International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

Raspberry Pi based Patient Health Monitoring System Using Android App

Prathiksha[1], Pratheeksha[2], Y.Srilikhitha[3] & Sushmitha[4]
[1,2,3,4] Visvesvaraya Technological University, Belgaum.

Abstract

Continuous Monitoring of Physiological parameter values such as Blood pressure, pulse rate, body temperature is essential for elderly and ill patients. There is a need for a Patient health monitoring system, when the patient is not in the Hospital. This system will enable the doctors and caretaker to monitor the patient health through an android app and take necessary action in case of emergency. In this paper, basic physiological parameter monitoring system based on Raspberry Pi microcontroller boards is implemented. The basic physiological parameters such as blood pressure, heartbeat, and body temperature and fall detection are measured using relevant sensors from the patient's body and sent to the Raspberry Pi.It is then send to the server and then can be accessed by the doctor and caretaker through android application. The measured physiological parameters values can be viewed from anywhere using an internet enabled device. When the value of the physiological parameters exceeds certain threshold, the notification is sent to doctor and caretaker. Also, a call to the ambulance is made using GSM modem so that the patient is immediately admitted in the nearby hospital. This system is helpful for elderly and ill patients.

Keywords

Physiological parameter monitoring; Sensors; Raspberry Pi; GSM Modem; java ; Python ;

1. Introduction

As the population increases, there is also an increase in the number of chronic and heart diseases. This portable system for continuous physiological parameter monitoring is essential for elderly and ill patients who are not in the hospital. Patient health monitoring system will enable the doctor and the caretaker to view patient's health status online so that necessary treatment can be given.

In this paper, a prototype of a patient health monitoring system is implemented that can measure basic physiological parameters such as blood pressure, pulse rate and body temperature. These parameters are uploaded on the server which is accessed by the doctor and caretaker using the android application so that they can monitor the patient online. The developed system is helpful for patients at home who need constant or periodical monitoring by the doctor or caretaker. When there is drastic change in physiological parameter value, a call to the ambulance is made using GSM modem so that the patient is immediately admitted in the nearby hospital .This would save the patient from future health problems which may arise and also save his life.

2. Basic physiological parameter

2.1. Blood pressure

Blood pressure (BP) is the pressure of circulating blood on the walls of blood vessels. Blood pressure is usually expressed in terms of the systolic pressure over diastolic pressure and is measured in millimeters of mercury (mmHg), above the surrounding atmospheric pressure .Blood pressure is one of the vital signs, along with respiratory rate, heart rate, oxygen saturation, and body temperature. Normal resting blood pressure in an adult is approximately 120 millimeters of mercury (16 kPa) systolic, and 80 millimeters of mercury (11 kPa) diastolic, abbreviated "120/80 mmHg. If blood pressure is above 140/90, it is known as hypertension. The early detection and control of hypertension can reduce risk of heart diseases and kidney failure.

2.2 Pulse Rate

Heart rate, also known as pulse, is the number of times a person's heart beats per minute. Normal range of heart rate for adults is 60 to 100 beats per minute, for adults 18 and older, a normal resting heart rate is between 60 and 100 beats per minute (bpm), depending on the person's physical condition and age Athletes and people who are very fit can have resting heat rate of 40 bpm. Heart rates lower than 60 doesn't

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

necessarily mean you have a medical problem. Irregular or rapid heartbeat shows cardiac abnormality. Dizziness, fainting, chest pain, or breathlessness can be correlated with affected pulse rate. Reduced pulse rate can also indicate a blocked blood vessel.

2.3 Body Temperature

Normal human body temperature is the typical temperature range found in humans. The normal human body temperature range is typically stated as 36.5–37.5 °C (97.7–99.5 °F). Body temperature higher than 37.8 °C is considered as fever.

3. Hardware description

In this paper, the blood pressure (systolic and diastolic BP), pulse rate, body temperature and fall detection are measured using relevant sensors. The measured values are sent to Raspberry Pi, which are then uploaded on the server along with the date and time stamp.

3.1 Block daigram of patient health monitoring system.

Figure 1 shows the block diagram of Patient Health Monitoring System. The BP and pulse rate module, Accelerometer, temperature sensor are connected to the raspberry Pi. These sensors measure the physiological signals from the patient and send the corresponding parameter values to Raspberry Pi. Raspberry Pi stores the readings received from sensors and uploads them on to the server along with date and time, which can be accessed using smart phone and also sends AT commands to GSM modem to send a predefined call and message along with location to ambulance in critical condition.

