

# Adaptive Heart Monitoring System Using Iot

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**Abstract:** Nowadays, heart diseases are the major problems in all age groups. In such cases continuous monitoring of patient by a doctor is impossible. To avoid this problem the proposed paper provide an efficient solution i.e., Cost effective continuous heart beat monitoring system using Raspberry Pi3 model B with IOT (Internet of things). IOT plays a vital role in our day today activities, which helps to transfer data over internet without the aid of human or human and computer interaction. In this Heart monitoring system IOT helps to conveys the patient's condition for every sixty seconds and during this period if the patient's heart beat is abnormal then it sends the condition of the patient to the authorized persons like Doctor, family members and relatives by email and SMS through Way to SMS. The patient's details related to health are already available in the Raspberry Pi kit for future processing in case of emergency. This proposed paper is cost effective and this method of tracking and monitoring system can be implemented to more number of patients with heart diseases at the same instant to save the life of human beings who encounters the cardiac disease and thus this proposed system avoids the fatal endings. Hence this proposed paper benefits the human society by extending the life.

**Index terms:** Raspberry Pi3 model B, python programming, ADS1015 converter, heart beat sensor, IOT

## I. INTRODUCTION

The innovation in the field of patient disease prevention and maintenance has enabled the monitoring systems. This proposed paper provides a Preventive, Predictive and individual method of Heart beat monitoring systems. It is an important technology in our life which helps to monitor the cardiac patients in a safe and secure way. The IOT is the emerging technology which contains smart devices connected to internet for communicating with each other. It makes our day to day life more comfortable, these IOT devices in medical field are used to monitor, collect, diagnosis, medical equipment tracking, detection, analysis etc., It plays an important role by collecting the patient's Condition and reporting to the authenticated persons through the SMS [1][2]. or SBC (single board computer) that plugs in to your TV, keyboard and it is the best tool for students, Hackers, hobbyists and artists. Its operating system is Debian based GNU/Linux. It is used for browsing, word processing, spread sheet, etc. It is a 64 bit processor which supports WIFI and Bluetooth. It is programmed in python language. It has high clock speed of 1.2GHz (50% faster than the Raspberry Pi 2). The heart beat sensor (SEN11574) senses the patient for

every sixty seconds and gives it to the ADC (ADS1015) convertor then it gives it to the Raspberry Pi kit which contains entire patient details and if the heart beat is less than the estimated level then it passes the information through the internet to the authorized persons like doctor, family members as warning/alert message.

## II. REVIEW OF RELATED WORKS

According to the literature survey, it is noted that each and every literatures concentrates on human health and it aims to save the cardiac patients from heart attack. However some existing technologies have few drawbacks.

Firstsystem "IOTBASED HEART ATTACK DETECTION AND ALERT SYSTEM [10]", researcher Designed a health monitoring system using AVR microcontroller over IOT. This system consists of ECG leads (electrode), LCD display, MMC (Multi Media Card) and buzzer. It uses Zigbee protocol. Here, ECG leads will be placed on the chest of the patient and it will convert the heartbeat into pulses. These pulses will be fed to the microcontroller circuit where threshold value of a pulse rate will be already programmed. If the heartbeat of a patient is less than the threshold value (60 BPM), then the buzzer will alarm and heartbeat value of a patient will be displayed on LCD through Zigbee protocol. Advantage of zigbee is that the network is very scalable and it consumes little energy. Drawback of this system is that the complexity of the circuit, cost is not economical and Zigbee does have limitations in the area of energy use restrictions for memory size, processing speed of data, and size of bandwidth [3][4].

Secondsystem "MICROCONTROLLERBASED HEARTBEAT MONITORING SYSTEM [11]" using GSM (Global System for Mobile communication) technology along with this amplifiers and filters are used. The MC has a CPU along with fixed amount of RAM, ROM, I/O PORTS and a TIMER embedded all on a single chip. The heartbeat sensor used here is PPG

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(Photoplethysmography)[5][6][7]. PPG can be placed on the human's chest, finger, earlobe etc., and it senses the heartbeat of the cardiac patient and the heartbeat will be sent to the microcontroller circuit.

Threshold value of a heartbeat is programmed in microcontroller. If the heart beat decreases than the threshold value, the GSM (Global system for mobile communication) will send the SMS to the authorized persons like doctor, nurse and relatives. Advantage

of GSM is it provides very cost effective products and solutions. Drawback of this system is delivery of message will consume more time.

