

## Design and Development of Healthcare System based on Internet of Things-Review

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**Abstract**— Healthcare systems have grown to be a crucial research area today. Chronic diseases and the cardiovascular diseases are the biggest challenge for India and these diseases are the main cause for the hospitalization of the elderly people. For this purpose, there is need to monitor some parameters of the patient continuously. This system is designed and developed for the remote patient monitoring in the healthcare field. It affords a useful tool where doctor can monitor the heart condition i.e. blood pressure and heart rate with posture and temperature of the patient continuously using web server. Once, the abnormality of the patient's condition is observed by the doctor, he can give the appropriate decision in the form of prescription to the caretaker of the patient. The availability of this system can help the physician to cover the distance between himself and the patient which helps in early recovery of the patient.

**Keywords**—IoT, Chronic Diseases, Remote Patient Monitoring, Blood Pressure, Heart Rate and Body Temperature

### I. INTRODUCTION

Nowadays, the internet is used by more than two billion customers around the world to browse the contents, send and receive emails, access multimedia resources, play online games and social networking. Also the internet is expected to serve as a global platform to interconnect physical objects or 'Things', thus, enabling new ways of working, interacting, entertaining and living [11]. The use of IoT technology alone can establish an information network that interconnects hospitals, communities, healthcare devices, homes, and other terminals [3]. The IoT is empowered by the recent developments in RFID, smart sensors, communication technologies, and internet protocols [4]. Healthcare represents one of the top challenges that every country is facing today. Although healthcare invests heavily in information technology but the expected results are not obtained up to the mark. This issue has to be addressed with the many continuous health monitoring gadgets which need to be transportable, low cost reliable and easy to operate even via a normal subject. For implementing this, there is need of different wearable biomedical body sensors. These sensors will collect the data from the patient. Information from the sensors will be processed by the Arduino controller which sends the data to the web server with the help of IoT. The data from the Arduino is stored on the cloud for long term storage and access. Accordingly, the doctor will give the prescription for the observed abnormality which gives a

chance to establish the healthcare facilities in many rural places where the advanced facility is not an option.

A recent healthcare system should provide better healthcare services to people at any time anywhere in an affordable and patient friendly manner. In this fast pace of life, people are facing many problems of unexpected disease and death. Humans are facing these problems because they are unable to get the medical treatments, as well as lack of medical care at right time to patient. In the traditional way the doctors play the major role. For necessary diagnosis and advising they need to visit the patients or the patient have to visit the hospital. There are two basic problems related to this approach:

1. The healthcare professionals must be at place of the patient all the time which is not possible practically.
2. The patient remains admitted in the hospital, wired to bedside biomedical instruments, for a long period of time.

Thus, it is very much essential that the medical parameters of the patient should be monitored regularly. This paper is organized as follows, Section I contains the introduction of the research work, Section II contains the related work in the field of healthcare and internet of things, Section III

describes the system overview, Section IV concludes the research work with the future directions and the future scope.

## II. RELATED WORK

Prosanta Gope et al., demonstrated the use of Body Sensor Network (BSN). It is the collection of the low power and light weight wireless sensor nodes that are used to monitor the human body function. Along with the BSN the focus is also given to the security. There are different issues that can affect the data privacy of the patient hence security is given an importance. For getting a high security different protocols are used like SR1, SR2, SR3, SR4, and SR5. The comparisons between the different techniques were made like Median, Alarmnet and BSN care. But in BSN care the CPU cycles required are less also the execution time is less. This makes the BSN more efficient which can accomplish various security requirements [1].

Ravi Kishore Kodali et al., have implemented a system which analyze and communicate real time medical information to the cloud, thus making it possible to collect, store and analyze large amount of data in several new forms and activate context based alarms. The Zigbee-Mesh Protocol is used in this system. But for monitoring the patient's physical parameters, they should be in hospital patients. It enhances the quality of care with regular monitoring and reduces the cost of care, actively engage in data collection and its analysis. The system also eliminates the need of healthcare professional. A physician can access the patient's data from anywhere using the internet. This module is designed to monitor only physical parameter i.e. temperature. Intel Galileo Generation 2 board acts as gateway to process the received data and it runs a web server in order to communicate the data with the cloud. Intel Galileo Generation 2 board connected with another XBee S2 module acts as gateway for the overall healthcare system. This gateway is used to gather, analyze, store and communicate the medical data to the cloud over a secure connection [2].

