PREMIER UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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Patient Monitoring System

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A project report submitted in partial fulfillment of the requirements for the Degree of Bachelor of Science in COMPUTER SCIENCE & ENGINEERING

PREMIER UNIVERSITY
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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Patient Monitoring System

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Declaration

This project report is submitted to the Computer Science and Engineering, Premier University, Chattogram in partial fulfillment of the requirements for the degree of Bachelor of Science. This is to certify that the work presented in this project entitled “Patient Monitoring System” is the outcome of the investigation carried out by me under the supervision of Mohammad Ariful Islam Bhuyan, Lecturer, Department of Computer Science & Engineering (CSE), Premier University Chattogram.

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Statement of Originality

It is hereby declared that neither this project nor any part there of it has been submitted elsewhere for the award of any degree.

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Date

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Dedication

To Our Beloved Parents and our Honorable Teachers

Acknowledgement

Firstly, we would like to thank the Almighty for giving us the opportunity, perseverance, determination and intellect to complete this project. A big and warm gratitude goes to our supervisor Md Ariful Islam Bhuyan for helping us all the way to complete our task successfully in time. He always pushed us to the edge, gave us healthy challenges and helped us through our thick and thins. It was a pleasure working under his guidance and supervision.
Lastly, we can never be too grateful to our loving parents for their blood, sweat and tears. We will always remain in debt of what our parents have provided us with. They have always encouraged us to gain knowledge. It is because of them and their effort we have reached this far away.
Finally, we would like to thank all the faculty members of the Department of Computer Science and Engineering of Premier University from whom we have gained knowledge and assistance to complete our project.

Abstract

The increased use of technologies and smart devices in the health zone has brought on extraordinary effect on the world's critical care. Health monitoring is one of the most crucial subject in modern era health care. And it is a new challenge to remotely monitor the health condition. Health specialists and doctors are using these technologies to create critical change in medicinal services during clinical settings. . The main aim of this 'Patient Monitoring System' is to build up a system fit for observing vital body signs, for example, heart rate, ECG. The system involves many sensors to screen fundamental signs that can be interfaced to the doctor's mobile or the web. It can be used to promote basic nursing care in home like the hospital environment by improving the quality of care and patient safety. Bangladesh is lack behind from the proper patient monitoring system from patient home. So, remote monitoring and guidance awareness by sharing information in an authenticated manner are the main objectives.

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CHAPTER-1

Introduction

1.1 Introduction

1.2 Motivation

1.3 Overview

1.4 Objective

CHPTER-1
Introduction

1.1 Introduction

Patient Monitoring System can be characterized as the system utilized for observing physiological signs that incorporate the parameters like the electrocardiogram (ECG), heart rate. Understanding and checking monitoring system is a piece of health innovation. It can be named as m-health or mobile health. These systems are utilized for the practice of medicinal and general health with the assistance of internet connected device. It may play a vital role to reduce labor cost, rather will be easy to assess from anywhere anytime and will be helpful to take immediate decision. Thus nursing system will be digitalized. In day to day life, people are affected by various serious and complex diseases like Diabetic Mellitus, Cardio Vascular Diseases, and Hypertension etc. which are highly sensitive diseases. So, people are continuously anxious about their health condition. They need to consult with doctors, according with reports and checkup all of that. These frameworks observation can be utilized nearby or remotely. Firstly, talk about sensor network which is the first step for monitoring patients as well as data collection. Secondly, the gateway system which is a continuous connection networks between sensors and cloud system. The death rate of 55.3 million people dying each year or 1,51,600 people dying each day or 6316 people dying each hour is a big issue for all over the world. So, we are proposing a model where patient can measure heart rate and ECG by himself or herself and that report continuously showed smart devices. If any emergency situation will arise so that the patient attendant and doctor can take a step to overcome this situation within very short time. It is also reduce valuable time for both patients and doctors.

They don't need to wait for the reports because sensors are giving real time data. The model is very effective for rural areas people. This system serves through GSM technologies data or patient report is sending to the doctors with time and date. This proposed model can use any type of persons like he or she affected with a disease or not. So, they can check it in regular basis because people pay more attention towards prevention and early recognition of disease. Here, all reports also live video recording will be recorded with real time. These health care services are getting better and less costly by recoding and collecting patients monitoring.

1.2 Motivation

The core to our motivation was to think ahead of our time and to make a contribution on the sector medical health which is undoubtedly the next big thing on the technological market. The idea of this project came to us by observing how easy it is to connect or integrate the

normal home appliances with the internet. This led us to the secluded health sector which is still lagging behind from other industries in terms of technology. We observed many case even from our daily lives that in the hectic world we are living right now, it is difficult to keep a watch over everything. Specially, to keep an eye on the elderly people is difficult and costly as well. These real life situations gave us the ideas and motivation to integrate the two sectors so that it helps in developing such a project which will create an economic and efficient health monitoring system and will pave the way for future work on the field of IOT

1.3 Overview

Our system will be beneficial to all age of people especially for the old aged or ICU patient. It will measure the Heartbeat and ECG of the patient and upload the result in the text message and web server. Therefore, we have developed website in which people can get access and see the output with date and time. Moreover, in case of emergency, nurse or patient‘s relative check out patient’s condition by using LIVE monitor option. Our goal was to build up a system with high accuracy with minimum cost so that anyone can use and afford this.

1.4 Objective

- Easy to use where use very handy tool as it shows all the data collection and information by using just only the internet.
- For better patient experience we can say that it allows monitoring patient continuously and remotely.
- Sending SMS update about heart rate to the doctors and relatives so that can take necessary action and saves lives in case of emergency.
- Giving a quality life for old aged people because the patient stay at home with their dear ones rather than visiting or passing time in hospitals.
- In case of emergency, nurse or patient‘s relative check out patient’s condition by using LIVE monitor option.
- Reduce costs this project helps to cut down cost for hospital stays and readmissions.

CHAPTER-2

Background Study and Literature Review

2.1 Introduction

2.2 What is ECG Patient Monitoring?

2.3 What is ECG (Electrocardiograph)?

2.4 What is Pulse?

2.5 Background Study

CHAPTER 02

BACKGROUD STUDY AND LITERATURE REVIEW

2.1 Introduction

Patient monitoring is basically model for monitoring sick people using different biomedical sensors. The reason we chose sick people for monitoring is because, sick people are usually more vulnerable to sickness and other health factors. So, usually it becomes difficult for working people to monitor the sick members of the family the whole time. Even if it is possible to take care of the sick people during they stay at home, it becomes rather difficult to observe their activities and condition during the working hours. Thus, it was eminent to come with a solution that is to make a health monitoring system which can observe the daily basic activities of elderly or sick people.

2.2 What Is Patient Monitoring?

Continuous measurement of patient parameters such as heart rate and rhythm, respiratory rate, blood pressure, blood-oxygen saturation, and many other parameters have become a common feature of the care of critically ill patients. [2] When accurate and immediate decision-making is crucial for effective patient care, electronic monitors frequently are used to collect and display physiological data. Increasingly, such data are collected using non-invasive sensors from less seriously ill patients in a hospital's medical-surgical units, labor and delivery suites, nursing homes, or patients' own homes to detect unexpected life-threatening conditions or to record routine but required data efficiently

2.3 What is ECG (Electrocardiograph)?

Electrocardiography is the process of producing an electrocardiogram. It is a graph of voltage versus time of the electrical activity of the heart using electrodes placed on the skin. These electrodes detect the small electrical changes that are a consequence of cardiac muscle depolarization followed by repolarization during each cardiac cycle (heartbeat). Changes in the normal ECG pattern occur in numerous cardiac abnormalities, including cardiac rhythm disturbances (such as atrial fibrillation and ventricular tachycardia), inadequate coronary artery blood flow (such as myocardial ischemia and myocardial infarction), and electrolyte disturbances (such as hypokalemia and hyperkalemia).

In a conventional 12-lead ECG, ten electrodes are placed on the patient's limbs and on the surface of the chest.[4] The overall magnitude of the heart's electrical potential is then measured from twelve different angles and is recorded over a period of time (usually ten seconds). In this way, the overall magnitude and direction of the heart's electrical depolarization is captured at each moment throughout the cardiac cycle. There are three main components to an ECG: the P wave, which represents the depolarization of the atria; the QRS complex, which represents the depolarization of the ventricles; and the T wave, which represents the repolarization of the ventricles.

During each heartbeat, a healthy heart has an orderly progression of depolarization that starts with pacemaker cells in the Sinoatrial node, spreads throughout the atrium, and passes through the atrioventricular node down into the bundle of His and into the Purkinje fibers, spreading down and to the left throughout the ventricles.[5] This orderly pattern of depolarization gives rise to the characteristic ECG tracing. To the trained clinician, an ECG conveys a large amount of information about the structure of the heart and the function of its electrical conduction system. Among other things, an ECG can be used to measure the rate and rhythm of heartbeats, the size and position of the heart chambers, the presence of any damage to the heart's muscle cells or conduction system, the effects of heart drugs, and the function of implanted pacemakers.

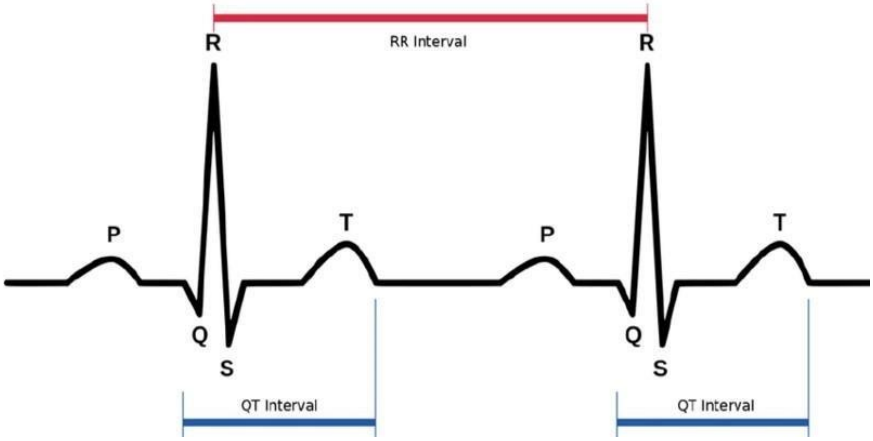


Figure 2.2: Normal sinus rhythm ECG

2.4 What is Pulse?

In medicine, a pulse represents the tactile arterial palpation of the cardiac cycle (heartbeat) by trained fingertips. The pulse may be palpated in any place that allows an artery to be compressed near the surface of the body, such as at the neck (carotid artery), wrist (radial artery), at the groin (femoral artery), behind the knee (popliteal artery), near the ankle joint (posterior tibial artery), and on foot (dorsalis pedis artery). Pulse (or the count of arterial pulse per minute) is equivalent to measuring the heart rate. The heart rate can also be measured by listening to the heart beat by auscultation, traditionally using a stethoscope and counting it for a minute. The radial pulse is commonly measured using three fingers. This has a reason: the finger closest to the heart is used to occlude the pulse pressure, the middle finger is used get a crude estimate of the blood pressure, and the finger most distal to the heart (usually the ring finger) is used to nullify the effect of the ulnar pulse as the two arteries are connected via the palmar arches (superficial and deep). The study of the pulse is known as sphygmology.

