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GUI BASED HEALTH MONITORING SYSTEM USING RASPBERRY PI

Paresh Valiya
Dept.Electronics and Telecommunication
Sardar Patel Institute of Technology
Mumbai, India
pareshkumar.valiya@spit.ac.in

Sejal Shinde
Dept.Electronics and Telecommunication
Sardar Patel Institute of Technology
Mumbai, India
sejal.shinde@spit.ac.in

Milind Paraye
Dept.Electronics and Telecommunication
Sardar Patel Institute of Technology
Mumbai, India
milind.paraye@spit.ac.in

***Abstract*—Now-a-days health problems like cardiac failure, lung failures heart related diseases are arising day by day at a very high rate. Due to these problems time to time health monitoring is very essential. A modern concept is health monitoring of a patient wirelessly. It is a major development in medical arena. Thus paper based on the monitoring of the patient that is done by the doctor continuously without actually visiting the patient. Health professionals have developed a brilliant and inexpensive health monitoring system for providing more comfortable living to the people suffering from various diseases using leading technologies like wireless communications, wearable and portable remote health monitoring device. As a result, visits of doctors to the patients constantly are decreased as the information regarding patient's health directly reaches to doctor's monitor screen from anywhere the patient resides. Also, based on this doctors can save many lives by imparting them a quick valuable service. In this, IoT is becoming a major platform for many services applications, also using Raspberry Pi not just as a sensor node but also a controller here. Paper propose a generic health monitoring system as a step forward to the progress made in this department till now.**

Keywords — Raspberry Pi, Pulse heart beat sensor, Body Temperature Sensor, Patient position sensor,Python GUI,VNC viewer,SQLite Database

I. INTRODUCTION

In current scenario on the earth, health related problems are increasing day to day . 151,600 people are dying per day. This graph can be reduced by modernization in the techniques used for patient monitoring. 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 [1]. 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 [2]. The Raspberry Pi which is a cheap, flexible, fully customized and programmable small computer board brings the advantages of a PC to the domain of sensor network [3]. In our system we are measuring patient's parameters (Body Temperature , Heart Rate, Pulse, etc) different available sensors. These sensors collected data i.e. bio- metric information is given to raspberry pi and then it is transferred to server. The data stored in a database and can be displayed in a website that can be accessed only by authorized personnel [4]. 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. PROPOSED SYSTEM

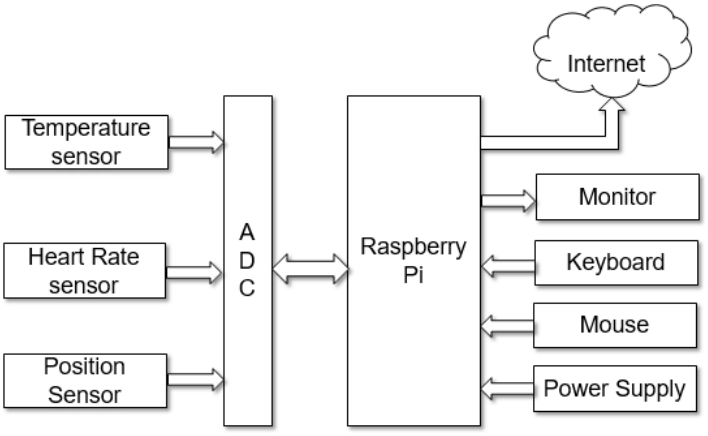

Fig. 1. Block diagram of Health Monitoring System using Raspberry Pi

A health monitoring system consists of several sensors connected to a patient and they communicate the data through the processing unit. In the project,Raspberry Pi is used as a data aggregator as well as a processor. The patient and doctor smartphone/ computer are used as a monitoring system. As in figure 1, the sensors system is used to obtain the information or readings from the patient and the reading which is read are converted into signals.Thsese Signals

These signals are provided for processing to Raspberry Pi, which is the IoT module. The Pi then displays the information on a Monitor and also stores the information over the cloud. This information can be accessed by the doctor on his phone/computer and get the information. If any emergencies, the patient is sent an alert automatically through the mail for medical medication.