Third system “HEARTBEAT MONITORING AND ALERT SYSTEM USING GSM TECHNOLOGY [12]” uses

the same previous system. PPG is a low cost optical technique that can be used to detect the blood volume changes in the micro vascular bed of tissue. PPG tools uses an emitter-receiver pair (infrared emitter and photodiode) pair to determine blood flow. Heartbeat sensor which adopted PPG is designed by using MATLAB software. But here Arduino microcontroller is used which is the advancement of normal microcontroller. Here also GSM technology is used. The arduino provides the effortless functions and it is easy to use. This system also consumes maximum time for communicating to the authorized persons in case of emergency. Another disadvantage of this system is that the arduino cost is not economical and the structure is complex[8].

Fourth system “IOT BASED PATIENT HEALTH MONITORING SYSTEM [13]” uses IOT

(Internet of Things) along with heartbeat sensor is used. The heartbeat sensor will be placed on cardiac patients chest and it has LED and LDR in it. The led light will pass through the human vein and LDR receives the electrical waveform of the heartbeat. In this system separate login id and password will be given to each and individual patient. So that the both doctor and relatives will be able to know the patient's conditions by login to their respective id. Advantage of this system is that it avoids the continuous monitoring of cardiac patients by a doctor or nurse. Drawback of this system is that if the network problem arises, that restrict the doctor to see the message and if doctor or relative forgot the password of patient then patient will be in danger.

III. EXSISTING TECHNOLOGY

In the existing technology they use wireless transmission for updating the data to the website using raspberry Pi and the concept of Internet of Things. The system uses online real time graphs which gives the Heart condition of the patient. The heart beat can be measured with the help of PPG (Photoplethysmographic) sensor. When the finger is placed on the sensor the LED will start to glow this indicates the sensor detects the heart beat .Then this signal is given to the microcontroller. This ARV microcontroller is a 16KB programmable flash memory is used for computing the

heartbeat from the output signal of heartbeat sensor and compiler is used for compiling the code. The controller uses crystal oscillator for counting the heart pulses this controller is used for counting the heart beat and it will be displayed on the LCD. Then the information is given to the Bluetooth used to transfer the information between short distance which transmits the information to the Raspberry pi version 2 models B which has the 512 RAM and clock frequency is 700MHz and the core is ARM cortex A7.

The raspberry pi and laptop can be connected by tethering and one of the script in Pi contains the user name and password which renders the security to the system. The raspberry Pi is used to connect to the Internet to the website through the THINGSPEAK.COM. The THINGSPEAK.COM is the website for sending the message which is an open source API (Application programming Interface) this channel can be used as both public and private. Then the message delivery from an online messaging shows that the 'System started' and if the patient's heart beat is beyond the threshold level it will send message to the doctor.

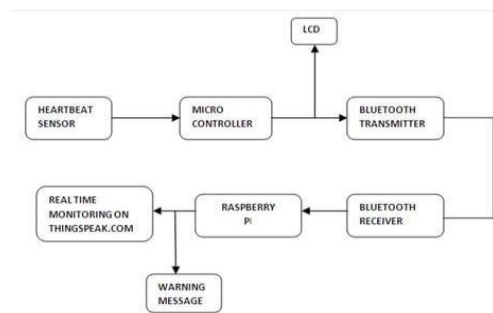


FIG1 shows the block diagram of existing method

PROBLEM IN EXSISTING TECHNOLOGY

The problem is that circuit is complex since it uses more number of components and the Bluetooth can only used for short distance. The clock frequency and RAM is less when compared to the latest version of raspberry pi. The existing circuit which is used to measure the heartbeat using sensor is complex and further it uses more number of components and there is a serious limitation of distance due to the Bluetooth technology used in the system. Memory capability is much limited when compared to the proposed model which works with raspberry pi. This proposed paper provides the efficient monitoring of patient and enhance the life time of patient affect with heart disease by extending his/her life and plays a important role in human society.

IV. PROPOSED MODEL

The proposed model consists of Raspberry pi model B, ADC convertor(ADS1015)and Heartbeat sensor(SEN11574)

Raspberry pi is a credit card size minicomputer. It has the ability to run multiple programs at a time. The raspberry pi 2 model does not have the Ethernet and extra USB port. But the pi 3 model has both Ethernet port and extra USB ports in addition to that it also have onboard Bluetooth and WIFI. The clock speed of this model is 1.2GHZ which is 50 percentages faster than pi 2

model. The pi 3 model is 80 percentages faster than the pi 2 models. It has 1 GB (Giga Bytes)RAM.

