Secured Monitoring and Tracking of Patient Health Using IOT

Thamilselvi.S.S [1],
Associate Professor
Department of ECE,
K.S.Rangasamy College of Technology,
sstamilselvi@ksrct.ac.in

Savitha.M [2], Sowmiya.K [3],
Swetha.S [4]
Department of ECE,
K.S.Rangasamy College of Technology,
sowmiyasmart218@gmail.com

Abstract-- In this project, various parameters of the patient is monitored using internet of things. In the   patient monitoring system, the real-time parameters of patient's health are sending to cloud using internet connectivity. These parameters are send to a remote internet location so that user can view these details from anywhere in the world. Here, arduino is used as a gateway to communicate to the various sensors such as heartbeat sensor, temperature sensor and pressure sensor. The arduino picks up the sensor data and sends   it to the network through IOT module and hence provides real time monitoring of the healthcare parameter for doctors. The data can be accessed anytime by the doctor. The arduino is also connected with buzzer to alert the caretaker about variation in sensor output and gives an alert message to the doctor's mobile using GSM. The position of patient is also tracked using GPS.

Index Terms— Arduino, Adafruit IO cloud, GSM, GPS, Heartbeat sensor, Internet of Things, IOT   module, MQTT protocol, Pressure sensor, Temperature sensor

1 INTRODUCTION

HEALTH monitoring system has rapidly evolved during   the past two decades and has the potential to change the way healthcare is currently delivered. Smart health monitoring system automates patient monitoring tasks and thereby improves the patient workflow management, their efficiency in clinical settings. In the recent years the emergence of wireless sensor significantly increased mainly in the areas like remote health monitoring, medical data access and communication with the caregivers in emergency situations. Using Wireless Sensor Network (WSN), a simple but efficient system to monitor the conditions of patient continuously can be easily designed.

Patients can be tracked and monitored in emergency conditions at their homes, hospital rooms and also in Intensive Care Units (ICUs). The mobile device has a convenient resource to keep the information about daily care of an individual at all times. The smart phone, in particular, is a device that has a wide variety of apps that can be used for health related purposes.

Technology plays a major role in healthcare not only for sensory devices but also in communication, recording and display device. It is very important to monitor various medical parameters and post operational days. Hence the latest trend in healthcare communication method using IOT is adapted. Internet of Things serves as a catalyst for the healthcare and plays prominent role in wide range of healthcare applications. In this project arduino picks up the sensor data and sends it to the network through IOT module and hence provides real time monitoring of healthcare parameters for doctors. The data can be accessed anytime by the doctor. The arduino is also connected with buzzer to alert the caretaker about variation in sensor output and gives an alert message about the temperature, heartbeat pressure and position of the patient to the doctor's mobile using GSM and GPS. But the major issue in remote patient monitoring system is that the data as to be securely transmitted to the destination end and provision is made to allow only authorized user to access the data. It can be achieved by creating a username and password for the doctor/caretaker to access the patient's detail in the webpage.

2 PROBLEM DEFINITION

In today's social insurance framework for patients who stays in home during post operational days checking is done either via overseer/ medical caretaker. Ceaseless

observing may not be accomplished by this system, on the grounds that anything can change in well being parameter inside of part of seconds amid that time is guardian/ attendant is not in the premises causes more noteworthy harm. So with this innovation created period where web administers the world gives a thought to add to another keen health awareness framework where time to time constant checking of the patient is accomplished.

3 PROPOSED SYSTEM

The main use of this project in healthcare is to protect the patients at the time of extremity and reduces the number of visits to the hospital and the cost of healthcare. The proposed system is designed to monitor the patient in any place. The system would constantly monitor temperature, heartbeat, pressure and compare it against a predetermined value set and if these values cross a particular limit it would automatically alert the caretaker through an alarm and send message to doctor using GSM modem and the position is also tracked using GPS. The major issue of healthcare monitoring system is security. It can be established by username and password concept. The major goal is to build a pervasive healthcare system using the mobile internet technology, cloud computing and sensor technology based on smart devices which can provide healthcare services to customers anywhere, anytime.

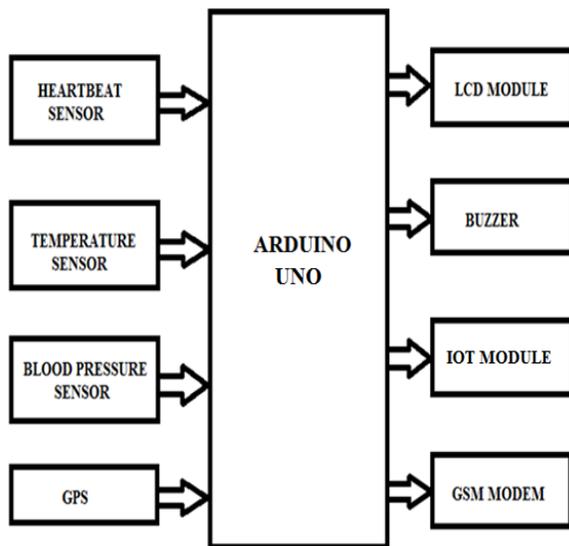The proposed diagram is the block diagram of secured monitoring and tracking of patient health using IOT.

