International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 07 | July 2020 www.irjet.net p-ISSN: 2395-0072

An IoT based Patient Monitoring System using Arduino uno

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Abstract - IoT (Internet of things) has become an interesting topic in the field of technological research. It is basically interconnecting of devices with each other over the internet. One of the best applications of IOT technology is health care monitoring system**.** Our paper is to focus on the development and implementation of an effective healthcare monitoring system based on IoT. The proposed system monitors the vital health parameters and transmits the data through a wireless communication through Wi-Fi module. The data can be accessed any time using IOT platform(Thing speak). In case any abnormal behaviour the caretaker, as well as the doctors are notified immediately through a message service. In order to design an efficient remote monitoring system, security plays an important role .Cloud computing and password protected Wi-Fi module handles authentication, privacy and security of patient details by allowing restricted access to the database

Key Words: *Arduino uno ATMEGA328P, Heartbeat sensor, Digital humidity Temperature sensor, GSM module, WI-FI module, Internet of Things*

1. INTRODUCTION

Telemedicine is a newest technology which combining telecommunication and information technology for medical purposes. It gives a new way to deliver health care services when the distance between the doctor and patient is significantly away. Rural area will get the benefit from this application. Patient monitoring is one of the telemedicine, which always needs improvement to make it better. It is vital to care in operating and emergency rooms, ICU.

Fusion of technology and medical science is moving at a warp speed. So the medical representatives are also taking advantage of these technologies to achieve that state. Here comes the world of IOT. IOT is nothing but connecting devices to the internet using sensors and a suitable platform. These sensors can be placed on health monitoring equipments. The information collected by these sensors is then sent to any remote destination.

Here we use IOT platform Thing Speak service that allows you to aggregate, visualize and analyze live data streams in the cloud. ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeak. This also helps to keep a track of the data for every patient.

In this project, we introduce a secure IoT-based healthcare monitoring system. To achieve system efficiency simultaneously and robustness of transmission within public IoT-based communication networks, we will utilize robust crypto-primitives to construct two communication mechanisms for ensuring transmission confidentiality.

Arduino uno ATMEGA328P is collect data from sensors and then it transfer wirelessly to IoT website. *Arduino uno ATMEGA328P* board is associated to the internet, that board MAC address is registered to the internet. After that in IoT website, add MAC address of this board. Then the sensors output is connected to the IoT website

S. M. Riazul islam et al [1] proposes an intelligent collaborative security model to minimize security risk; discusses how different innovations such as big data, ambient intelligence, and wearables can be leveraged in a health care context; addresses various IoT and eHealth policies and regulations across the world to determine how they can facilitate economies and societies in terms of sustainable development; and provides some avenues for future research on IoT-based health care based on a set of open issues and challenges

Junaid mohammed et al [2] monitors patient's ECG wave anywhere in the world using IOIO- OTG Microcontroller. Android application is created for ECG Monitoring. IOIO-OTG microcontroller is connected to android phone using USB cable (or) Bluetooth dongle. After collecting data, the wave is send to android application. Monitor and store ECG waves in that android based application.

Mohammed S. Jasses et al [3] focused on body temperature monitoring using Raspberry pi board in cloud based system. In that paper, Raspberry pi is monitor body temperature and then these parameters are transfer by wireless sensor networks (WSN). Then these data's are added to the cloud based websites. Using this website monitor bodytemperature.

Hasmah Mansor et al [4] monitors body temperature using LM35 temperature sensor. The LM35 temperature sensor is connected to the Arduino uno board. Afterthat creating a website in SQL database format. Arduino uno board is connected to that website. Then sensor output is send to the website. Using this website anybody can monitor body temperature in login process.

Afef Mdhaffar et al [5] present a new loT-based health monitoring approach in which collected medical sensor data is sent to an analysis module via low-cost, low-power and secure communication links provided by a LoRaWAN network infrastructure

Mathan Kumar et al [6] discussed about monitors ECG, Respiration rate, heart rate and body temperature. These sensors are connected to PIC16F887A microcontroller. After collecting data from sensors, the data is uploaded to the website manually For monitoring purpose created an android application and webpage for monitoring the health status.

Soumya Roy et al [7] monitors ECG waves of patient's. AT Mega 16L microcontroller is used for monitoring ECG waves. Zigbee module is used for transferring ECG waves. Zigbee module is sends data to nearest connected system for zigbe

Shreyaasha Chaudhury et al [8] monitors the vital health parameters and transmits the data through a wireless communication, which is furthertransferred toa network via a Wi-Fimodule.

