A SURVEY ON HEALTH CARE MONITORING SYSTEM USING IOT

Sasippriya Saminathan, K. Geetha

PG Student, Senior Assistant Professor, School of Computing, SASTRA University, Thanjavur-613401.
sasippriya32@gmail.com, geethavalavan@gmail.com

Abstract: Owing to recent technological advancements in consumer electronics and growing costs of healthcare, a vision of connected e-health system has been evolving which constitute Personal Health Devices (PHD). Incorporation of Information and Communication Technology (ICT) in healthcare industry explored the possibilities to optimize the supply of all the available medical resources and provide reliable, efficient healthcare services to the aged people and patients with physical disabilities and chronic illness. This paper throws some light upon the existing techniques that are available for Health care application used in Internet of Things (IoT). The proposed work is to design and develop a Mobile-IoT based healthcare system which is featured with Pattern Matching Algorithm by gathering patient’s data from various PHD sensors and timely alert the caretaker as well as doctor by sending messages. It monitors the patient’s physiological parameters remotely and diagnoses the diseases as early as possible. This can be implemented in wearable alert system through Wireless Body Area Network (WBAN). The network overhead and suitability of the proposed solution for different environments is presented which includes the integration of different wireless interfaces with a cloud service.

Keywords: Personal health care, CoAP, WBAN, MQTT.

1. Introduction

The sedentary lifestyle and current food habit increases chronic diseases such as Cardio Vascular disease (CVD), hypertension, stroke and diabetes. According to World Health Organization (WHO), 31 percent of global deaths are due to cardio vascular diseases (estimated 17.7 million people in 2015). People with diabetes have been rapidly increasing from 108 million in 1980 to 422 million in 2014. The rising cost of healthcare services has increased the pressure for providing effective and efficient healthcare to the patients in most of the developing countries.

Internet of Things (IoT) is an emerging technology which lets humans and things to interconnect anywhere and anytime. The scope of IoT is not only constrained to connect things, it allows devices to interact and exchange their data associated with users. Experts forecasts that 50 billion devices or things will be linked to the Internet by the year 2020. IoT merges telecommunication and information technology for providing better medical services. By means of IoT, medical information can be exchanged from one location to another to diagnose the diseases and arrange for proper medications to improve the patients’ health conditions even at rural locations. This technology enables to deliver healthcare services over a long distance and also minimizes the cost of healthcare services by managing the chronic diseases with less hospital stays, less travel time and shared clinicians and professionals.

A wireless body area network (WBAN) is a wireless network of sensors connected through wearable computing devices. WBAN devices may be located inside or outside of the human body. Through WPAN gateway devices, it connects the wearable devices on human body with the internet. This way, patient data can be accessed online using the internet even at remote locations. MQTT is an application layer protocol which is used to transmit message services by connecting all devices through constrained devices. It is light weight protocol while comparing to all other protocol. It based on publish subscribe model. The devices are low bandwidth, limited process and memory resources. MQTT data are as engender dynamic represented. Pattern matching algorithm is used for comparing the health data with a existing data set of a person and enable it to analyse further. If there is any predictable disease identified, then pass on the information to the caretaker, and if the situation is emergency, then the data can be forwarded to the Doctor for further treatment.
Table 1. Medical applications of IOT

