IoT-BASED PULSE RATE AND BODY TEMPERATURE MONITORING SYSTEM.

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering.

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DHAKA, BANGLADESH

DECEMBER 2019

APPROVAL

This Project title, "**IoT-Based Pulse Rate and Body Temperature Monitoring System**" submitted by Md. Rasheduzzaman, ID No: 161-15-7495 and Md. Moniral Awal, ID No: 161-15-7501 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 7th December 2019.

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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Md. Abbas Ali Khan, Lecturer, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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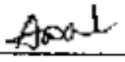

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ACKNOWLEDGEMENT

First we express our heartiest thanks and gratefulness to almighty Allah for His divine blessing makes us possible to complete the final year project successfully.

We really grateful and wish our profound our indebtedness to **Mr. Md. Abbas Ali Khan , Lecturer**, Department of CSE Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of Internet of thing (IoT) to carry out this project. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior draft and correcting them at all stage have made it possible to complete this project.

We would like to express our heartiest gratitude to **Dr. Syed Akhter Hossain**, **Professor and Head,** Department of CSE, for his kind help to finish our project and also to other faculty member and the staff of CSE department of Daffodil International University.

We would like to thank our entire course mate in Daffodil International University, who took part in this discuss while completing the course work.

Finally, we must acknowledge with due respect the constant support and patients of our parents.

ABSTRACT

The Internet of things (IoT) is a system that contains embedded technology or a way of interrelated computing devices that have network connectivity that provides value by allowing them to send and receive data with another connecting device without requiring human-to-human or human-to-computer interaction. The IoT field is increasing every day. People are using IoT device everywhere like home, working place. Every year 15% to 20% IoT device increasing even Industrial Internet of Things (IIoT) say that in 2020 the connected device over IoT will be thirty billion, which is four times larger than the total human being in the world. In the healthcare system, IoT plays a significant rule. A revolution is awaiting in the healthcare industry in form IoT will make these devices like a sensor, actuator, and smart device along with applications that will interact and make health monitoring, diagnostics and treatment more personalized and bring down the cost of the treatment. The IoT market of healthcare is poised to grow at a Compound annual growth rate (CAGR) of 56.27% for the period 2016-2021.The concept of this research project we are developing a device and a smart mobile app, where the device will measure the pulse rate in Bit Per Minute(BPM) and body temperature send data to an internet server and the app will show the data from anywhere through the internet. For this project, we use a pulse sensor to detect pulse rate and temperature sensor to detect body temperature in NodeMCU ESP8266.

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CHAPTER 1
Introduction

1.1 Introduction

The healthcare or health monitoring system IoT has changed the lives of people, especially elderly patients, allowing for constant monitoring of health conditions. This has a big impact on people living alone and their families. The IoT is redefining medical care by ensuring better care, better treatment results and lower patient costs, as well as workflows, improved performance and patient experience for healthcare professionals.

That's why we want to build a live pulse and body temperature monitoring system using pulse sensor, temperature sensor, NodeMCU and Arduino UNO. Heart rate and body temperature are a vital sign of the health parameter directly related to the human cardiovascular system. Pulse rate indicates the number of beats per unit of time, generally expressed in beats per minute (BPM). People's hearts beat to absorb oxygen and rich blood in muscles and transport cellular waste away from tissues and expel carbon dioxide. Normally, pulse rate varies from person-to-person based on their age, physical and mental condition and activity, such as exercise, sleep, anxiety, stress, illness and drug use. The human being who is adult and has a healthy pulse rate between 60 and 100 beats per minute (BPM). While for an athlete, his pulse rate is higher, which is between 120 and 160 BPM and for his children's pulse rate is between 75 and 110 BPM. The temperature of the human body is normal of (36.5–37.5) ° C (97.7–99.5) ° F, Fever (37.5 or 38.3) ° C (99.5 or 100.9) ° F, Hypothermia (35.0°C or 95.0 ° F).

In our Implement device measure pulse rate and body temperature by using the heart sensor. The device heart rate and body temperature is measurable by putting finger above sensor or attaches the sensor anywhere of the body part and count pulse rate within 10 seconds and pulse rate (bpm) can be shown in LCD display or it found in the mobile app using the internet anywhere in the world. Users by using this device will get easier healthcare system for their lives. Anyone will be able to use the device and get services

using an easily understandable user interface. The device is not very cost-effective people get this device around 20$~25$.

1.2 Motivation

One of the general goals of IoT is to give computation power to every object and gives intelligence to them. The healthcare or health monitoring system developed day by day using IoT. For people's medical care, pulse rate, blood pressure, respiratory rate and body temperature are four vital signs is an important part of the body. Today we see everywhere that people have devices to measure blood pressure. In our project we have developed a device to measure another vital sign, heart rate and body temperature. We choice this research-based project to help every people like who are admitted to the hospital, older parents etc. By this device, people get help in an emergency case of their health which has a big impact on people living alone and their families. In certain case, people's heartbeat going off or very high-low and he didn't get the first notification so that didn't get the first treatment, in this case, people go to die. Our device users get first notification if their heart rate has major change by a smartphone.

1.3 Problem Statement

Heartbeat or pulse rate and body temperature is one of the major parts of our body part if it off or major changes all of the body will be affected. So many cases we need to monitor our pulse rate, for doctor checkup or stay fit. When a person is outside of the house and her house has an old or ill person he can’t see what is happening to them. By using this device, the person can check the patient's condition anywhere by using the smartphone through the internet and bad situation he will take proper action of them. So, it is really suspicious when a person outside of a home and can monitor his patient. In the hospital so many times doctors need to monitor the heart rate of a patient, every time check pulse rate and body temperature is very difficult for the doctors. By using this device doctor can check the patient pulse rate continually through the LCD display.