The hardware parts are USB (Universal Serial Bus) port which is used to connect the raspberry pi on keyboard and display, GPIO (General Purpose Input Output). There are 40 input and output pins are available which are connected to the external electrical and electronics component. Ethernet port was used for connecting the raspberry pi to the internet. HDMI (High Definition Multimedia Interface).This HDMI port is used to provide interface between audio and video source such as set up box, DVD player. The inbuilt SD card is used for installing the raspbian operating system. The raspberry pi model is designed by python language. The 5V power supply is need for this raspberry pi 3 model that supply was given to the power port

FIG 2 shows the PQRS waveform of humans throughput and this system delivers the message in time .This system has a high reliability when compared to the existing model.

The performance of our proposed system is implemented and thoroughly studied and evaluated in this section while comparing to arduino and microcontroller, raspberry pi provides an efficient

### Working principle:

Initially the heart beat sensor's skin touch pad will be placed on the patient's body such as, finger, fore head, ear lobe etc., this sensor measures the heartbeat which will be in the form of electrical signal and it is given to the ADS1015 convertor .The ADC convertor converts the electrical signal into corresponding digital value and the value is given to the raspberry pi module. The mentioned/given value of the heart beat will be programmed already using python language in the raspberry pi module .If the incoming value is lower than the threshold value then the system will produce the alert /warning message to the authenticated persons like doctor, family, relatives using IOT via "WAY TO SMS" In order to avoid the increasing fatal results due to cardiac diseases.

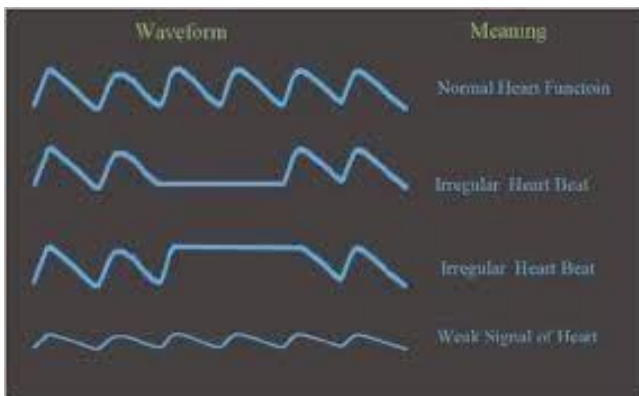
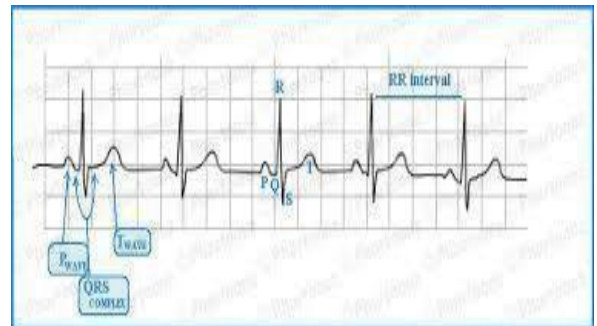


FIG 4 shows the waveform of heartbeat signals  
PERFORMANCE ANALYSIS:

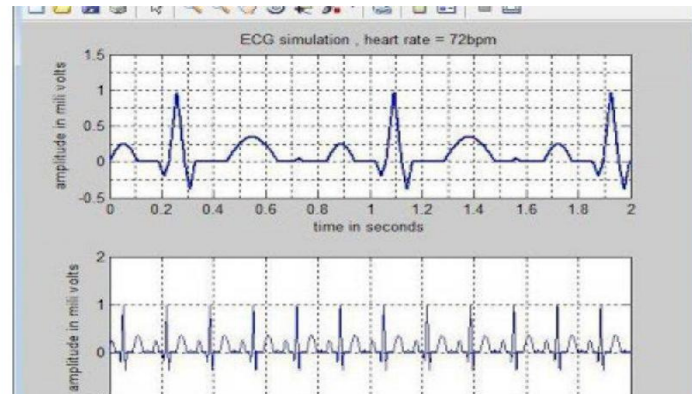
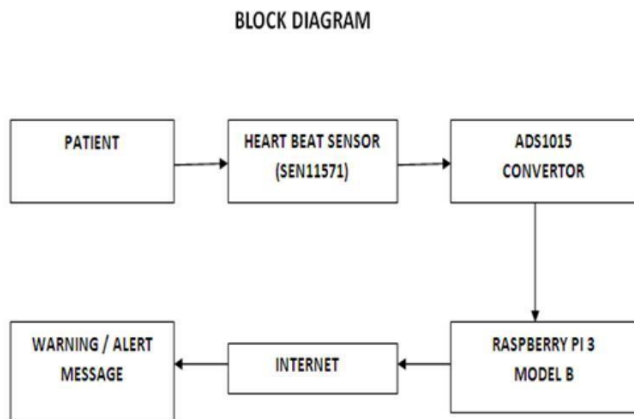


