Department of Electrical and Computer Engineering
North South University

Senior Design Project

REMOTE HEALTH MONITORING SYSTEM

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Fall, 2019

DECLARATION

This is to certify that this project is our original work. No part of this project's work has been submitted elsewhere partially or fully for the award of any other degree or diploma. Any material produced in this project has been properly acknowledged.

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APPROVAL

We, Najmus Sakib Borson (1610538642), Mayesha Tasnim (1520254642), Faysol Akib (1420093042), members of CSE/EEE/ETE: 499 (Senior design) from the Electrical and Computer Engineering department of North South University have worked on the project titled “REMOTE HEALTH MONITORING SYSTEM” under the supervision of Dr. Atiqur Rahman as a partial fulfillment of the requirement for the degree of Bachelor of Science in Engineering and has been accepted as satisfactory.

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ACKNOWLEDGEMENT

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ABSTRACT

Remote health monitoring is beneficial to patients in a way that the process or implementation will save the hospital bills, waiting time as we do not have to go and wait in line before our time comes also it reduces time complexity in the hospitals. The system is designed in such a way that a patient can be monitored remotely in real time. To complete this project, we needed sensors which measures body temperature, heart rate controlled by the microcontroller. Readings can be seen from a distant place or from anywhere around the world. This will help the health professionals to observe critical patient on a continuous basis and tracking their health issues. Many projects on this topic have been done throughout the world which are quite complicated as well as expensive to implicate in real life. But we propose a system which is financially feasible and easy to implement. This project is all about exploring Improved services for patients. Monitoring patients properly is a vital part and hence remotely monitoring and raising awareness in an authenticated manner is the purpose behind this Project. Hence, the main objective of the proposed project was to collect data through Arduino microcontroller and transfers it to the cloud where it is further processed and analyzed.

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CHAPTER 1: Overview

1.1 Introduction

Using of IoT devices in modern medical services brought about a revolutionary change in the whole system. On different sectors, ioT is taking the job load of human beings and doing it with great glory. It is helping us get the work done with great speed as well as more accurately than ever before. On this project, we have proposed a system that will measure different health parameters (Heart rate, body temperature, ECG signal etc.) remotely. It will help the doctors to monitor critical patients and to those people who needs to be under doctor's supervision continuously. This is a reliable and efficient real-time remote patient monitoring system that will play an important role in providing better care for the patients. IoT based systems is a growing concept where it is creating a huge effect on people nowadays because in our day to life people are too much conscious regarding their health as we are being affected by serious diseases. Starting from cardiovascular diseases to many other such problems which leads to much bigger problems, that is why regular consultation with doctors and keeping updated with their own health is a common thing we see today. Hence to make it easier IoT based system is becoming more popular.

1.2 Purpose of this project

Technology wise patient monitoring system is one of those biggest developments because of its innovative technology. An automatic Wireless Health Monitoring System is used to measure body temperature and heart rate using this technology. In hospitals we see that everyday staff members are checking a patient's body temperature constantly and keeps a record so with the help of this ioT based technology we can make life easier as people now do not have to rush to hospitals in every interval. We also see that as all rushes together at a time, patients are not being handled properly or taken care of efficiently so this can also be reduced. The need for a cost-effective and fast responding mechanism is very important to cope up with patients. It will be a very handy tool as it shows all the data collection and information via the internet, so it removes the stress of bringing the patient to the hospital for a check-up on a regular Basis. This project reduces unnecessary costs for hospital stays or admissions, moreover we will get an error free result and more approximate result without any cause of human error. Most of the people specifically the old aged people they usually prefer to stay at home rather than visiting hospitals, so to make their life easier, this is the best way to get a proper result of health issues in hand.

1.3 Project Goal

The basic goal is to make sure that via this technology maximum benefits is served to those in need. The whole system should be sustainable prior to future improvements without creating any problems with the current scenario of the treatments provided to the patients. Entire thing is designed using minimum number of components also main objective is to make it user-friendly so that even people with zero technical knowledge can also use it. Health sector can be made strong and beneficial to everyone, in this way the technological sector can also be improved with time. Health care is all about taking care of the patients and their needs and most of the time it is observed that patients feel uncomfortable to move freely and visit doctors, thus this is a way it can resolve all the problems and people can do a regular check-up on their own and use the real time data to analyze what can be done next in order to overcome the problems.

Chapter 2: Literature Review and Background Study

2.1 Summary of previous works

Life expectancy in most countries has been increasing continually over the several few decades thanks to significant improvements in medicine, public health, as well as personal and environmental hygiene. However, increased life expectancy combined with falling birth rates are expected to engender a large aging demographic in the near future that would impose significant burdens on the socio-economic structure of these countries. Therefore, it is essential to develop cost-effective, easy-to-use systems for the sake of elderly healthcare and well-being. Remote health monitoring, based on wearable sensors and modern communication and information technologies offers an efficient and cost-effective solution that allows the elderly to continue to live in their comfortable home environment instead of expensive healthcare facilities. These systems will also allow healthcare personnel to monitor important physiological signs of their patients in real time, assess health conditions and provide feedback from distant facilities.

Mobile health monitoring to detect physiological deterioration requires technology that can alert a first responder capable of reversing the condition in a timely manner, and be broadly deployed throughout the continuum of care. A wireless on-body digital architecture, sotera's visit mobile system is developed for continuous measurement of different parameters like heart rate or ECG, respiration rate, body temperature and blood pressure. In view of all these, a wireless monitoring system is developed. This system enables the doctor to remotely monitor a patient staying at home. The system enables interactive communication between the patient and the doctor, can remotely direct the course of rehabilitation and treatment. The doctor has access to the biomedical parameters monitored, such as ECG, heart rate, respiration rate, temperature etc. With advances in micro electro mechanical (MEMS) technology, it is possible to implement a self-powered system-on-chip (SOC). In 1992, L.G.linberg and others proposed a new method, which often uses fiber optic probe to monitor heart rate and respiration rate simultaneously [17]. In 1998, J.L. Kalju developed a system, which is capable of measuring different physiological parameters and are used to design a system for heart rate reconstruction for rate adaptive pacing. In 2000, M. Nakagawara & K. Yamakoshi introduced a portable instrument to monitor blood pressure, cardiac output and other cardiovascular variables. In 2001, Loren Schwiebert, Sandeep K.S. Gupta and Jennifer Weinmann described the strength of smart sensors which are developed from the combination of sensing materials along with combined circuitry for other biomedical applications. In 2001,

Eugene Ingshawshih explained the use of wireless microsensors networks for medical monitoring and environmental sensing. In 2002, Gentili G.B proposed a simple microwave technique to monitor the cardiac activity. This technique is dependent on changes in modulation envelope of amplitude modulated waves passing through the body.