Heart rate known as pulse rate is the number of times a person's beat per minute. Normal heart rate varies from person to person but a normal range for adults is 60 to 100 beats per minute. Also normal heart rate depends on the individual age, body size, heart condition also the person is sitting or moving, medication use and even air temperature. Emotion can vary heart rate for example getting excited, scared can increase the heart rate. According to American Herat Association (AHA) well trained athlete may have a normal heart rate of 40 to 60 beats per minute.

2.5 Background Study

Design and development of e-health care monitoring system as we are dealing with e-health care monitoring system, our system designs is based on the wireless sensor networks and smart devices.**[1]** It is very important to have strong networks between doctor, patient, and care givers judges the condition of the patient. Sensors are used to monitoring of patient surrounding as well as health, these sensors are medical and environmental sensors. Sensors are relayed to the prior devices through the transmitter and them to the end user. In this system doctor and care takers can observe patient without exactly visiting the patient actually. And further they can upload medicines and medical reports on the web server which after can be accessed by the patient anywhere at any time. It is very much easy process and convenient for both the doctors and patient. With the help of this data doctors can understand and observe patient from private home patient to public health care centre patient. This is the cost reducing technique.

Mobile telemedicine system for home care and patient monitoring this paper describes the implementation of a telemedicine system for patient monitoring using mobile telephony, using this application any patient can be monitored with Rs232 interface.**[1]** The system proved to be quick and reliable. Therefore, it represents an applicable solution to tele-

homecare. Additionally, the high costs involving the conventional internment and the frequent problems in patient transporting do necessary a different way of providing good medical care. This system is based on client server application in which server stores data collected from client, role of client is to collect proper data from patient & transfer it to.

Patient health management system using e-health monitoring architecture this system is based on an android application & a wireless network which will be used for monitoring patient health report in real time. This system is developed in a such way that it would be more useful in emergency conditions. With this system it will be possible to analysis patient using tele-monitoring. Sensors will be used to monitor patient health continuously and it will be updated on server. The patient medical history is being stored on cloud for global access.

2.6 What Can Be Done With It?

According to the WHO, 4.9 million people died from lungs cancer, over weight 2.6 million, 4.4 million for elevated cholesterol, 7.1 million for high blood pressure. Patients who need a regular monitoring by doctors to discuss the state of health condition, patient monitoring system is useful for them.**[4]** The main concept of this project which is integrated with electronic devices that connect with doctors or health monitoring persons

Thus, most the related works done related to our project was highlighted in this segment. Some of those researches conducted really helped us understanding the importance of this sector and inspired to go the extra-mile on this field. The platform monitoring the daily activities of the host will be useful for the physician attending the host. The daily activities monitoring conducted by the system will help the physician to develop a conclusion and prediction to diagnose the host in a swift manner.

CHAPTER-3

Working Methodology

3.1 Operational instruction

3.2 Workflow of Electrical Components and Control Unit

3.3 System Model

3.4 Hardware Implementation Method

CHAPTER 03

WORKING METHODOLOGY

The system consists of six major embedded electronics.

- NodeMCU ESP8266
- Heart Beat or pulse sensor
- GSM Module
- ECG Sensor
- LCD Display

For power on, 5 volt adapter is using with NodeMCU and attached with GSM module externally. Patient will touch the heart beat sensor. After counting beat from blood flow wait for 20 seconds. The result will upload and the heart beat value will show in LCD display. Similarly receiver will get the value in mobile message, web page. For implement the function of ECG sensor, the sensor will be attached with patient's chest. In the meanwhile, it will generate the ECG curve. After that, the curve will upload in web page.

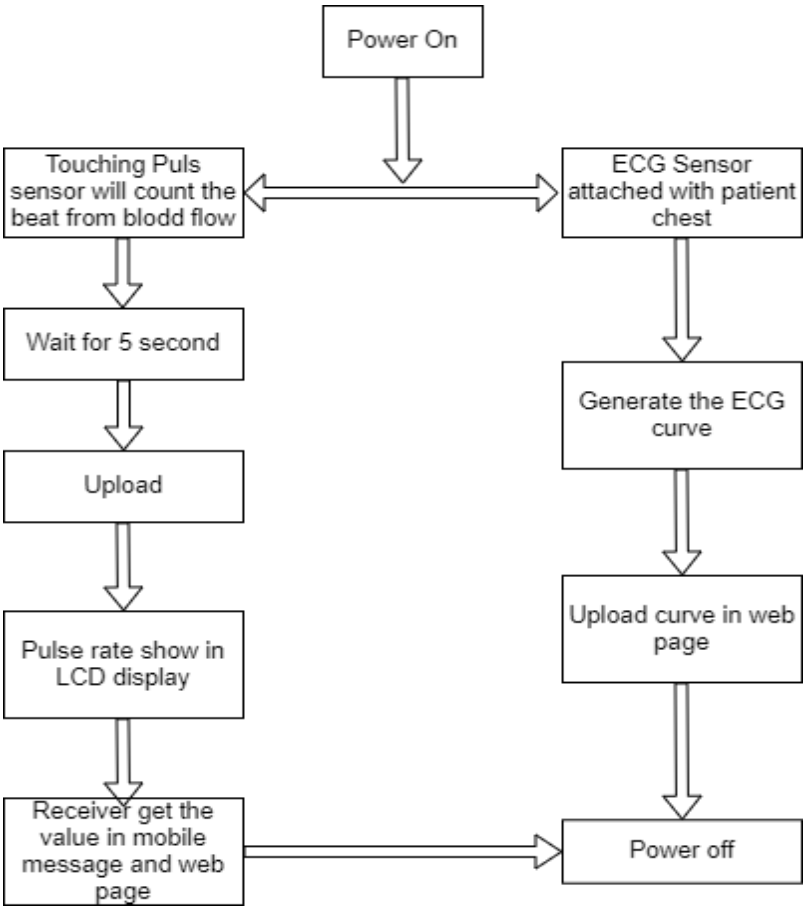


Figure 3.0 Workflow diagram

3.1 Operational Instruction

After power on, one hand finger will touch the Pulse sensor and the LED light will start blinking continuously after 1000 milliseconds. After 20 seconds, the person will get the heart beat value that LED light will blink. It means the operation is progressing on until power off. Then the value will directly send on mobile message, device as well as web page within 3 seconds. For ECG measurement, the ECG sensor attached with chest. The receiver will get the result in web page with time and date within 3 seconds.

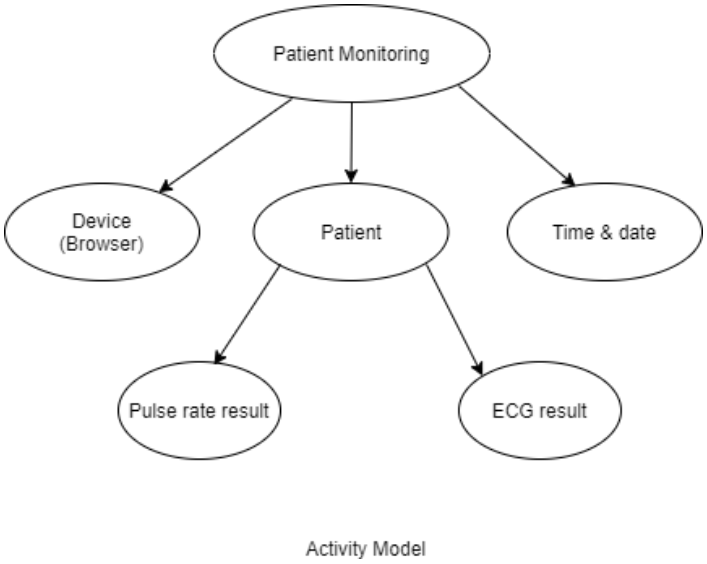


Figure 3.1: Operational instructional

3.2 Workflow of Electrical Components Control Unit

The NodeMCU ESP8266 development board comes with the ESP-12E module containing ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects. NodeMCU can be powered using Micro USB jack and VIN pin (External Supply Pin). It supports UART, SPI, and I2C interface.

In thus project one power adapter are using which is 5v 1amp. From this power sources heart beat sensor is getting 5v. 3.3 v power is driven in ECG sensor if more power is driven in the ECG sensor it will get damage. The GSM module is driven by 5v.

3.3 System Model

Our project is comprised of both hardware and software. In hardware part, pulse and ECG sensor are used. Therefore, NodeMCU ESP8266 integrates with the GSM Module. When the pulse or heartbeat and ECG are measured, GSM module helps to upload it in mobile message.
Moreover LCD displays the pulse result too.

