IoT based Patient Health Monitoring System

Ms. Prachi Patil
(Author)
Dept. Instrumentation Engineering
Vidyavardhini's college of Engineering and Technology
Mumbai, India

Mr. Swapnil Patil
(Author)
Dept. Instrumentation Engineering
Vidyavardhini's college of Engineering and Technology
Mumbai, India

Mr. Gaurav Parab
(Author)
Dept. Instrumentation Engineering
Vidyavardhini's college of Engineering and Technology
Mumbai, India

Ms. Mugdha Salvi
(Guide)
Dept. Instrumentation Engineering
Vidyavardhini's college of Engineering and Technology
Mumbai, India

Mr. Ananthu Nair
(Author)
Dept. Instrumentation Engineering
Vidyavardhini's college of Engineering and Technology
Mumbai, India

***Abstract*— In today's era, there are many cities which are working on transforming themselves into smarter cities. If the city is going to be known as Smart City, then it should have all the possible advancements in the sector of smart technology. Improving efficiency in the healthcare sector is one of the difficult and most challenging jobs. That includes various aspects such as getting an ambulance within a minimum amount of time, providing proper treatment to the patient in time so that the chance of surviving increases in critical condition. The idea here is to provide an intelligent smart health monitoring system using some sensors and ATmega328P. The system aim is to design a device in which sensors will sense the heartbeat, blood pressure, glucose level and oxygen-level with pictorial representation of the human body. After sensing, sensors will send respective data to the ATmega328P. After that ATmega328P will analyze and sent it to the internet or IoT cloud thought to get the way. In the collaborated hospital the patient's data will be sent through the internet. In the hospital, the respective doctor will continuously monitor the patient's health system. It is very advantageous as the amount of time taken to get patients medical record gets decreased and the patient's data and all history can be accessed by the doctor before the patient reaches the hospital. Sending the patient's health information to the hospitals helps the hospital staff to get things ready required for the treatment.**

Keywords—*Glucometer, Blood pressure, AD8232, Pulse Oximeter, Temperature, ECG module, ESP8266 Wi-Fi module, API key, Thingspeak cloud.*

I. INTRODUCTION

The main purpose is to design communication between the staff of the ambulance and the monitoring station i.e. hospital. The requirement can be achieved by using the system in the ambulance which uniquely transmits the status of patients i.e. heart rate, blood pressure, glucose level and oxygen level.

The embedded technology in the objects helps to interact with the internal system or the external environment, which affects the decisions. Internet of Things can connect devices embedded in various systems through the internet. When devices can represent themselves in the digital world, they can be controlled from anywhere. The connectivity then helps us to capture several data from more places. Using the IoT cloud data of the several parameters measured are transmitted to the collaborating hospital.

II. LITERATURE SURVEY

Ananda Mohan Ghosh et al. [1] has proposed a health monitoring system for managing the hospital to allow family members and consultant doctors to remotely monitoring the patient's health condition through the internet with E-health sensor shield kit interface kit. But it does not send any notification such as email and SMS alert to the respective family members and doctors.

P Kumar et al. [2] has proposed a patient monitoring healthcare system which is controlled by a raspberry pi such as the heartbeat rate, respiration level, and temperature and body movement of the patient is monitored and data is collected by using sensors and displayed it on the screen using the putty software. However, it does not provide the alarm notification for insisting the family members or doctors give the prescribed drugs to the patient which is included in our proposed solution.

Sarfraz Fayaz Khan [3] has demonstrated a useful patient's healthcare monitoring system with the help of IoT and RFID tags. But, it does not contain preventive measures concerning the patient health condition by controlling the appliances and providing the prescribed drugs to the patient which is included in our paper.

Freddy Jimenez et al. [4] have considered only on monitoring the patient's health condition and sending the necessary information and notification to doctors, family members. Moreover, it does not contain the appliance control, which is included in our project; it only focused on Monitoring and provides notification to the respective people on time.

S. Siva [5] et al. has demonstrated to monitor a patient's health condition by using the smart hospital system. The health condition of the patients can be monitored by using the spark kit. It gathers information about the temperature and heartbeat rate of the patient and sent an alert notification if any of the obtained parameters crosses the predefined threshold value.

