

PULSE OXIMETRY AND ECG MONITORING USING IOT AND GSM

Alan Roddick S, Manoj Kumar G, Karthik. M, Ragul R and *P. Aravind

*Department of Instrumentation and Control Engineering, Saranathan College of Engineering,
Tamil Nadu, India*

**Author for Correspondence: mkarthikkarthik60@gmail.com*

ABSTRACT

Managing of health and monitoring a patient over a continuous period of time provides an upper hand in identification and diagnosis of abnormalities in patient through data if any. Our paper focuses on the implementation of an effective monitoring of patient's cordial activity and oxygen concentration in blood by acquiring and transmitting the data by wireless communication to a personal cloud storage through IoT. Method of acquiring and monitoring data in system is implemented using LabVIEW interconnected with myRio. The data can be accessed any time in order to observe the current status of the patient. In case of abnormal behavior in the detected signals, the caretaker and doctors are notified immediately through a Short Message Service (SMS) via GSM module. Cloud computing and password protected account provides privacy and security of patient details by allowing restricted access to the database.

Keywords: *IoT, LabVIEW, GSM, Healthcare, MAX-30100, AD-8232*

INTRODUCTION

Nowadays, the probability of getting cardio disease has increased over in adults as well as in new born babies and it is necessary to monitor the patient's heart periodically in order to maintain their health. The reason behind the development of this project is that to provide an easier and efficient way of health monitoring to the people. As we all already know that internet of things makes our life easier, it is obvious that we have decided to make an IoT based pulse oximetry and ECG monitoring. IoT performs an amazing work with its efficiency in the applications like communication, monitoring, recording, storage and display. When a patient is monitored on a continual basis, effectively analyzed information with IoT can bring a bigger change in the field of healthcare. The current food habit and sedentary lifestyle increases chronic diseases such as Cardio Vascular disease (CVD), hypertension, stroke and diabetes. 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) works as one of the emerging technology, which allows us 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 and merges telecommunication and information technology for providing better medical services. By means of IoT, medical information or data are transmitted from one location to another location 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 minimizes the cost of healthcare services by managing the chronic diseases with less hospital stays, less travel time and shared clinicians and professionals.

LITERATURE REVIEW

Jaiswal et al., (2016) stated that 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 sensor's data using myRio. The doctor's healthcare is developed and displayed on a webpage where doctors and patients can access and communicate each other without physical presence. Pramila, (2013) said that as it is a long-range wireless technology, unexpected situation of the patient's health is quickly detected and timely intervention leads to save the life of the patient. Due to costlier healthcare and higher waiting time in hospitals, the in-home patient monitoring system concept have been

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emerging in the recent years. This system collects data of various body parameters through biosensors, wearable devices and smart textiles and it transmits data to the central node server securely through Cipher Text Policy Attribute Based Encryption method. In turn, the server shares the collected data to the hospitals for further treatment. The server rings alarm to the ambulance during emergency. It is very beneficial for elders and chronic patients who require continuous monitoring.

The main challenge that this paper has overcome is to make elders equipped with for growing new International Journal of Pure and Applied Mathematics Special Issue 250 technologies and to become familiarity towards 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 system. Smart devices with new and upgraded technologies enhances 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.

IoT along with smart devices reduce complexity and complications in the healthcare system. The involvement of mobile technologies and smart devices over healthcare system have caused a huge impact on the world. The full-fledged utilization of M-health and E-health applications in today's world makes people aware for improving and maintaining the good quality of life. Apart from regular monitoring of patient's condition through M-health system, the main objective is to educate them through the recommendations of healthy eating habits and effective fitness routines for improving their quality of healthy life Gómez *et al.*, 2016.

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 (Chiuchisan *et al.*, 2015).

BLOCK DIAGRAM OF HEALTH MONITORING SYSTEM

The diagram basically gives us about the working of health monitoring system. The data that had to be managed for health management is acquired for various parameters namely oxygen saturation of blood

