Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 3, July 2021: 5394-5401

Research Article

WIRELESS PATIENT HEALTH MONITORING AND ALERTING SYSTEM

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Abstract

The main objective of the code is tobuild a health monitoring system for patient so that doctor can easily observe the condition of patient on his android phone. For this purpose we need to connect the sensors and mobile phone toan interface like Raspberry pi. The normal rangeis fixed for each device reading and if it thereadings are abnormal then alert is generated forthe health monitoring person to take action for saving the patient.

***Keywords*—** Physiological signals, ECG, BP, Oxymeter (SPO2), Raspberry pi, SQL, Android Application.

I.INTRODUCTION

The Covid-19 pandemic has made the world realise about the importance of good health infrastructure. One of the major problem is the shortage of doctors and nurses for taking care of patient. The health infrastructure is also an important thing that help us to get better view of hospital and its capabilities. Intraditional method the medical staff has to take careof patient's by observing physiological readings. The most important devices of any patientmonitoring system includes temperature sensor, oxygen sensor, heartbeat sensor and ECG. Any fluctuation of any of these readings can lead tocritical situation of any patient.

So keeping above scenario in mind we have come up with an idea to solve the problems by implementing technology here. Our model makes it possible for doctors to monitor the condition of patients using their mobile application. The complete update of the patient's health condition is there in doctor's mobile phone. This application shows the digital readings of patient such as temperature, oxygen level, heart beat and ECG andalso generates an automatic alert if the readings arenot there in specific range. This will help the doctorto focus on more critical cases 24 by 7. The corona patient health monitoring application is accessible only by a particular login ID and password which enhances the security level for this.

As we know most of the devices in hospitals provide Analog readings, so we are using ADC (Analog to Digital convertor) to convert the Analog readings into Digital numbers which are easily scalable. The digital values are then sent to the server using Raspberry pi board. This board cantake input from multiple devices in a single time and send them to server. The information sent to server is continuously available in the mobile application within several milli-second thus making it faster to work and the appropriate actioncan be taken within time.

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RELATED WORK

Due to the lack of much technical infrastructure in healthcare sector is need of hour. For this many research scholars have contributed to this. A model regarding the use of Internet of things in health care is developed [1]. Remote patient health monitoring using cloud computing technique [2]. A model to note the readings of patient health reading e-health care sensors using cloud platform is developed to make the study of patient's medical history more readable for better treatment [3]. An individual temperature sensor is used for determining the health condition using IoT technology [4]. Embedded technology is not behind in this. Information of sensors is displayedon the LCD screen with wires connection only [5]. A new approach named as m-health based on cloud and IoT technology developed by S.H. Almotiri [6]. Another work has been done like IoT which is named as Internet of Medical Things(IOTM) which is specially related to medical science [7]. Smart Healthcare is developed for the continuous monitoring of medical equipment's with controlling features [8]. A unique approach for better development has been developed by performing case studies, applications and future directions [9]. Survey regarding IoT in healthcare system is done which helps in more studies regarding the agenda [10]. We also need the system to be cost efficient along with working applications so this innovative approach has been made in Biomedical research for reducing the costof the project

METHODOLOGY

Given section provides the detail of all the processed, devices, softwares needed for the model to operate as per our requirements.

Overall Design

The only thing that need to be done in traditional health monitoring system is to setup a good communication between the medical team and patient health monitoring devices from anywhere and anytime. Therefore, we have developed this project based on Embedded technology and Internetof Things which makes it portable. This can make the doctor aware of the patient's health condition sothat necessary actions can be taken when prompted in case of severe conditions. This model establishes a connection using network of sensors like pulse oximeter (SPO2), electrocardiogram (ECG), blood pressure (BP) and thermometer and digital display like Android display of a smartphone. This application can only be accessed by using a user id which is kept only with doctor.

The complete information is stored in the serverwhich can be accessed to generate health report of afunction and provide required treatment whenneeded. The alert is automatically generated in the mobile application whenever the readings of sensorsare abnormal in case of emergencies.

Software

The software required for the operation are LINUX based OS for Raspberry pi and a android application for smartphone.

Raspbian OS

The complete operating system needed for the operation of raspberry pi is completely called

Raspbian. It works same like other operating sytemslike android, windows, mac, etc. The booting time ranges from 30 to 50 seconds. We can write the program by connecting the raspberry pi board to anymonitor display using HDMI cable, keyboard and mouse. This will make raspberry pi behave like a mini computer. The raspbian operating system supports playing games, python programming,videos, and many other features.

Mobile Application

The mobile application acts as an interface between the user and database. Raspberry pi 3 is sending the recorded data of patient to to the serverusing internet facility. This data is extracted by the mobile application and displayed on the mobile screen of the doctor. If any of the values of the respective sensors are not within the given range then auto alert will be prompted on the doctor's mobile phone. This helps the doctor to take necessary actions in case of emergency. The securityof the app is maintained using a log in ID andpassword for every patient.