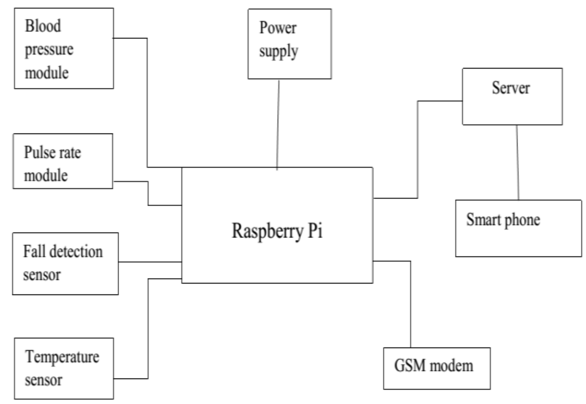

Fig 1: Block diagram of patient health monitoring system

3.2 Blood pressure sensor

The MPS-2000 features silicon pressure sensors in 6-pin dual in-line packages. Fig 2 shows blood pressure sensor. All parts in these series are uncompensated high-performance die mounted on a substrate with a plastic cap. Pins are designed for through-board assembly. The MPS-2000 is ideal for applications requiring low hysteresis, high reliability and stability. With constant voltage excitation, the MPS-2000 produces a voltage output that is linearly proportional to the input pressure. The user can provide MPS-2000 with signal conditioning circuitry to amplify the output signal or to maximize OEM value added. The MPS-2000 is compatible with most noncorrosive gases and dry air. All values are Minimum/Maximum and are measured at +5 VDC and 25°C.

Fig 2: Blood pressure MPS-2000

3.3 Pulse rate module

International Journal of Research
Available at https://edupediapublications.org/journals

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

Heart beat sensor is designed to give digital output of heat beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heartbeat. This digital output can be connected to microcontroller directly to measure the Beats per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse. It is Compact Size and the Working Voltage is +5V DC. The output is digital level at around 5V supply. The duration between pulses are used to calculate the heartbeat.

Fig 3: pulse rate sensor

3.4 Fall detection sensor

ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. The user selects the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for the X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis.

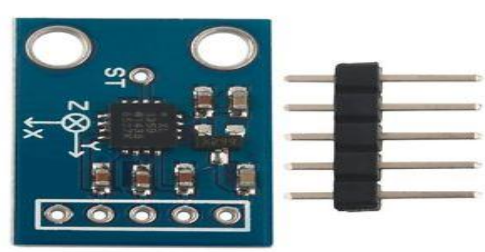

Fig 4: Accelerometer ADXL335

3.5 Temperature sensor

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range.

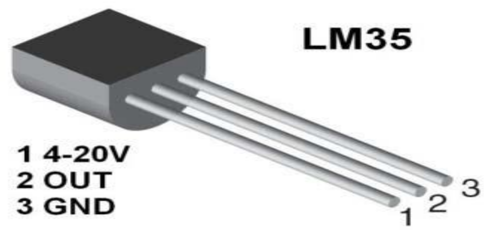

Fig 5:LM 35 temperature sensor

3.6 Raspberry Pi

The Raspberry Pi is a tiny and affordable computer that you can use to learn programming through fun, practical projects. This block diagram describes Model B and B+; Model A, A+, and the Pi Zero are similar, but lack the Ethernet and USB hub components. The Ethernet adapter is internally connected to an additional USB port. In Model A, A+, and the Pi Zero, the USB port is connected directly to the system on a chip (SoC). On the Pi 1 Model B+ and later models the USB/Ethernet chip contains a five-point USB hub, of which four ports are available, while the Pi 1 Model B only provides two. On the Pi Zero, the USB port is also connected directly to the SoC, but it uses a micro USB (OTG) port.

International Journal of Research
Available at https://edupediapublications.org/journals

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

Fig 6: Raspberry Pi model B+ microcontroller board

3.7 GSM modem

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates.