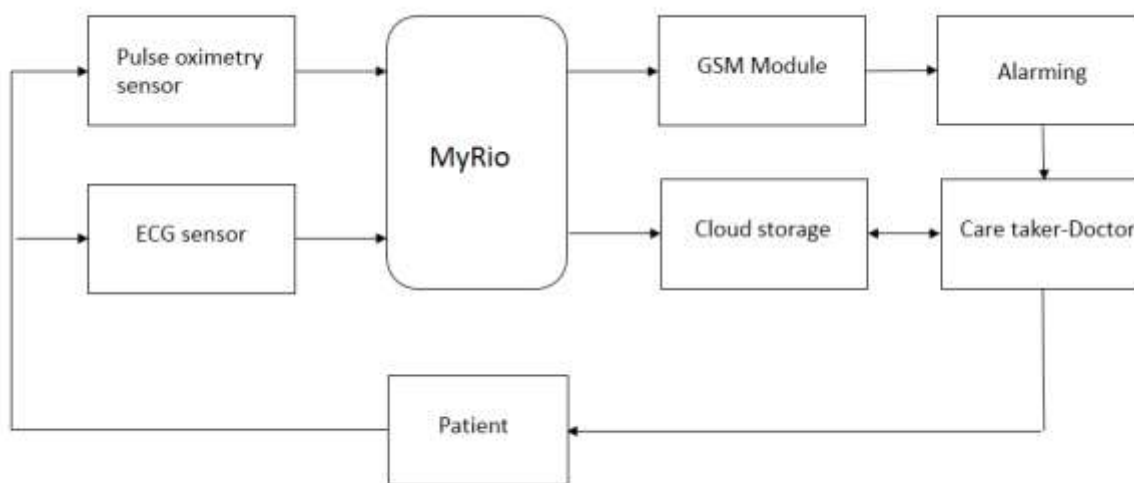


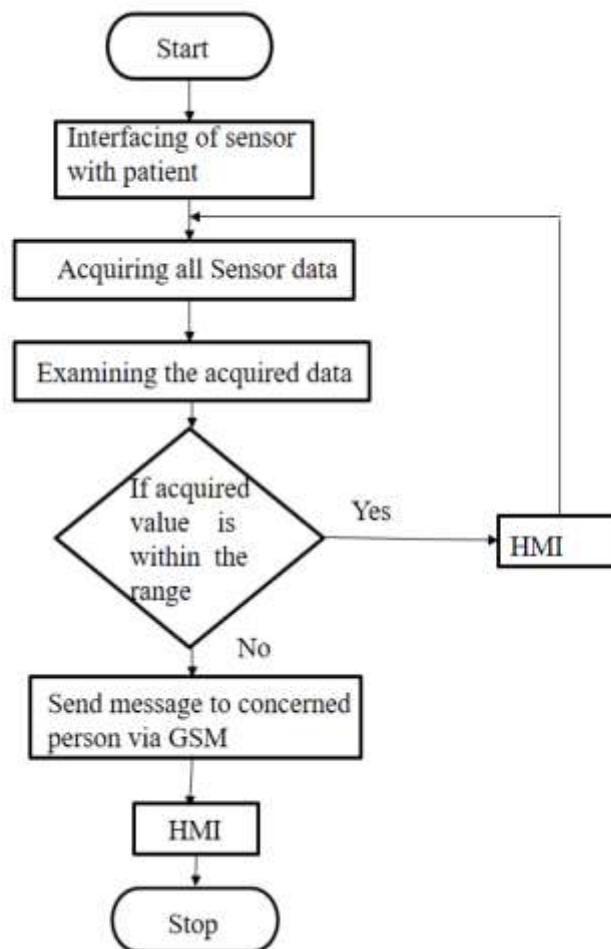
Figure 1: Design of the Health Monitoring System

and ECG. A sensor named MAX30100 is used to acquire the data for the amount of oxygen saturated blood. MAX30100 is an integrated pulse oximetry and heart rate monitor sensor solution by combines

two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals. It operates in supplies ranging from 1.8V and 3.3V power supplies. The sensor named AD-8232 with electrodes stuck to patient's chest to pick up ECG signals. It is connected to heart rate monitor using wires. This is done to reduce the noise in the received signal by AD8232 acting as an OP-AMP. The sensors are cost effective and give signals in PR and QT intervals. The data from these sensors are acquired and processed using myRio and LabVIEW programs. LabVIEW (Laboratory Virtual Instrument Engineering Workbench) is a system design platform and development for a visual programming language from national instruments and the LabVIEW programs designed to process specific data for each sensors have various condition for each parameters in order to evaluate the patient's health condition. The evaluated patient data is stored in a password protected Cloud storage account and is provided access to doctors and concerned caretakers.

PROPOSED METHODOLOGY AND DISCUSSION

The entire methodology of the system depends upon the body sensor network mainly consisting of the wearable sensors (namely MAX30100 sensor and ECG sensor). They act as data collecting units,



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Figure 2: Overview of the working

collecting the physiological signals from the patient's body. These collected data are viewed through LabVIEW. Then the data are transmitted to the base station or the gateway server (cloud). At the base station, the received data is stored in the form of files for further use. With correct access codes for the cloud storage one can access the account for the patient's data. The accomplishment of transmission and storage of data in cloud storage is achieved by the use IoT platform. The last part of the architecture is

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used to store, analyze and present the received data in a graphical and text format. The GUI sends an SMS to the physician or the patient's family through the GSM Modem. The measured body parameters are fed to MyRio. A MyRio is a device which can be programmed by LabVIEW. MyRio acquires the data from the sensors and processes them according to LabVIEW program. Generally, the problem faced in processors are their processing speed but the advantage of using MyRio device is that its processing speed is ten times of the standard general micro-controllers and micro-processors. The measured parameters are transferred to the cloud database (IoT-IBM), by this way there will be a transparency between the medical organization and the patients. The MyRio device is then connected to the GSM module. In case the acquired data doesn't match the reference values denoting any abnormal conditions (like pulse rate exceeding 100 or 110 BPM) it will send a SMS to the caretakers via GSM module. The Cloud database is password protected, so it provides privacy and security of patient details by allowing restricted access to the database.