Fig.1. Android Application Interface

Hardware Components

Raspberry Pi 3 Board

It is an embedded device using both microcontroller and microprocessor in it. Thisboard is also called Single Board Computer (SBC). It can work as a mini computer if we connect display, mouse, keyboard to it. Raspberry pi is also having its applications in gaming sector, python programming and several other technologies like IoT , ML. The unique thing about raspberry – pi is that it is based on LINUX OS and this is the reason whyit takes some time while booting up and shut down. Raspberry has 40 GPIO pins which can be used for connecting and input and output devices at a time. The RAM ranges from 256 MB to 1024MB which makes it to process the information faster than other boards. It also comprised of inbuilt wifi module, Bluetooth, Ethernet connection. Raspberry pi operates ona voltage range of nearly 5.1 volts and any mobile charger can be connected to raspberry pi as a power source.

Oxygen Saturation (SPO2) Sensor

Human body requires a specific amount of oxygen concentration in blood. A device names as

pulse oximeter is used for thispurpose. It is clipped to figure which gives an estimation of oxygen concentration in our blood using infrared rays.
The normal range of oxygen is above 90% and drop below this is abnormal and can lead to serious problems like cardiac arrest. The oxygen level can also be measured by taking sample of blood. Our device does this work by giving analog output. The analog values are converted to digital using 22 bit Analog to Digital Convertor (ADC).The device allows to have complete control over its timers. Thecritical alerts can be set up. The pulse oximeter sends the detecting reading to the raspberry-pi which are later analysed so thatfurther actions can be taken early in case of emergency. Max30100 is the sensor we are using in our project.

Electrocardiography (ECG)
Electrocardiogram is a procedure used for measuring the electrical activity of heart using electrodes attached to the skin. The electrical impulses produced by our heartfrom polarisation and depolarisation of cardiac muscles are recorded. These signals are recorded in the form of waveforms whichcan be analysed to ensure the well functioning of human heart. It also tells us about any damage or defect in any of the heart muscle along with the size and exact position of chambers.

Temperature Sensor
The DS18B20 is used for measuring thecontinuous temperature of human body. It measures the temperature in celcius and does not require any additional calibration.
It has linear output with low output impedence which gives it a high accuracy. This temperature sensor derives power directly from a single wire bus which is working as a data line. It contains 64 bit serial output which is sent to central controlling unit. DS18B20 can be used for purpose where continuous monitoring is required.

Heart Rate Sensor
Heart Sensor is used for measuring the pulse beats which helps in monitoring the heartbeat and keeps the health to normal state. This work can be done using ECG but it is little bit noise. AD8232 gives clearer signalwithout any noise in the output. The output isin analog form which can be later converted into digital values. These digital values are displayed on the monitor. If the values are nor in specific range defined then the alert isgenerated which can help the medical staff totake necessary actions for patient's health. The health rate monitor can be connected to Arduino, Raspberry pi for making the wireless health monitoring system.

IMPLEMENTATION

Architecture
The architecture including the sensors and other components is show in below diagram. All the sections are divided into separate blocks to reduce the complexity. The ECG sensor, heartbeat sensor, spo2 sensor and temperature are providing the physical input to the Raspberry pi 3 in digital form. The LCD , Android app and buzzer are linked to the raspberry pi 3 and receiving the output for observing and alerting system. The 5v power supply is also connected using an external adapter.

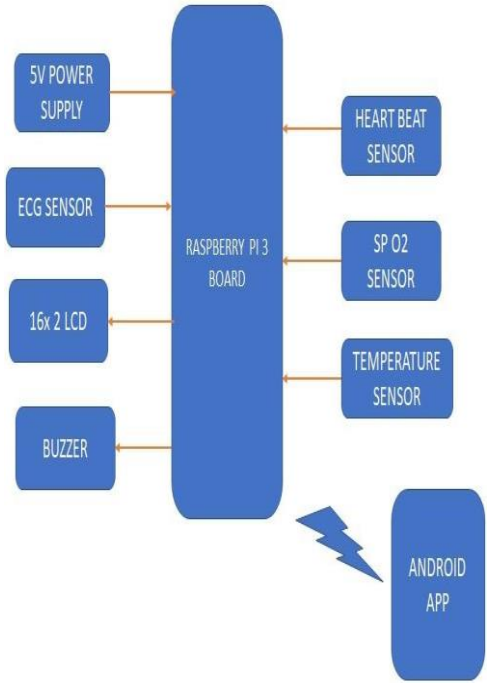

Figure. 2. Block diagram of the project

Flowchart

The sequence of code flow can be easily understood in term of flowchart where step by step execution forall inputs is given.