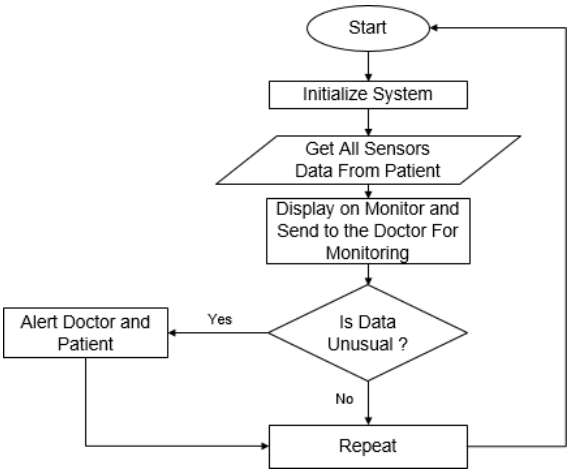

Fig. 2. Flow Diagram of Health Monitoring System using Raspberry Pi

The flow diagram of the project is shown in figure 2, the sensors value are read and displayed on the monitor and stored in the cloud for future use. If the data found to be Abnormal then the Alert is sent to the patient automatically ,to consult the doctor.

III. COMPONENTS USED IN IMPLEMENTATION

For implementing the Health Monitoring System, there is a need of essential components that are suitable and manipulate health problems. The components use generally includes Raspberry Pi Module , Body Temperature Sensor, Heart beat Sensor, Position Sensor.

A. Raspberry Pi

It is a powerful, low cost, and a small card sized device which is a perfect platform for interfacing with many devices. The board contains a processor, graphics chip, RAM memory, interfaces to other devices and connectors for external devices, of which some are necessary and some are optional. There are much versions of Raspberry Pi but the CPU (BCM2835) of all the models of Raspberry Pi remains same. The CPU is somewhat cheap, powerful and efficient and it does not consume a lot of power. It works in the same way as a standard PC requiring a keyboard for giving commands, a display unit and power supply. Here, in Raspberry Pi, SD card is used in the same way as the hard disc in the computer. The connectivity of raspberry pi to the internet may be via a LAN (Local Area Network) cable / Ethernet or via a USB modem. The main advantage of Raspberry Pi is that it has a large number of applications . It also has 4 pole stereo output and composite video port. Video processing applications are also possible using using raspberry pi like video compression. Compressed video can successfully decrease the bandwidth required to transmit the video through terrestrial broadcast, cable TV, or satellite TV services [19]. The Raspberry-Pi runs on Linux based OS, an open source operating system. In this system we used Raspbian OS which is Linux based OS. The programming language for the Raspberry-Pi for the system implementation is Python.

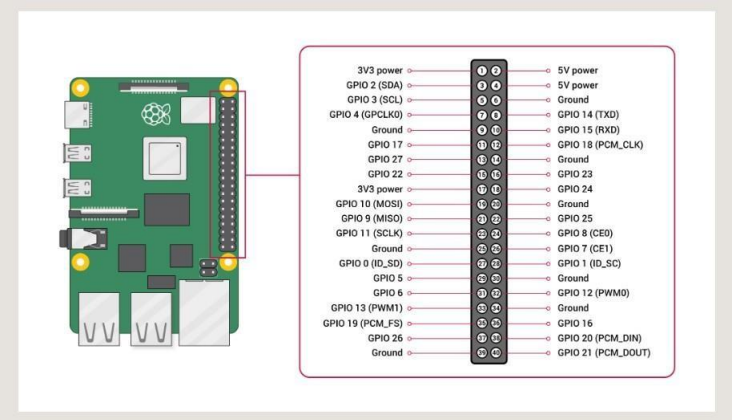

Fig. 3. Raspberry pi Pin diagram

B. Body Temperature Sensor-DS18B20

This is human body temperature sensor. It can be applied to the skin surface of your body and show the body temperature after reaching steady state. The sensor is accurate and stable and complies with medical certification. It can be used in many applications such as child incubators, patient monitoring, and medical research labs.