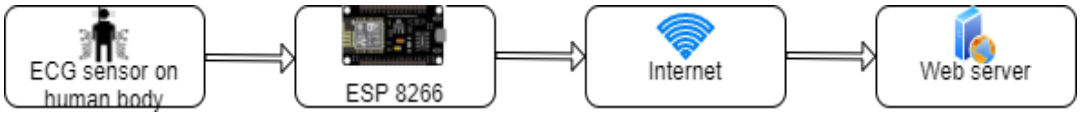


Figure 3.3(a): System model for ECG sensor

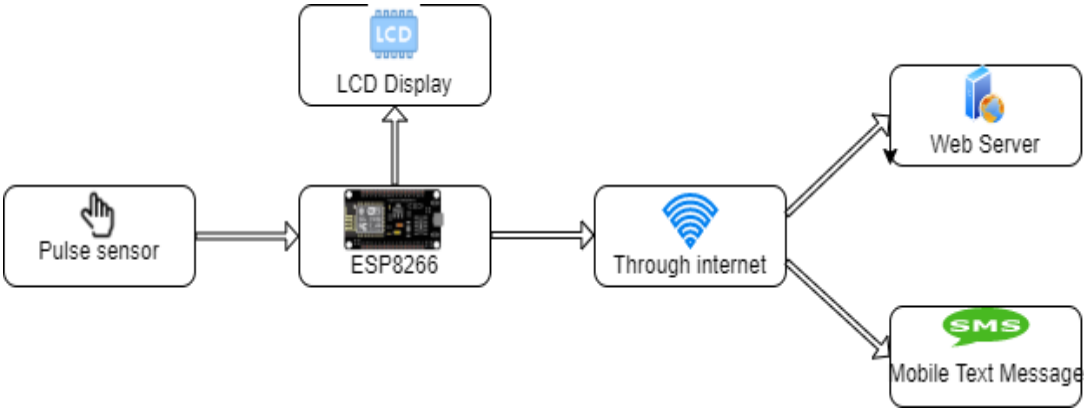
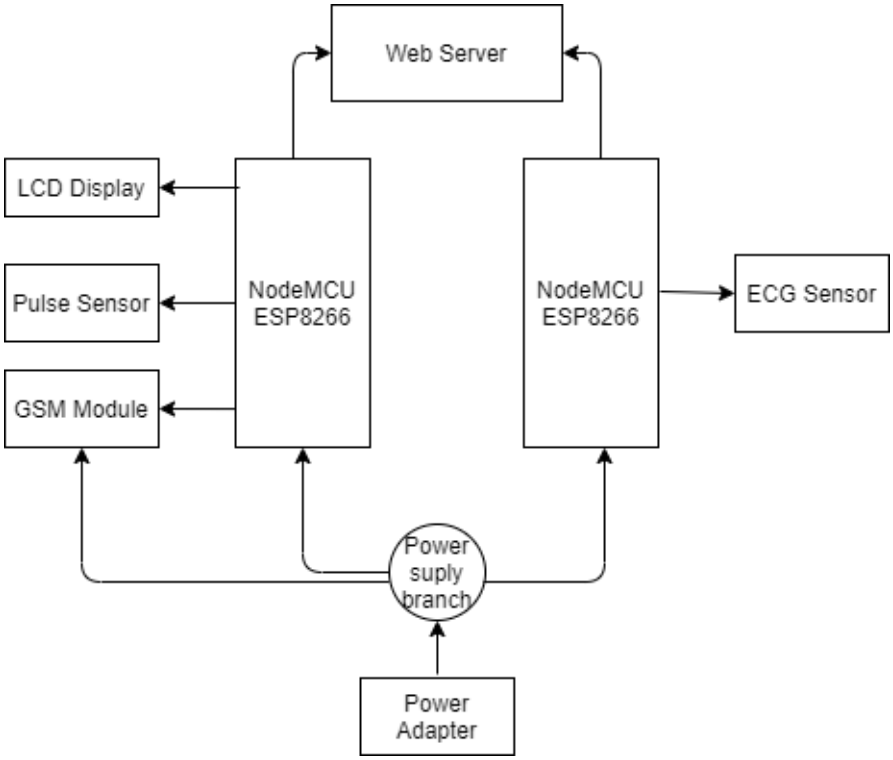


Figure 3.3(b): System model for Pulse sensor

3.4 Hardware Implementation Method

To run the system first we need to connect NodeMCU with the power supply as NodeMCU ESP8266 is the main control unit. In input side, we have pulse sensor, ECG sensor and some manual buttons. On the other hand, output is shown in the LCD display. Moreover, GSM Module helps to send data in the cloud and when the data gets uploaded, we can check the output by using Laptop or Computer by log in to the server. First of all, a finger is placed in the pulse sensor so that the system can read data. After that, it shows result in the LCD display. Also it can upload the output in webpage and send text message through GSM module. Similar process is done with the ECG sensor but instead of placing a finger,

3 electro pads are placed in the body and the data reading is taken but LCD display is unable to show the ECG result in its display as the characters are too long. For this case, shows the ECG curve in the Web page.
This is all about the block diagram which shows the entire process of hardware.



3.3 Block diagram of hardware implementation

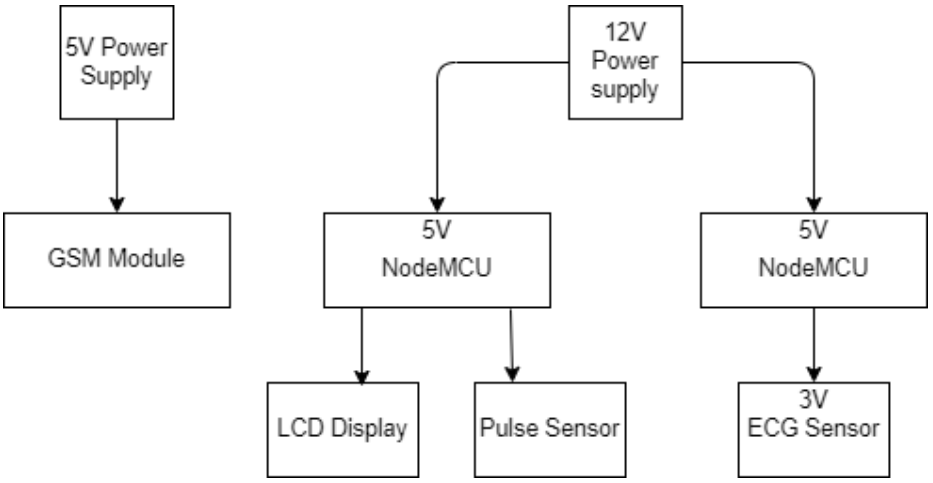


Figure 3.5: Power flow of Block Diagram of hardware implementation

CHAPTER-4

Implementation

4.1 Schematic Diagram

4.2 List of Used Component

4.3 Image of Whole Hardware System

4.4 Software Implementation

Chapter 4
Implementation

The whole circuit will work successfully if the entire components connected successfully. There are many individual components which performing different individual tasks. Connection scenario of individual part with each other and all over the circuit description is given below

4.1 Schematic Diagram

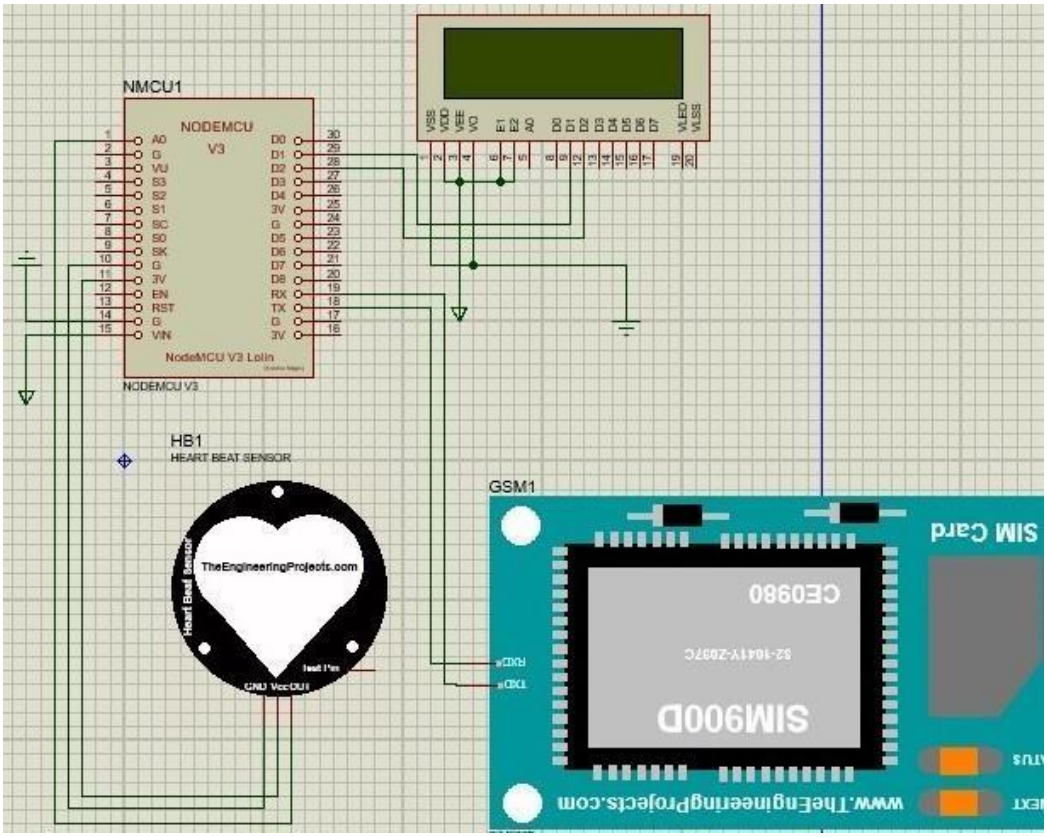


Figure 4.1.1: Circuit diagram NodeMCU with heart beat sensor

NodeMCU's A0 pin is connected with heart beat sensor sub circuit. Heart beat sensor has 3 input.

One is connected with arduino, second one is connected with 3 volt and last one is connected with Ground pin. GSM module has TXD and RXD pin. GSM TXD pin connected with NodeMCU RX pin, GSM RXD pin connected with NodeMCU TX pin. First of all, LCD display has 14 pin. Pin of LCD D1 and D2 pin are connected with D1 and D2 pin of NodeMCU.