P.Karthick et al [9] the system is designed to be used in Home or hospital for measuring and monitoring various parameter like ECG, Body temperature and Blood pressure. By using new technology Internet of Things (IOT) makes all objects interconnected and it has been recognized as the next technical revolution. The results can be recorded using Raspberry Pi displayed on a HMI interface display. Also the results can be sent to server using IOT and text message using GSM module. Relatives or Doctors can login to a website and view those results.

2. METHODOLOGY

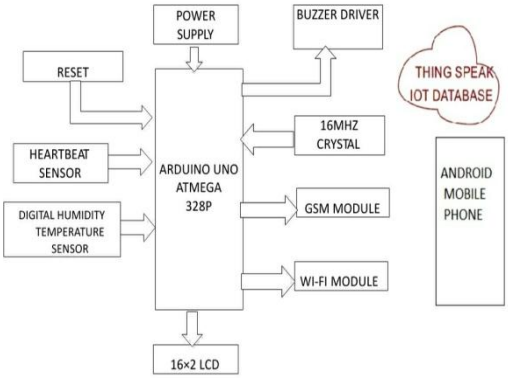

Fig 1: Block diagram of Patient Monitoring system using IoT

The proposed system is mainly dived into 4 subsystems and given below.

1. Buzzer and crystal oscillator
2. Sensor system
3. Control system
4. Data transferring system

Buzzer

We can select the upper limit and lower limit for the temperature and heartbeat as well. While monitoring, if the temperature is increased beyond the set high limit or is decreased below the set limit then the buzzer sounds and the load Aturns off. Similarly, when we remove the heartbeat sensor and system detects low heartbeat and buzzer buzzes and the load is switched off. This buzzer can help the patient's well-wishers to take action in an emergency. When the temperature and heart rate come into control the bulb turns on and the alarm gets off.

Crystal oscillator

Crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric materials create an electrical signal with a precise frequency. This frequency is often used to keep track of time, to provide a stable clock signal for digital integrated circuits and to stabilize frequency. It is mainly used to give the clock pulse to controller.

Various Sensors are used to collect vital health parameters frompatient and explained below.

DHT 11 Sensor: DHT11(Digital Humidity Temperature) Sensor The temperature range of DHT11 is from 0 to 50 degree Celsius with a 2-degree accuracy. Humidity range of this sensor is from 20 to 80% with 5% accuracy. The sampling rate of this sensor is 1Hz .i.e. it gives one reading for every second. DHT11 is small in size with operating voltage from 3 to 5 volts. The maximum current used while measuring is 2.5mA. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc… to measure humidity and temperature instantaneously.

Pulse sensor: An alternate name of this sensor is heartbeat sensor or heart rate sensor .Pulse Sensor is a well-designed plug-and-play heart-rate sensor for Arduino. It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart- rate data into their projects. The sensor clips onto a fingertip or earlobe and plugs right into Arduino.

Control System: Microcontroller is main part of the system.The entire system is controlled by microcontroller,in this project we use Arduino Atmega 328p as microcontroller.

Arduino Atmega 328p: The Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWMoutputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power

jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connecting it to a computer with a USB cable or powering it with a AC-to-DC adapter or battery is enough to get it started.Having its own memory unit and processor, microcontrollers or mini computers are used to implement the entire software using the hardware. source microcontroller based on the microchip at mega 328p. This has some valuable facilities like they can easily convey the required information with a computer or with other microcontroller. In short, we say that the project depends on the software code in the microcontroller.

2.1 Data transferring System:

This system is used to transfer the collected data which is monitored by Arduino Uno. Data will be transferred to mobile and cloud using SIM 800L and WI-FI Module.

SIM 800L:
SIM 800L is used as GSM Module to transfer the data to particular user or care taker(which number is given in the code) through a message in the mobile. SIM800L is a complete Quad-band GSM/GPRS solution in a LGA type which can be embedded in the customerapplications.SIM800L support Quad-band 850/900/1800/1900MHz, it can transmit Voice, SMS and data information with low power consumption.

WI-FI Module: WI-FI Module(ESP8266) Is used for wireless data transmission to the cloud(Thing speak).It continuously transfer the data to the cloud if and only if ARDUINO monitors the sensor data. It collects data from ARDUINO UNO. ESP8266 offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor. When ESP8266hosts the application, and when it is the only application processor in the device, it is able to boot up directly from an external flash.

In this paper we have temperature, Heart beat of patient's signal is given to base of the BC 557 (PNP) and BC547(NPN) switching transistors in order to convert the TTL voltage 0 to 5 v level . Finally the TTL output is given to 7414 IC inverter to invert the pulse in digital form. Then the final square wave signal is given to arduino uno.