Normal	The average normal temperature is 37°C. But "normal" varies from person to person.
Abnormal	Oral, temporal artery temperature Fever: 38°C to 39.9°C High fever: 40°C and higher
	Armpit(auxiliary) temperature Fever: 37.4°C to 39.4°C High fever:39.5°C and higher
	A rectal or ear temperature of less than 36.1°C means a low body

Fig. 4. TABLE II. BODY TEMPERATURE [6]

The DS18B20 digital thermometer has 9-bit to 12-bit resolution of Celsius temperature measurements. The DS18B20 communicates over a 1-Wire bus that by definition needs just one data line (and ground) for communication with a central chip. In addition, the DS18B20 can take power directly from the data line, eliminating the need for an external power supply. Each DS18B20 has a unique 64-bit serial code, which allows multiple DS18B20s to function on the same 1-Wire bus. Thus, it is simple to use one microprocessor to control many sensors like temperature sen

DS18B20s distributed over a large area. A 64 bit ROM stores the device's unique serial code. This 64 bit address allows a micro-controller to receive temperature data from a virtually unlimited number of sensors at the same pin. The address gives instruction to the micro-controller which sensor a particular temperature value is coming from.

C. Heart Beat Pulse Sensor

Heart beat pulse rate data is very helpful if you are planning an exercise routine, studying your activity. The problem is that heart beat can be difficult to measure manually. Luckily, the Heart Beat Pulse Sensor can solve that problem. It can be used by athletes, gymnastics, students and mobile developers who want to easily incorporate live heart beat pulse rate sensor into their projects. It has a simple photo sensor with amplifier and unwanted noise remover circuitry making it fast and easy to get reliable pulse readings. Also, it uses less power with just 4mA current draw at 3.3V so it's great for mobile applications. Simply clip the Heart Beat Pulse Sensor to earlobe or fingertip and plug it into your 3 or 5.5 Volt Raspberry pi and you're ready to read heart rate! The 24" the Pulse Sensor cable is terminated with standard male headers so there is no soldering required. For most adults, normal heart rate is 60 to 80 BPM. Well-trained athletes can have a normal heart rate of 40 to 60 BPM.

Age Span	Heart Beat Pulse rate (BPM)
Less than 1 month	120-160
1-12 months	80-140
12 months – 2 years	80-130
2-6 years	75-120
6-12 years	75-110
More than 12 years	60-100

Fig. 5. TABLE I. HEART BEAT PULSE RATE OF AGE SPAN [7]

D. Patient Position Sensor-ADXL335

Body Position Sensor monitors the patient proper and wrong sleeping position. In many cases, it is necessary to monitor the body movements and positions made by patient because of their relationships to particular diseases. Analyzing movements during sleep also help in determining regular sleep quality and irregular sleeping patterns. The body position sensor could help also to detect fainting or falling of elderly people or persons with disabilities.

The accelerometer sensor ADXL335 used here is a full -3-axis accelerometer with small, thin, low power, signal outputs. This measures the full range of acceleration (3g). This sensor is able to find the gravitational fixedacceleration in various applications. The user sensor uses the X, Y and Z capacitors at XOUT, YOUT, and ZOUT pins. Bandwidths range from 0.5 Hz to 1600 Hz for X and Y axes, and range from 0.5 Hz to 550 Hz for Z Axis.

IV. TECHNOLOGIES USED IN IMPLEMENTATION

A. Python GUI

Python offers multiple options for developing GUI (Graphical User Interface). Out of all the GUI methods, tkinter is the most commonly used method. It is a standard Python interface to the Tk GUI toolkit shipped with Python. Python with tkinter is the fastest and easiest way to create the GUI applications. Creating a GUI using tkinter is an easy task.