<table>
<thead>
<tr>
<th>Accessing Technology</th>
<th>Development Method</th>
<th>Merits</th>
<th>Demerits</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAN, LAN-IF Health Alliance</td>
<td>Continua More Efficient, Cost effective</td>
<td>Low data rate while compare with other network, Short range (10M)</td>
<td>Primary Prevention, General wall begin.</td>
<td></td>
</tr>
<tr>
<td>RHHC Reference Architecture</td>
<td>Continua Reduce device cost, save time; improve communication, Simplifies complex Task.</td>
<td>Decision making problem, Interrupted information</td>
<td>Chronic diseases management</td>
<td></td>
</tr>
<tr>
<td>Body Area Network Mobile phone based architecture.</td>
<td>Large scale implementation, 256 device per network, Timely medical care</td>
<td>Range (2-5 meter), Network density (2-4 m)</td>
<td>Care elderly, Disable person, Diabetics.</td>
<td></td>
</tr>
<tr>
<td>Wireless Body Area Network Windowing and learning based technique.</td>
<td>Geographical large area location monitoring.</td>
<td>Low security, complicated and complex task, High cost.</td>
<td>Cardiac, Rehabilitation, Diabetics, Home care chronic</td>
<td></td>
</tr>
<tr>
<td>M-IOT Heterogeneous, 3-Tier Structure</td>
<td>Tele treatment services, Easily deployable, Easily prone to hacking</td>
<td>Neurology, Obstetric trauma care, Pulmonary medicine</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1 depicts the synergistic technologies that form an integral part of adapting IoT in Medical applications. In order to address the key issues present in the existing healthcare systems, the proposed project aims to design and develop an IoT based Patient Monitoring System which is featured with combination of Wide Body Area Network and Pattern Matching logic. The proposed system will be used by the doctors and medical professionals to diagnose the diseases as soon as possible and provide appropriate treatments.

2. Literature Survey

Internet of Things (IoT) and cloud computing plays a vital role in today’s Tele-monitoring health system. This system keeps track of patient’s physiological parameters through collection of body sensors’ data using Raspberry Pi board. The patient’s health card are developed by the doctors and displayed on a webpage where doctors and patients can access and communicate each other without physical presence [1]. Using cloud computing, the data can be stored, updated and accessed from anywhere in the world. It is very suitable for rural areas where medical facilities are not available.

In Remote health monitoring system using IoT, Body wireless sensor Network (BWSN) is used to transmit the patients’ health parameters collected through Raspberry Pi microcontroller to the physicians and caretaker wirelessly [2]. Being long range wireless technology, emergency situation of the patient’s health is quickly detected and timely intervention leads to save the life of the patient.

Owing to costlier healthcare and long waiting time in hospitals, the concept of in-home patient monitoring system have been emerging in the recent years. This system collects data of various body parameters through Biosensors, wearable devices and smart textiles and it transmits the data to central node server securely through Cipher text Policy Attribute Based Encryption (CP-ABE) method. In turn, the server shares the collected data to the hospitals for further treatment. The server rings alarm to the ambulance [3] during emergency situation. It is very beneficial for elders and chronic patients who require continuous monitoring.

The specialized healthcare monitoring system for elderly people is a growing need in the aging population world. This system performs basic health checkups by measuring the body parameters regularly and report the data to the doctors. The result data are then displayed as statements in a web application where doctors and patients can interact with each other[4]. Evaluation is of two parts: 1) Qualitative interviewing and 2) Quantitative Survey. The main challenge is to make elders equipped with for growing new
technologies and to become familiar with smartphone, computer, etc.

IoT-based smart healthcare with the help of smart devices and objects improves the healthcare monitoring system effectively, thus by reducing the inefficiencies of existing healthcare systems. Smart devices with new and upgraded technologies enhance the data accuracy to be collected, real-time accessibility of patient’s condition, intelligent integration of data collected, maintaining the integrated data smartly through cloud service, etc. [5]. IoT along with smart devices reduce complexity and complications in the healthcare system. The penetration of mobile technologies and smart devices over healthcare systems cause huge impact on the world. The full-fledged utilization of M-health and E-health applications in today’s world is made aware to the people for improving and maintaining the good quality of life. Apart from regular monitoring of patients’ condition through M-health system, the main objective is to educate them through recommendations of healthy eating habits and effective workout routines for improving their quality of healthy life [6].

In remote mobile health monitoring systems, the patient health parameters are recorded by a smartphone by eliminating an additional hardware and transmit data through a web interface [7]. It facilitates end-to-end monitoring through three steps. Firstly, the real-time health parameters are measured through wearable sensors and transmitted to a smartphone which shows the patient health status in a graphical interface. Secondly, this system provides a data to family members and doctors through web interface for further monitoring. Thirdly, it provides real-time alarm if the patient is at emergency situation such as heart attack, etc.