Figure 3(a) : Block diagram of secured monitoring and tracking of patient health using IOT

IOT patient monitoring system has 3 sensors. First one is a temperature sensor, second is a heartbeat sensor and

the third one is blood pressure sensor. The arduino UNO board continuously reads input from 3 sensors and sends this data to the cloud by sending this data to a particular website through IOT module. This process is repeated after a particular interval of time. It is very useful since the doctor can monitor patient health parameters just by visiting a website. So now the doctor or family members can monitor or track the patient health. The security issue is been addressed by logging into the website using username and password. At the time of extremity situation alert message is send to the caretaker's or doctor's mobile using GSM and also the position of patient is tracked using GPS module connected to arduino. This GPS module will find out the position or location of the patient using the latitude and longitude received. Then doctors can find out the position of the patient in case they have to take some preventive action. If the alert message is not viewed by the doctor, then it is sent to some other higher authorities.

The GSM modem connected to arduino which provide information to doctor's/caretaker's mobile when the temperature is greater than 102 degree Fahrenheit or less than 97 degree Fahrenheit and when the pressure is less than 120 over 80 mmHg or less than 140 over 90 mmHg and when the heart rate is less than 60 bpm or more than 100 bpm. During this time the buzzer turns on and alerts the doctor/caretaker. LCD is connected to arduino to display the transaction process and healthcare data. Hence continuous monitoring of patient data is achieved.

4 IMPLEMENTATION METHODOLOGY

4.1 HARDWARE DESCRIPTION
4.1.1 Arduino UNO
The Arduino UNO SMD is a version of the Arduino UNO, but uses a surface mount version of the Atmega328P instead of the through-hole version. The ATmega3 has 32KB of flash memory, 2KB of SRAM and 1KB of EEPROM.

It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller. Simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

In this project arduino UNO is used as a gateway to communicate to the various sensors such as temperature sensor, heartbeat sensor and pressure sensor. The arduino picks up the sensor data and sends it to the network through IOT module and hence provides real time monitoring of the healthcare parameters for doctors.

4.1.2 16x2 Liquid Crystal Display (LCD)

Liquid Crystal Display is a important device in embedded system. Now a day it is very common for screen industry to use LCD instead of cathode ray tubes (CRT). LCD is connected to arduino to display the transaction process and healthcare data.

4.1.3 LM35 Temperature Sensor

Temperature sensor is used to measure temperature with an electrical output proportional to the temperature. Temperature sensor module is based on the semiconductor LM35 temperature sensor. The LM35 linear temperature sensor module can be used to detect ambient air temperature. This sensor is produced by National Semiconductor Corporation and offers a functional range of -40 degree Celsius to 150 degree Celsius. It is used to measure skin surface temperature as it is more accurate than a thermistor.

4.1.4 Blood Pressure Sensor

Blood Pressure is the pressure of the blood in the arteries as it is pumped around the body by the heart. When heart beats, it contracts and pushes blood through the arteries to the rest of the body. This force creates pressure on the arteries. Blood pressure is recorded as two numbers-the systolic pressure (as the heart beats) over the diastolic pressure (as the heart relaxes between beats). Blood pressure sensor is used to measure systolic diastolic pressure.

4.1.5 Heartbeat Sensor

Heartbeat Sensor is an electronic device that is used to measure the heart rate i.e. speed of the heartbeat. The heartbeat is measured in beats per minute or bpm, which indicates the number of times the heart is contracting or expanding in a minute. The change in the volume of blood in an organ is measured by the changes in the intensity of the light passing through that organ. In this project AccuSure TS, Automatic Blood Pressure Monitor is used to measure the blood pressure and heartbeat of the patient. This device gives accurate reading. It is more easy to use and has 60 memory positions which help in better monitoring of blood pressure and heartbeat.

4.1.6 GSM Modem

GSM (Global System for Mobile communication) is a digital mobile telephony system. It operates either at 900 MHz or 1800 MHz frequency band. The digital system has an ability to carry 64 Kbps to 120 Mbps of data rates. A GSM modem requires a SIM card to be operated over a network range subscribed by the network operator. It can be connected to a computer through serial, USB or Bluetooth connection.