Telemedicine would become an important health care procedure in future due to population increment and increment in treatment expenditure. There is a huge number of communication techniques to transfer the data from a point of case to a hospital. But it is unsuccessful when a patient needs to undergo continuous checkups and monitoring. YuM.Chi and Gert cauwenberghs proposed a 3-lead wireless ECG device which uses a remote based WSN to transfer the measured heart rate signals from a patient's body to a PC for monitoring and storage.

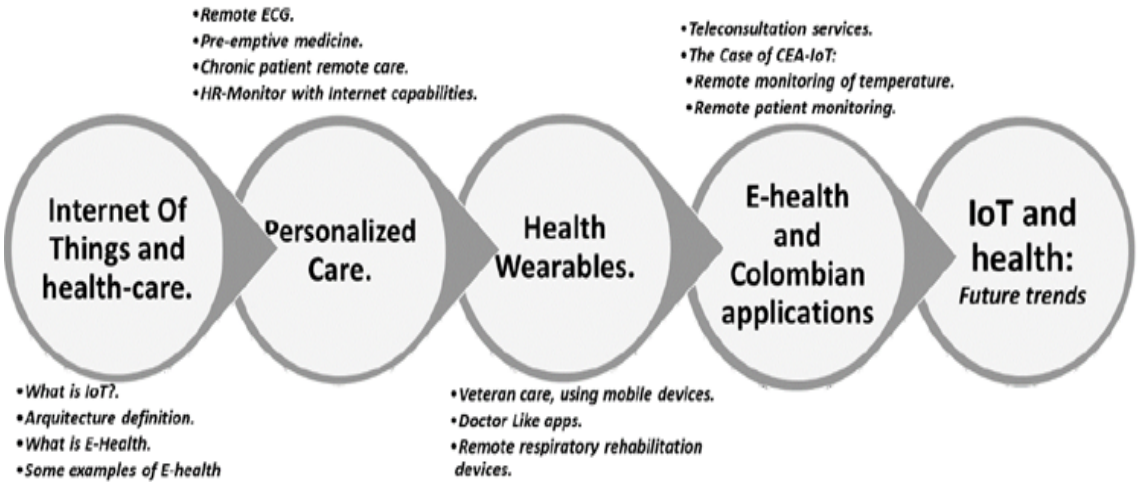


Figure 1 : Uses of IoT in Health

2.2 Existing Solutions

(1) CENSON TECHNOLOGY:

It is a web application for clinicians, so that healthcare professionals can receive measurements, view and analyze patient data, also initiating video calls with the patients to talk and share views regarding their health and prepare clinical workflows. Clinical workflows include questions and requests that what are the health benefits or measurement that particular patient has to take using the devices. Depending

on the current scenario of the health of the patient further instructions are given to carry out the next tests for getting a detailed information about the condition. It is a tablet app where the patients are being guided on how to take measurements. Variety of devices are connected. This technology supports exchanging data with relevant entities. When patients are being able to share health related information through health measurements guide and clinical workflows, CENSON is then able to help their patients with their individual problems. This technology helps the users to monitor better and monitor their own health. Increases mobility for patients as they do not have to get admitted in the hospitals. Evidence based support. Improves quality of life and reduces transportation costs. The mobile app connects to devices through Bluetooth, USB or the internet. With this user-friendly app, they provide the necessities to the patients, like instructions are provided, diagnostic questions are answered, vital signs are monitored and video consultation can also be established. All data collected in the app are then immediately available to the clinicians on the web portal.

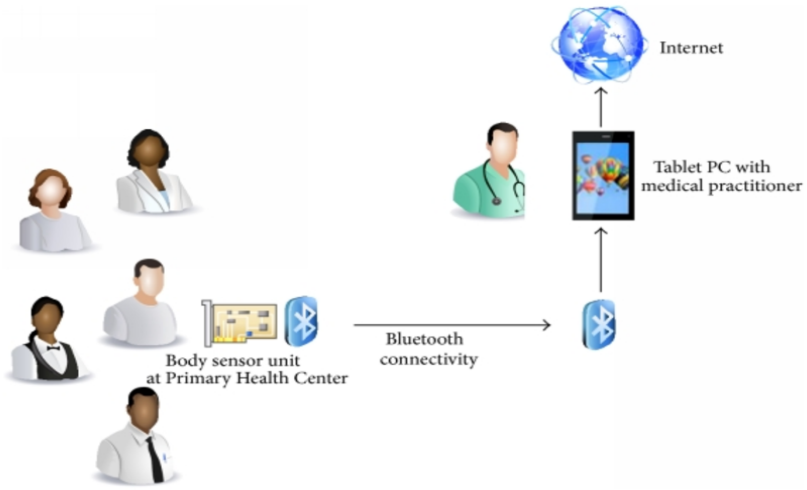


Figure 2 : Censon Technology Diagram

(2) REMOTE HEALTH MONITORING OF ELDERLY PEOPLE USING WEARABLE DEVICES:

Smartphones and wearable devices are used to monitor elderly people using real-time. This improves the efficiency of healthcare by providing more reliable healthcare system that enables home based monitoring. The main task is to monitor physiological data collected from patient's wearable device then those data are recorded in the data center. Sensors will be connected to the patient's body to collect physiological data. Such sensors are measuring vital-sign, such as, blood oxygen saturation, skin

temperature and heart-rate. Monitoring these symptoms in patient's body is very important, for example abnormal blood pressure causes a kidney disease or diabetes.