1.4 Expected output

The ultimate target of the project is to build a smart heart rate and body temperature monitoring device based on IoT. Users can take extra care of their health or older parents or grandparents or seek family members. Users can check the current status of this device from anywhere anytime. They can share data with a doctor. The doctor can heart rate and body temperature and make some instant decisions based on those data. The development of the project is a low-cost portable pulse rate monitor that uses a pulse sensor that will form the basis of a portable and cheap heart rate monitor. This prototype would benefit users by monitoring their pulse rate at home or anywhere.

1.5 Report Layout

The entire project is composed of 6 chapters. In the report, the layout is summarized that 6 chapters. Discuss the summarized below:

Chapter 1 presents the introduction of this IoT base healthcare system and the pulse rate and body temperature measure device and its motivation, objective and our whole system expected output.

Chapter 2 presents an extensive literature review of previous works on pulse rate monitoring using IoT and its system design and similar others work, Health Monitoring System and also show Technical Challenges.

Chapter 3 presents highlights the description, block diagram, details about our proposal and our implementation requirements.

Chapter 4 presents the project design and implementation with practical details of our project design and implementation for testing the project.

Chapter 5 presents Experimental Results and Discussion of the research project.

Chapter 6 presents Summary, Conclusion, Recommendation and Implication for Future Research of this project.

CHAPTER 2

Literature Review

2.1 Introduction

Internet of things (IoT) is one of the growing portions of modern technology. It is the way to control physical devices by computer or software through the internet. That means controlling any device from anywhere and anytime. In 2013, the Internet of Things had become a system that used multiple technologies, from the Internet to wireless communication and from microelectromechanical systems (MEMS) to integrated systems. Experts estimate that the IoT devices accrued by thirty first from 2016 to eight.4 billion in 2017 it'll additionally embody regarding thirty billion objects by 2020. it's additionally calculable that the worldwide IoT value can reach $ seven.1 billion by 2020[8].

Figure 1.1: IoT in healthcare system.

A revolution is a waiting in the healthcare industry in form IoT will make these devices like a sensor, actuator, and smart device along with applications that will interact and make health monitoring, diagnostics and treatment more personalized and bring down the cost of the treatment. The IoT market of healthcare is poised to grow at a Compound annual growth rate (CAGR) of 56.27% for the period 2016-2021 [9]. So the human using IoT in

computer-based systems and resulting in greater efficiency, health care, accuracy and economic benefits as well as less human intervention.

2.2 Literature Review

Kevin Ashton is a co-founder of the MIT Automatic Identification Center first uses the term “Internet of Things” in 1999 [7] to describe a system where the physical world is connected with the Internet via Ubiquitous Sensor. From then there are a lot of works, project creates in IoT concepts in so many areas.

Health monitoring is the major problem in today’s world, by using IoT developed lot of thing in healthcare system. Biniyam, Guta Tesema, Akrem Mohammed, Dr.Narayana Swamy Ramaiah and Ato.Eyassu devlope heart beat monitoring using PIC microcontroller [1]. where use PIC16F877A microcontroller, IR sensor RED and Photodiode sensor to control the whole system, where LCD screen to display the result and there is a buzzer sound to show abnormal patient condition [2].

Toshihiro Kitajima, SangOn Choi and Edwardo Arata Y. Murakam are develop Heart Rate Estimation based on Camera Image [3]. They motion of heart and motion of body cannot be separated when body moves by using smartphone or camera are set on the sink of tv. They focused attention on the blood oxygenated hemoglobin which absorbs the green light and measured the heart rate by detecting the intensity variation of the green light of a person's face by using radiofrequency protocol.

There are multiple methods to measure the pulse and heart rate with non-contact, such as using radio-frequency [3], optical interferometric signal [4], Magneto elastic Sensor Fe_{40} operational amplifier [5] Arduino UNO and pulse sensor are used to detect hart rate [6]. There are lot of methods and protocol are used in detect pulse rate measurement.

The propose method we are use NodeMCU and pulse sensor to detect pulse rate and body temperature measurement over internet. We save our riding data over clouded for future analysis. Chapter 3 will describe details of this project.

2.3 Scope of the problem

Hart bit and temperature square measure a number of the key very important signs of a piece. heart condition poses AN particularly giant public ill health. It appears that a replacement epidemic of upset, affects nearly five.8 million individuals within the u. s. and over twenty three million individuals worldwide. within the u. s., quite 550,000 individuals square measure diagnosed with heart condition for the primary time once a year and one in five have a time period risk of developing this syndrome [10]. in keeping with reports from the yank Heart Association (AHA), heart condition was the underlying cause in 283,000 deaths in 2008 and IC mortality with a primary identification or identification that seems to be 281,437 (124,598 men and 156,839 women). In 2008, HF portrayed over $ thirty five billion in tending prices within the u. s. [10][11]. Asian country may be a giant population country, there square measure numerous issues associated with heart.

The scopes during this project embody the hardware and code components. For the hardware half, the heartbeat device Mesure vital sign and temperature unendingly and therefore the liquid crystal display can show the heartbeat knowledge instantly. The software part will show data from anywhere from the server using the app. So there is a lot of scope of this project for heart problems and body temperature.