Yuan Jie Fan et al., uses the Ontology based-Automated Design Methodology. Ontological approach is attempted to have a quick construction of design scheme taking relation as joint tie and easy information sharing. Ontology helps the structured domain and easy knowledge sharing. It aims to interconnect all the resources and provide immediate information interaction. This approach is needed to meet the mainstream for quickness, correctness and efficiency. This work suggests a rationale for performing larger controlled clinical studies to further evaluate feasibility, efficiency, convenience and rapidity of using proposed ontology based automating design for smart rehabilitation system [3].

Maradugu Anil Kumar et al., practically monitored patient's health condition where the biological parameters like oxygen, heart rate and temperature using web server and android application. As the elderly population increasing and demands caretaking, so to monitor them an android application is developed which can easily transmit the patient's physical parameters to the doctor easily with help of the application. Whenever it comes to the monitoring of the patient it is also important for the doctor to know the previous history of the patient. This problem is easily solved using this application where the patient's history will be stored on the web server and doctor can access the information whenever needed from anywhere and need not to be physically present [5].

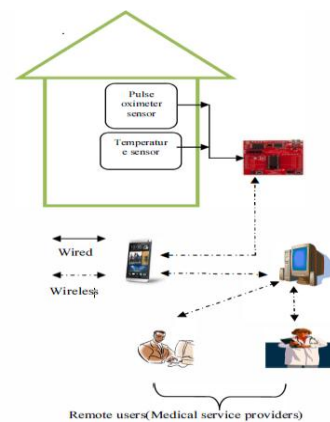


Figure 1: Architecture of Android based Healthcare Monitoring System [5]

In [8], Big Data Analytics on IoT based Health Care System is proposed. These things produce huge volume of data that could not be handled by the physician. Finger humidity, blood pressure sensors and heart beat rate sensors are considered for monitoring. IoT agent in this work and is used to deploy the health information of patients into the ThingspeakCloud. The Cloud managed and processed the increasing volume of health data using Hadoop framework's Map Reduce process. The management of health parameters is executed by means of alert messages through mobile phones using GSM/GPRS connection possibilities of the IoT agent.

In most of the research works, IoT is the heart of the systems. Hence it is required to know the IoT. Sajjad Hussain Shah et al., had done the survey on IoT. The technologies, challenges, applications are well described here [4]. This is empowered by developments in RFID, smart sensors, communication technologies, internet protocols. When IoT was developed initially the RFID was essential but now there is no such requirement. Also other concepts like NFC and M2M are well described here.

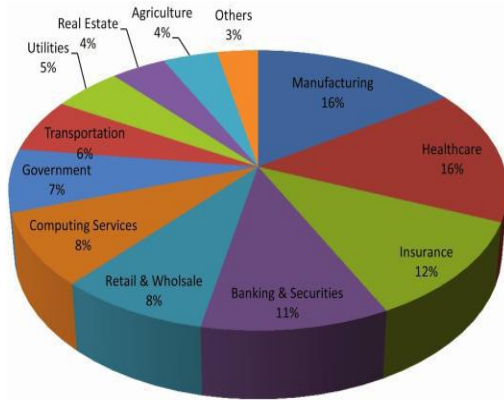


Figure 2: Projected market share of IoT [4]

In [10], the author has integrated and interoperated IoT's data flexibly which can provide support to emergency medical services like Intensive Care Units (ICU). The patient is connected with health monitoring system which consists of a heart rate sensor and a temperature sensor. The live graph of the patient's heart rate and temperature is being monitored on a Xampp based database server. The Home page of the web portal consists of various tabs including the Login, Services, About Us, Contact and Upload. This web portal gives the different personal information of the patient like name age, blood group and essential details in order to maintain the records systematically. In the Login tab, the user can login into the web portal as a patient or as the doctor as per the credentials given. In this approach, the patient's data is uploaded to the server so as to maintain the records.