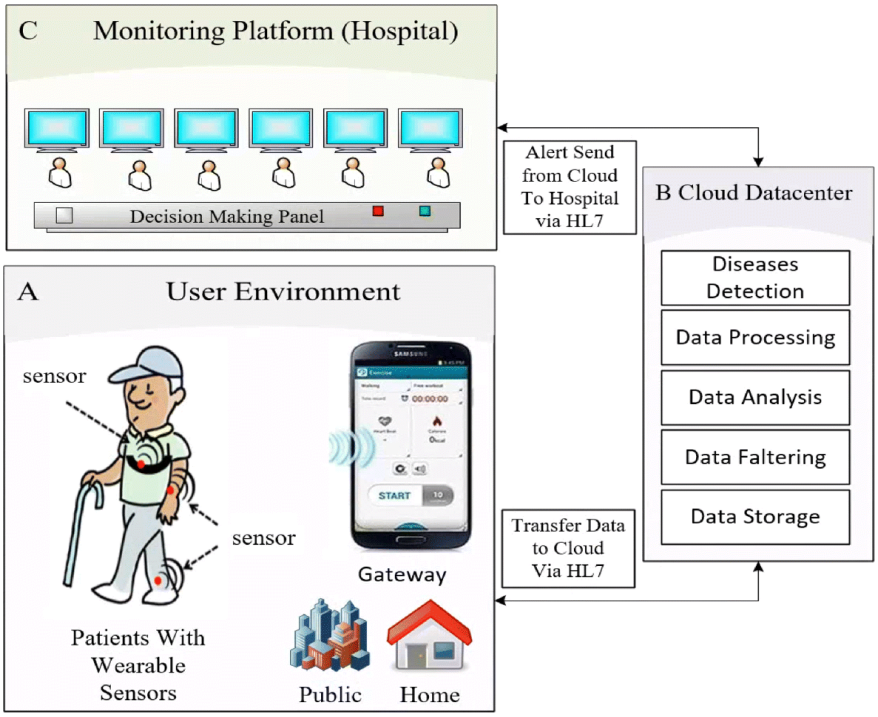


Figure 3 : Remote Health Monitoring Working Diagram

The data are transmitted to patient's smart-phone app via Bluetooth device and ultimately to a cloud database. The Cloud refers to the place where the system data is stored and processed. Cloud receive patient's data from their smartphone over internet to be sorted and then it became available for doctor's inspections. In addition, all data analysis and processing will be held in the cloud for any disorder detection in patient's data thus all the resulted data will be reported either to patient's and doctor's platform or emergency unit or both depend on patient status. The development of the system starts with a database that is able to handle system services and storing patient data. The process of storing and accessing data within the system have two processes. First process involves data encryption/decryption according to the patient's data security. Second process involves data storage. A pulse sensor has been used to measure patient's heart-rate and transfer the data through Bluetooth device to the mobile app. The pulse sensor used to measure heart-rate through an optical heart-rate chip the reading of the sensor sends to patient mobile app through Bluetooth device that is connected to the Arduino.

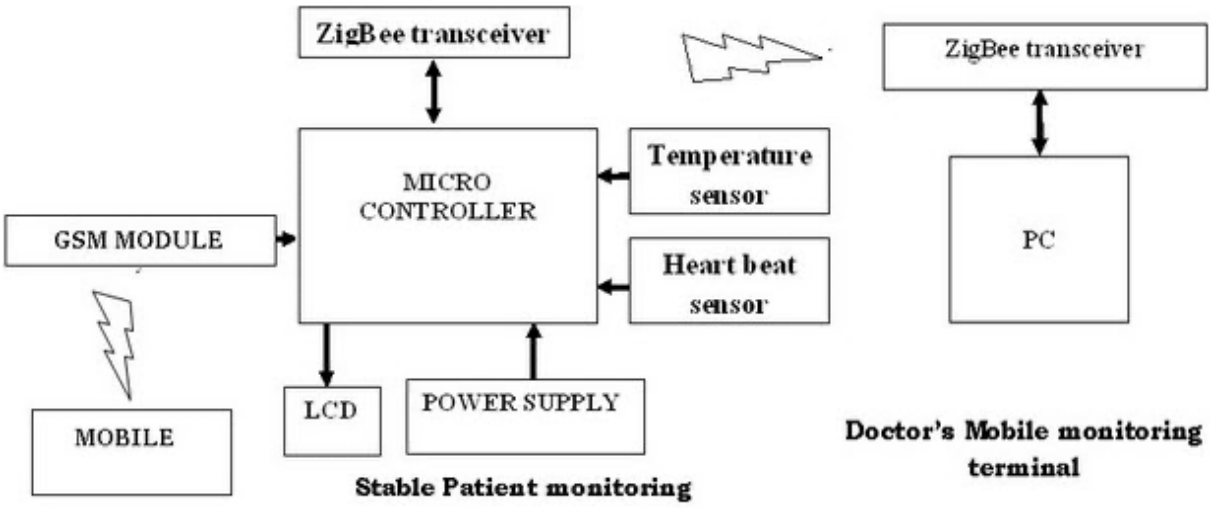


Figure 4 : Data Transmission Diagram

The system consists of a set of biomedical sensors attached with the body of a patient A wireless transmitter is used to send the data. Many sensors are used and those sensors convert the physiological changes of the patient's body into biomedical signals. Arduino reads data from the sensors and controls the transmission of data to a monitoring unit. The data is then displayed that is used by the physicians for necessary medical attention. The data is recorded and analyzed. Wireless receiver consists of Xbee that receives data and then sends to local. It later sends reports and alarming messages to the healthcare professionals, and this is found out when the data does not match with the normal allowable range that is provided by the system. Thus, the system is designed in a way where it can also let the doctors know about any unusual activities in the reports of the patient. The microcontroller receives the signals from the sensors and processes them before sending them to the module. The signal that is received is then transmitted. The receiver antenna receives the data sent by the transmitting antenna and then the data are sent to a PC.