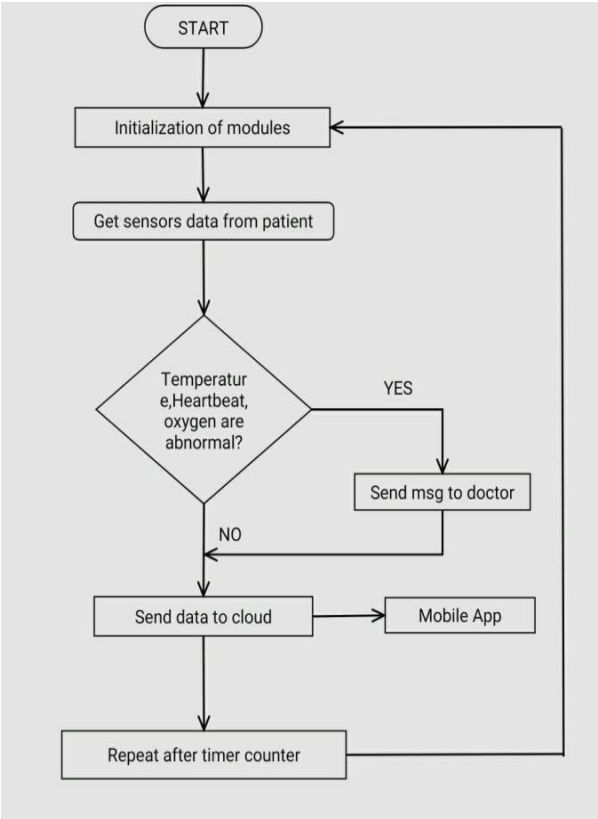

Fig.3. Flowchart of model

The raspberry pi 3 board is initialized and data of patient's physiological health is received by it. The data is first converted into digital form using Analog to Digital Converter (ADC) which makes it easy for raspberry pi to process further. The raspberry will check the data and if the readings are not within the set range then the message of alert is sent to the doctor's mobile. If the data is normal it is sent to thedata and stores there which can be later accessed bythe android application. During this complete process the timer will be repeating continuously

Schematic Diagram

The connections of raspberry pi with all the devices is given in the below diagram using pin numbers.

GPIO pins are used for taking any input or giving any output to the raspberry pi 3.We are using 4 pins of LCD out of 8. Address of physical pins on raspberry pi board are different than in the program.

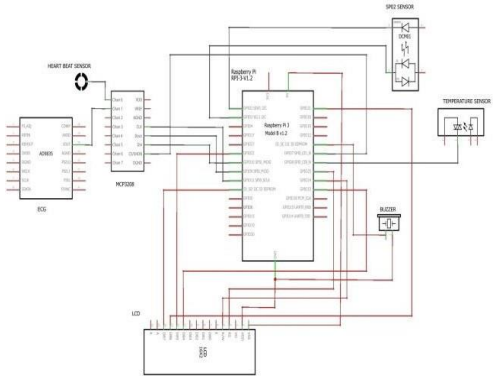

Fig. 4. Schematic Diagram of Circuit

TEST AND RESULTS

After connecting the hardware as per the giveninstructions and programming the raspberry pi as per the given flowchart and requirements, we have got thefollowing circuit. The readings were observed as normal. If we bring any hot object near to the sensor then the alert saying "abnormal temperature detected"will be displayed.

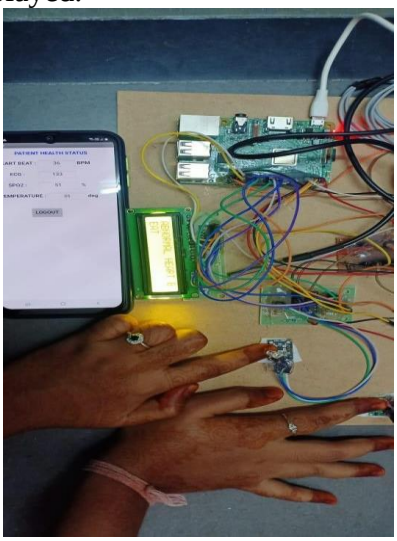

Fig. 5. Working Condition of Model

V. CONCLUSION

Internet of Things is one of the most valuable technologies in the world as it is more feasible for controlling devices from anywhere using internet. The online clouds are used for storing of patient's data with encryption such that only the authorized person can only get access to it. In this paper a healthmonitoring and alerting system was developed to reduce the gap between the patient and doctor by using a mobile application. The live recorded valuesof temperature, heart rate, oxygen level and ECG reports are sent to the doctor via an

Interface of cloud and raspberry pi. With the help ofthe readings the doctor can diagnose and take propermeasures for analyzing the health condition of patient.

Future Scope of Improvement

The application could be more advanced if we addcamera monitoring to it so that doctor can get livevisual knowledge of patient's health. The voice calling feature will make the doctor talk with medical staff near the patient to take any action.

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