III. METHODOLOGY

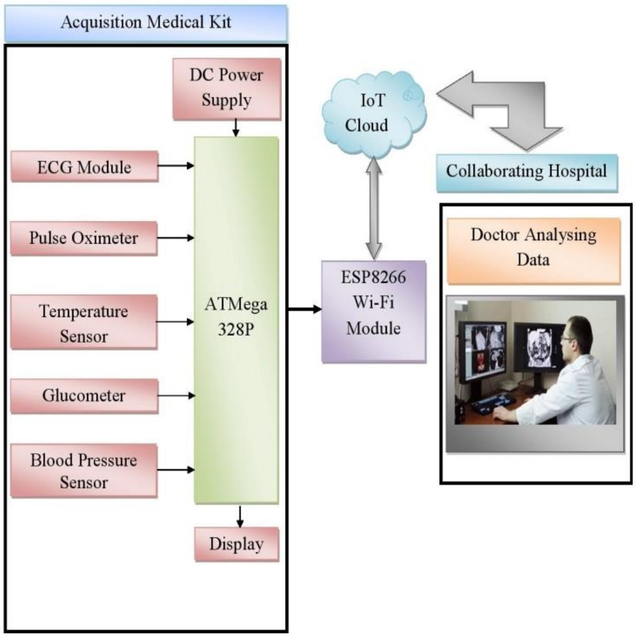

Fig.1. Block Diagram of Smart Ambulance Medi-kit

Our proposed solution is divided into three basic parts

1. *Sensor Modules*
2. *Microcontroller and Wi-Fi Module*
3. *IoT Server*

For the initial important stage sensors such as glucometer sensor, blood pressure sensor, temperature and humidity are being selected for real-time monitoring of data. The data is analyzed and processed and sent to the monitoring station using the IoT cloud.

A.Sensor Modules

1. ECG Module

The AD8232 is an integrated signal conditioning block for ECG and other bio-potential measurement uses. It is designed to sense, amplify, and filter small bio-potential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement. This design allows for an ultralow-power analog-to-digital converter (ADC) or an embedded microcontroller to retrieve the output signal easily. [6].

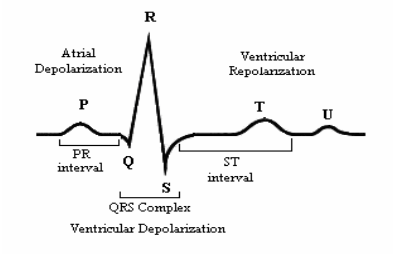

Fig.2. Heart rate pulse

2. Pulse Oximeter

The MAX30100 is integrated pulse oximetry and a heart-rate monitor module. It consists of internal LEDs, photodetectors, optical elements, and low-noise electronics with ambient light rejection. The MAX30100 gives a complete system solution to ease the design-in process for mobile and wearable devices [7].

3. Temperature Sensor

LM35 is a temperature sensor used to sense the temperature it works on the principle of Peltier effect. Its accuracy is +/- 0.4℃ which is much more than a thermistor. It does not undergo oxidation as it is completely sealed. It has linearity of 10mV/℃. Current drain is less than 60mA. Self-heating is of 0.08℃

4. Glucometer

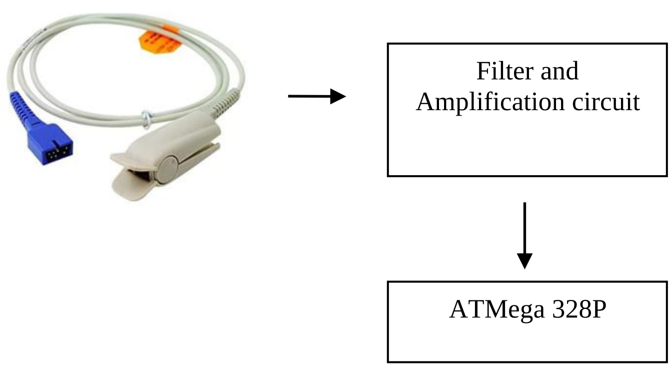

Fig.3. Block Diagram of Glucometer

A Spo2 probe, Nellcor DS 100A is being used, consisting of two LEDs having wavelengths i.e. red and infrared, 660 nm and 940 nm, respectively. The sensor used for non-invasive glucose measurement gives accurate signal output and has high SNR (signal to noise ratio). A signal received from the sensor is filtered via cascaded low and high pass filter with cut off frequencies 10 Hz and 0.5 Hz, respectively. The fundamental working principle is based on Beer Lambert's law depicts the protocol followed by a microcontroller to get the final glucose value. Once a filtered signal is acquired from hardware and fetched to Arduino then intrinsic molecular properties have been administered such as near-infrared light absorption characteristics, molar extinction coefficients calculations and optical path length, transmitted and incident light intensity determination. The algorithm evaluates the transmittance and optical density performs mathematical modelling and takes the mean of the optical density values which are taken at different times i.e. t, t+1 and so on. Addition and subtraction of the mean value in the experimental values helps to overcome the error. Furthermore, experimental values are fetched in a linear curve fitting equation to perform linear regression get the best glucose values. That equation gives the errorless predicted values to the reference values by best fitting the curve. Closer to the curve line, less erroneous results would be and vice versa. Intensities attained from the sensor are fetched to microcontroller and rest of the transmittance and absorbance calculations, linear regression; curve fitting and analytical modelling is done [8].