2.4 Technical Challenges

In a typical IoT project we face some technical challenges. These are

- **Power Management:** Every IoT system needs a power source and proper power management to operate functionality. This can be provided by a battery or some other power sources
- **Sensors and Actuators:** Sensors and actuators are the vital requirement for IoT system. It is needed to interact with the physical area. For that physical data is important. Sensors and actuators gather all sorts of data for experiment purposes for IoT system.
- **Wireless Communication:** The main theme of IoT is wireless communication. Without wireless communications IoT is just valueless. So, before a system design, we must need a proper internet connection or wireless communication.

- **Processor:** The processor is must for any IoT system. Processor is needed to read data, manipulate it and provide necessary behavior to physical devices or physical area.
- **Hardware and software fault:** Hardware and software fault is very common challenges in hardware related tasks as well as IoT. Sometimes some hardware and software lost its working power slightly or completely. Sometimes it affects seriously budgeting and time maintenance.

CHAPTER 3

System Description

3.1 Required Concept

The design of the project is considered the most important phase of the development process of each project, therefore this phase requires a considerable time for the general life cycle of the project.

If we consider the project as a system containing several parts, the proposed system can be divided into two main units, the hardware, and the software units. In this chapter, the high-level design followed by the detailed about the design of the project is being the center of attention for detailed discussion. Both hardware and software requirement designs are being discussed here intensively, describing their components and their circuit diagrams. As well as specifying the detailed functions of the project's units and interfaces implemented between them.

3.2 Description of Proposed System

The overall project aim is taking continuous measurements of the patient very important signs so as to observe a pulse and blood heat before it happens therefore it will be treated directly.

The pulse sensing element converts the blood pulse into electrical signals and temperature sensors live blood heat which can be next processed mistreatment the MCU board. Then output the measured information within the liquid crystal display and golem application interfaces via the net. Finally, the golem application can receive information from the server to be displayed inside its interfaces. whereas the golem application offers communication between patients and doctors through, measured information are recorded and uploaded to our information from inside the patient's accounts. At constant time, MCU can keep observance the period of time 60 minutes therefore the liquid crystal display.

Figure 3.1: Overall system's illustration

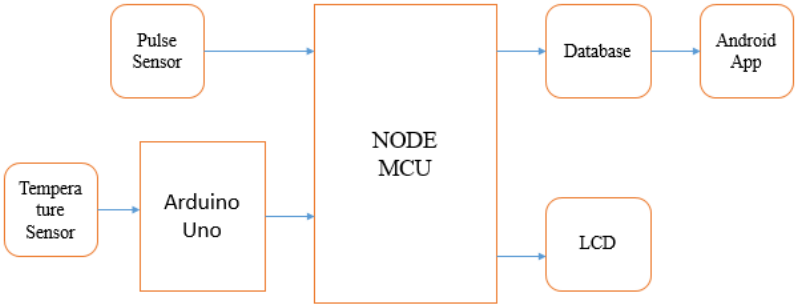


Figure3.2: System's block diagram.

3.3 Detailed Level Project Design

The project we consider as a system containing two parts, the proposed system can be divided into two main units, the hardware, and the software units. For further simplification, each one of these units is classified into categories based on their functions as illustrated in Figure 3.3.

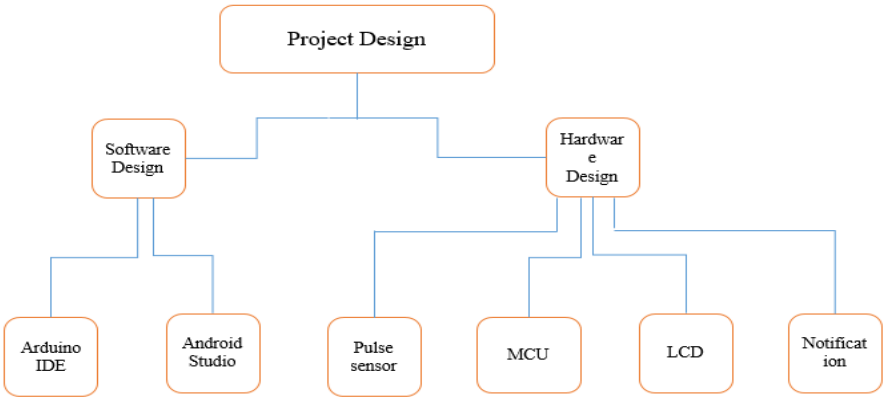


Figure 3.3: Project's system classification of units.

3.4 Hardware Requirements

Pulse Sensor

It is an open-supply coronary heart fee display screen considered a PPG tool used to manipulate the non-invasive heart price. Measure coronary heart price in actual time and calculate BPM with the assist of algorithms done through MCU.

This sensor has two components, the coronary heart-customary the front is the aspect that sticks to the pores and skin. There are 3 pulse sensor pins, as shown in Figure 3.4 below.

If the front side is facing you, the leftmost pin is the GND, while the central one is the input voltage that will be connected to the + 5v of the Arduino. The last one for the electricity output and will be wired with the analog pins of the NodeMCU.

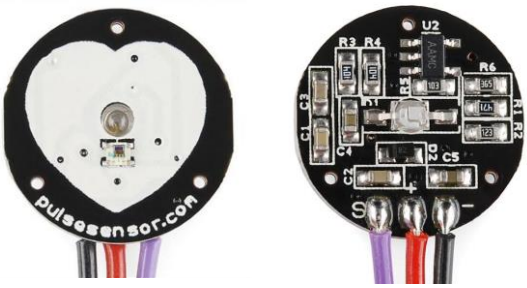


Figure 3.4: pulse sensor.

