

Health Monitoring System using Raspberry PI

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Abstract - As the population increases, there is also an increase in the number of chronic and heart diseases. The current hospital centric healthcare system is becoming inefficient to treat conditions that demand immediate treatment such as heart strokes. So, the focus is now tilting from hospital centric treatment to patient centric treatment. This project proposes a health monitoring system which monitors vital parameters of the patient such as temperature and heart rate using sensors as well as a fitbit which are connected to a raspberry pi board. The project involves alerting the doctor through SMS if any vital parameter of the patient deviates from the normal value. Apart from helping the doctor monitor the patient's basic health parameters this health monitoring system also ensures that the patient takes the prescribed medication at the right times. The raspberry pi acts as a personal server which logs the details of the patient's medication. The patient is sent reminders to take medicines through SMS according to his prescription.

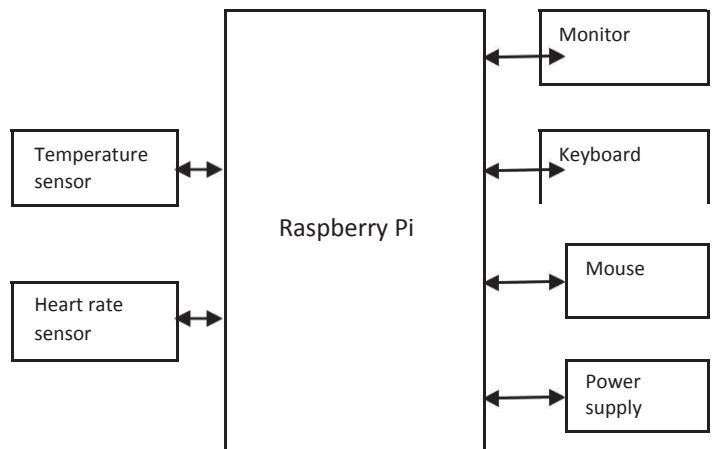
Index Terms – Raspberry Pi, Internet of Things, health monitoring system.

I. INTRODUCTION

The advancement in the new innovative technology and Internet of Things (IoT) has had a substantial influence on the healthcare system. Moreover, the fusion of novel advances in technology with healthcare systems provides us with a wide window for improvements in the areas of patient care and communications. But the fragmented nature of the healthcare system, which is further worsened by the lack of tools for communication between specialists stimulates the need of functional interoperability to ameliorate this coordination. Currently, information technology is considered a necessity rather than a supporting tool. A major aspect in the healthcare system is the monitoring of the patient's vital signs such as temperature and heart rate. Many monitoring devices that display the patient's vital signs are commonly present in the critical care units in operating rooms. But there could be instances where the doctor couldn't be alerted in time when there is an emergency, despite

of 24 hours of monitoring. Also the data couldn't be shared remotely with the other doctors who are specialists in that field and the family members. Technology that enables all these activities are available but aren't affordable by many people in developing nations. Our project aims to overcome this problem by developing a healthcare system that uses a Raspberry pi, an affordable credit card sized single board computer.

II. PROPOSED SYSTEM



The proposed health monitoring system has 3 functionalities:

Measuring body temperature of the patient:

The **DS18B20** temperature sensor connected to the Raspberry pi is used to check the patient's body temperature. If the temperature of the patient is above normal, the doctor is alerted through an SMS immediately.

Measuring heart rate of the patient:

A lot of research is taking place in the wearable sensor field in recent years. We use a fitbit wearable sensor module for heart rate sensing. From the heart rate measured using the fitbit, if any abnormality is found, the doctor is alerted about the patient through SMS immediately.

Patient medication details:

We use the forms shown below to input the patient's medication details. The data is stored in the raspberry pi which acts as a personal server. We access the patient's medical database and remind the patient to take medication according to prescription through SMS.

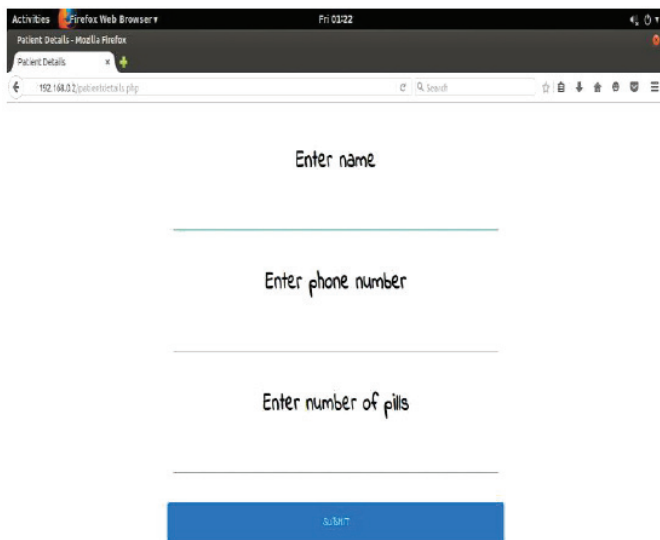
A screenshot of a web browser window titled 'Patient Details - Mozilla Firefox'. The address bar shows '192.168.0.2/patientdetails.php'. The form contains three text input fields with labels 'Enter name', 'Enter phone number', and 'Enter number of pills'. Below these fields is a blue 'Submit' button.

