

## Patient Parameter Monitoring System using Raspberry Pi

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**Abstract—** In India, everyday many lives are affected because the patients are not timely and properly operated. Also for real time parameter values are not efficiently measured in clinic as well as in hospitals. Sometimes it becomes difficult for hospitals to frequently check patients' conditions. Also continuous monitoring of ICU patients is not possible. To deal with these types of situations, our system is beneficial. Our system is designed to be used in hospitals for measuring and monitoring various parameters like temperature, ECG, heart beat etc. The results can be recorded using Raspberry Pi displayed on a LCD display. Also the results can be sent to server using GSM module. Doctors can login to a website and view those results.

**Keywords—**raspberry pi; monitoring system; GSM module; sensors

### I. INTRODUCTION

Health is one of the global challenges for humanity [1]. In the last decade the healthcare has drawn considerable amount of attention. The prime goal was to develop a reliable patient monitoring system so that the healthcare professionals can monitor the patients, who are either hospitalized or executing their normal daily life activities.

Recently, the patient monitoring systems is one of the major advancements because of its improved technology [2]. Currently, there is need for a modernized approach. In the traditional approach the healthcare professionals play the major role. They need to visit the patient's ward for necessary diagnosis and advising. There are two basic problems associated with this approach. Firstly, the healthcare professionals must be present on site of the patient all the time and secondly, the patient remains admitted in a hospital, bedside biomedical instruments, for a period of time. In order to solve these two problems, the patients are given knowledge and information about disease diagnosis and prevention. Secondly, a reliable and readily available patient monitoring system (PMS) is required [4].

In order to improve the above condition, we can make use of technology in a smarter way. In recent years, health care

sensors along with raspberry pi play a vital role. Wearable sensors are in contact with the human body and monitor his or her physiological parameters. We can buy variety of sensors in the market today such as ECG sensors, temperature sensors, pulse monitors etc. The cost of the sensors varies according to their size, flexibility and accuracy [7]. The Raspberry Pi which

is a cheap, flexible, fully customizable and programmable small computer board brings the advantages of a PC to the domain of sensor network [5].

In our system we are measuring patient's parameters (ECG, temperature, heart rate, pulse, etc) different available sensors. This sensor collected data i.e. biometric information is given to raspberry pi and then it is transferred to server. Biometric information gathered can be wirelessly sent using different options available such as Wi-Fi, 3G, GSM, Bluetooth, 802.15.4 and ZigBee depending on the application [6]. The data stored in a database and can be displayed in a website that can be accessed only by authorized personnel [3]. The doctors, RMOs, patient or his family members can be given authorization. The system even facilitates the doctor to view the patient's previous history from the data in memory.

### II. LITERATURE SURVEY

Raspberry Pi is a credit card sized single board computer with ARM11 microprocessor. In this study, a system is designed to continuously monitor the Electrocardiogram (ECG) and other vital parameters. This data is stored in a database and can be displayed in a website that can be accessed only by authorized personnel [3].

Patient monitoring system and control using feedback and GSM technology is used to monitor the different parameters of an ICU patient remotely and also control over medicine dosage is provided. This system enables expert doctors to monitor vital parameters viz body temperature, blood pressure and heart rate of patients in remote areas of hospital as well as he can monitor the patient when he is out of the premises [8].

A module that provides mobility to the doctor and the patient, by adopting a simple and popular technique, detecting the

abnormalities in the bio signal of the patient in advance and sending an alert SMS to the doctor through Global system for Mobile(GSM) thereby taking suitable precautionary measures thus reducing the critical level of the patient [9].

### III. SYSTEM MODEL

The proposed model is described with the help of architecture diagram and the block diagram

#### A. System Architecture

The interconnection between different components is explained using the architecture of system. Architecture diagram is shown in figure 1. The patients connect the sensors to their body and the other end of the sensors is connected to Raspberry Pi. The data acquired by sensors is stored in the Raspberry pi B+. The data values (i.e. Biometric data) are shown on LCD display and at the same time if the values exceed the normal range, the alarm triggers. The values stored are sent to server with the help of GSM. All the values are stored on the server and the most recent value is displayed on webpage. The doctor along with their login credentials can login and see the patient data. Doctors can see all previous records of a patient and suggest medicines and changes in prescription. Also patients are given unique user id and password to view their records.

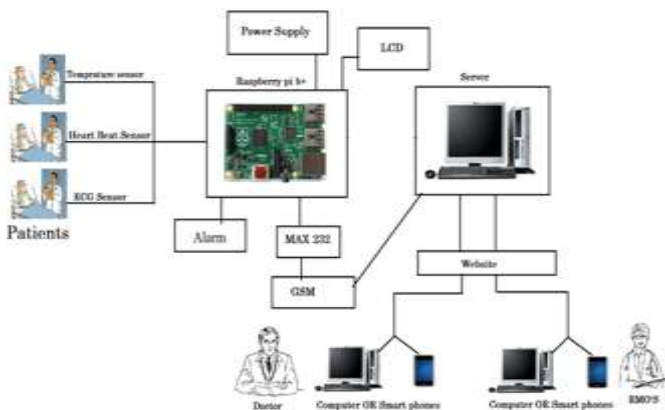


Fig. 1 Architecture diagram

#### B. Block diagram

Block diagram is shown in figure 2. The diagram is divided into two sections: Transmitter and receiver. In the transmitter section the collected data is stored in the Raspberry Pi B+ and the data is sent to the server using GSM module. In the receiver section a web page is built and data collected is displayed on the web page.