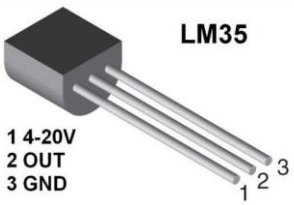
The pulse sensing element can convert the physical PPG into electrical signals. The sensing element emits AN unformatted signal of analog voltage fluctuations, amplifies it and normalizes the V / 2 wave shape.

At every heartbeat, a pulse wave travels on all the arteries to the tissues wherever the heart beat sensing element is connected. When this pulse wave passes beneath the device, the signal undergoes a fast increase in price. come back to the traditional purpose and before future pulse device passes beneath the device, the signal is stabilised to close noise.

Due to the repetitive nature of the heartbeat wave, the height is chosen as a point of reference as a result of it's recognizable. By applying the time calculation formula between every 2 serial peaks, the guts rate is measured. Ideally, we wish to search out the moment heartbeat moment for precise measurements.

LM-35 Temperature Sensor

It is thought-about as a solid-state device. The exactitude integrated-circuit temperature device shows the output of a voltage linearly proportional to the centigrade temperature. With LM35, the temperature is measured a lot of accurately than employing a semiconductor. The temperature device for correct readings, the sensor's package needed



to be in reality directly with the patient arm tissues together with the heart beat device. It comes as a wrought package or plastic package that is employed during this project.

Figure 3.5 LM35 Temperature Sensor

It has some important features, such as:

1. Ganeral temperature +25℃.

2. Lowest (-55℃) & Highest (+150℃).

3. Easily usable.

4. It can run 4-30 volts.

5. Take heat as input and give impedance as output.

LM-35 has three pins the left pin is VCC, the middle one output for the signal and the right is for GND

NodeMCU

The filtering of the taken signals applies the calculation in it and prepares it for transmission to the next unit performed mainly by the microcontroller unit. In this project, the microcontroller chosen is an Arduino Nano card based on the ESP8266 microcontroller. The main development of the board's equipment shows that the ESP-12E module containing the ESP8266 chip has a 32-bit Tensile XTensa® LX106 RISC microprocessor that operates at a clock frequency adjustable from 80 to 160 MHz and supports RTOS.

There are also 128 KB of RAM and 4 MB of Flash memory (for programs and data storage) sufficient to handle the large strings that makeup Web pages, JSON / XML data and

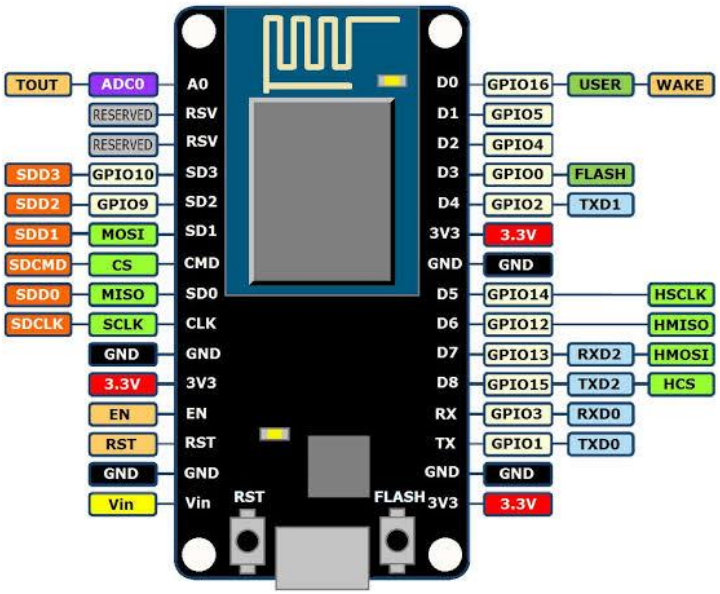


Figure 3.6: NodeMCU microcontroller ESP8266.

everything we throw into IoT devices today ESP8266 Integra is an HT40 802.11b / g / n Wi-Fi transceiver, so not only can you connect to a Wi-Fi network and interact with the Internet, but you can also configure your network, allowing devices to connect directly to it. This makes NodeMCU ESP8266 even more versatile. Since the operating voltage range of the ESP8266 is between 3V and 3.6V, the board is supplied with an LDO voltage regulator to keep the voltage at 3.3V stable. The ESP8266 can reliably supply up to 600

mA, which should be more than sufficient when ESP8266 extracts up to 80 mA during RF transmissions.

LCD display

LCD (Liquid Crystal Display) may be a reasonably flat panel show that uses liquid crystals in its primary sort of operation. LEDs have an oversized and ranging set of use cases for shoppers and businesses, as they will be usually found in smartphones, televisions, pc monitors and instrument panels.

LCDs were a giant leap in terms of the technology they replaced, that embrace a diode (LED) and gas-plasma displays. LCDs allowed displays to be abundant dilutant than beam tube (CRT) technology. we have a tendency to show that LCDs show do not consume abundant power than diode and gas-display displays as a result of they work on the principle of block light-weight instead of emitting it. wherever we have a tendency to show that AN diode emits light-weight, the liquid crystals in AN LCD produces a picture employing a backlight.