Fig 7:GSM modem

3.8. GPS module

A GPS navigation device, GPS receiver, or simply GPS is a device that is capable of receiving information from GPS satellites and then to calculate the device's geographical position. Using suitable software, the device may display the position on a map, and it may offer directions.

Fig 8: GPS tracker

4. Software description

4.1 Java

Java is a general-purpose computer-programming language that is concurrent, class-based, object-oriented,[15] and specifically designed to have as few implementation dependencies as possible. It is intended to let application developers "write once, run anywhere" (WORA), meaning that compiled Java code can run on all platforms that support Java without the need for recompilation. Java applications are typically compiled to bytecode that can run on any Java virtual machine (JVM) regardless of computer architecture.

4.2 Python Language

Python is a high-level and interpreted programming language. Python has a bulk of preceded libraries for more specific tasks. It is very portable and cross-platform compatible on UNIX, Windows and Macintosh. Python is fully supported programming language for Raspberry Pi.

4.3 ExtraPuTTY

Extra PuTTY is a software tool used to access Raspberry Pi wirelessly. PuTTY is a free and open-source terminal emulator; serial console and network file transfer application. It can support various network protocols such as SCP, Telnet, rlogin, and raw socket connection.

4.4 AT command

AT commands are instructions used to control a GSM modem. AT is the abbreviation of ATtention. Every command line starts with "AT" or "at". That's why modem commands are called AT commands. Many of the commands that are used to control wired dial-up modems, the starting "AT" is the prefix that

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

informs the modem about the start of a command line. It is not part of the AT command name.

5. System design and software flowchart

5.1 System architecture

The system architecture of patient health monitoring system is shown in Fig.9. It consists of Pulse rate module, fall detection sensor (ADXL35), Temperature sensor (LM35), Blood pressure sensor (MPS-2000). All these sensors are connected to the Raspberry Pi which runs at a power supply of +5V. These sensors measure the physiological parameters from the patient and send it to the Raspberry Pi. These data are sent to Raspberry Pi at an interval of 60 s. Using a python coded program, we initialize the serial ports of Raspberry Pi and set baud rate to 9600 bits/sec for serial communication with GSM. The Raspberry Pi stores the readings of the physiological parameter values and it also uploads them to the server database, which can be accessed by doctor and caretaker by giving IP address of Raspberry Pi. The doctor and caretaker can view the patient using an android application. When the physiological parameter value exceeds threshold a notification is send to doctor and caretaker .This helps to take appropriate action at that instant of time, and would save the patient from future health problems. . If there is any drastic change in physiological parameter value or if the patient has fallen, then Raspberry Pi sends AT commands to GSM modem for sending a SMS alert along with the location of the patient and predefined call to the ambulance.