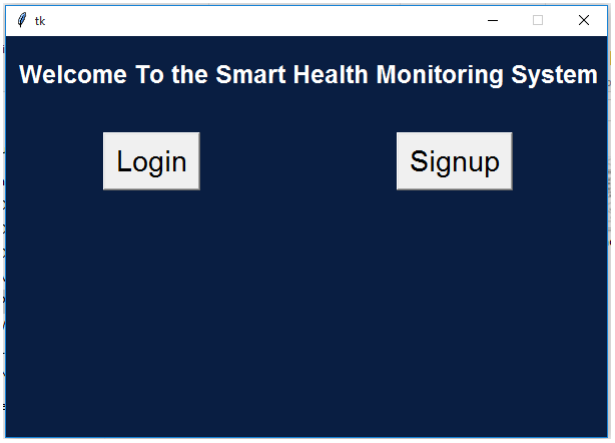

Fig. 6. Home Page

B. VNC Viewer

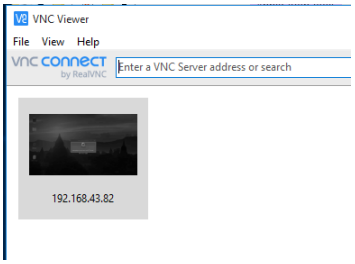

Fig. 7. Vnc viewer

VNC Viewer transmits the keyboard and either mouse or touch events to VNC Server, and receives updates to the screen in return. You will see the desktop of the Raspberry Pi inside a window on your computer or mobile device. You'll be able to control it as though you were working on the Raspberry Piitself.

Fig. 8. Rpi Desktop

C. SQLite Database

SQLite is a relational database management system (RDBMS) contained in a C library. In contrast to many other database management systems, SQLite is not a client–server database engine. Rather, it is embedded into the end program.

Fig. 9. sql database

V. SYSTEM PROCESSING

The system is classified into two parts, viz. Hardware Software; whereas hardware unit consists of transmitter section and receiver section and software unit consists of software languages like python, MATLAB, etc as well as their inter- facing. Here we discuss IoT applications that are useful to health monitoring.

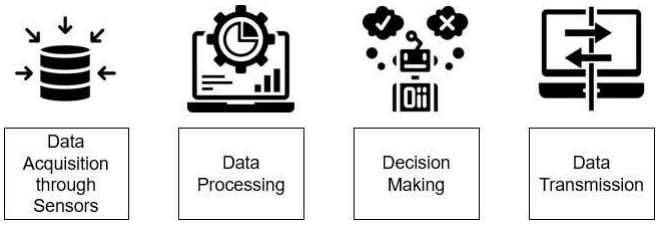

Fig. 10. Application stages

The general operation stages of an IoT application include
1. Data Acquisition
2. Data Processing
3. Data Storage and Decision Making
4. Data Transmission

The first and last stages exist on every application, while the processing and storage may or may not exist in some applications [10].

1. Data Acquisition

Data acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be manipulated by a computer.

The components of data acquisition systems include: Sensors-to convert physical parameters to electrical signals, Signal conditioning circuitry-to convert sensor signals into a form that can be converted to digital values.Analog-to-digital converters-to convert conditioned sensor signals to digital values. Data Acquisition is used as real-time raw data transmission and real time on-board process.[12]. This Unit Acquires All the Data from Patients using sensors.

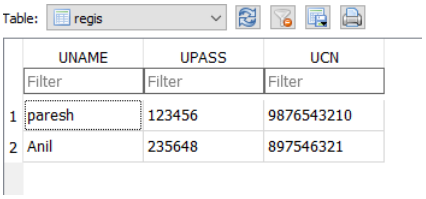

Fig. 11. User data

This Unit Acquires All the Data from Patients using Various sensors(Body temperature sensor,Pulse sensor,Positi on sen- sor).After Data Acquiring,this data sent to the Data Processing Unit.

2. Data Processing

Data processing is, generally, ”the collection and manipulation of items of data to produce meaningful information.”In this sense it can be considered a subset of information processing, ”the change (processing) of information in any manner detectable by an observer.”

This Unit takes the data from Data Acquisition Unit and Process the Data(Data Summarization , Data Analysis) and Makes the Report and sent it to the Decision Making Unit.

3. Data Storage and Decision Making

Data storage is the recording (storing) of information (data) in a storage medium. Data Storage Unit Stores All the data of patients Health. Decision Making takes the Report and Analyzes all the Data and based on that analysis it Make the Decision to sent Alert to the Doctor or not Depending upon Unusual conditions.