The GSM modem is used for sending and receiving the messages from patient to the doctor and vice versa. Whenever the temperature, heartbeat and blood pressure exceeds the threshold value, arduino UNO automatically sends the signals to the GSM modem. Through the GSM modem the message will be concerned to the person or the doctor. The status of the GSM modem, as well as temperature, pressure and heart rate is continuously displayed using the LCD display.

4.1.7 GPS

The Global Positioning System (GPS) is a satellite-based navigation system made up of at least 24 satellites. GPS is a device that is capable of receiving information from GPS satellites and then to calculate the device's geographical position. GPS works in any weather conditions, anywhere in the world, 24 hours a day, with no subscription fees or setup charges. The GPS modem sends the latitude and longitude position with link pattern with the help of that SMS can track the current position of the patient. The system is very helpful for getting health status information of patient and providing them instant help.

4.1.8 IOT MODULE (ESP8266)

ESP8266 offers a self-standing Wi-Fi networking with TCP/IP protocol stack which can give Wi-Fi connection to any microcontroller. ESP8266 when connected on-board it has storage and processing capabilities hence can be easily connected to the sensors based on the application. This module provides Wi-Fi connection to arduino to send the sensor data to cloud for the real time access of healthcare parameters.

4.2 SOFTWARE DESCRIPTION

4.2.1 Arduino IDE

Arduino consists of both a physical programmable circuit board and a piece of software or IDE that runs on computer, used to write and upload computer code to the physical board. It runs on windows, Mac OS X and Linux. In fact the arduino language is merely asset of c/c++ function. It provides comprehensive facilities to computer programmers for software development. This software is used to upload the sensor program to the arduino UNO board.

4.2.2 Adafruit IO

MQTT or Message Queue Telemetry Transport is a protocol for device communication that Adafruit IO supports. MQTT protocol is a message based protocol, extremely light weight and for this reason, it is adopted in IOT ecosystem. This protocol uses publish-subscribe paradigm. The key component in MQTT is the MQTT broker which receives messages from publisher and

dispatches these messages to the subscribers. While it dispatches messages, the MQTT broker uses the topic to filter the client that will receive the message. A topic is a virtual channel that connects a publisher to its subscriber. Adafruit IO that allows us to control the healthcare system anywhere in the world. To use Adafruit IO with the MQTT protocol on an arduino uses the Adafruit MQTT arduino library. This general purpose MQTT library for arduino is built to use as few resources as possible so that it can work with platforms like the arduino UNO. This protocol is used to upload the sensor data to the cloud for the reference of patient's detail.

5 RESULT
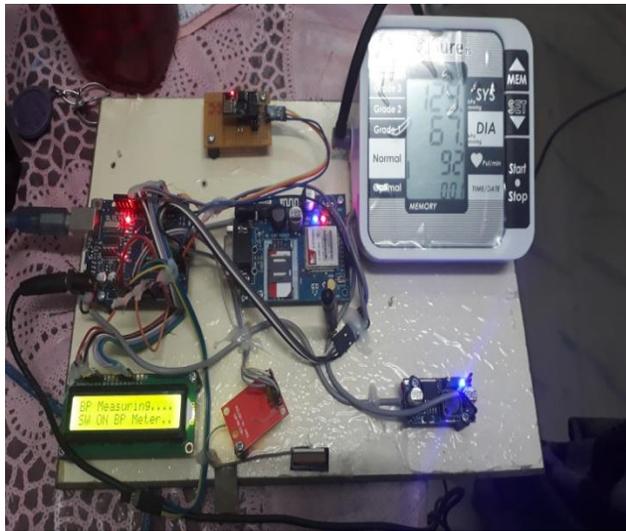
Figure 5(a): Output of temperature sensor, pressure sensor and heartbeat sensor

Following process goes on step by step when hardware is powered.

Step 1: When the power supply is ON, LCD displays the message "Health Care System".

Step 2: Then, LCD displays the message "Waiting for GSM". After the GSM connection LCD displays the message "Waiting for GPS" for GPS connection. After GSM and GPS starts working, it involves in the further process.

Step 3: Then LCD displays the previously measured temperature, pressure and heartbeat. LM35 measure the current temperature. Then, LCD displays "Switch ON Pressure Meter" to measure the current pressure and heart beat of a person.

Step 4: After measuring, it displays the current values of temperature, pressure and heartbeat in the LCD.

Step 5: The measurement of temperature, pressure and heartbeat is continued until the power is switched OFF.

Step 6: The measured sensor values are send to cloud using ESP8266 IOT module through MQTT protocol.