CHAPTER 3: TECHNICAL DESCRIPTION AND IMPLEMENTATION

3.1 Technical Description

The system consists of few major embedded electronics:

1. *ECG Sensor.*
2. *Pulse-Rate Sensor.*
3. *Temperature Sensor.*
4. *Arduino UNO.*
5. *Microcontroller.*
6. *Capacitor.*
7. *Resistors.*
8. *Jumper Wires.*
9. *Laptop.*

Heartbeat Sensor is an electronic device that is utilized to check the pulse for example the speed of the heartbeat. Patient will touch the Pulse-rate sensor, and then the sensor's ray will count the beat from blood flow. After counting beat from blood flow, we will push the button Pulse Beat and wait for a few seconds. The result will upload and the heartbeat value will show in the display. For implementing the function of ECG sensor, the sensor will be attached to the patient's chest and push the button 'ECG'. In meanwhile, it will generate the ECG curve and the result will be displayed. Body temperature is one of the vital signs that can reflect health conditions, body temperature increases in infections and in other inflammatory conditions. It is often measured manually at a frequency ranging from once every few hours to once a day, there is always a need to have a monitoring system to improve the quality of healthcare, such as temperature monitoring of elderly and challenged persons using a wireless remote temperature monitoring system.

3.2 Workflow of Electrical components

The Arduino Uno has 14-digit digital input\output (which 6can be used as PWM output) another 6 analog inputs, a 16 MHz crystal oscillator a USB connection, a power jack, an ICSP header and reset button. Arduino Uno can be connected to a computer with a USB cable or power it with an AC to DC adapter or battery to get it started. In this project we used two microcontrollers, 3 sensors, 2 resistors and one capacitor. Power of 3.3v is used for Temperature and Pulse-Rate Sensors and 5v for ECG. In Arduino there is no built in wi-fi module hence a wi-fi module is also used. In ECG, a transmitter receives physical signals of the heartbeat, processes the data and sends through Wi-Fi. Then the data is transferred by the receiver to the computer. The transmitter uses a microcontroller which detects the patient's pulse and converts it

to a voltage signal and then displayed. The idea is the same with wearable sensors, the difference comes in the fact that here the sensors which detect body temperature, blood pressure or a heartbeat rate are located on the patient's body with no wires.

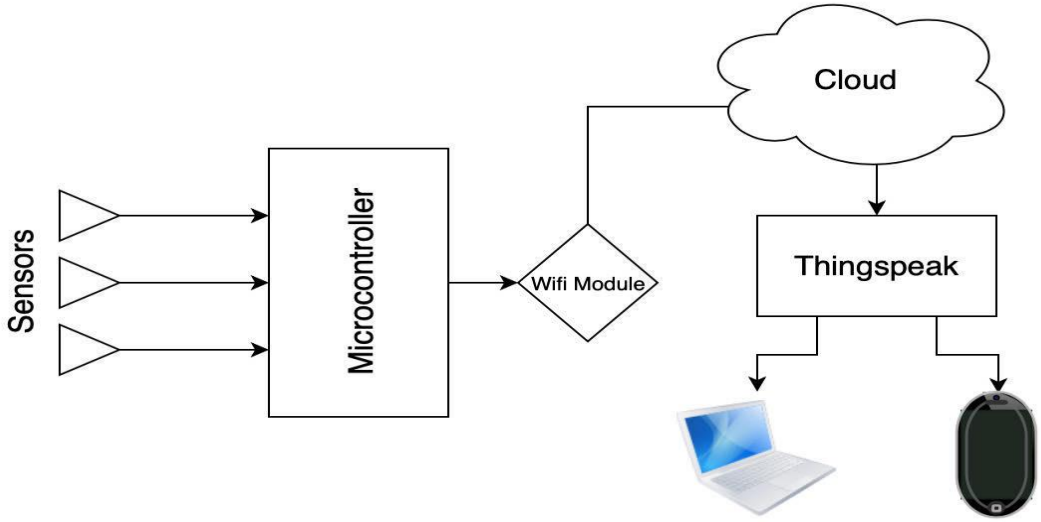


Figure 5 : Block Diagram of the working system

3.3 Hardware Implementation:

To run the system first we need to connect Arduino with the power supply as Arduino is the main control unit. In input side, we have pulse-rate sensor, ECG sensor, temperature sensor. On the other hand, output is shown in the display. The data is uploaded to the cloud once the measurements are taken and we can check the output I in the display. First of all, a finger is placed in the pulse-rate sensor and push button is pressed so that the system can read data. After that, it shows result in the display. Same 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. The device is attached directly to the chest to detect every heartbeat. The electrodes of ecg sensor will convert the heartbeat to electric signal. The same with the temperature sensor which will send the readings to a microcontroller and result is shown.

3.4 Power Flow of Hardware Implementation:

The block diagram below shows the power supply of the components that is used in the entire project. How many volts each component is designed to withstand for the project to run smoothly without destroying the sensors is shown below.

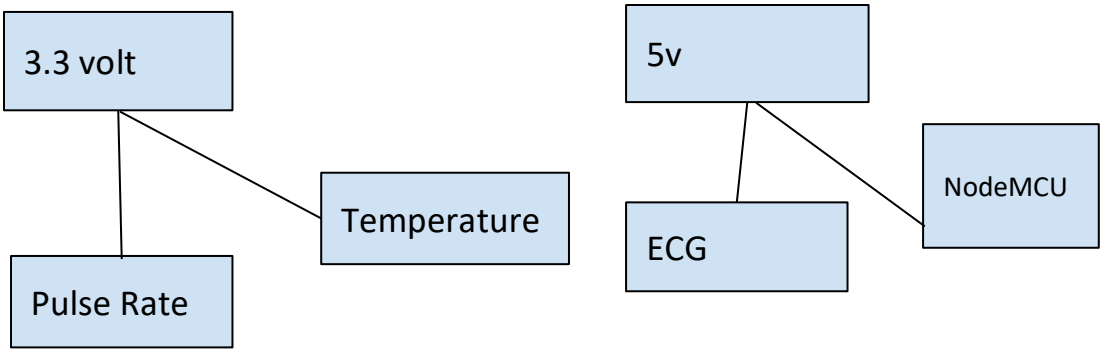


Figure 6 : Power Supply Diagram

3.5 COMPONENTS

To begin with the project, it is very important to know all the information about both hardware specifications. The components we are using are as follows:

3.5.1 Arduino UNO

Arduino is an open-source physical computing platform based on a simple I/O board and a development environment that implements the Processing/Wiring language. It can be used to develop stand-alone interactive objects or can be connected to software on the computer. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. We can tell our board what to do by sending a set of instructions to the microcontroller on the board.