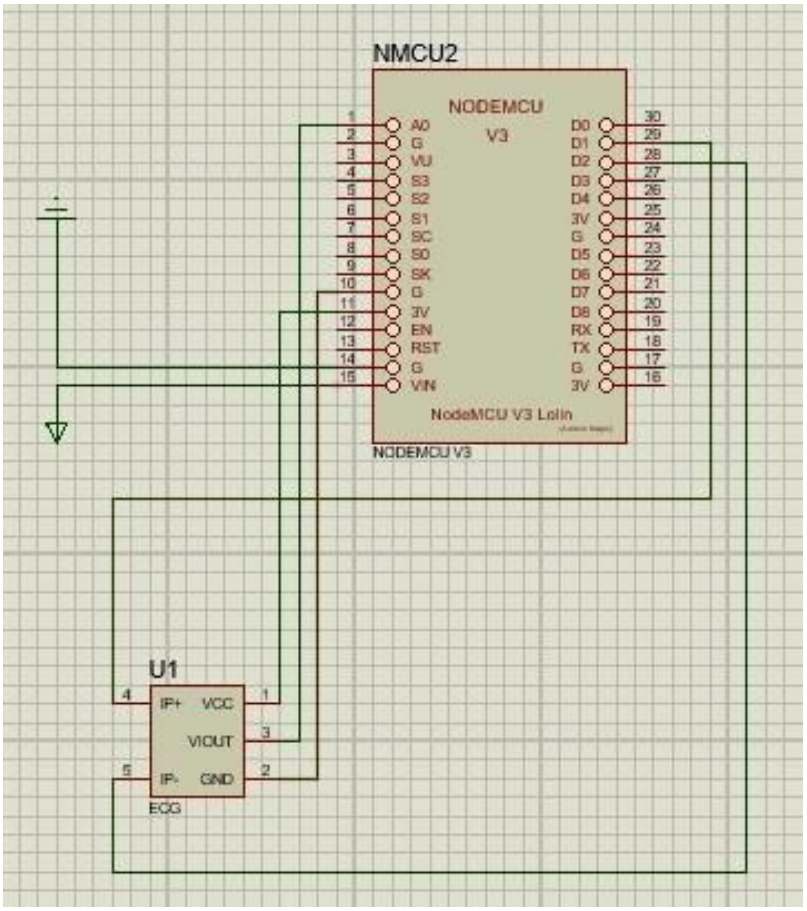


Figure 4.1.2: Circuit diagram NodeMCU with ECG sensor

ECG sensor has also 3 inputs. First one is connected with A0 pin of NodeMCU. Another input is connected with 3 volt of NodeMCU. Last one is grounded.

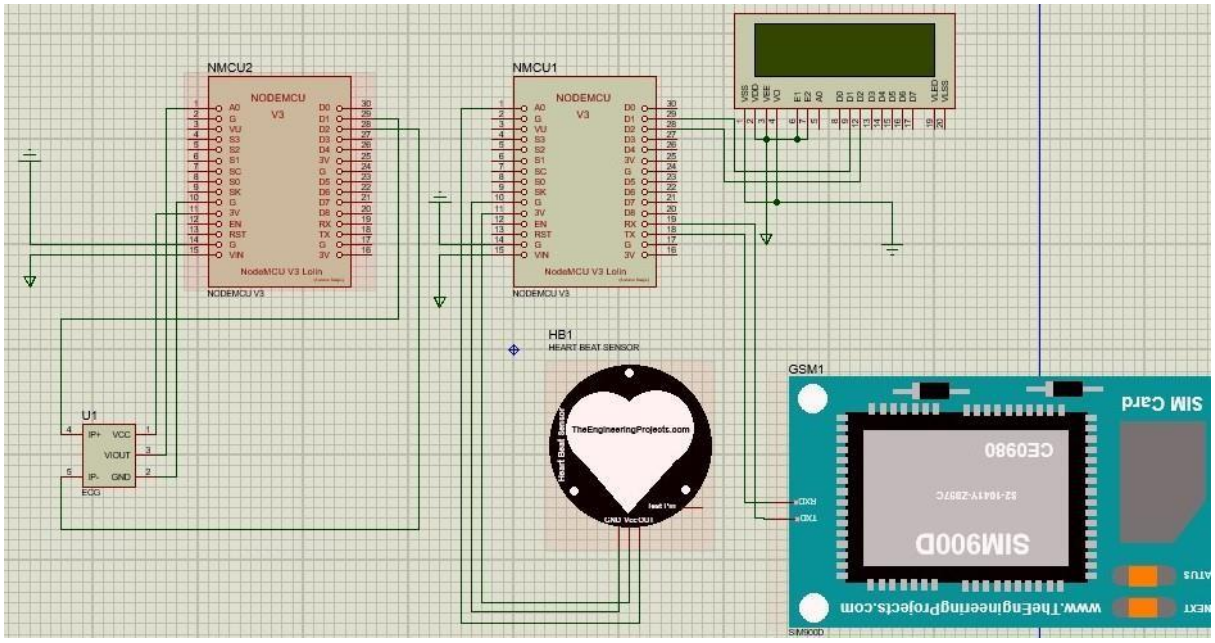


Figure 4.1.3: Circuit diagram with all the components

4.2 List of Used Component

4.2.1 Hardware Tools:

a) NodeMCU ESP8266
b) SIM 900A GSM Module
c) ECG Sensor
d) Pulse Sensor
e) Power Adapter
f) LCD Display
g) Jumper Wire
h) Laptop
i) PBC Board

4.2.2 Software Tools:

a) Arduino IDE
b) PHP

4.3 Image of Whole Hardware System

After connecting and programming all the components with each other, we have performed the experiment. According to the proposed system, we have designed prototype Patient monitoring System. Arduino, GSM module and all the sensors are connected with lots of wires.

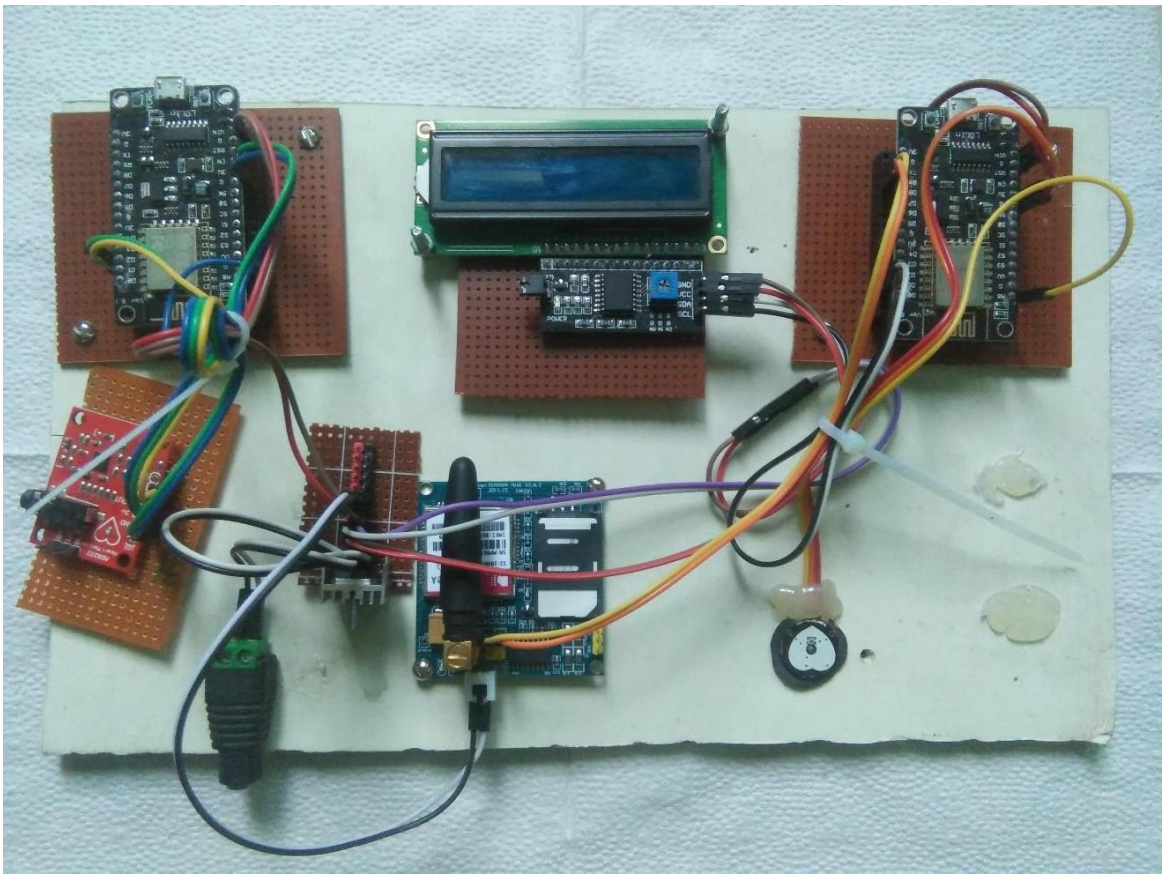


Figure 4.2.3: Top view of whole system

4.3 Software Implementation

Over 10 years after its presentation, REST has turned out to be a standout amongst the most critical advances for Web applications. REST remains for Representational State Transfer, which is a compositional style for arranged hypermedia applications. Its significance is probably going to keep developing rapidly as all advances move towards an API introduction. Each significant improvement dialect now incorporates structures for building RESTful Web administrations. To implement our website, we integrate our hardware with service call to show in the website. It show the real time value in the website. We created a web front with a device interface. PHP/ Java script language is used for create the website. PHP used to call the server and get the data from server. When heart beat is measured in heart beat sensor, it uploaded into the server and showed real value into the website according to date and time. It also generates the ECG curve graphically in the website according to the time and date. Chart.js is a powerful data visualization library. It is used to create the graphical line into the website. Web service is used to show ECG graphically by calling data from the server and generate it from the NodeMCU code. In other part, one can also make a live monitoring of the patient by using login username and password. https://www.youtube.com is a cloud based video streaming and also have a live feature which is used our system for live monitoring monitoring system.