4. Data Transmission

Data transmission refers to the process of transferring data between two or more digital devices. Data is transmitted from one device to another in analog or digital format. Basically, data transmission enables devices or components within de- vices to speak to each other. This Unit Transmit all the Data and Report On the Server so that Doctor can easily Monitored a patient Based On that Doctor can give a Prescription to the patient.

VI. THE PROPOSED METHOD

As discussed in section III, system is divided into hardware and software section. Software is responsible for better working of the system, also for interfacing. Both sections work in parallel process. Hardware is again classified into transmitter section and receiver section. Implementation of transmitter is important part, because transmitter section is directly attached to the patient or human body.

Raspberry Pi is a master device in proposed system; all the other devices like different sensors are connected to it. A DC power supply of 5V is provided for working of raspberry pi.IoT server is attached to the system; it allows the connectivity for data exchange with other devices. IoT allows connected objects to identify and control remote access across network.

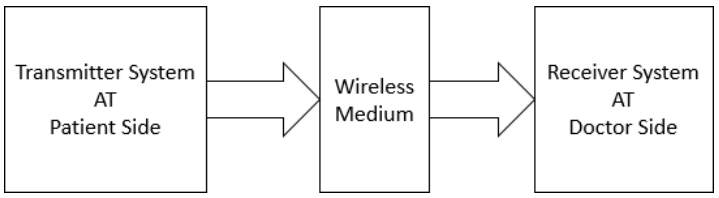

Fig. 12. Transmitter and Receiver system

The output of temperature sensor and heartbeat sensor is displayed on LCD at user end too. The output of ECG is sent to the receiver or doctor end. All the information is first acquired, processed and stored at memory of raspberry pi. The stored information is then transferred to the receiver by means of IoT server.

The Receiver section is present at doctor end. At receiver section, all the information is received. Monitor displays the result of each sensor which is attached to raspberry pi.

