, providing patients with personalized, sustainable services. In particular, e-Health solutions are defined by several features, such as context-conscious, personalized, anticipatory, and adaptive, ubiquity, accessibility, efficiency, protection, privacy.

From a practical point of view, such systems can be useful in various fields, including diagnosis, prognosis, assessment, behavioral exploration, rehabilitation[5], decision support, hospital management, prediction of surgical procedures effectiveness, Continuous monitoring, medication, clinical and diagnostic relationship discovery. In addition to these features and tasks, low cost and user-friendly interface also contribute to improving users ' comfort and quality of life.

Integrated e-health systems, including clinical information systems, information systems, radiology, telemedicine management, etc., are useful not only in addressing healthcare issues, but also in administrative and financial matters, research, and related scientific information.

2. Telemedicine and Home monitoring System:

Telemedicine[6] and home monitoring play a major role in chronic disease management, such as asthma, heart disease, and diabetes. Information and communication technologies (ICT) including various smart sensors, devices for monitoring, technology, portable medical devices, provide an electronic site for the transmission of patient health parameters to doctors who are able to monitor patient health condition remotely. The quality of self-care can be improved in this Manner: the patient can communicate with medical specialists frequently; If required, the physician is advised, may prescribe the necessary medication, may carry out other procedures and may also plan face-to-face meetings much more effectively and efficiently than in the absence of ICT.

By adding Wireless Personal Area Networks (WPANs), Wireless Body Area Networks (WBANs)[7], the development of an omnipresent network to improve health care for a wide range of users Bluetooth technology 02.15.1, IEEE 802.15.3 and local wireless networks (WLANs), combined with large-scale wireless networks (WWANs), such as mobile 2G, 2.5G, 3G and 4G, on the internet.

The first step in introducing an integrated health system includes using intelligent sensors and appropriate instrumentation to transform a volume of signal variance of interest, usually electrically measured. Another issue is the need for appropriate instruments and methods of data analysis capable of processing complex data and providing health solutions.

3. RFID based health monitoring:

The RFID[8] card is used to establish secure access to personal data and medical records of the patient. The primary objective of health monitoring using the RFID project is to create a better way to store and retrieve data. To get the patient Id, this project uses the hardware kit. The hardware kit sends the patient

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Id to the system's serial port. After logging into the doctor's account, the respective doctor can access the patient ID by scanning the RFID card. The doctor is able to view and correct the medical records and medications of the patient. The patient will sign in to his account and execute apps that are showing his previous medical records and prescriptions. The administrator registers doctors and patients and assigns to the respective doctors and patients a specific doctor I d and patient Id along with a password. Some records, such as medical records, require a high level of privacy. All medical information is stored and retrieved online at any point of time using this technology. Updating, adapting and growing is easy. Trying to identify an unconscious patient or patient who cannot communicate can lead to therapy delays. With this program, emergency departments improve efficiency while rising patient care quality.

IoT and RFID play an important role in the smart healthcare system based on RFID. The different sensors are embedded in the patient body in this system and the patient can be monitored according to the sensor signals, RFID and IoT. RFID tags involuntarily commit entity identification by testing the tag that was attached to objects. Between the two RFID tag forms viz. Active RFID and passive RFID, usually used for negligible power consumption by passive RFID tags, RFID tag reader yields the power through which it is energetic for reader transmission. RFID-based networks require LTE 4G or 3G networks.

Through electronic healthcare[9], the privacy of the patient is not taken into account, although it is necessary through the case of the patient and this is the main drawback of this system. To prevent this disadvantage, RFID technology is used. It treats patient records with simplicity and transparency. The main advantage of RFID is that it avoids all kinds of attacks and risks, with very less noise in the signal. In order to develop a costless RFID platform, it is important to build an efficient ultra-lightweight cryptography protocol.

4. NDN based Healthcare:

To improve and simplify such IoT communication, Named Data Networking (NDN)[10] can be applied. NDN is a proposed future Internet architecture that is a prominent example in the broader ICN field. NDN essentially moves from host-centric to data-centric the network communication model. Instead of sending packets identified by numerical IP addresses between source and destination devices, NDN disseminates named data at the level of the network, directly transmitting it to names carrying semantic applications. In addition, at the time of production each packet in NDN is secured, allowing data replication anywhere in the network and preserving data security properties throughout its lifetime. NDN allows applications to name the IoT things, such as the light in the above example, and directly use those names to have the network forward related data it enables both IoT and network infrastructure applications to operate with simpler, more consistent semantics, less fragility, and increased security.

The NDN-based healthcare system operates in hierarchical fashion where the lowest layer gathers raw data from home-disposed sensors and sends it for local processing to the home server and senses the likelihood of an emergency that cannot be expected For this purpose, this secret Markov Model (HMM)[11] could be used on the local server of early detection and monitoring of changes in the patient's health using the vital signs of the patient so that doctors, family members, etc. could be extra vigilant during this period. For easier tracking and visualization, the cloud service gathers critical patient signs from the home server and facilitates data analysis and visualization. The cloud server and physicist then monitor the patient's previous records and take the necessary action. Cloud server uses the probabilistic model to predict disease possibilities using the patient's regularly updated vital signs. It improves the effectiveness of real-time healthcare monitoring, suppliers of healthcare services are able to respond to any emergency and signs of disease can be identified by data analysts working on the data collected after verification of the accuracy of the case, the cloud server will notify the patient about further actions.

It is possible to connect NDN-based home server and cloud server via wired / wireless links and

communicate with each other using NDN. This health system could use NDN communication at regular intervals to collect process and publish the patient's vital signs. Using push-based multicast, the cloud server and other parties may subscribe to data through NDN-based publishing and subscribing paradigm. The emergency HMM can be identified and labeled can be used. A context-aware adaptive forwarding (Cdf) strategy based on NDN could be used to transmit data even in the worst network conditions.

CONCLUSION

As discussed above, IoT applications are constrained by internet-related issues that do not address data integrity, reliability, data provenance and trust management, which are key factors in the development of robust applications. The e-health system discussed above increases access to information and resources, enhances patients ' ability to make better health care decisions, improves patient safety and quality of life, but lacks robustness, confidentiality and integrity of data.

The patient's privacy is important in e-healthcare, which has not been taken into account and is the major disadvantage of this program. The RFID system is used to prevent the. With its versatility and accessibility, it handles the patient's records. The advantage of RFID is that it can withstand all kinds of attacks and threats so there is less noise in the signal.

It is possible to use the NDN-based healthcare system to overcome these communication issues and improve healthcare data collection. As mentioned above, the healthcare system focused on NDN improves the reliability, data integrity and confidentiality of real-time healthcare monitoring as healthcare providers are able to respond to any emergency and also reduce communication costs.

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