Fig1: User details to be stored in database

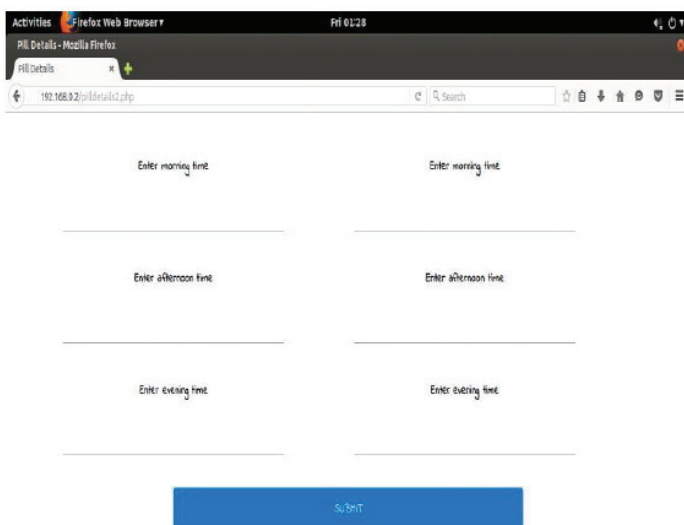
A screenshot of a web browser window titled 'Pill Details - Mozilla Firefox'. The address bar shows '192.168.0.2/pilldetails2.php'. The form has six text input fields arranged in three rows and two columns, each labeled 'Enter morning time', 'Enter afternoon time', and 'Enter evening time'. A blue 'Submit' button is at the bottom.

Fig2: Details regarding frequency of pills to be stored in database

The doctor's details are similarly entered in a form and are used to alert the doctor to abnormalities in the patient's vital parameters.

III. TECHNOLOGY USED

Temperature sensor (DS18B20):

The DS18B20 digital thermometer provides 9-bit to 12-bit Celsius temperature measurements and has an alarm function with non-volatile user-programmable upper and lower trigger points. The DS18B20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. In addition, the DS18B20 can derive power directly from the data line ("parasite power"), eliminating the need for an external power supply. A benefit of using the one-wire DS18B20 temperature sensor in our application is that it is useful when measuring something far away from the raspberry pi.

Heart rate sensor:

Fitbit is a wearable device that is used to measure heart rate. We used the Bluetooth module in the fitbit device to transfer heart rate data to the raspberry pi. The Raspberry Pi 3 has Bluetooth functionality on board. We had to set up Bluetooth on the Raspberry Pi in order to receive heart rate data from the fitbit device.

Raspberry Pi:

The Raspberry Pi is a single board, low-cost, high performance computer. The raspberry pi board comprises a program memory (RAM), processor and graphics chip, CPU, GPU, Ethernet port, GPIO pins, UART, power source connector and various interfaces for other external devices. The Raspberry Pi 3 also has on-board Wifi, Bluetooth and USB boot capabilities.

IV. ALGORITHM

ALGORITHM FOR THE CODE:

Raspberry pi is installed with a linux based operating system, Raspbian.

The code is implemented in Python.

The function of the algorithm is to detect the body temperature of the human as well as the heart rate and alert the doctor via SMS in case of any aberrancy. The temperature is detected using the DS18B20 sensor. The heart rate is detected by using a fitbit module which transfers data using a Bluetooth module. The Raspberry pi also functions as a pill reminder, whereby it reminds the person to take his daily pills at the times recorded by him in the database.

The Algorithm is executed as follows:

Step 1:

Every person records his details in the database, mentioning his doctor's Contact number, number of pills to be taken daily and their respective times.

Step 2:

Raspberry pi continuously receives the data from Fitbit and extracts the heart beat.

Step 3:

The program checks if the heart beat falls in the normal accepted range. If the heart beat is detected as abnormal, alerts the doctor via sms and records the anomalous value in the database.

Simultaneously, the person can check his body temperature using the temperature sensor and if unwell, the raspberry pi will alert the person as well as the doctor.

The raspberry pi also serves as a pill reminder; fetches the timings at which the person should consume pills from the database and reminds the person to take them.

V. RESULT AND DISCUSSION

TABLE 1: Measured temperature

TEMPERATURE °C	FREQUENCY
36.4	3
36.5	5
36.7	8
36.8	2
37.4	6
37.5	5
37.6	4
37.7	2
37.8	3
38	2

The temperatures were recorded for different patients and tabulated based on the number of occurrences as shown in the table and histogram.