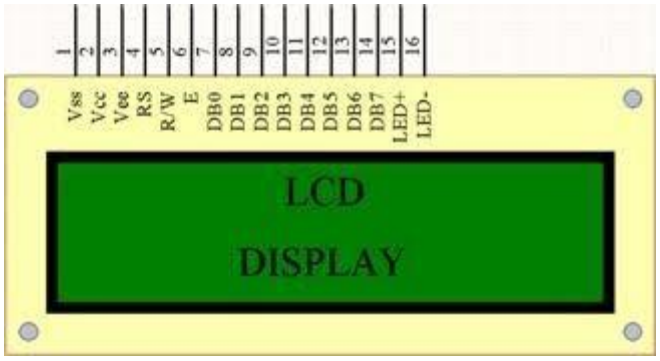


Figure 3.7: LCD Display.

A show is created from many pixels. the standard of a show usually refers to the quantity of pixels; for instance, a 4K show is created from 3840 x2160 or 4096x2160 pixels. A picture element is created from 3 subpixels; a red, blue and green—commonly known as RGB. once the subpixels in an exceedingly picture element amendment color combo, a special color is made. With all the pixels on a show operating along, the show will build

many totally different colors. once the pixel's square measure speedily switched on and off, an image is formed.

Alarm Unit

This alarm unit consists of a 5V DC buzzer which can sound if the center rate rises or falls below the desired threshold. the brink prices square measure a hundred and fifty for the utmost value of FC and thirty for the minimum.

Buzzer 5v DC

The buzzer is AN audio device that has several applications that embody timers and alarm devices. There area unit many sorts of stamps, in the main mechanical device, mechanical and electrical stamps.

Figure 3.8: 5v DC buzzer.

Some important features of buzzer are:

1. Required power (3-6 DC)

2. Sound level 82dB

3. Only 30mA current required.

3.4 Software Requirements

Several computer code tools are utilized in all the event procedures of this project to program the Arduino board, that is taken into account the core of this project, moreover as developing the robot application which will find and warn once a pulse is suspected.

Arduino IDE

It is the software package atmosphere necessary to program Arduino by writing the code and uploading it to Arduino. It additionally generates the results for the analysis exploitation each the serial monitor and also the serial plotter. The version employed in this project is that the one.8.3 (original) that supports each the serial monitor to print the hour wave and also the serial monitor. The Arduino IDE wont to write a code in Arduino Nano that contains a main perform. The functions are: live the beats per minute ANd warn once an anomaly is detected. The Arduino IDE provides the software package library of the Wiring project, that provides several common input and output procedures. once writing the code, the user needs solely 2 basic functions, to begin the sketch and also the main program cycle, that is compiled and coupled to a main program stub () during a cyclic supervisor feasible with the chain of wildebeest tools, additionally enclosed with the IDE distribution. The Arduino IDE uses the mentioned program to convert the feasible code into a computer file into a positional representation system encryption that is loaded into the Arduino board by AN transfer program into the card's microcode.

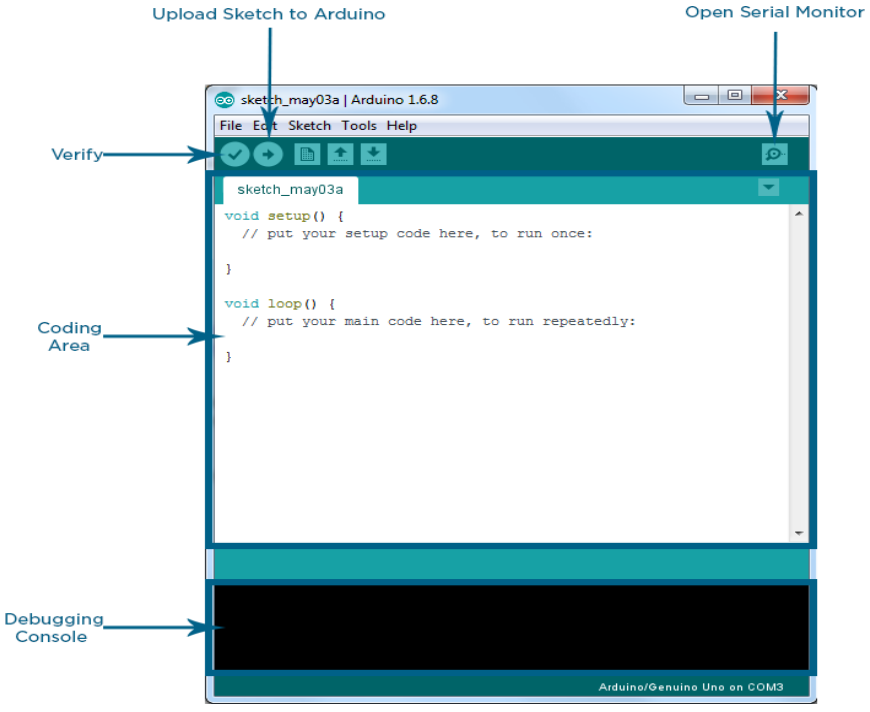


Figure 3.9: Arduino IDE.

CHAPTER 4

Implementation

4.1 Introduction

In this chapter, the proposed system design was demonstrated in detail for both the hardware and software units of the project. This design was proposed in such a way to make it available and suitable for use by most people.

Furthermore, there are so many arm-bands today that people actually buy and use. Hence this project's function can be simply added to one of these bands along with the main services it offers such as Monitoring Fitness and calculate steps walked daily.

4.2 Hardware Implementation

Is done to test the overall system functionalities, the hardware is implemented as it was discussed throughout this chapters with aid of figures including all components and using the software Arduino IDE.

The final system's circuit is shown below in Figure 4.1.