EXPERIMENTAL RESULT WITH TABLE AND DISCUSSIONS

This paper suggests a better and efficient way of health monitoring by continuously monitoring the vital body parameters (i.e. ECG, oxygen concentration in blood) and this way of approach greatly reduces the hospitalization and also comprising a smart way of providing data transparency by using IoT and Cloud storage. As per the tabulations, the real time data has been provided from measuring ECG and oxygen saturation of blood. For each data, various conditions are used to send alert messages to concern persons. For pulse rate measurement, reference value ranges (60-100 bpm, <60bpm, >100bpm) are used for comparison of determining normal, high and low conditions. Considering oxygen saturation of blood, quality is determined in percentages ranging from 94 to 100 for healthy human. Considering animals and other organism, the range differs according to each's condition thereby can also be used when the range is changed according to the required range. Thus the accuracy and precision is increased thereby providing an efficient and dependent health monitoring system.

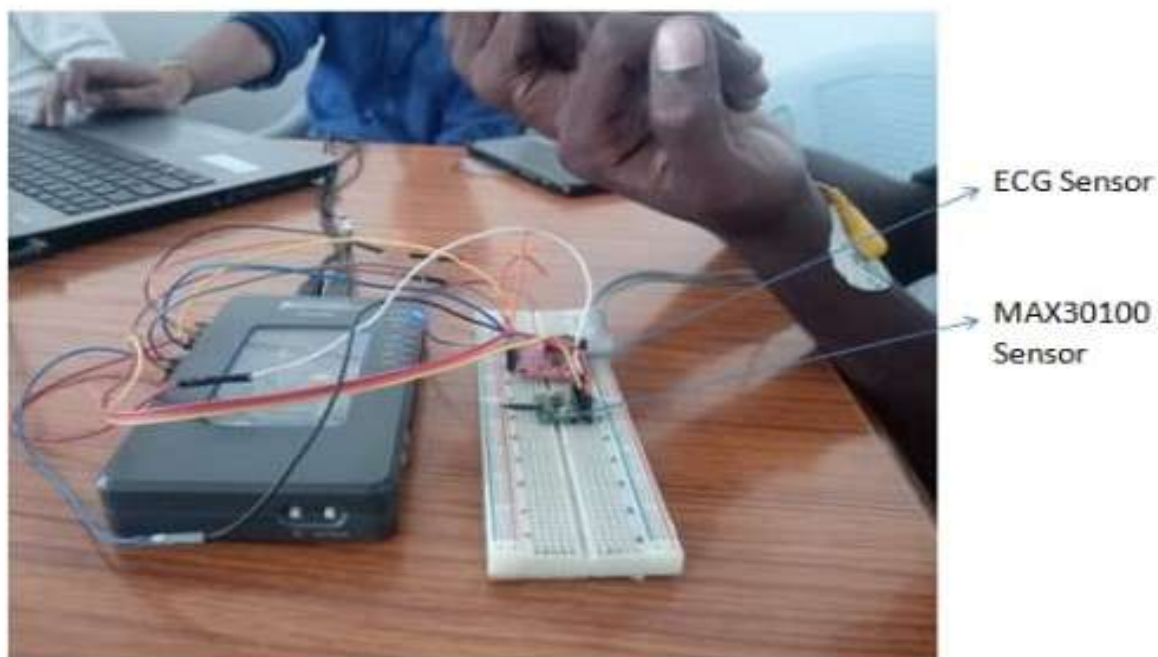


Figure 3: Represents the hardware representation of the system

Table: The real-time patient data

S.NO.	PATIENT NAME	DOB	AGE	EMAIL ID & CONTACT NO	PATIENT CONDITION	
					PULSE RATE(BPM)	OXYGEN CONCETRATION IN BLOOD %
1	S. Alan Roddick	08.02.1999	21	alanjosh151@gmail.com 6383893281	74	98
2	G. Manoj Kumar	17.09.1998	21	manojvandayar@gmail.com 7339464145	89	98
3	R. Ragul	21.04.1999	20	rraghul9121@gmail.com 8754960494	78	98
4	M. Karthik	02.12.1998	21	mkarthikkarthik60@gmail.com 7667101034	84	96
5	R.S.Saran Kumar	01.11.1998	21	sarangreenz@gmail.com 74185214323	75	97

CONCLUSION

The outcome of this project is that it provides an continuous monitoring of health and an open platform for patients to get to know their health using IoT(IBM). As discussed earlier, various health parameters have been identified to determine a patient's health condition. The LabVIEW program for determining the heart rate determination by ECG signal(PQRS wave) and Max30100 measures pulse rate and oxygen concentration in blood has been designed and the output for these parameters have been uploaded on IoT providing the access to patients as well as to respective medical centers. Now according to the values the message is sent using GSM module and the main advantage is that we have greatly reduced hospitalization.

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