Despite monitoring, there are quite few challenges in using wearable tracking devices for a long time. Firstly, the daily use of wearable tracking devices is based mainly on small size, rough use and low energy consumption [8]. Secondly, the major challenge is of the accuracy, validity, and integrity of measurement data with other devices. Thirdly, the usability and the experiences of the user with the device and its friendly supporting software play vital role in continuing regular and long period use of wearable tracking devices. The use of Internet of Things (IoT) and its e-Health applications in the Tele-medicine health system leads to seamless flow of information between doctors and patients, thus making healthcare cost effective and improving the quality of patients’ treatment. This system uses the K53 Tower System platform for e-Health applications to expose the benefits of IoT in medical system. The two fundamental aspects in monitoring people at risk are: 1) Prevention 2) Effective and early intervention during medical emergency [9].

Table 2 compares the various methodologies/techniques that are used in IoT in the survey with advantages and shortcomings that need to be addressed in the future for betterment of the healthcare monitoring system.

<table>
<thead>
<tr>
<th>References</th>
<th>Techniques/Methodology</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>[4]</td>
<td>Technology Acceptance Model</td>
<td>Widely recognized technologies to be used for easy access</td>
<td>Adoption of new technologies is difficult to equip with for elders</td>
</tr>
</tbody>
</table>
### Context Model through OWL and SWRL (Semantic Web Rule Language)

Contextual recommendations such as workout routine and healthy eating habits apart from regular monitoring. Recommendations are so general and not personalized for each treatment.

### Monitoring through Smartphone by Indoor Localization Algorithm

Wifi-fingerprints are used to find the location of patients in indoor environment during emergency situation. Data may not be accurate always due to environmental interference by Wifi-signals.

### Wearable Monitoring devices

Portable and user-friendly Inaccurate data due to wrong positioning of devices

### K53 Tower System platform for

Custom monitoring through single platform of hardware and software Multiple applications lead to complexity

### 3. Motivation

Existing methodologies in patient monitoring system focuses on providing better healthcare facilities to a number of patients with limited medicinal resources. These monitoring systems limit the patients to the bed and enable them to move around only a particular range from the bed side. Out of this range there is no possibility to collect the data from patients. The decisions or suggestions given by the system are not highly accurate. The traditional forecasting techniques do not provide timely and accurate results. This increases the risk of error in providing appropriate clinical services. Remote patient monitoring system eliminates the hurdles such as distance and improves the access of medical services. Patient monitoring through android mobile phone enables the clinicians to monitor the patient from multiple locations. Pattern Matching Algorithm is used to determine the type of diseases and give the indication to Doctor. It helps to protect the person from risk factor.

#### 3.1 Overview of Health care Monitoring System

In Fig [1], overview of health care monitoring system is depicted. Patients’ vital parameters such as Heart Beat and temperature is continuously monitored via medical sensors and periodically stored in cloud service. The proposed system collects real time data from the patients and delivers an updated patients status to the medical professionals and to the caretakers using WSN. This autonomous system replaced the traditional method to collect the parameters regularly by nurse. It avoids the human errors in collecting the patients’ data manually. MQTT is light weight protocol used for transfer the messages. The observed vital signs of the patients are analyzed and checked against the standard range to detect the abnormal condition of the patients.

![Figure 1. Overview of Health Monitoring System](image-url)
4. Conclusion

This paper focuses on a real-time pervasive healthcare monitoring system using IoT and cloud computing service which are more beneficial for elders and chronic diseases’ patients. The current methods available for realization of Healthcare services are surveyed and the challenges that are part of realization are also highlighted. This paper proposes an intelligent real-time patient monitoring system that monitors the subject’s vital parameters such as temperature, pressure, fall detection, breath activity and ECG through PHD prototype model as well as detects any abnormality accurately. Appropriate medications are suggested based on the diagnosis of the provided set of symptoms. The system sends an alert message to the caretakers and doctors in case of any abnormality through WBAN. The system enables the clinicians to optimize the usage of available medical resources and minimize the costs in monitoring the patients. In the future, we will focus on improving wearing sensor experience by using softer materials and enabling controlled sharing of information among the doctors, the patient, and the patients’ family through social networking paradigm.

5. Acknowledgement

The authors wish to express their sincere thanks to the Department of Science & Technology, New Delhi, India (Project - ID:SR/FST/ETI - 371/2014) and SASTRA University, Thanjavur, India for extending the infrastructural support to carry out this work.

References