Step 7: Hence, doctor can view the patient's detail and location of the patient in the Adafruit.io cloud for real time patient monitoring.
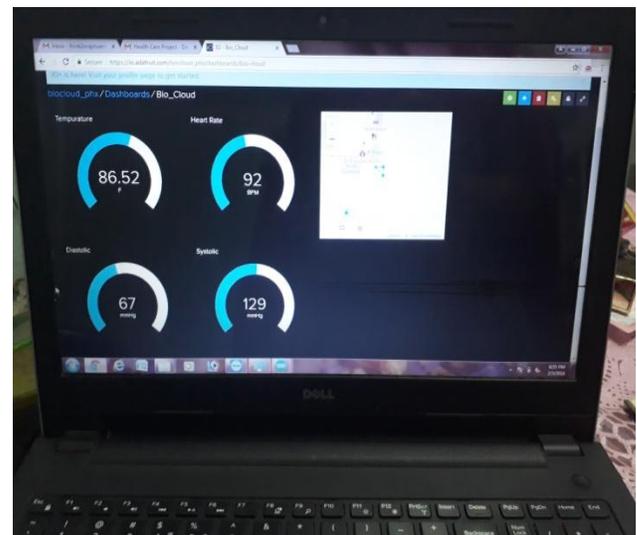
Figure 5(b): Adafruit.io webpage displaying patient data

6 CONCLUSION AND FUTURE WORK

The increased prominence of the use of technology in the health care arena poses predictable challenges for many lay users, especially people with low health literacy, cognitive impairment, or limited technology experience. The temperature, heartbeat and pressure sensors connected to the arduino which collects the data from the sensors for analysis, sends the data to the cloud for real time patient monitoring. IOT is a technology that is having major impacts in many different domains. Healthcare will be greatly benefited from this technique in the future. With the wide use of internet this work is focused to implement the internet technology to establish a system which would communicate through internet for better health. The future work of proposed system is when the output of three sensors from the

arduino is abnormal it gives an alert message to the doctor/caretaker's mobile phone through GSM about the abnormal range of temperature, heartbeat and pressure along with the latitude and longitude of the patient through GPS module.

7 ACKNOWLEDGEMENT

8 REFERENCE

[1] Mrs. Boomika.B.K, Dr. K.N Muralidhara (2015) "Secured Smart Healthcare Monitoring System based on IOT", Proceedings of International Journal on Recent and Innovation Trends in Computing and Communication, Volume: 3 Issue: 7 ISSN : 2321-8169 4958-4961, July 2015.

[2] Mr. Sunil L. Rahane, Prof. Ramesh S. Pawase (2015) " Wireless Sensor Network with GSM Modem for Healthcare Monitoring System", Proceedings of International Advanced Research Journal in Science, Engineering and Technology, Vol. 2, Issue 11, November 2015.

[3] Alex Page, Tolga Soyata, Gaurav Sharma, Mehmet Aktas (2014) " Reliable Transmission Protocol for GSM and http based on Wireless Patient Monitoring", Proceedings of International Journal of Advance Engineering and Research Development, Volume 1, Issue 12, December-2014.

[4] Sara Amendola, Rossella Lodato, Sabina Manzari (2014) " RFID Technology for IOT-based Personal Healthcare in Smart Spaces", Proceedings of IEEE Internet of Things Journal, VOL. 1, NO. 2, APRIL 2014.

[5] Sultan H. AlMotiri, Murtaza A. Khan, Mohammed A. AlGhamdi (2016) " Mobile Health (m-health) System in the context of IOT", Proceedings of 4th International Conference on Future Internet of Things and Cloud Workshops.

[6] Gao Zhiqiang, He LIngsong, Tian Hang (2015) "A Cloud Computing based Mobile Healthcare Service System", Proceedings of IEEE 3rd International Conference on Smart Instrumentation, Measurement and Application (ICSIMA).

[7] Moeen Hassanalieragh, Alex Page, Tolga Soyata (2015) "Health Monitoring and Management using Internet-of-Things (IOT) sensing with Cloud-based Processing: Opportunities and Challenges", Proceedings of IEEE International Conference on Services Computing.

[8] Suleman Awan, M.Ali Rafique (2014) "MCPSC: Memory Conservation Protocol for Secure Communication in Wireless Sensor Networks", Proceedings of ISBN: 978-1-4799-5754-5/14/$26.00 ©2014 IEEE.

[9] Chen Kan, Yun Chen, Fabio Leonelli and Hui Yang (2015) "Mobile Sensing and Network Analytics for Realizing Smart Automated Systems towards Health Internet of Things", Proceedings of IEEE International Conference on Automation Science and Engineering (CASE).

[10] Junaid Mohammed, Abhinav Thakral and Colin Jones (2014) "Remote Patient Monitoring Using Web Services and Cloud Computing", Proceedings of IEEE International Conference on Internet of Things (iThings 2014).

[11] Anup.B.Goutham, Manjunath Iyer B.s, Rajiv R (2010) "Patient Data Management System- Periodic Model using GSM", Proceedings of 978-1-4244-7571-1/10/$26.00 ©2010 IEEE.