When the temperature spikes above 37.5°C then an sms alert was sent. The threshold was selected to be 37.6°C. When the number of heart beats per minute exceeded the threshold 80, an sms alert was sent.

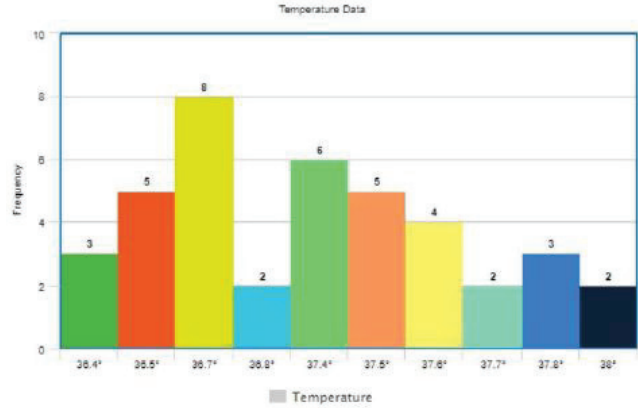


Fig 1: Histogram Plot where X axis is temperature and Y axis is the frequency of occurrence

TABLE 2 : Measured heart beat using fitbit

HEART BEAT RANGE	FREQUENCY
60-65	5
66-70	5
71-75	10
76-80	7
81-85	2

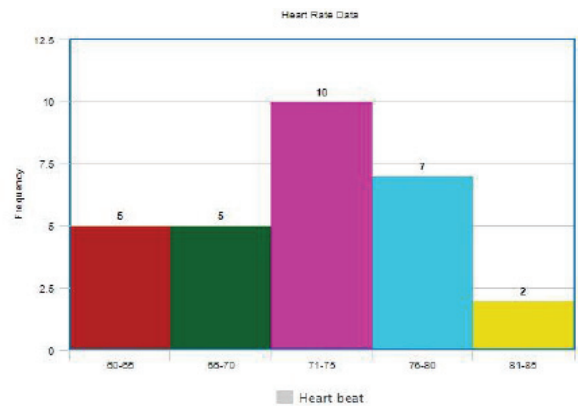
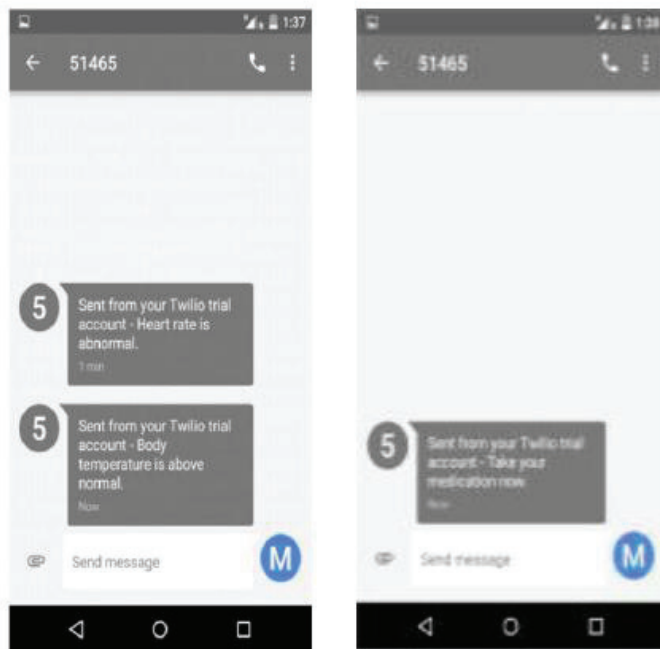


Fig 2: Histogram Plot where X axis is heart beat range and Y axis is the frequency of occurrence

The heart rate was recorded for different patients and tabulated based on the number of occurrences as shown.

SMS ALERTS ARE SENT AS SHOWN BELOW:



A large amount of data can be collected using this system. This could serve as a prediction modelling system ; for example if a patient's health parameters are changing in the same pattern as a previous patient in the database , the nature of the disease/ health problem can be easily identified and can help in finding the remedy faster.

VI. CONCLUSION

Health care system is an integral part of every society. Automating these services helps in reducing the burden on human beings and yields more accurate results. The transparency of the system helps people to rely on it. That is when there is a spike in the heart rate, the raspberry pi immediately alerts the user. The objective of developing such a system is to reduce health care costs and also provide a faster way to detect a problem. We have used Raspberry pi in particular because of its multi-tasking capability and its low power consumption.

This system can be easily installed in hospitals, houses and can serve as a large database to collect data. The results can be integrated with the mobile by developing an application so that it can be easily accessed at all times and at all locations.

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