5. Blood Pressure Sensor

Blood pressure is the pressure of the blood in the walls of arteries as it is pumped around the body by the heart. When your heart beats, it contracts and circulates blood through the arteries to the rest of your body. This force creates pressure on the arteries. Blood pressure is recorded as two types the systolic pressure (as the heart beats) over the diastolic pressure (as the heart relaxes between beats). The unit which measures this is called a sphygmomanometer.

	Systolic (mm Hg)	Diastolic (mm Hg)
Hypotension	<90	<60
Desired	90-119	60-79
Prehypertention	120-139	80-89
Stage 1 Hypertention	140-159	90-99
Stage 2 Hypertention	160-179	100-109
Hypertensive Crisis	>=180	>=110

Table I. Classification of blood pressure for adults (18 years and older)

Output Reading

Following are example output readings from sensors. Each value consists of 15 bytes at 9600 baud rate. The reading packet's last byte is always entered key character (0*0A in hex and 10 in decimal) so you can view each reading on a new line. Also, this character can be used to sync in microcontrollers after each reading.

The output reading is 8bit value in ASCII format fixed digits, from 000 to 255.

B. Micro-controller and Wifi Module

In our model in used ATmega328P as a micro-controller and ESP8266 is used as Wi-Fi Module. All the raw data of sensors are collected by ATmega328P then it compares with the reference value and gives an alert message in the display. Here the Data is transferred serially to Node-mcu which has ESP8266 Wi-Fi Module receives the values and transmits wirelessly to IoT platform i.e. Thingspeak.

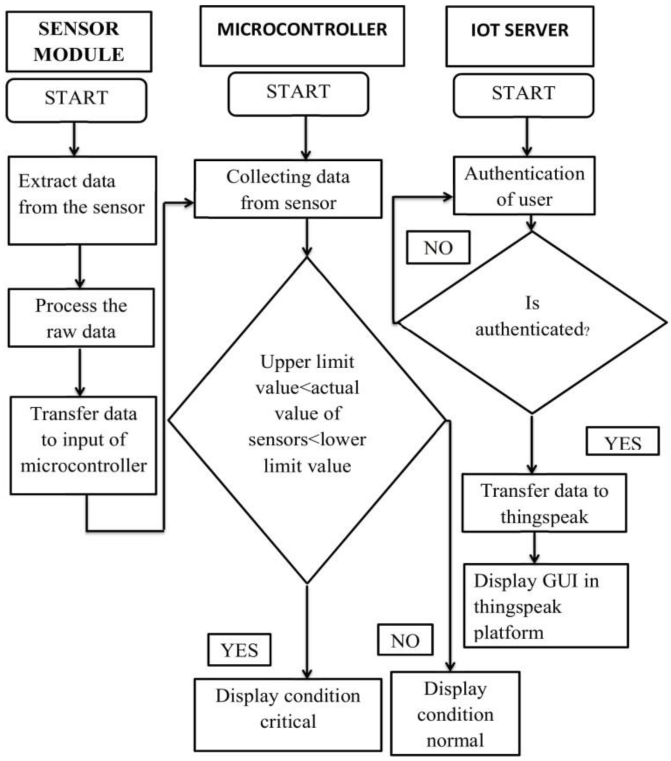

Fig.4. Flowchart of Smart Ambulance Medi-kit

The above flowchart depicts the algorithm of programming and the overall process.

STEP 1:

The module consists of sensors and signals conditional circuits. Sensors sense the physical parameter such as temperature, glucose, heart rate, haemoglobin and blood pressure. These parameters are converted in the form of current or voltage by different sensors. These sensors provide very low current and voltage rating hence there is a need for signal conditioning. Signal conditioning is done with amplifiers and filters to avoid noise and attenuation.

STEP 2:

The signal is then further transferred to the microcontroller. The algorithm is such that it compares the higher and lower value with the actual value of the sensors and the condition of the patient is displayed in the LCD screen.

STEP 3:

Data is then sent to the cloud using a Wi-Fi module. The Wi-Fi module is connected to the server with the help of hotspot created by the router. These values are displayed in GUI format.

C. IoT Server

Internet of Things (IoT) is defined by many people but in simple words, IoT is nothing but some devices that connect and interact using the internet. In this project, we are using ThingSpeak IoT platform. ThingSpeak is an IoT platform and API for data collection and analytics. It serves as a bridge connecting edge node devices, such as temperature and pressure sensors that collect data and data investigating analysis software that analyzes the data. [9].