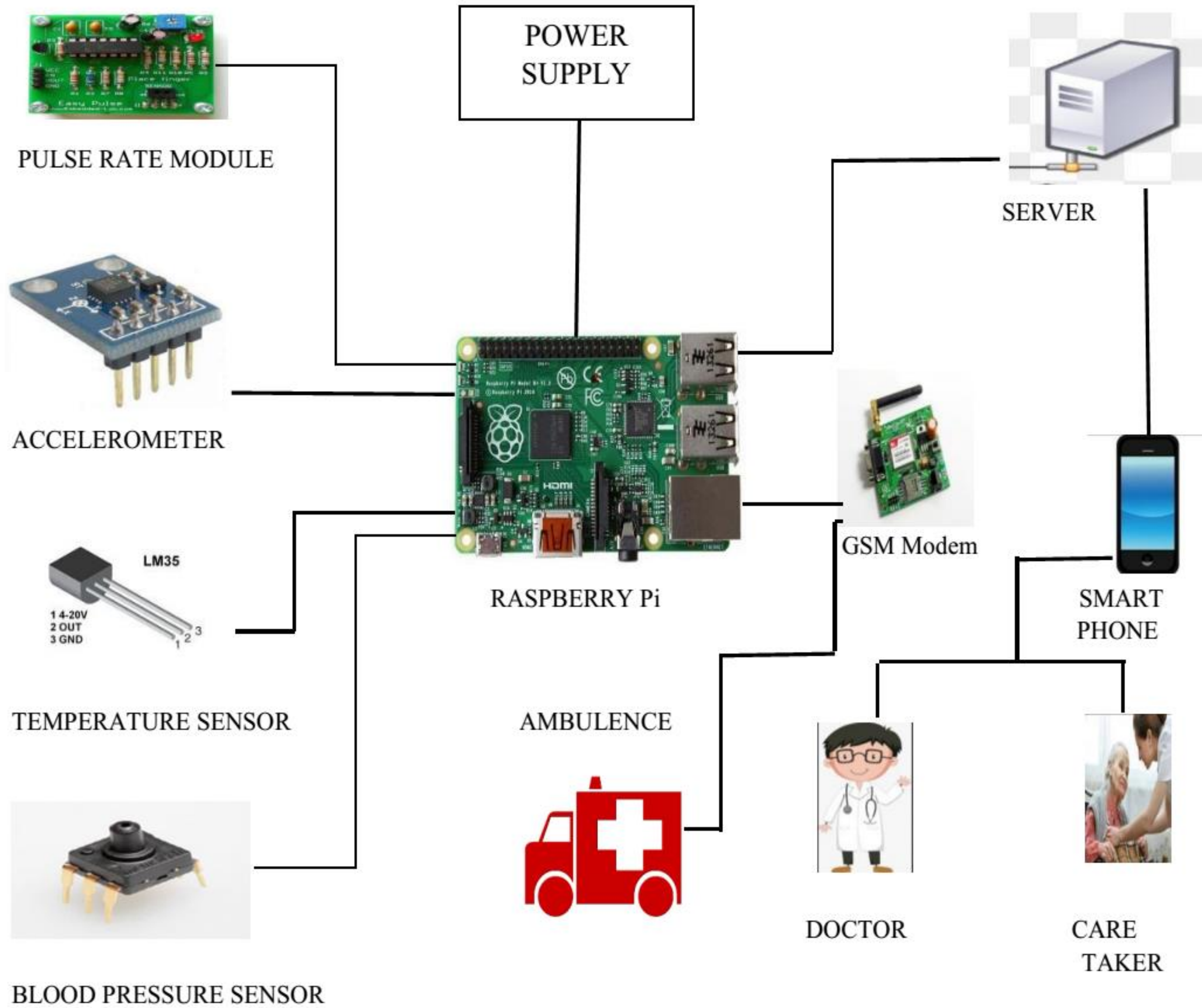

Fig 9: system architecture of patient health monitoring system

5.2 Software flowchart

Fig.10 shows the flowchart of patient where the sensors are used to measure the physiological parameter from the patient which are uploaded to the server. If the physiological parameter values exceeds threshold then notification is sent to caretaker and doctor and predefined call and message will be sent to ambulance. The patient information and values measured by sensor are stored in database. Fig.11 shows the flowchart of doctor where doctor first has to register to the health monitoring system application. He has to enter his username and password to login. If it is valid he can add patient, view patient and receive notification about the patient.Fig.12 shows the flowchart of caretaker. This flowchart is similar to that of the doctor but caretaker does not have authorization to add patient.