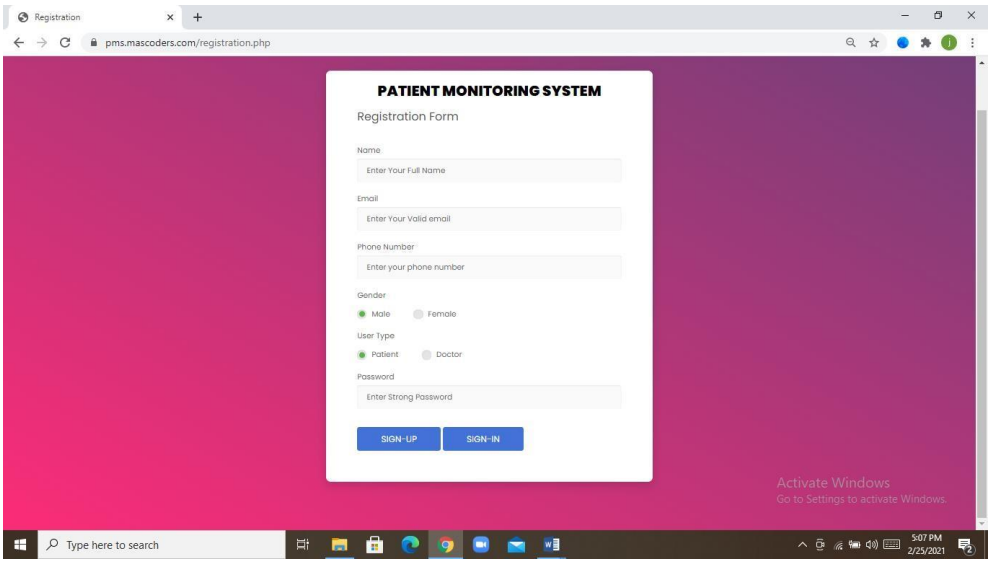


Figure 4.3.1: Patient attendant and Doctor Registration form

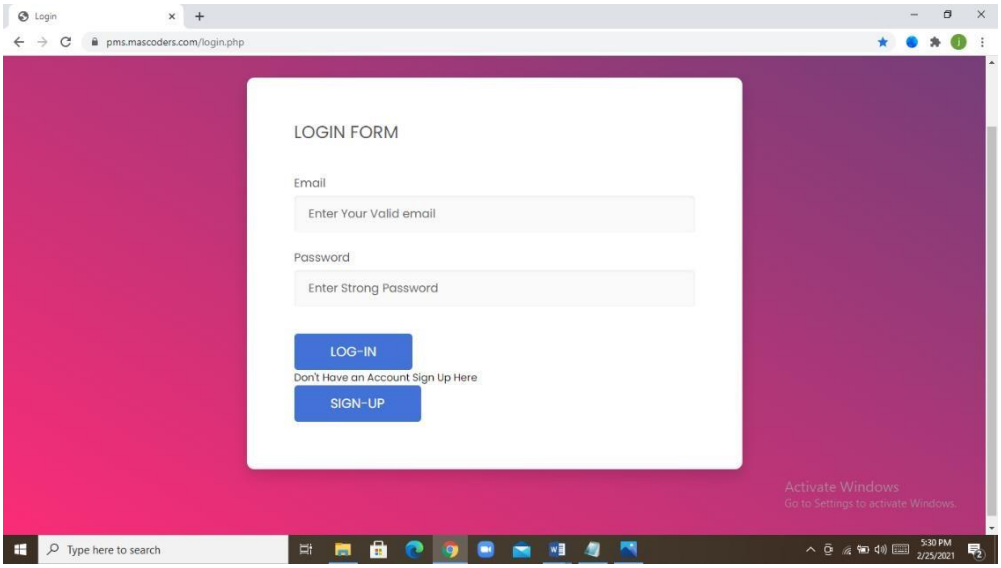


Figure 4.3.2: Patient attendant and Doctor Registration form

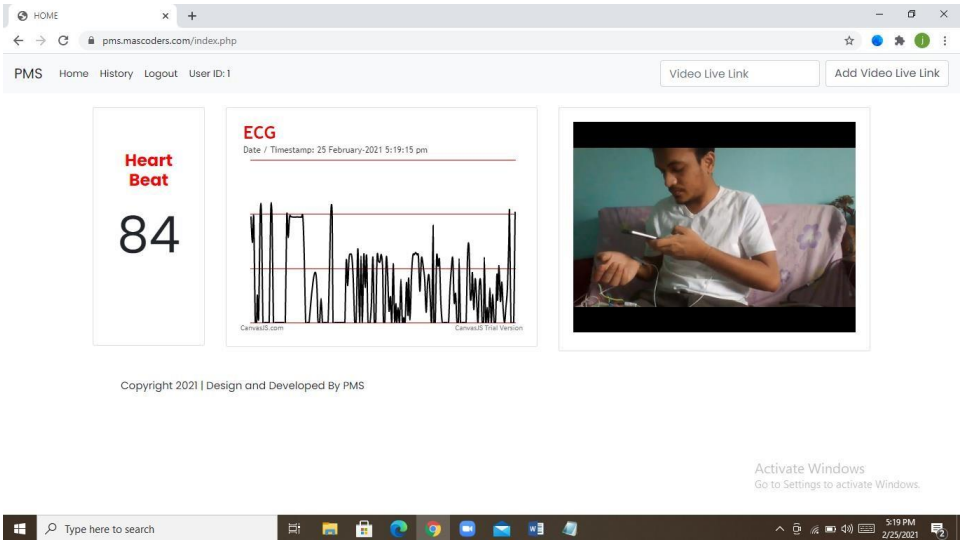


Figure 4.3.3: Patient Monitoring Interface

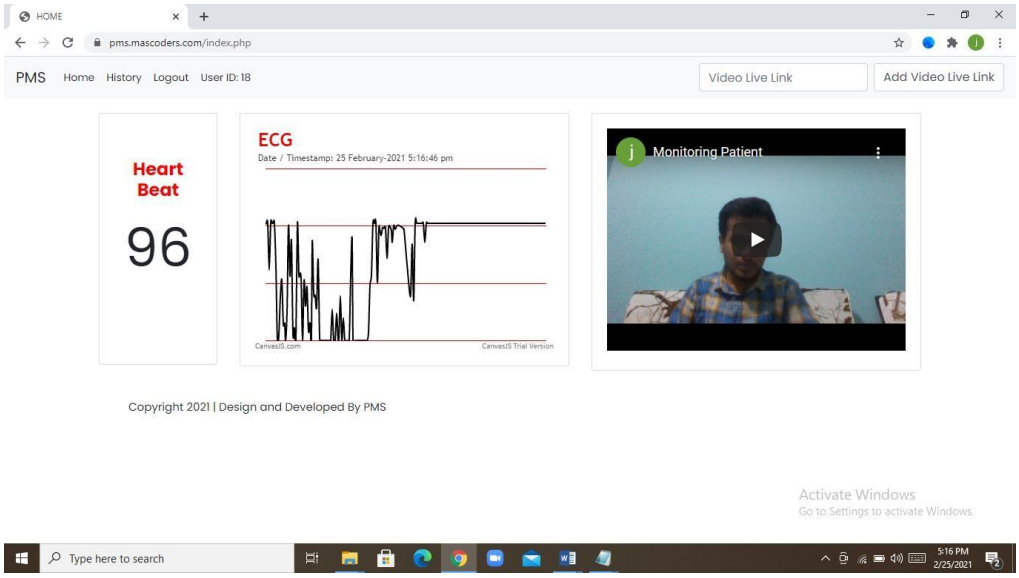


Figure 4.3.4: Patient Monitoring Interface

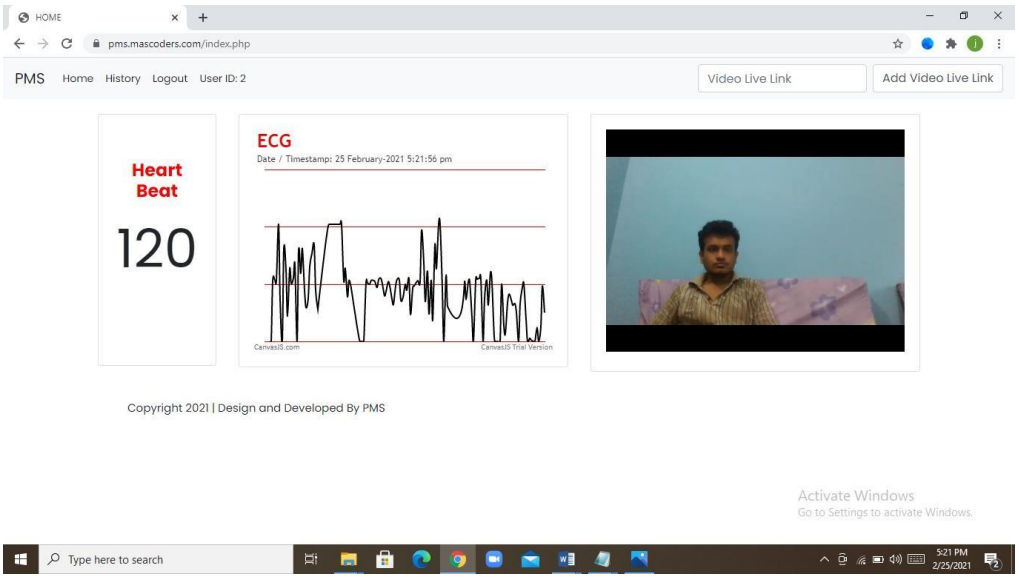


Figure 4.3.5: Patient Monitoring Interface

Figure 4.3.6: Patient Monitoring Interface

CHAPTER-5

Result and Data Analysis

5.1 Pulse Result Analysis

5.2 Pulse Result in Mobile Message

5.3 ECG Result Analysis

5.4 Cost Analysis

CHAPTER-5
Result and Data Analysis

5.1 Pulse Result Analysis

To verify whether the heartbeat sensor is working or not, we compare the heartbeat result with an automatic blood pressure machine's heartbeat output. To proceed with this thought, we have checked the data which is taken from 5 various people having specific age limit. The data is given below with specific date and time.

Age	Sex	Time & Date	Pulse output from BP Machine	Pulse from our system
20-30	Male	11.20am		
20-25	Male	11.30am		

Table 5.1(a): Pulse result analysis

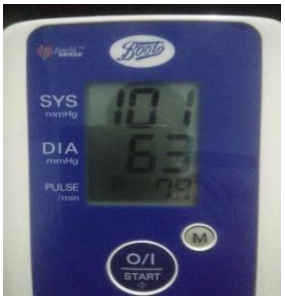
Age	Sex	Time & Date	Pulse output from BP Machine	Pulse from our system
60-65	Male	11.35am		
15-20	Male	11.40am		
60-65	Male	12.00pm		

Table 5.1(a): Pulse result analysis

5.2 Pulse Result in Mobile Message

From the previous tables of heart beat results, now in this figure, the same results are shown by mobile message with time and date.