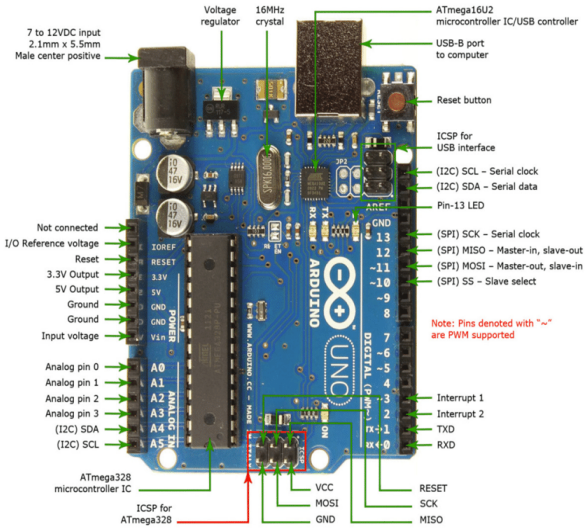


Figure 7 : Arduino UNO pinout

3.5.2 ESP8266 NodeMCU

As the operating voltage range of ESP8266 is 3V to 3.6V, the board comes with an LDO voltage regulator to keep the voltage steady at 3.3V. It can reliably supply up to 600mA, which should be more than enough when ESP8266 pulls as much as 80mA during RF transmissions. The output of the regulator is also broken out to one of the sides of the board and labeled as 3V3. This pin can be used to supply power to external components. Power to the ESP8266 NodeMCU is supplied via the on-board MicroB USB connector.

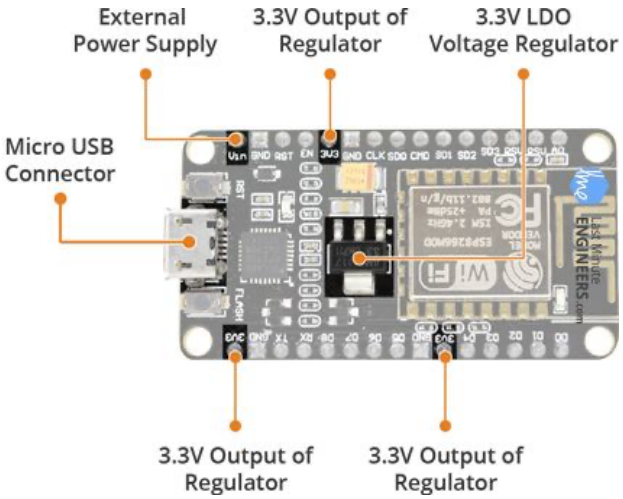
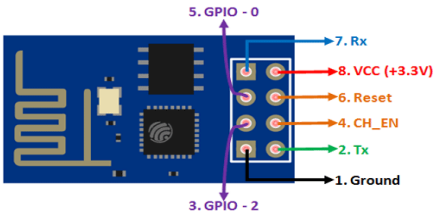


Figure 8 : NodeMCU pinout

The ESP8266 NodeMCU has a total of 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.

- ❏ 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. 1 VIN pin and three 3.3-volt pins. The VIn pin can be used directly to supply the ESP8266 and the peripherals since we have regulated a 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.



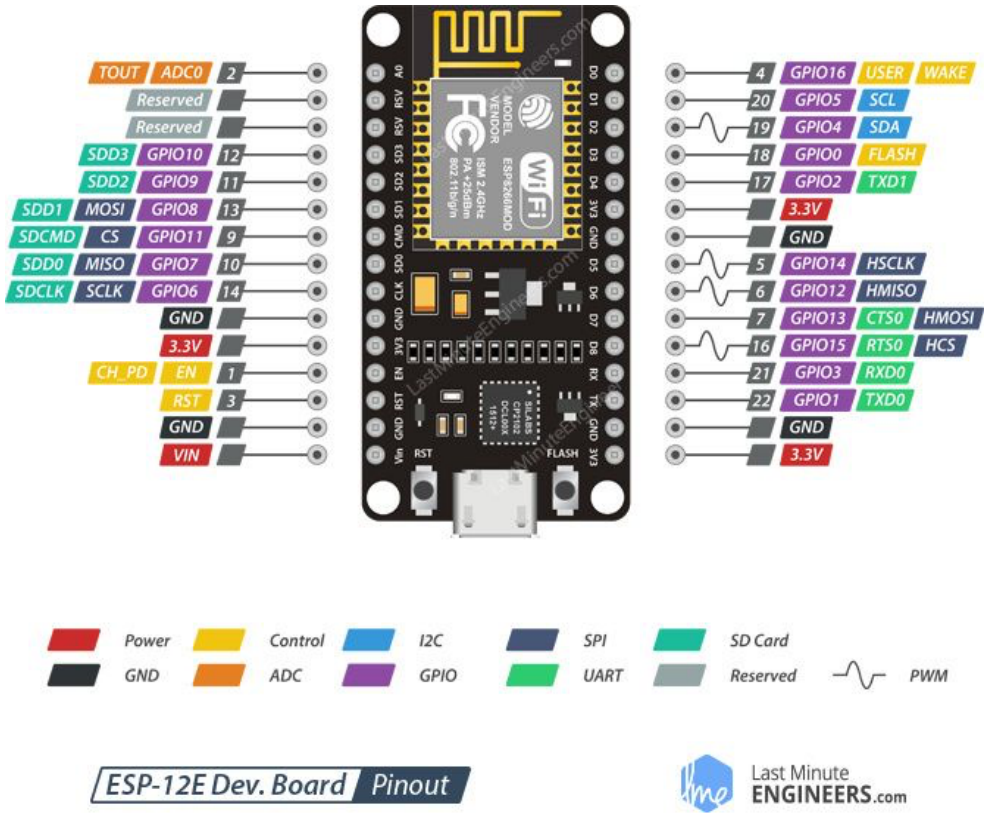


Figure 9 : Pin Configuration of NodeMCU

ESP8266 is the name of the microcontroller and the microcontroller has the ability to perform WIFI related activities hence it is widely used as a WIFI module. The ESP8266 is a very user friendly and low-cost device. The module can both work as an access point that is creating hotspot and can be connected to wi-fi. Hence it can easily fetch data and upload it to the internet making IOT as easily as possible. It can also fetch data from the internet using API's hence the project could access any information that is available in the internet, thus making it much smarter. The module can be programmed using the Arduino UNO which makes it a lot more user friendly.