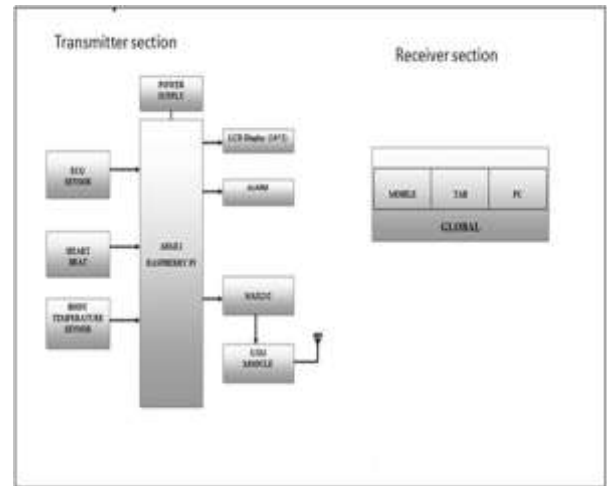


Fig. 2 Block diagram

### IV. DESIGN METHODOLOGY

The design of the system is divided into two parts: Hardware components and software components.

#### A. Hardware components

1) *Temperature sensor (LM35)*: It is a sensor used to measure temperature. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. It measures temperature more accurately than thermistors. It is sealed and does not undergo oxidation. It does not require output voltage to be amplified.



Fig. 3 Temperature sensor (LM 35)

2) *ECG sensor*: ECG electrode sticks to chest to pickup ECG signals. Then wires are connected to AD8232. This sensor is a cost-effective board used to measure the electrical activity of the heart. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op amp to help obtain a clear signal from the PR and QT Intervals easily.

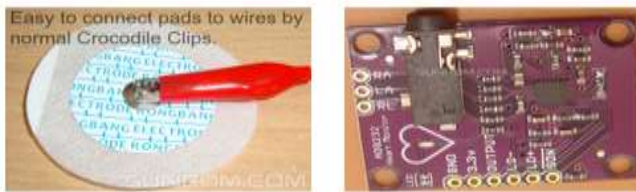


Fig. 4 ECG sensor

- 3) *Heart Rate sensor*: The sensor gives the digital output of heart beat when a finger is placed on it. When the sensor starts, the LED flashes in unison with beat. The output generated is in Beats per Minute (BPM) rate.



Fig. 5 Heart rate sensor

- 4) *Raspberry Pi*: The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. The Raspberry Pi Model B+ has dual core ARM11 processor with 512MB SDRAM and powers through Micro USB socket of 5V. Sensors are connected to the Raspberry Pi Model B+. Raspberry Pi sends the information to servers through GSM module.



Fig. 6 Raspberry Pi

- 5) *GSM module*: It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network. The use of GSM to send health information to webpage. This gives patient the ability to leave the hospital but still he has to stay in some known places to ensure the ability to reach him in emergency cases. Even with this solution the patient can't move freely and be far from his home.
- 6) *Max232*: The MAX232 IC is used to convert the TTL/CMOS logic levels to RS232 logic levels during serial communication of microcontrollers with PC. This makes it difficult to establish a direct link between them to communicate with each other. The intermediate link is provided through MAX232. Low Supply Current 8 mA.

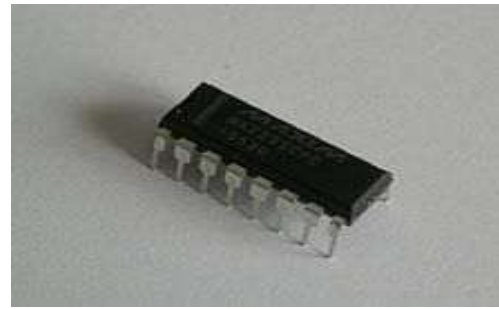


Fig. 7 MAX232

- 7) *LCD*: Liquid crystal display a type of display used in digital watches and many portable computers. It is used to display the measured data. We have used 16 x 2 Alphanumeric Display which means on this display we can display two lines with maximum of 16 characters in one line.



Fig. 8 LCD Display

## B. SOFTWARE COMPONENTS

- 1) *Server* - The data send by Raspberry pi is stored on a server. The detailed information of patients and doctor is registered through website on stored on server. The website can be accessible from anywhere.

## V. PROBLEM DEFINITION

1. Problem definition of our underlying system which is basically useful for doctor's for monitoring patient's health parameter and gets the accurate result.
2. The doctors are continuously monitor the health parameter of ICU patients from any location and virtually connected to the patient through website.
3. Also through this system real time parameter values can be measured so this system is beneficial for hospitals as well as in clinic also.
4. Through this system, the doctor can able to calculate temperature, ECG, heart rate values efficiently and store data on raspberry pi temporarily.
5. The values are in form of - Temperature we are getting Celsius, heart rate in pulses, ECG in percentage shown on display as well as on website.
6. The any threshold value will be fluctuating from specified value then the alarm will be triggered which is connected through raspberry pi and RMO's get the alert.

## VI. CONCLUSION AND FUTURE SCOPE

As health care services are important part of our society, automating these services lessen the burden on humans and eases the measuring process. Also the transparency of this system helps patients to trust it. When threshold value is reached, the alarm system that consists of buzzer and LED alerts the doctors and he can act more quickly. The objective of developing monitoring systems is to reduce health care costs by reducing physician office visits, hospitalizations, and diagnostic testing procedure.

The GSM technology helps the server to update the patient data on website. Many further improvements can be made in our system to make it better and easily adaptable such as adding more advanced sensors. The biometric information of the patient which is stored and published online can be given to scientists and researchers of medical fields to analyze the value and find patterns or for other research work. To simplify the hardware and reduce wiring we can have used wireless sensors.

Instead of medical application we can use our system in industrial and agricultural application by using sensors like humidity sensors, fertility check sensors, etc.

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