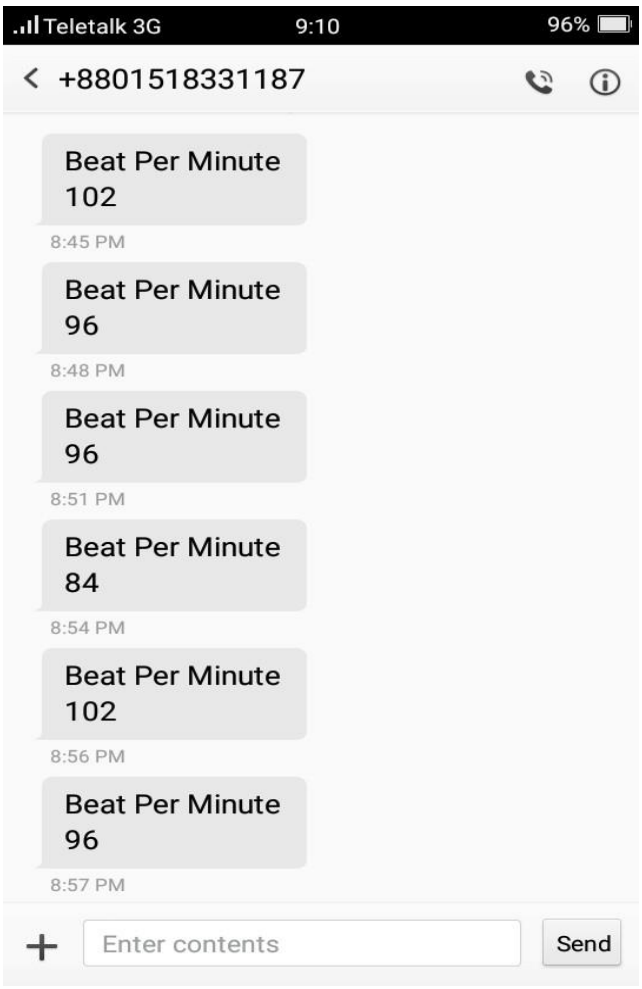


Figure 5.2: Pulse Result in Mobile Message

5.3 ECG Report Analysis

At first in our ECG sensor we have 3 electrodes placed in the patient's chest. The red color electrode is placed in the right side chest where the heart beat is producing. And the green color electrode place in left side chest and last one yellow electrode place in below green color electrode. Then we have to press ECG push button. The value will generate curve and upload in website

Here we are presenting some ECG results:

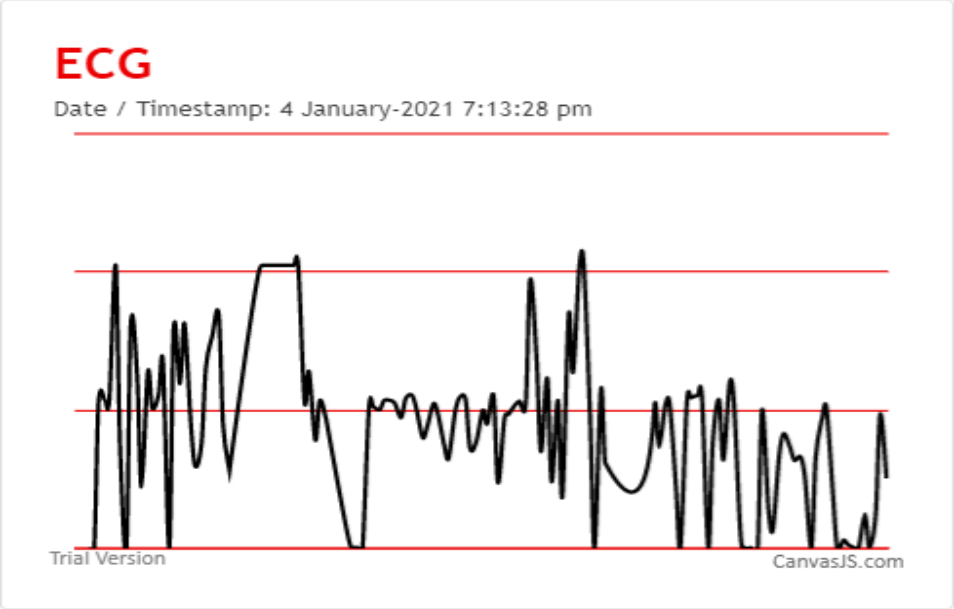


Figure 5.3(a): ECG report from the system

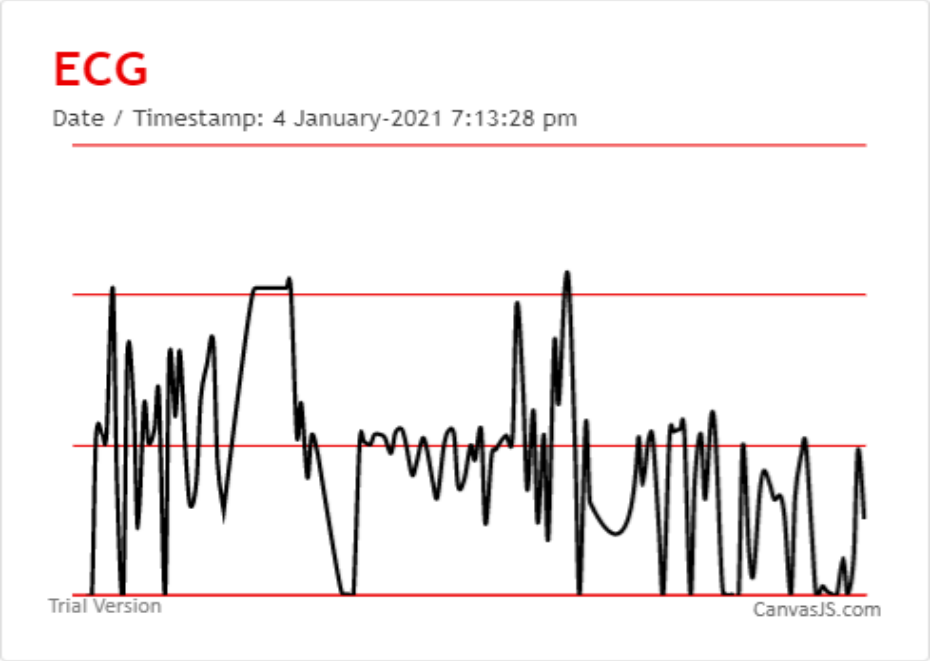


Figure 5.3(b): ECG report from the system

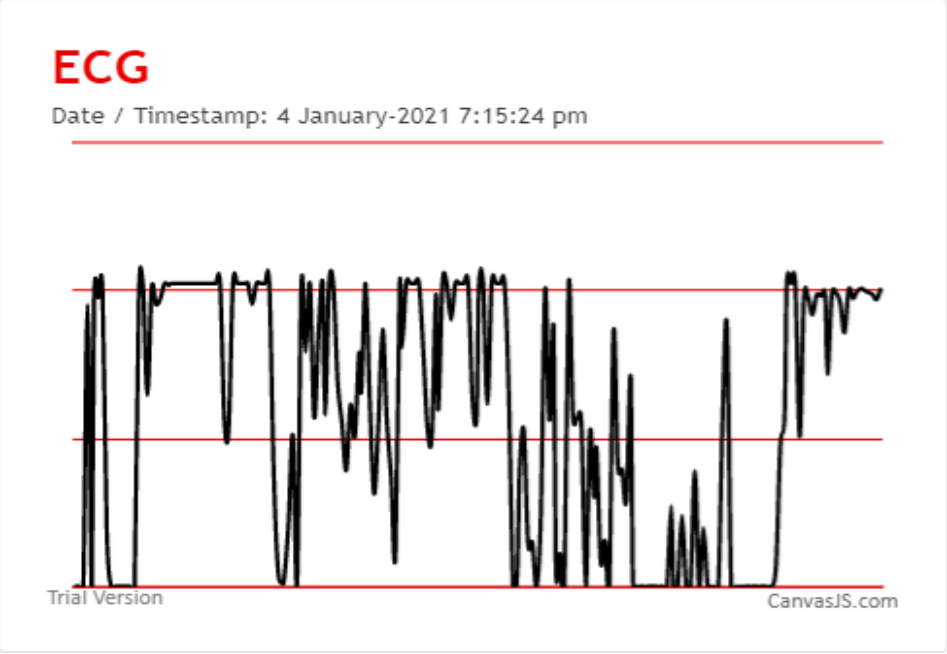


Figure 5.3(c): ECG report from the system

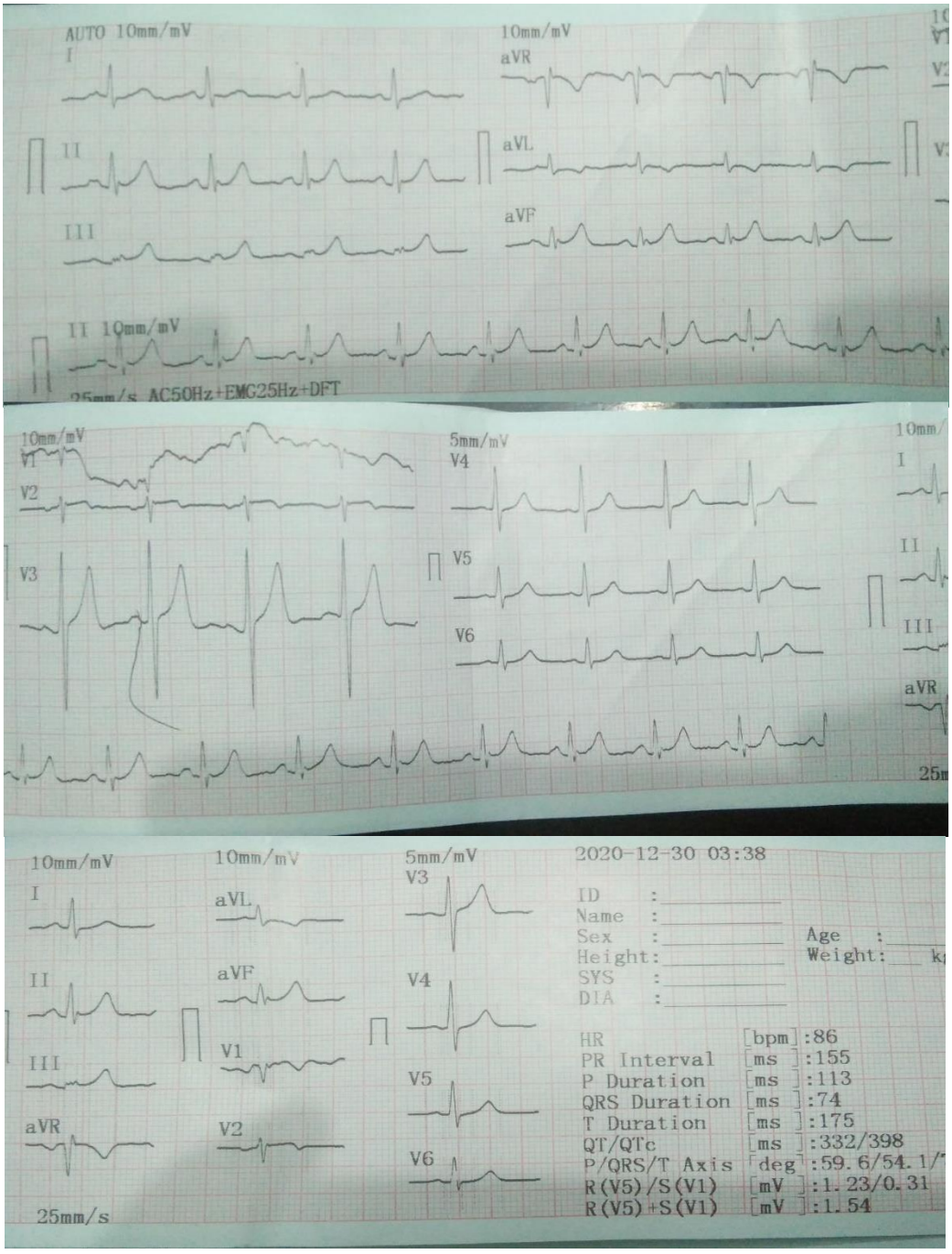


Figure 5.3(d): Doctor referred ECG report

5.4 Cost Analysis

This paper proposes a low cost and portable patient monitoring system for e-Health services in Bangladesh. NodeMCU based system has been developed which can be used by nontechnical for collecting different sensor data such as ECG signal, heart beat signal. A web based application has been developed for both doctor and paramedics for efficient communicate with each other. It has been found that the system can be suitable for village health care center of Bangladesh. We glad that, it took very much cheap price to build our project. Our every component is very cheap and the quality is also good. So, everyone can afford it without having any financial headache.