ESP8266 features includes low cost, compact and very powerful. It has a power supply of 3.3v, current consumption 100mA, I/O Voltage of 3.6 volt maximum and I/O source current: 12mA (max). It contains 512KB of flash memory and supports serial communication hence compatible with many big platforms.

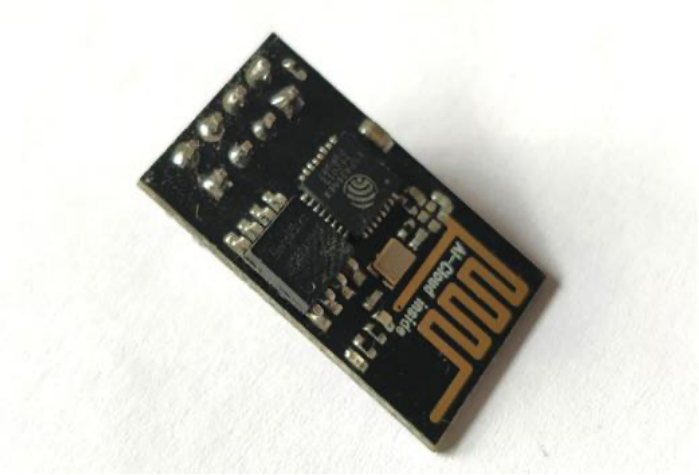


Figure 10 : ESP-8266 wifi module

3.5.3 Pulse-Rate sensor

The working of the pulse/ heartbeat 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. 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 light since they will be reflected by the blood, this minor change in received light is analyzed over time to determine our heart Beats.

Further application of this sensor includes:

(1) Sleep tracking.
(2) Anxiety Monitoring.
(3) Health Bands.
(4) Advanced gaming consoles.
(5) Health Monitoring Alarm System.

Figure 11 : Pulse Rate Sensor

Pin Number	Pin Name	Wire color	Description
1	Ground	Black	Connect to ground
2	Vcc	Red	Connect to 5/3.3v supply voltage
3	Signal	Purple	Pulsating output signal

Table 1 : Pin Configuration of Pulse Rate Sensor

3.5.4 ECG AD8232 Module

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 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. Electrocardiography is used to help diagnose various heart conditions.

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 using our own custom sensors. Additionally, there is an LED indicator light that will pulsate to the rhythm of a heartbeat.

An ECG is a digital recording of the electrical signals in the heart. It is also called an electrocardiogram or an EKG. The ECG is used to determine heart rate, heart rhythm and other information regarding the heart's condition. ECGs are used to help diagnose, heart attacks, pacemaker function and heart failure. ECG can be analyzed by studying components of the waveform. These waveform components indicate cardiac electrical activity.

Figure 12 : ECG sensor

This sensor is a cost-effective board used to measure the electrical activity of the heart. This electrical activity can be charted as an ECG or Electrocardiogram and output as an analog reading. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an op amp to help obtain a clear signal from the PR and QT Intervals easily.

3.5.5 Temperature Sensor

The DS18B20 digital thermometer provides 9-bit to 12-bit Celsius temperature measurements and has an alarm function with nonvolatile user-programmable upper and lower trigger points. The DS18B20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for

communication with a central microprocessor. Each DS18B20 has a unique 64-bit serial code, which allows multiple DS18B20s to function on the same 1-Wire bus. Thus, it is simple to use one microprocessor to control many DS18B20s distributed over a large area.

It requires only the data pin connected to the microcontroller with a pull up resistor and the other two pins are used for power. The DS18B20 temperature sensor is a one-wire digital temperature sensor. This means that it just requires one data line (and GND) to communicate with the Arduino.

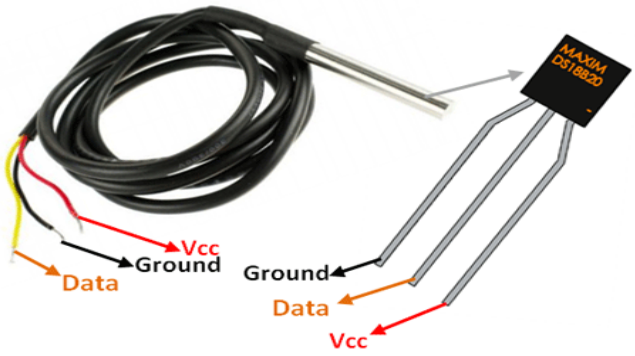


Figure 13 : Temperature Sensor

Number	Pin Name	Description
1	Ground	Connect to the ground of the circuit.
2	VCC	Powers the Sensor, can be 3.3V or 5V.
3	Data	This pin gives output the temperature value which can be read using 1-wire method.

Table 2 : Temperature Sensor Pinout

Applications:

~~ Industrial System.

~~ Thermally Sensitive Systems.

~~ Thermometers.

~~ Thermostatic Controls.

~~ Consumer product

CHAPTER 4: CONNECTION SETUP

Arduino is connected with the ECG and Temperature sensor and we used two microcontrollers that is nodeMCU. Microcontroller is used for the pulse rate sensor because in Arduino there is no built in wi-fi available but in nodeMCU it is already present that is why we used ESP8266 through which data is passed in the cloud. At first, we started with nodeMCU only but it is not analogue, output is only one so we could only use one sensor and not multiple sensors also we only data of that sensor could have been passed in the cloud so we used Arduino later. Two pull up resistors are used one is 4.7 kilo-ohm another is 1 kilo-ohm. We used one capacitor that is 10 micro-farads, capacitor is mainly used for noise reduction in the output signal. Pulse rate sensor is connected with the output signal. Voltage of each sensor are as follows: 3.3v for pulse rate, 5v for ECG and 3.3v for temperature sensor. The whole circuit will work successfully if the entire components connected successfully.

There are many individual components which perform different individual tasks. Connection scenario of individual part with each other and all over the circuit description is given below.

4.1 ECG with Arduino UNO

The AD8232 is a neat little chip that measures the electrical activity of the heart. This electrical activity can be expressed as an ECG or an electrocardiogram. An electrocardiogram is used to help diagnose various heart diseases.