RESULTS

The propose system was implemented, live information of the patient is provided over the Thingspeak cloud channel. When the modern sensors are attached to the patient's body the doctor of the collaborated hospital can view the status of the patient and diagnose the patient at the same time. The previous data of the patient is stored in the database; it helps doctor to treat the patient accurately. The system sends the real time data at a particular interval to the cloud channel. Due to graphical representation of data it becomes simpler to read the data and compute the results.

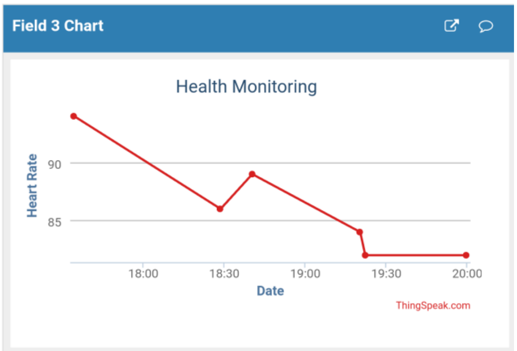

Fig.5. Heart rate of patient

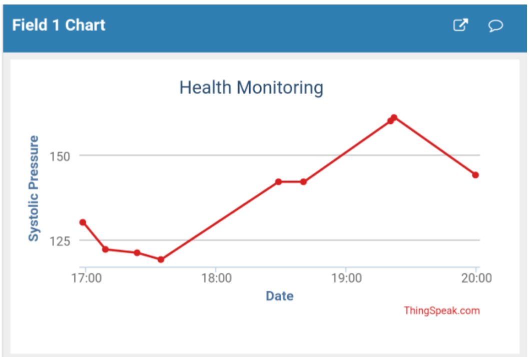

Fig.6. Systolic Pressure of patient

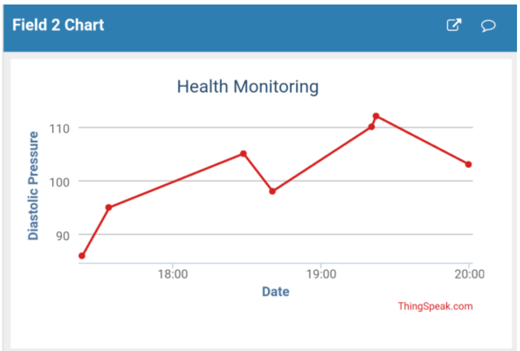

Fig.7. Diastolic pressure of patient

CONCLUSION

By taking into account immense practical importance of IoT based live monitoring system for patients with the risk of heart attack, uneven accidents and emergency cases, a simple low-cost health monitoring scheme is presented in this Project. ATmega328P is used for this application because of its multi-tasking capability and low power consumption. Also, this system can be installed easily in all the ambulance and huge data obtained can be stored in the database. Moreover, this data is much valuable. Also, we learned software embedded C for simulation; in this, some problems are faced. It reduces the doctor's workload and also gives accurate results.

ACKNOWLEDGEMENT

We are thankful to several individuals who have contributed towards our project and without their help; it would not have been possible. Firstly, we offer our sincere thanks to our project guide, Ms Mugdha Salvi for her constant and timely help and guidance throughout our preparation. We are grateful to all project coordinators for their valuable inputs to our project.

REFERENCES

[1] Ananda Mohon Ghosh; Debashish Halder; S K Alamgir Hossain, Remote health monitoring system through IoT, 5th International Conference on Informatics, Electronics and Vision (ICIEV)

[2] R. Kumar; M. Pallikonda Rajasekaran, An IoT patient-based monitoring system using Raspberry Pi, 2016 International Conference on Computing Technologies and Intelligent Data Engineering (ICCTIDE'16)

[3] Sarfraz Fayaz Khan, Health care monitoring system in the Internet of Things (IoT) by using RFID, 2017 6th International Conference on Industrial Technology and Management (ICITM).

[4] Freddy Jimenez, Romina Torres; Building an IoT – aware healthcare monitoring system, 2015 34th International Conference of the Chilean Computer Science Society (SCCC).

[5] S. Siva1, P. Suresh, S. Seeba Merlin and R. Punidha; A Smart heart rate sensing system in IoT, IJCTA, 9(9),2016, pp. 3659-3663.

[6] Datasheet of AD8232.

[7] Datasheet of MAX30100.

[8] Nazo Haroon Department of Mechatronics Engineering, CEME National University of Sciences and Technology (NUST) Islamabad, Pakistan Mohsin Islam Tiwana Department of Mechatronics Engineering, CEME National University of Sciences and Technology (NUST) Islamabad Design and Development of Non-Invasive Prototype to Measure Pulse Rate, Blood Glucose and Oxygen Saturation Level in Arterial Blood Future Technologies Conference (FTC) 2017 29-30 November 2017 Vancouver, Canada

[9] Thingspeak IoT Platform