Connect Pulse Sensor output pin to A0 of Arduino and other two pins to VCC & GND. Connect LM35 Temperature Sensor output pin to A1 of Arduino and other two pins to VCC &GND. Connect the LED to Digital Pin 7 of Arduino via a 220-ohm resistor. Connect Pin 1,3,5,16 of LCD to GND. Connect Pin 2,15 of LCD to VCC. Connect Pin 4,6,11,12,13,14 of LCD to Digital Pin12,11,5,4,3,2 of Arduino. The RX pin of ESP8266 works on 3.3V and it will not communicate with the Arduino when we will connect it directly to the Arduino. So, we will have to make a voltage divider for it which will convert the 5V into 3.3V. This can be done by connecting the 2.2K & 1K resistor. Thus the RX pin of the ESP8266 is connected to pin 10 of Arduino through the resistors. Connect the TX pin of the ESP8266 to pin 9 of the Arduino.

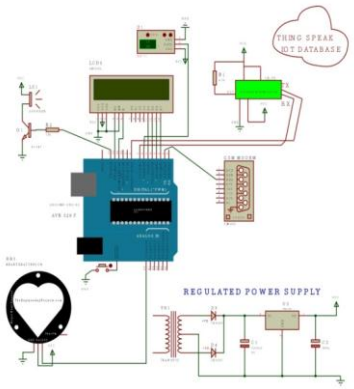

Fig 2: circuit diagram for health monitoring system using IOT

This system continuously monitors the heart rate and the temperature reading of the patient. In this health monitoring system project, we use two 7 segment modules to display the parameters, as the display has a greater viewing distance. We can select the upper limit and lower limit for the temperature and heartbeat as well. While monitoring, if the temperature is increased beyond the set high limit or is decreased below the set limit then the buzzer sounds and the load turns off. Similarly, when we remove the heartbeat sensor and system detects low heartbeat and buzzer buzzes and the load is switched off. This buzzer can help the patient's well-wishers to take action in an emergency. When the temperature and heart rate come into control the bulb turns on and the alarm gets off Hardware connection setup for Patient Monitoring system using Arduino uno

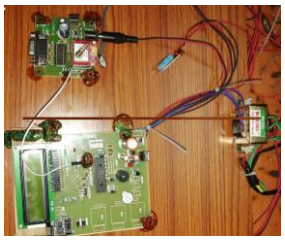

Fig 3 Hardware connection setup for Patient Monitoring system using Arduino uno.

3. RESULTS

Fig a shows SMS in mobile which has been sent by GSM module. It also show alert message health parameters are above the normal range.

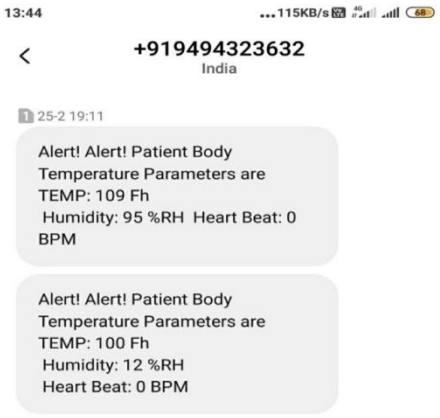

Fig 4: SMS alert in mobile

Fig b shows field charts for health parameters temperature, humidity and heart beat in IOT platform.

Fig 5 Humidity temperature and heartbeat outputs on thing speak

4. CONCLUSION

In this project, IOT based Health monitoring system is developed that allows patients to be mobile in their social areas. When the patient's vital data reaches a predetermined limit value, the mobile application alerts the patient and the people in the vicinity. This warning is made at a volume level that people near the patient can hear. If there is nobody in the vicinity of the patient who can help him, the patient's heart rate, body temperature, and coordination information are sent to family members and the doctor through message notifications. The main purpose of the device is to make provide that they get medical aid as soon as possible, in case of a possible discomfort for heart diseases. So there will be an increased chance of survival of patients.

5. FUTURE SCOPE

We can add a GPS module in IOT patient monitoring using Arduino MEGA .This GPS module will find out the position or the location of the patient using the longitude and latitude received. Then it will send this location to the cloud that is the IOT using the Wi-Fi module. Then doctors can find out the position of the patient in case they have to take some preventive action.

Now a days peoples are suffering from BP and heart attacks so if we add BP, ECG, EEG sensors in this project. With the help of these sensors we will find Blood pressure and we will check heart condition. Wi-Fi is an external module connected to Arduino mega. It is better if it is in built so, complexity can be reduced.

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