Chip AD8232 which is placed in ECG sensor is a kind of low noise amplifier. In every IC there has some obstacle noise but the advantage of this chip is the obstacle is too low. In ECG sensor there are 3 probes and the reasons for having 3 probes is to create differential amplifier so that it can eliminate noise. AD8232 is placed in a board to perceive the ECG signal, to start producing the output signal from the AD8232 board. The output signal will give approximately 1.5 volts, producing a 1k sample per second. Then, these signals will be sent over the USB from the Arduino.

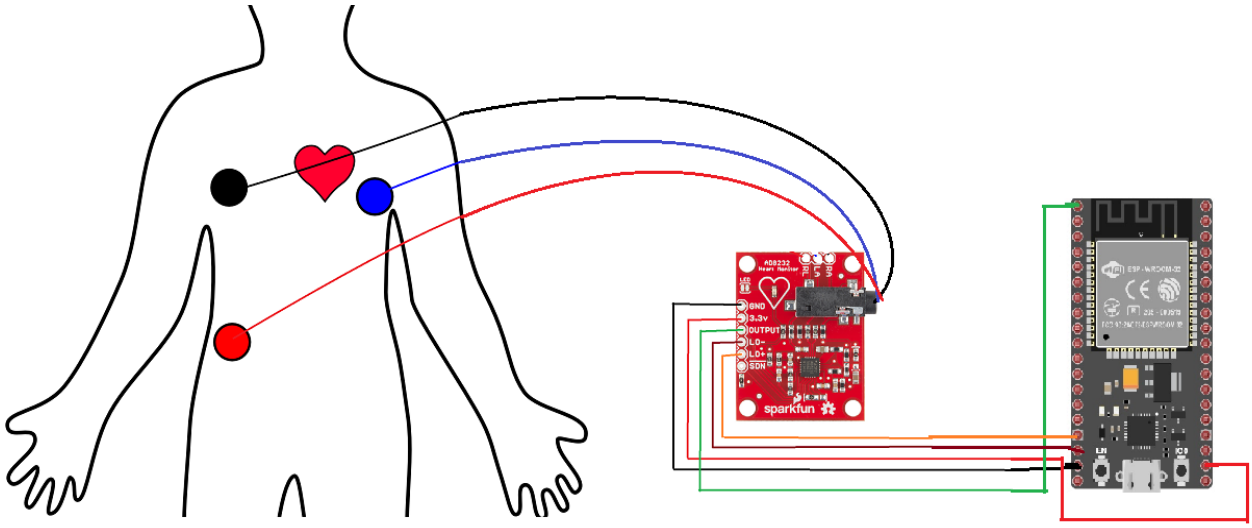
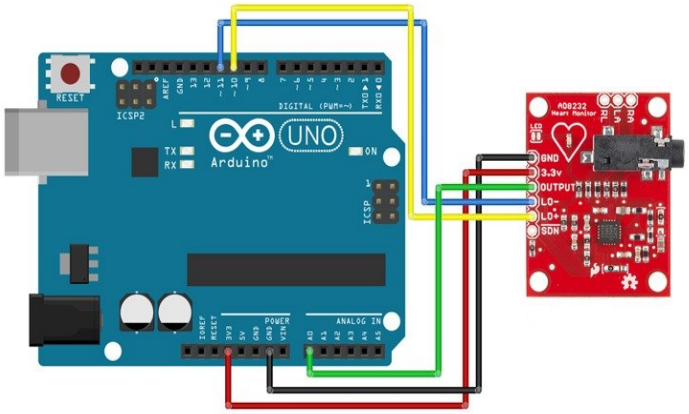


Figure 14 : Connection Setup of ECG

The AD8232 Heart Rate Monitor breaks out nine connections from the IC. We will have to connect five of the nine pins on the board to Arduino. The five pins we need are labeled GND, 3.3v, OUTPUT, LO,and LO+.It is important to snap the sensor pads on the leads before application to the body. The closer to the heart the pads are, the better the measurement.



Board Label	Pin Function	Arduino Connection
GND	Ground	**GND**
3.3v	3.3v Power Supply	**3.3v**
OUTPUT	Output Signal	**A0**
LO-	Leads-off Detect -	**11**
LO+	Leads-off Detect +	**10**
SDN	Shutdown	**Not used**

Figure 15 : ECG Sensor connection and Pin Configuration

4.2 Arduino with Temperature sensor

The temperature sensor will measure temperature in both Celsius and Fahrenheit scale. There are three pins in the sensor. And the pin out is shown on the following picture.

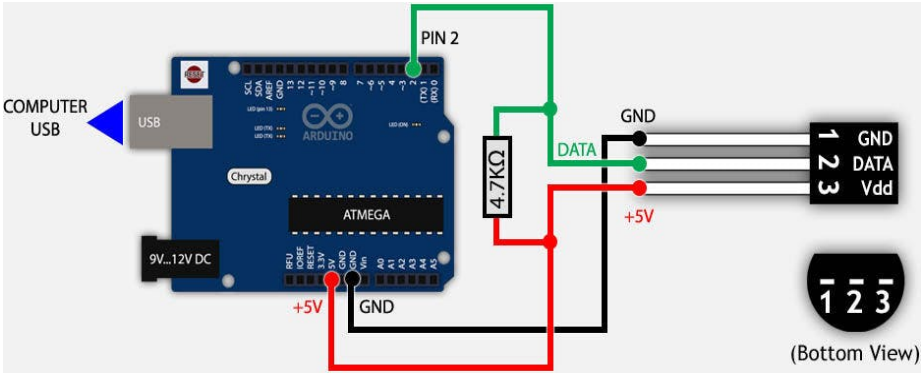


Figure 16 : Connection Diagram of Temperature Sensor

4.3 Arduino connection with Pulse-rate sensor

Here, in this project we made pulse rate monitoring over internet using ThinkSpeak and ESP8266 with Arduino that will detect the pulse rate using the Pulse Sensor and will show the readings in BPM (Beats Per Minute) on the display as well as on the Internet. It will send the readings to ThingSpeak server via Wi-Fi module ESP8266, which can help to monitor the heartbeat via Internet at any part of the world. ThingSpeak is an IOT application and API to store and retrieve data. There is also a LED in the center of this sensor module which helps in detecting the heartbeat Below the LED, there is a noise elimination circuitry which is supposed to keep away the noise from affecting the readings. The ESP8266 is a very user friendly and low-cost device to provide internet connectivity to projects. The module can both create hotspot and can connect to wi-fi hence it can easily fetch data and upload it to the IOT Platform.