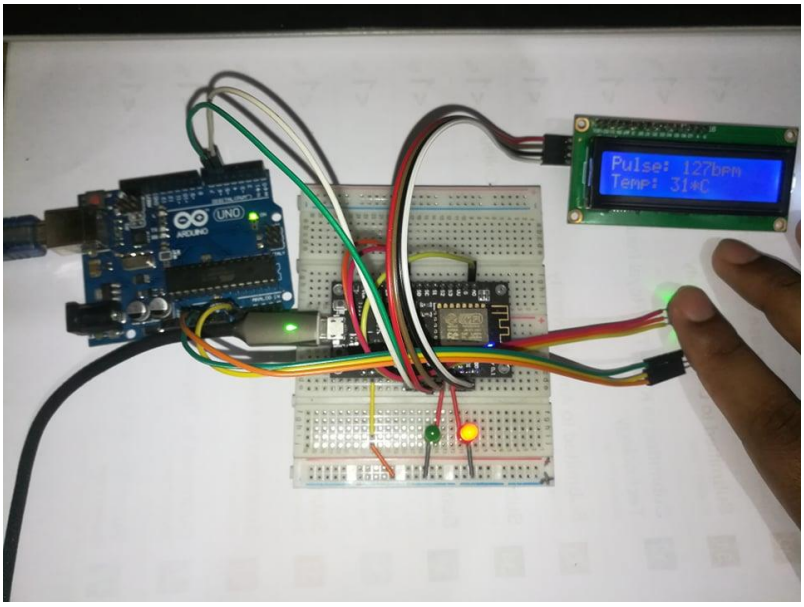


Figure 4.1: Implementation of the Overall System.

This project shows that the NodeMCU connected with the pulse sensor when the pulse sensor collects the pulse rare from users. The NodeMCU will send data to the adafruit Io server, which is free and open-source.

4.3 Software Implementation

Arduino IDE

The Arduino IDE will implement the code for the project to detect pulse rare measure. For implemented code will work in some basic function in Arduino IDE.

BPM Calculation

The algorithm for measuring BPM is:

1. Select board and port from tools.

    Baud Rate = 9600.

2. Connect the pulse sensor to A0.

3. Get the voltage differents by the sensor.

4. Perform data calculations.

5. Print it on the serial monitor.

6. Wait 5000 ms until the next reading.

7. Return step 3 and continue the process.

Android App

For the entair project, we will use an open-source android app “Blynk”. According to Blynk’s website, “Blynk is a Platform with iOS and Android apps to control (Arduino, Raspberry Pi based) IoT system over the Internet and Bluetooth. It's a digital panel where you can create a graphical interface for your project by simply dragging and dropping the widgets.

We can use Blynk's platform quickly without a ton of learning time. It can support both Arduino and Raspberry Pi over Wi-Fi, Ethernet, or an ESP8266 chip.

Getting started with Blynk. After creating your account, create a "New Project".

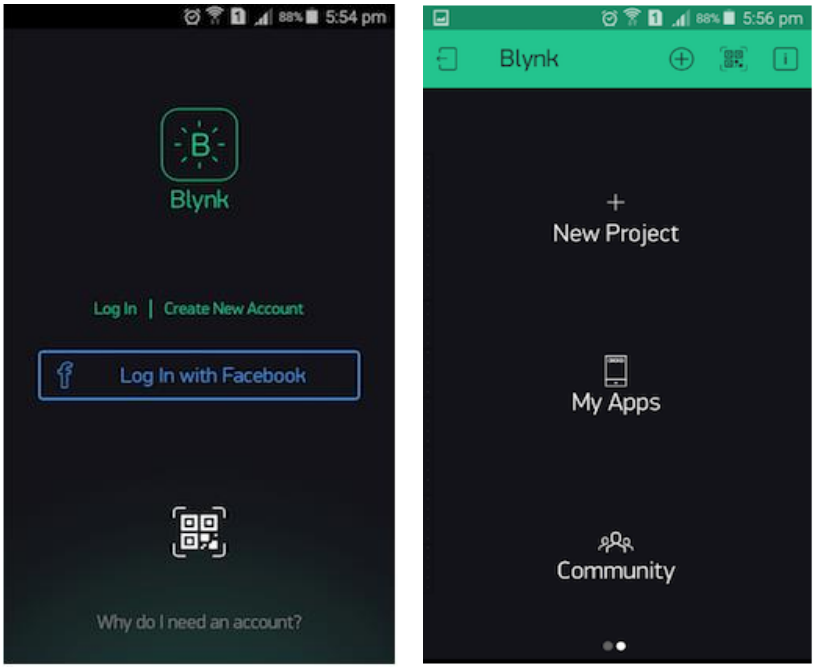


Figure 4.2: Login and registration Interface.

From there, assign a name to your project and select the card you are using. We are using the ESP8266 NodeMCU chip. He will say that the automatic token was sent to your e-mail and you will see a screen similar to the one shown below. If you have iOS, it may be different. Now tap the screen and you'll see the widget window.

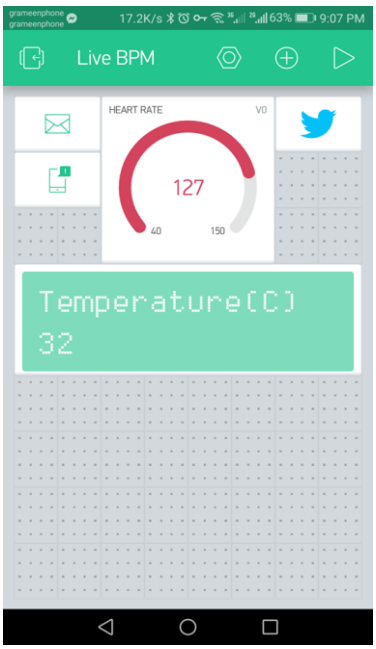


Figure 4.3: Live BPM and body temperature.