Sapna Tyagi et al., introduced a conceptual framework for IOT based Healthcare System using Cloud Computing. They introduced the applications of IoT in the field of Healthcare. This will bring the technological revolution in the field of domestics, healthcare, good monitoring and logistics. The proposed IoT-Health cloud represents an enabling technology form many healthcare providers to face many challenges such as rising healthcare, delivery costs, information sharing and shortage of Healthcare professional's better care and enhanced services for the patient [11].

Vikas Vippalapalli et al., demonstrated the system which can monitor the patient using a collection of lightweight wearable sensor nodes for real sensing and analysis of various vital parameters of the patients. It also eliminates the collection of manual data, which will have high quality services also provides the real time gathering. This system focused on the need of healthcare professional to be present with the patient every time and with it the wired connection of patient to the machine was also one of the major issues. Along with the vital parameters, it can also see the location of the patient. To implement this system the hardware used was Arduino Fio Transmitter and Receiver

from which the data from Arduino Fio is read through the USB and the received by the Labview software[14].

Kasim M. Al-Aubidy et al., realized the realtime monitoring and alarming system for patient's health especially for patient's dealing with diseases in their normal life. This system has microcontroller connected to a set of sensors and Bluetooth. According to the system design requirements, the Atmel Mega2560 microcontroller has been used in the system realization. This program module mainly consisted about having Bluetooth connection with the hardware device, friendly GUI, and internet connection to connect to database besides having access to SMS and GPS locations when they are needed [15].

### III. SYSTEM OVERVIEW

In today's hard pace of life, it is necessary to take care of our health. A capable and most trustworthy substitute to existing healthcare techniques is the improvement of sensors to check different parameters of the human body such as blood pressure, body temperature, and heart rate. Its higher sensitivity, less cost for construction, portability, diagnosis of the chronic diseases is the biggest advantage of the device. This project work deals with all those patients who can't visit the doctor on a regular basis. The focus is mostly given that how the subject can be treated by the doctor at the subject's location so that dealing with the emergency situation can be done in a much suitable way. The block diagram of the research work and the hardware details are well described in the nest sections of this chapter.

The system designed in the proposed research work is as shown below:

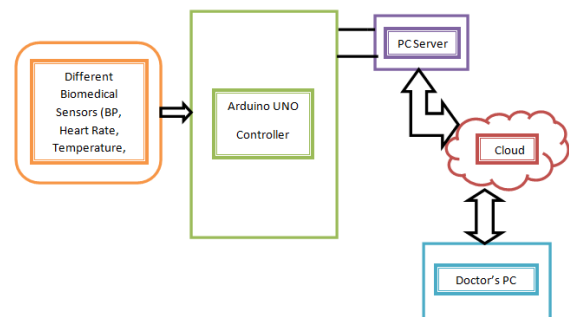


Figure 3: Block Diagram of the system to be designed

The system to be designed focuses on the basic parameters of the patient which are observed to be abnormal these days i.e. Blood Pressure, Heart Rate, Body Temperature. The main requirement is to remotely monitor the parameters of the patient those are suffering from the cardiovascular diseases like bachycardia, tachycardia, arrhythmia, High Blood Pressure, Low Blood Pressure. Here,

the sensors are applied to the body of the patient. The sensors will start measuring the different body parameters of the patient. Then the sensor's data will be transferred to the doctor's PC or mobile with the help of internet of things. When the parameters are received, the doctor will observe the patient's condition and accordingly the doctor will take appropriate decisions and give the prescriptions to the patient. Thus, the prescriptions will help the patient to cure as soon as possible. This system will save the time, make the diagnosis easier, deal with the distance between doctor and the patient, to improve the quality of life.

#### IV. CONCLUSION

The systems built till dates are focusing on how the physical parameter of the patient to be transferred to the doctor. The main disadvantage with these systems is that no actions are taken on how the patient can be treated in the absence of doctor. The literature review suggests that automated system to be developed for the patient who is suffering from the diseases. The automated system means ringing of buzzer i.e. the alarm indication for the abnormalities observed when the patient is treated. But, ringing the buzzer is not sufficient for the person suffering from the inconveniency. The involvement of the doctor is must for the patient who is suffering from the chronic diseases. The research focuses on how the patient can be treated from anywhere by the doctor not only just the physical parameters that are measured are transferred but also the prescriptions for the person who is unwell are given so that real time monitoring of the patient is done.

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