Component	Unit Price
1. NodeMCU	2400
2. SIM 900A GSM Module	1600
3. Pulse Sensor	700
4. ECG Sensor	1300
5. LCD Display	550
6. other	1500
Total	8050

Table 5.4: Cost analysis table

CHAPTER-6

Conclusion

6.1 Conclusion

6.2 Challenges

6.3 Future works

CHAPTER-6
Conclusion

6.1 Conclusion

Our main objective in this project was to successfully monitor the pulse rate, ECG curve and live monitoring the patient during sick situation without any human interaction. We wanted to make a mark on the field of health sector with computer science technology. With the rise of computer science technology, the era of technology is moving towards a far superior dimension. In order to keep pace with the new technologies, this project can sure make way for the advancement in this sector. Though our model is tested and implemented, it will be difficult to continue the project without superior quality hardware support along with a lot of new integration. The real benefit of this work can only be fully realized when it can be implemented in full scale.

In general health care platform which connects with smart sensors attach with human body for health monitoring for daily checkup. The system technologies being used by smart devices or gadgets in present time where we also mentioned about advantages, challenges and opportunities. Due to the importance of observing medical patient, continuous remote monitoring is necessary. Our project work is giving the opportunity to monitor patient continuously by using the web application along with live monitor and mobile message service. This project also compared the early aged medical system between present time health monitoring. The present time represents the time reducing, reduce health care cost especially for rural area people.

6.2 Challenges

There are three basic challenges we face during the project implementation.

ESP-8266 WiFi Module

The wifi module works in its own specific language. So, we had to face a lot problem regarding the ways of its language. Sometimes the wifi module itself cannot with the local network as a result the data sending got interrupted many a times. So, a better hardware support for wifi module is expected to send data smoothly.

Pulse Sensor

The data that is retrieved from the pulse sensor can give some error reading sometimes. Better pulse sensor are not available in our country. And the data comparison of the local and foreign sensor was noticeable. This delayed our implementation of the project in some ways as pulse sensor is an integral part of this project.

6.3 Future works

- Integrating more sensors for more specific data acquisition and analysis.
- Will be applicable in army services in active situation.
- Will be used to provide health service to rural areas in affordable price.
- Huge database will be built for doctors to diagnose people from different areas and cultures.

In software segment we will upgrade the Website as well as the Apps. We will build a user friendly feature in the website which will show the patient name, previous analytical observation, description in the ECG segment automatically. We will be develop an app and uploaded in the Play store for hand to hand monitoring. Therefore, people will get the opportunity to download the Apps from Google Play Store and install it in their Mobile phone.

Our project can be considered as platform to develop in the field of IoT on the health sector. In developing countries like ours, this kind of innovative and cost effective project can improve the future of technology. So, we are looking forward to implement the project in order to make an impact in the new era of technology.

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Structural health monitoring of civil infrastructure using wireless sensor networks.

APPENDIX-A

Pin Description:

NodeMCU ESP8266

The NodeMCU ESP8266 development board comes with the ESP-12E module containing ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects.

NodeMCU can be powered using Micro USB jack and VIN pin (External Supply Pin). It supports UART, SPI, and I2C interface.

The ESP8266 NodeMCU has total 17 GPIO pins broken out to the pin headers on both sides of the development board. These pins can be assigned to all sorts of peripheral duties, including:

- ADC channel – A 10-bit ADC channel.
- UART interface – UART interface is used to load code serially.
- PWM outputs – PWM pins for dimming LEDs or controlling motors.
- SPI, I2C & I2S interface – SPI and I2C interface to hook up all sorts of sensors and peripherals.
- I2S interface – I2S interface if you want to add sound to your project.

There are four power pins viz. one VIN pin & three 3.3V pins. The VIN pin can be used to directly supply the ESP8266 and its peripherals, if you have a regulated 5V voltage source. The 3.3V pins are the output of an on-board voltage regulator. These pins can be used to supply power to external components.

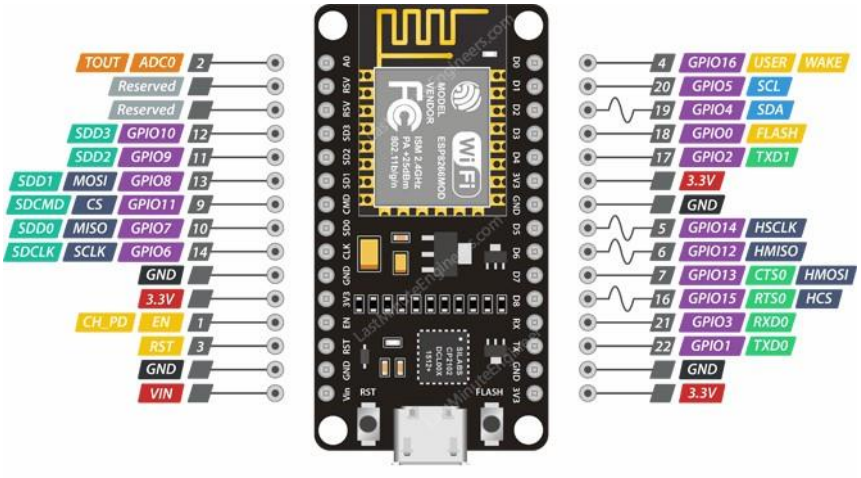

Figure 3.5.1: NodeMCU ESP8266

SIM 900A GSM Module

This is an ultra compact and reliable wireless module. The SIM900A is a complete Dual-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications allowing you to benefit from small dimensions and cost-effective solutions. Featuring an industry-standard interface, the SIM900A delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3 mm, SIM900A can fit almost all the space requirements in your applications, especially for slim and compact demand of design.

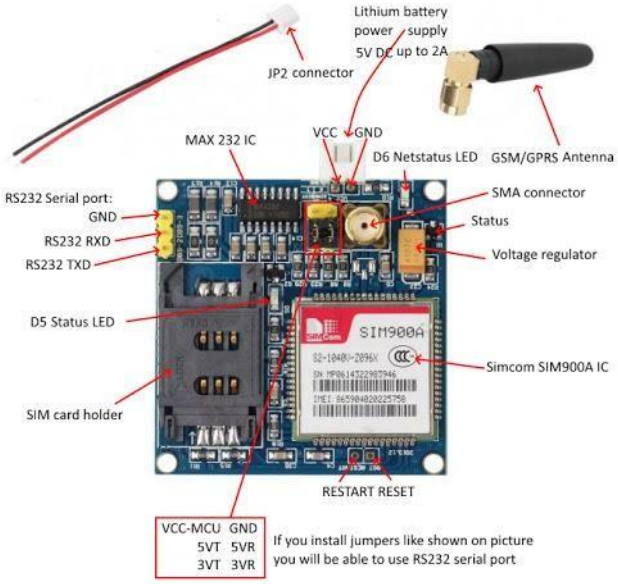

Figure 3.5.2 SIM 900A GSM Modules

ECG Sensor

The ECG sensor is a commercial board used to calculate the electrical movement of the human heart. This action can be chart like an Electrocardiogram and the output of this is an analog reading. Electrocardiograms can be very noisy, so to reduce the noise the AD8232 chip can be used. The working principle of the ECG sensor is like an operational amplifier to help in getting a clear signal from the intervals simply.

An ECG Sensor with disposal electrodes attaches directly to the chest to detect every heartbeat. The electrodes of ECG sensor will convert heart beat to electric signal. ECG sensor is very light weight, slim and accurately to measures continuous heart beat and shows data rate of heart beat. The AD8232 is a little chip used to measure the electrical activity of the heart. The electrical activity can be charted as an ECG or Electrocardiogram.

Features

The AD8232 module breaks out nine connections from the IC that you can solder pins, wires, or other connectors to. SDN, LO+, LO-, OUTPUT, 3.3V, GND provide essential pins for operating this monitor with an Arduino or other development board. Also provided on this board are RA (Right Arm), LA (Left Arm), and RL (Right Leg) pins to attach and use your own custom sensors. Additionally, there is an LED indicator light that will pulsate to the rhythm of a heart beat.

Figure 3.5.3: ECG Sensor

Pulse Sensor

A pulse wave is the change in the volume of a blood vessel that occurs when the heart pumps blood, and a detector that monitors this volume change is called a pulse sensor. The working of the Pulse/Heart beat sensor is very simple. The sensor has two sides, on one side the LED is placed along with an ambient light sensor and on the other side we have some circuitry. This circuitry is responsible for the amplification and noise cancellation work. The LED on the front side of the sensor is placed over a vein in our human body. This can either be your Finger tip or you ear tips, but it should be placed directly on top of a vein.

Now the LED emits light which will fall on the vein directly. The veins will have blood flow inside them only when the heart is pumping, so if we monitor the flow of blood we can monitor the heart beats as well. If the flow of blood is detected then the ambient light sensor will pick up more light since they will be reflect ted by the blood, this minor change in received light is analysed over time to determine our heart beats.