VII. SIMULATION RESULTS

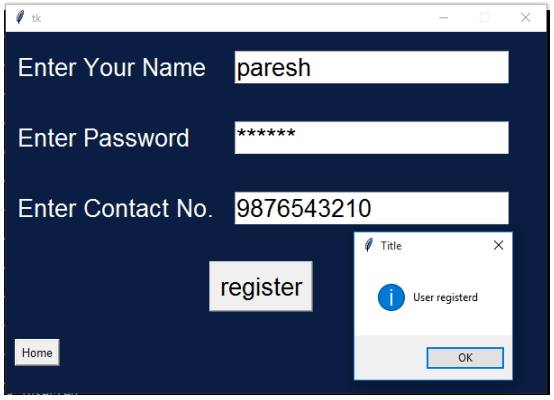

Fig. 13. sign-up page

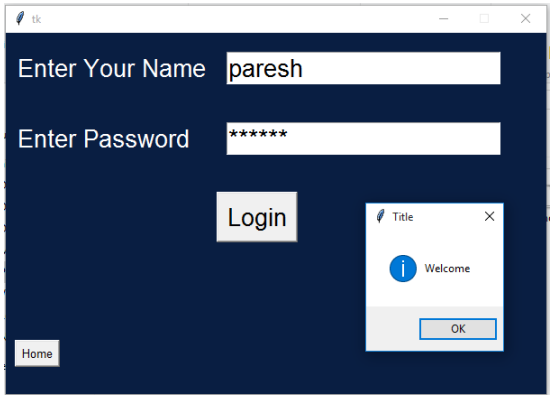

Fig. 14. login page

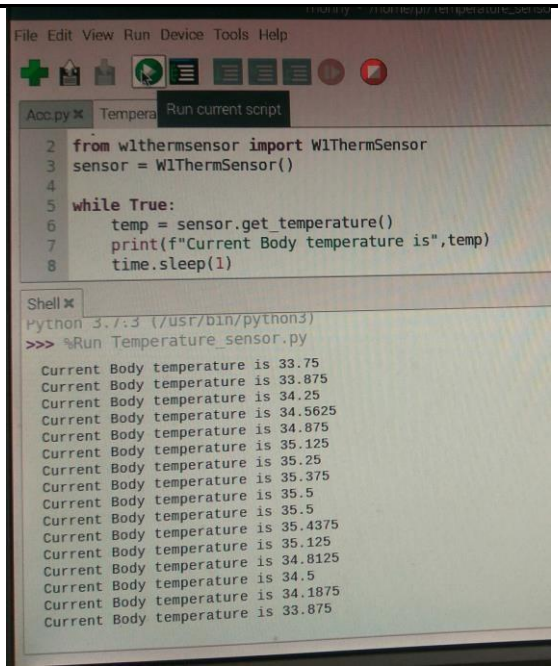

Fig. 15. Body Temperature

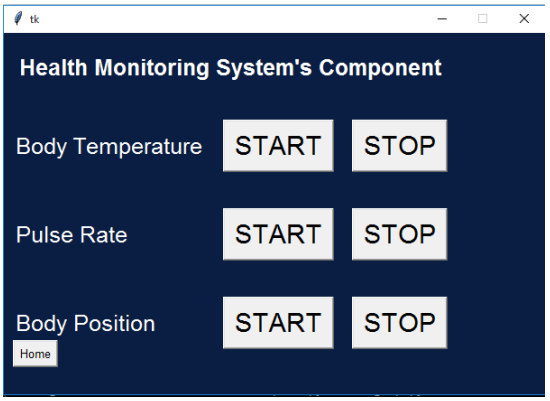

Fig. 16. Main page

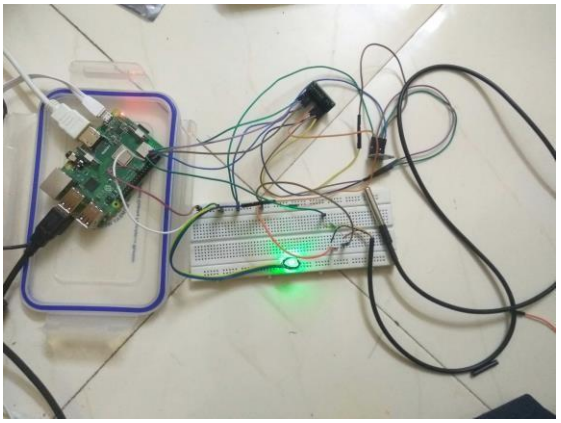

Fig. 17. System setup

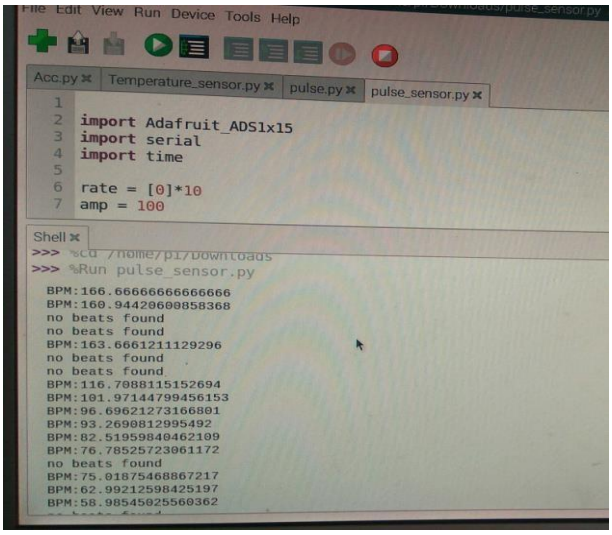

Fig. 18. Pulse rate

VIII. 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.

IX. FUTURE SCOPE

In the future add more parameters for monitoring patients health status. Add EEG, ECG and more parameters are added for monitoring patients' health status. Webcam is also possible to connect to the Raspberry Pi. After connecting the webcam to the Raspberry Pi anybody can monitor patient's directly anywhere in the world. Wifi adapter is also available for Raspberry Pi. So after connecting the wifi adapter it acts as a server. So within a small circle there is no extra internet connection for monitoring a patient's parameters. Switch on to wifi in your laptop, mobile phone and connect wifi internet from Raspberry Pi and monitor these values using the IP address.

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