CHAPTER 6: TESTING AND RESULTS

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

Pulse rate result analysis:

The standard pulse rate for an adult is 60 to 100 BPM which varies from person to person. In the following figure we can that, our system has detected the pulse rate of a person with a good accuracy.

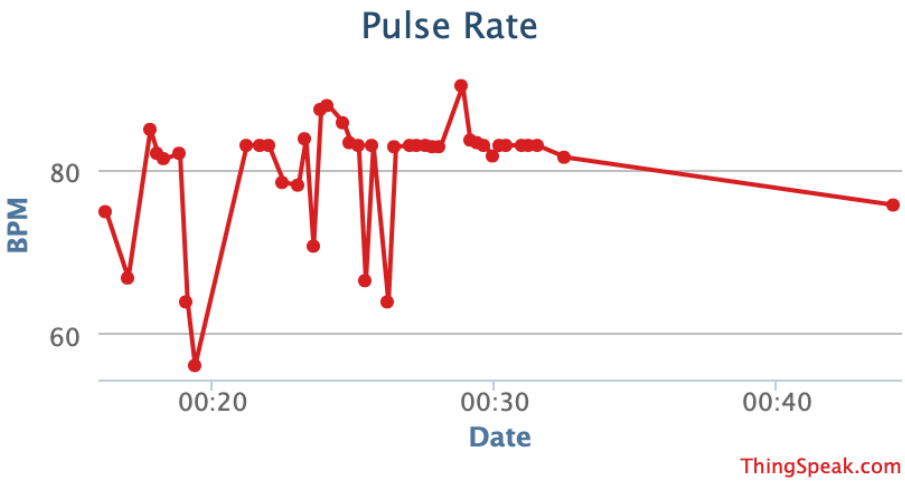


Figure 17 : Pulse Rate Graph

ECG result 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.

Temperature sensor analysis:

The temperature sensor also out performs with a good accuracy. The Sensor works with a precision of +0.5 or -0.5 errors.

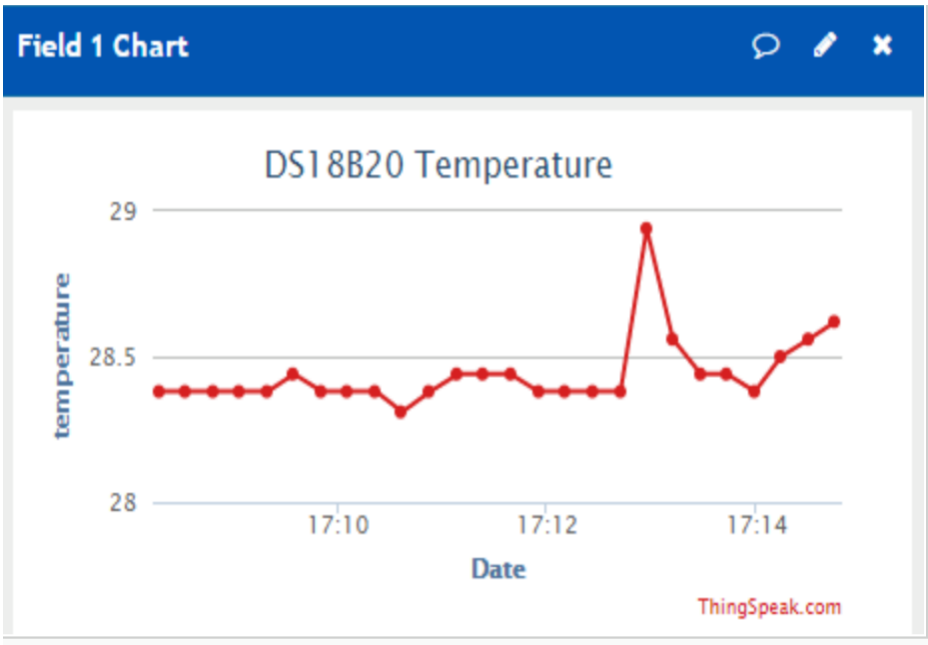


Figure 18 : Temperature Graph

COST ANALYSIS:

In our country like Bangladesh, many new health equipment is found in the hospital. Moreover, most of the best hospital brings health equipment like ECG machine, Laser machine, MRI machine from outside of the country. Therefore, hospital authorities have to pay a large number of costs for bringing the equipment so that they can give the best service to their patients.

But we are 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. It took only approximate 3 thousand taka to build this project.

To build out project, we have used Arduino Uno, NodeMCU, Pulse sensor, ECG sensor, and other components like resistor, capacitor, breadboard and connectors.

CHAPTER 7: CONCLUSION AND FUTURE PLANS

CONCLUSION:

In general, IoT based health care platform which connects with smart sensors attached with human body for health monitoring for daily checkup. We discussed about the technologies used and about IOT based system for patient health monitoring. Due to the importance of observing medical patient, continuous remote monitoring is necessary, this project is all about how it helps people of all kinds to monitor their health regularly and continuously by using the web services provided to them. We can clearly see the difference when comparing the old medical system with the new modern technologies.

The present time shows the time reducing factor where we do not have to rush to hospitals for regular check-ups all the time and can buy ourselves free time. Also reduces health care costs, especially for rural area people.

FUTURE PLANS:

Due to the importance of observing medical state of patients who are suffering from acute diseases, especially cardiovascular diseases, a continuous remote patient monitoring is essential. Internet of Things is able to provide tools to build those services. The things which are done in this proposed system can be upgraded both in hardware and software side for example in hardware pare we can further use as many as sensors or alternative to medical equipment as much as possible for example sensors for measuring diabetes then blood pressure level and many more to make the system as useful as possible. Many more features can be added to improve the accuracy level. In software part as our project was limited to hardware part only and we did not deal with websites or apps so further improvements can be done to this project by creating websites or apps. We can build a user-friendly feature in the website which will show the patient name, date and time description in the ECG segment automatically, similarly
apps can be useful as well if uploaded in the play store where people can download the app and keep it in their phone and use it when needed.