FIG 5 shows the simulation of

FIG 3 shows the block  
diagram of proposed method

```

pi@raspberrypi:~$ 
pi@raspberrypi:~$ python heartBeatsPulseSensorAlgo.py
BPM: 109
BPM: 114
no beats found
no beats found
BPM: 45
BPM: 45
BPM: 46
BPM: 48
BPM: 50
BPM: 53
BPM: 55
BPM: 58
BPM: 61
BPM: 65
BPM: 69
BPM: 74
BPM: 74
BPM: 75
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FIG 6 Output of our proposed syste

## V. COMPONENTS USED HEART BEAT SENSOR:

Heart beat sensor used here is SEN11574 Heart beat sensor consists of light emitting diode (LED) and Light detector (LD). It works on the principle of light modulation by blood flow through the finger at each pulse. Working of light detector is same as the photo detector. When a tissue is illuminated with a LED light source it reflects or transmits the light. Some of the light will be absorbed by the blood. The reflected light is then received by the light detector. The received signal is in the form of electrical signal and is proportional to the heart beat. The LED blinks on each heart beat. The operating voltage and current are +5V dc and 100 mA respectively.



FIG 7 shows heart beat sensor

## B. ADC CONVERTOR:

Here the ADS 1015 convertor is used. It is under the type of delta sigma analog to digital convertor. The advantages of this delta sigma ADC is that it has high resolution and no precision external components are needed. The ADC pins are VDD (power supply), GND (ground), SCL (serial clock line), SDA (serial data line), ADDR (address), and A0 to A3 (analog pins). It uses I2C (Inter- Integrated Communication protocol). Which transmits and receiving the information between the two or more than two devices, which requires a communication path between them. The



speed ranges of this protocol are divided into three modes. They are standard mode, fast mode and high speed mode. It supports 7 bit and 10 bit address.

FIG 8 shows ADC convertor

## C. RASPBERRY PI MODEL B;

Raspberry pi is a credit card size minicomputer. It has the ability to run multiple programs at a time. The raspberry pi 2 model does not have the Ethernet and extra USB port. But the pi 3 model has both Ethernet port and

extra USB ports in addition to that it also have onboard Bluetooth and WIFI. The clock speed of this model is 1.2GHZ which is 50 percentages faster than pi 2 model. The pi 3 model is 80 percentages faster than the pi 2 models. It has 1 GB (Giga Bytes) RAM. The hardware parts are USB (Universal Serial Bus) port which is used to connect the raspberry pi on keyboard and display, GPIO (General Purpose Input Output). There are 40 input and output pins are available which are connected to the external electrical and electronics component. Ethernet port was used for connecting the raspberry pi to the internet. HDMI (High Definition Multimedia Interface). This HDMI port is used to provide interface between audio and video source such as set up box, DVD player. The inbuilt SD card is used for installing the raspbian operating system. The raspberry pi model is designed by python language. The 5V power supply is need for this raspberry pi 3 model that supply was given to the power port.



FIG 9 shows Raspberry pi 3 model B

## VI. CONCLUSION:

The heart beat causes changes in the flow of blood, so the cardiac diseases increasing in our society. Biomedical engineering helps us to apply the engineering principle to the medical for preventing the patient health care. It also includes preventing the patient from the severe cardiac diseases. The continuous monitoring of heart beat is necessary for every cardiac patient. The proposed system allows the real time monitoring of a patient who is in abnormal condition. The continuous monitoring will reduce the need of doctor. This system is cost effective and it reduces the complexity in existing technology.

Here the raspberry pi plays an important role which is used for sending the patient condition to the authorized person with the help of inbuilt WIFI. We can also send the e-mail to the authorized person. It sends the warning message through way to SMS when the heart beat attains the critical value. The proposed system is



used for number of individual patient who are suffered by cardiac diseases. This system will extend the life of cardiac patient.

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