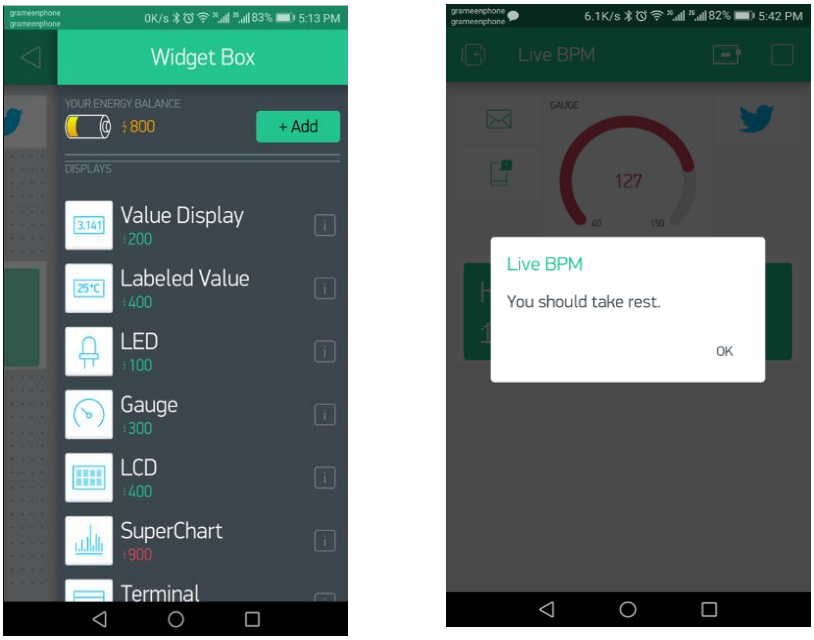


Figure 4.4: Widget Box and Alert system.

The widget box has a lot of controllers; we use those for creating our system. Notify when the heart rate is high.

Use's server

For this project, we will use associate ASCII text file IoT base "Adafruit Io" server. Adafruit IO may be a system that produces information helpful.IO includes consumer libraries that wrap our REST and MQTT arthropod genus. IO is constructed on Ruby on Rails and Node.js. Dashboards square measure a feature integrated into Adafruit IO that permits you to chart, graph, gauge, log, and show your information. you'll read your dashboards from anyplace within the world.

The Adafruit Io server uses MQTT, or message queue telemetry transport is a protocol for device communication that Adafruit IO supports. Using an MQTT library or client we can publish and subscribe to a feed to send and receive feed data.

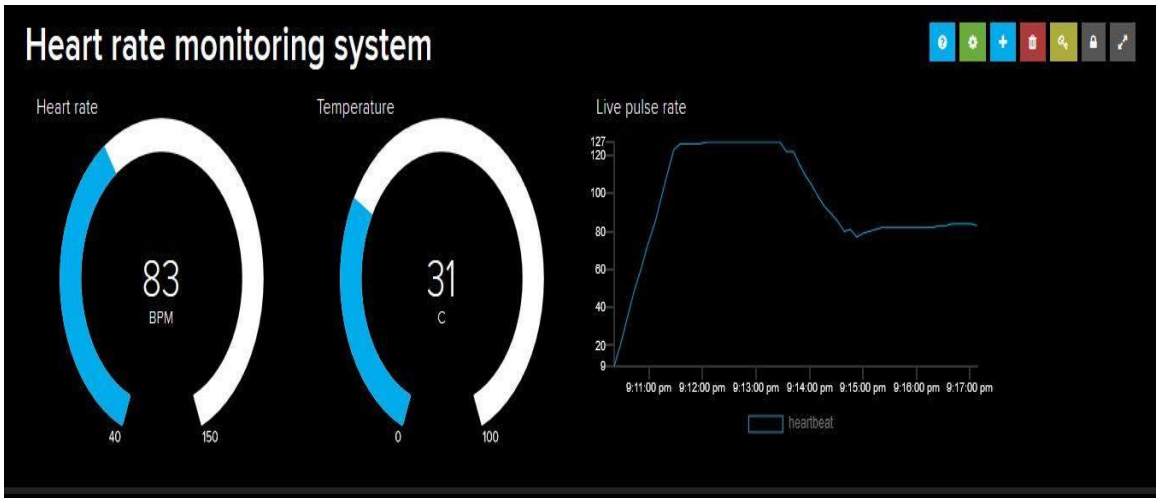


Figure 4.5: Server dashboard.

CHAPTER 5

Experiment Result and Discussion

5.1 Design Methodology

Our research work is based on the practicability of using a smartphone as a trustful device for monitoring a subject's heart rate and body temperature over the internet from the server by using the android app. In order to work on the research front, we carried out a literature review and made an analysis of the technology available on the android application market.

5.2 Testing and Data Collection Procedure

The heart rate was obtained mistreatment 2 strategies, the manual methodology and mistreatment the heartbeat detector to work out the accuracy of the planning circuit. The circuit is high-powered by an influence of three V. For as correct a reading as doable, your finger or articulatio radiocarpea should be positioned about to the detector.The output result as an electrocardiogram (ECG) on the serial plotter has been plotted for accuracy.

Figure 5.1: HR Wave Output in Server

After that, the same experiment was repeated but this time results were outputted via the Serial Monitor as shown in Figure 4.2 above.