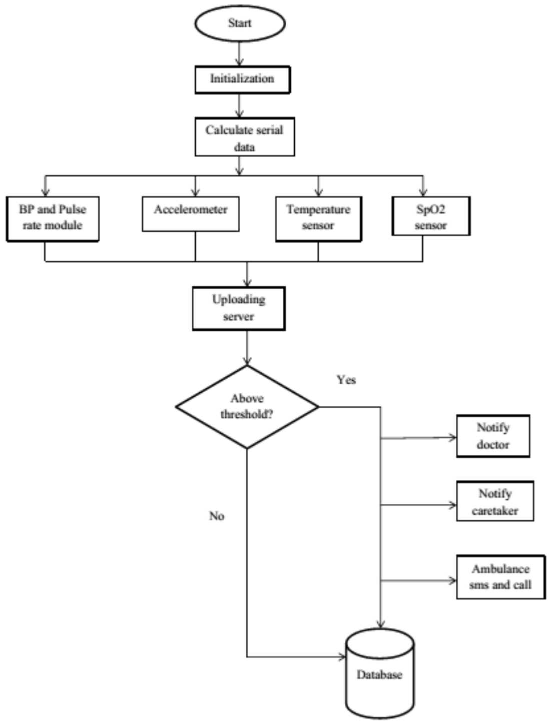

Fig 10: Flowchart of patient

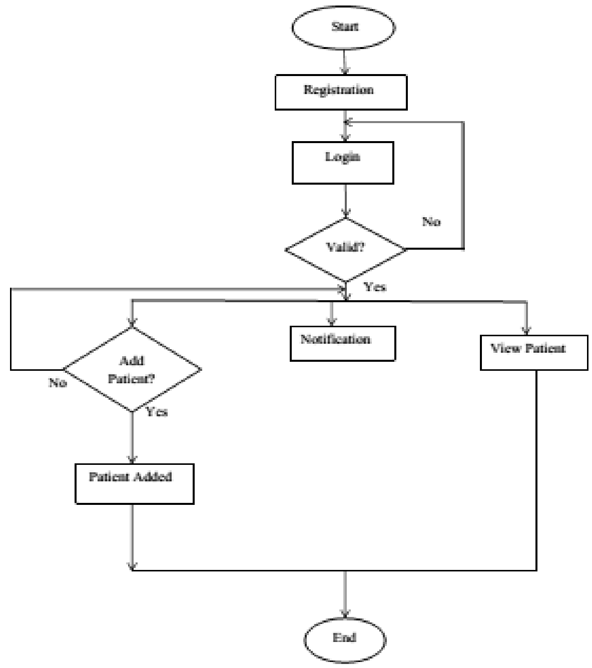

Fig 11: Flowchart of doctor

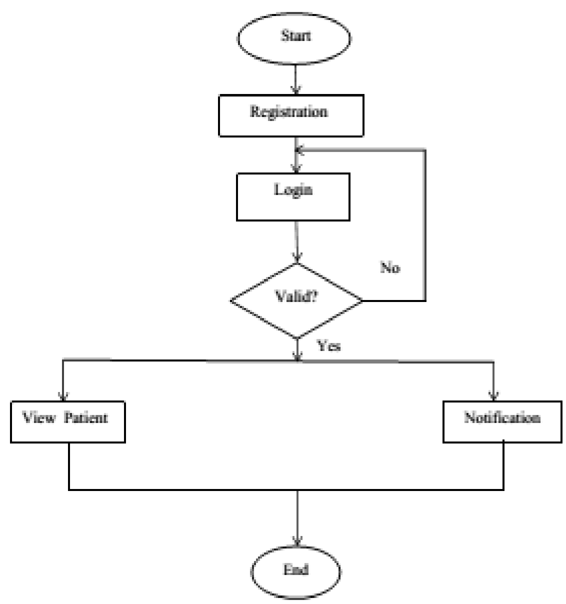

Fig 12: Flowchart of caretaker

6. Result and discussion

The below figures shows the screenshots of health monitoring system application. The patient and caretaker has to register to this application to access information about the patient. To login to the application the doctor and caretaker has to enter their contact number and password and select if they are doctor or caretaker as shown in fig.13.

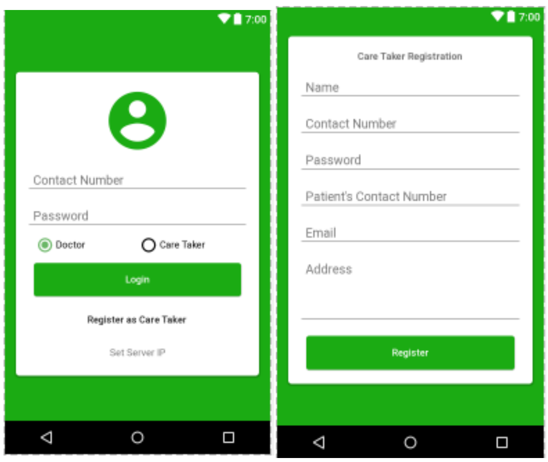

Fig 13: Login page and registration page for caretaker

The dashboard of doctor and caretaker is shown in fig: 14. The doctor has option of adding the patient and viewing the patient whereas caretaker can only view the patient. Fig 15 shows how the doctor can add the patient and the patient information page gives details like his name address and phone number .The doctor and caretaker can view patient's current reading and history reading. Fig 16 shows the screenshot of Physiological parameter values and summary of current reading