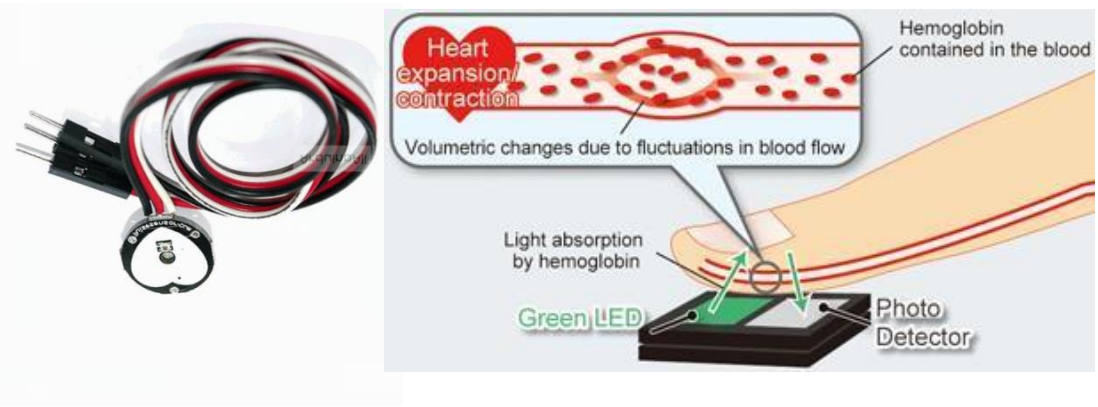

Figure: Heartbeat Sensor

Power Adapter

The 12 Volt Power Supply Adapter is a throwback to the early days of electronics when 12V was a common battery output voltage. In order to run our project we need 5V 1A power adapter to connect with NodeMCU and to connect with GSM module we are using 5V 2A power supply

Figure: Power Adapter

LCD Display

A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. ... 20x4 means that 20 characters can be displayed in each of the 4 rows of the 20x4 LCD, thus a total of 80 characters can be displayed at any instance of time.
Features

- Character LCD 20x4
- 5x8 dots includes cursor
- Bulit-in controller (RW1063 or Equivalent)
- +5V power supply (Also available for +3V)
- Negative voltage optional for +3V power supply
- 1/16 duty cycle
- LED can be driven by PIN1, PIN2, PIN15, PIN16 or A and K

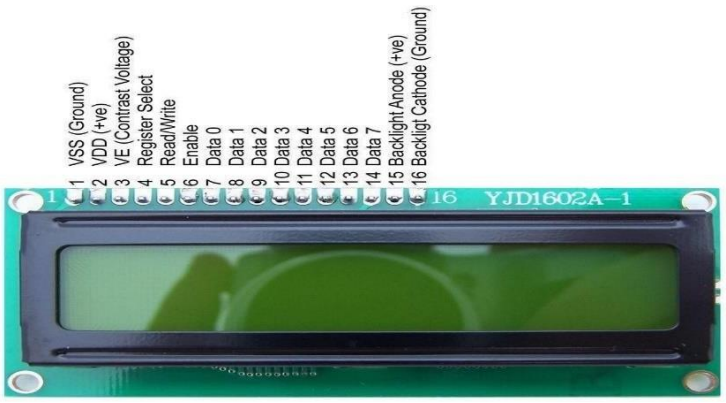

Figure: LCD Display

Jumper Wire

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with bread boards and other prototyping tools in order to make it easy to change a circuit as needed Jumper wires are used for making connections between items on the PCB and NodeMCU's header pins. It is required to use them to wire up all the circuits.

Figure: Jumper Wire

Laptop

In order to do coding, monitor data we need a laptop or computer to browse.

Figure: Laptop

APPENDIX-B

Source Code:

In software implementation, we integrate software part with our hardware part. Our hardware part we have Arduino, ECG sensor, Heart Beat Sensor, GSM Module and LCD display. To implement hardware part, we have to write code part. In our coding part, heart bit pin initialized in pin 7, heart beat button initialized in pin 6, ECG button initialized at pin 2. At the initial stage, value of ECG and Heart Beat is 0. There is a method setup which is used for set up the LCD's number of columns and rows. In here, button is taking as input. There is a call back method which is used for not interrupt when heart beat is counting for 20 seconds. It is execute in 1 second after by after.

In the hbeat method, which is used to set read the heart beat from the hardware. Heart beat count for 20 seconds and here, heat bit pin is high and start to calculate the value. Heart beat value is count here for 60 seconds or 1 minute.

After that, in send hbeat method start to upload the heartbeat.. "AT+CMGF=1\r" command line is used for set GSM modem in text mode. It is a readable text. "AT + CMGS =" command is used for write the mobile number where the SMS will show from the GSM module.

In up Heartbeat method, AT+SAPBR=3, 1, command is used set the connection with GPRS and connect the APN of the website. "AT+HTTPINIT" command initializes the HTTP services to the server. "AT+HTTPACTION=0" command line for use enter button and "AT+HTTPREAD" command line is used for read the data from the page. AT+HTTPPARA AT command sets up HTTP parameters for the HTTP call.

```
#include <ESP8266WiFi.h>
#include <LiquidCrystal_I2C.h>
#include <Wire.h> int id=1;
LiquidCrystal_I2C lcd(0x27, 16, 2);
//////////////////////esp////////////////////////////  const  char*  ssid          = "isteaque"; const char*
password = "isteaque@@355"; const char* host = "pms.mascoders.com";
//////////////////////gsm////////////////////////////
#include <SoftwareSerial.h>
SoftwareSerial Gsm(9, 10);
char phone_no[] = "+8801536138514";
////////////////////////////////
int sensorPin = A0;                          // A0 is the input pin for the heart rate sensor float
sensorValue = 0;                         // Variable to store the value coming from the sensor int
count = 0;
unsigned long starttime = 0; int heartrate = 0; boolean counted = false; int BPM;

void setup (void) {
  Serial.begin (115200);

  delay(100);
```

```
  Serial.println();
  Serial.println();
  Serial.print("Connecting to ");
  Serial.println(ssid);
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {      delay(500);
    Serial.print(".");
  }

  Serial.println("");
Serial.println("WiFi connected");
Serial.println("IP address: ");
Serial.println(WiFi.localIP());
Serial.print("Netmask: ");
Serial.println(WiFi.subnetMask());
Serial.print("Gateway: ");
Serial.println(WiFi.gatewayIP());

  delay(500);
  ////////////////////////////////
  Wire.begin(D2, D1);

  Gsm.begin(115200);
  Gsm.print("AT+CMGF=1\r"); delay(300);
  Gsm.print("AT+CNMI=2,2,0,0,0\r"); delay(500);
}

void loop () { starttime = millis();
  while (millis() < starttime + 2000)              // Reading pulse sensor for 5 seconds
  {
    sensorValue = analogRead(sensorPin);
    if (sensorValue > 514 && counted == false) // Threshold value is 514
    {       count++;
      //Serial.print ("count = ");       //Serial.println (count);       delay (20);       counted = true;
    }
    else if (sensorValue < 510)
    {
      counted = false;
    }  }
  heartrate = count * 12;

  Serial.println ();
  Serial.print ("BPM = ");
  Serial.println (heartrate);                       // Display BPM in the Serial Monitor
  Serial.println ();
```

```
  ////////////////////////// lcd.begin(); lcd.home(); lcd.print("BPM ="); lcd.println(heartrate);
  ////////////////////////////////// count = 0;
  ////////////////////////////////////
  Serial.print("connecting to ");
  Serial.println(host);

  WiFiClient client;     const int httpPort = 80;     if (!client.connect(host, httpPort)) {
Serial.println("connection failed");     return;
  }
  String b = String(heartrate);
String url = "/addheartbeat.php?id=1&heart_beat="+b;

  Serial.print("Requesting URL: "); Serial.println(url);
  client.print(String("GET ") + url + " HTTP/1.1\r\n" +
               "Host: " + host + "\r\n" +
               "Connection: close\r\n\r\n");


  delay(500);

  ////////////////////////////////////////// while (client.available()) {
    String line = client.readStringUntil('\r');
    Serial.print(line);
  }

  Serial.println();
  Serial.println("closing connection"); delay(3000);
  ////////////////////////////////////
  bool newData = false; unsigned long chars; unsigned short sentences, failed;

  Gsm.print("AT+CMGF=1\r"); delay(400);
  Gsm.print("AT+CMGS=\"");
  Gsm.print(phone_no);
Gsm.println("\""); delay(300);
  Gsm.print(" ");
  Gsm.print("HB=");
  Serial.print(" "); Gsm.print(heartrate); delay(200);
  Gsm.println((char)26); // End AT command with a ^Z, ASCII code 26     delay(200);
Gsm.println(); delay(2000);
}
```

For up ECG method is also same command line as the heart beat method. Here, ECG count is used for check ECG rate in 50. If this ecg count is smaller than 50, than ecg count send analog data to the web server to show the ECG curve.

```
#include <ESP8266WiFi.h> String ECG;
const char* ssid     = "isteaque"; const char* password = "isteaque@@355"; const char* host
= "pms.mascoders.com"; int user_id=18;
String id = String(user_id); void setup()
{
  // initialize the  serial communication:    Serial.begin(115200);    pinMode(D1, INPUT); //
Setup for leads off detection LO + pinMode(D2, INPUT); // Setup for leads off detection LO
- Serial.println();
  Serial.println();
  Serial.print("Connecting to ");
  Serial.println(ssid);


  WiFi.begin(ssid, password); while (WiFi.status() != WL_CONNECTED) {
    delay(100);     Serial.print(".");
  }

  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
  Serial.print("Netmask: ");
  Serial.println(WiFi.subnetMask());
  Serial.print("Gateway: ");
  Serial.println(WiFi.gatewayIP());

  delay(100);
}

void loop() {
Serial.print("connecting to ");
Serial.println(host);

  WiFiClient client;      const int httpPort = 80;      if (!client.connect(host, httpPort)) {
Serial.println("connection failed");     return;
}
String ecgdata = String(ECG);
  String url = "/addecg.php?id="+id+"&ecg="+ecgdata;

  Serial.print("Requesting URL: ");
  Serial.println(url);

  ////////////////////////////////////////////
```

```
  ////////////////////////////////////////////

  if ((digitalRead(D1) == 1) || (digitalRead(D2) == 1)) {
    Serial.println('!');
  } else {
    // send the value of analog input 0:
    ECG=analogRead(A0);       Serial.println(ECG);       client.print(String("GET ") + url + "
HTTP/1.1\r\n" +
                "Host: " + host + "\r\n" +
                "Connection: close\r\n\r\n");


    delay(170);
  }
  //Wait for a bit to keep serial data from saturating   delay(100);      while (client.available())
{     String line = client.readStringUntil('\r');
    Serial.print(line);
  }

  Serial.println();
Serial.println("closing connection");

}
```