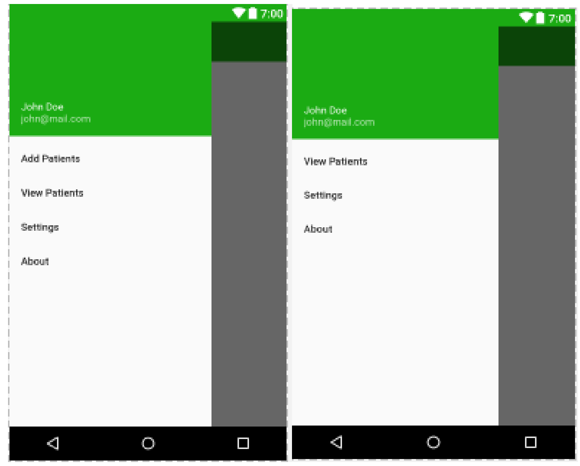

Fig 14: Dashboards of doctor and caretaker

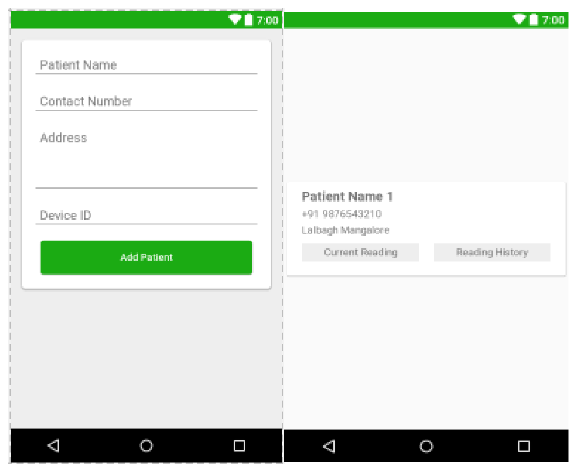

Fig 15: screenshot to add patient and patient information page

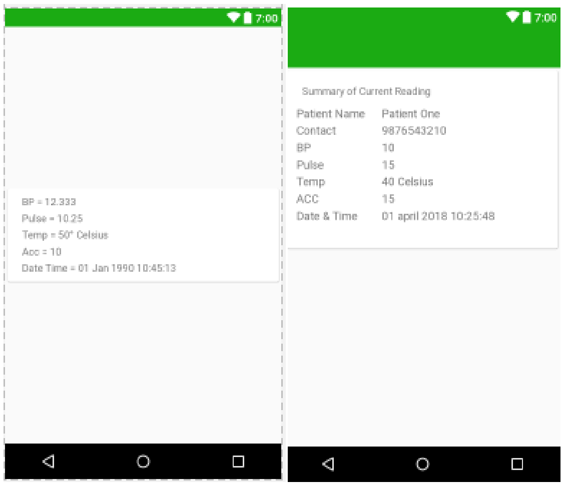

Fig 16: Physiological parameter values and summary of current reading

7. Conclusions

In this paper, implementation details of an automatic physiological parameter monitoring system using Raspberry P1 are presented. The physiological parameters of the patient are Updated every 60 s on the server database. Also, when the value of the physiological parameters exceeds certain threshold, the doctor/caretaker is alerted with notification. When there is drastic change in physiological parameter value, a call to the Ambulance is made using GSM modem so that the patient is immediately admitted in the nearby hospital. This system is useful for monitoring the health status of elderly and ill patients who are not able to visit hospital daily and require assistance in critical conditions.

8. References

[1]Dhiraj sunehra, Pini Ramakrishna, "Web Based Patient Health Monitoring System using Raspberry Pi"

[2] Ling, TH.Y., Wong, LL, Tan, J.E.H., Lee, CK, "XBee Wireless Blood Pressure Monitoring System with Microsoft Visual Studio Computer Interfacing", 6" Int. Conf. on Intelligent Systems, Modeling and Simulation (ISMS), 9~12 Feb. 2015, IEEE, pp.5-9.

[3] Gerard J. Tortora, Bryan H. Derrickson, "Principles of Anatomy and Physiology", Wiley, 2014. '

[4] Webster, J.G., "Design of Pulse Oximeters", CRC liress, 1997.

[5] Website I: http://wwwsunrom.com/p/blood-pressure-sensor~seria1output. . .

[6] Texas Instruments Inc., "LM35 Precision Centigrade Temperature Sensors Data sheet", Aug. 2016 (www.ti.com).