5.3 Experimental Results

The pulsed calculated manually, to determine the accuracy by comparing the manual with Serial Monitor value.

From the serial monitor value plot a graph and get average value almost ~91.

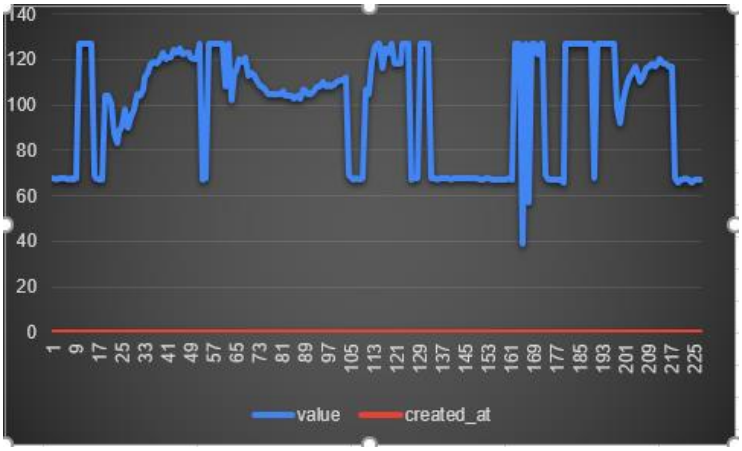


Figure 5.2: Graph Of Output Value in Serial Monitor.

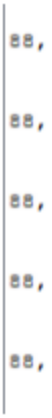


Figure 5.3: HR Values Output in Serial Monitor

Error was calculated from serial plot value and average value of wave to be {(exact value - approximate value)/exact value} x 100 [10].

E= {(91-88)/88}*100 = 3.41%

That's mean the result almost 96.5%.

5.4 Descriptive Analysis

According to the research project, the heart rate measurable, in other words, the signal is noisy and has to be filtered first in order to be able to extract heart rate value from it.

The ambient noise may be generated from the improper holding of a pulse sensor or the component has defected.

On the other hand, the result was much better which outputted data with an accuracy of almost 96.5%.

The microcontroller NodeMCU was enforced properly and performed their supposed functions with success which is detection pulse value and pairing with it as well as receiving data from pulse sensors and monitoring over the internet the patient respectively.

5.5 Summary

In this chapter, the proposed system experiment result and discussion was demonstrated in details for both serial plotter and wave system of software units of the project. This design was proposed in such a way to make it available and suitable for use by most people.

CHAPTER 6

Conclusion and Future Scope

6.1 Conclusion

The key objective of the event of this project with the assistance of the open supply platform Blynk and Adafruit IO is to right away alert the medical emergency and also the patient's emergency contacts on the patient's health standing.

In this research work, we have studied the different approaches used for mobile devices to extract heart rate measurements of individuals. We evaluated the accuracy of a smart-phone application for retrieving non-contact heart rate with values retrieved from the Adafruit IO server. We strongly believe that the best part of the device in a way of monitoring a subject without touching them. The results of our evaluation pointed out that it is very reasonable to use a smart-phone application for building a heart-rate monitoring system.

We square measure developing a digital device ANd an application that uses continuous observation of the parameters so the center rate exceeds or falls below the required intensity. it's helpful once continuous observation is needed in essential conditions. Moreover, it's a really helpful device because of its movableness, which suggests that patients will take it with them, therefore, it's not necessary to remain within the hospital as a result of the center rate monitor is applicable nearly all over.

Together with the center rate monitor, we have a tendency to use AN robot application that permits users to act with one another, record the info received from the center rate monitor on the web and permit access to those records to the doctor.

6.2 Limitation

This project Janus-faced many challenges and limitations throughout the complete project life cycle. the primary was with the heart beat sensing element. The sensing element failed to notice correct readings if it was placed with excessive or loose pressure on the body.

Although the heart beat device amplifies and filters the diagnostic technique (ECG) signal, there'll be a disturbance of the EKG signal on the alphanumeric display screen and on the serial monitor. The Cables connected to the patient's body play a very important role in getting an honest gait worth. This noise is slightly reduced if all connections area unit properly grounded.

The next challenge was the fact that some of the purchased components were provided without datasheet, copy product, highly and not available in our country. The pulse sensor used for this project which made it difficult to fully understand the sensor specifications. Hence, for all the equipment we depended on the basic information supplied by the vendors on their website.

Another limitation was with the Android development environment, which took a considerable time for installation and setting up. In addition to the time spent fixing inconvenient Gradle errors that seemed never-ending keeping in mind, it was working correctly after it has been installed.

The final limitation we have used the server as Firebase Database but if we can build our own web server it will be more secure and easily usable for us because each and every rule would be defined by us. We have used a free service to send Notification through Actuators (Email and Phone Text Option) that sends a limited number of notification and sometimes it gets blocked.

6.3 Implication for Further Study

According to our research questions, we limited the scope of our work to check the viability and level of trust of using a smartphone and device for monitoring heart rates on a subject with the intention to predict abnormalities or heart conditions. Our work can be continued with different possibilities:

- To ensure the accuracy of the heart rate monitor, multiple tests can be performed on more people with different ages and weights.
- More the parameters of important signs should be added to extend the worth of the project for patients. These will embrace pressure, temperature device, vital sign and different parameters.

- Implement pulse measurements and different parameters victimisation the mobile camera along with different integrated sensors to get these parameters on demand if the patient has begun to indicate some symptoms or anomalies.
- Using different ECG types of equipment and comparing the results to those that we get a better results.
- A microcontroller (MCU for microcontroller unit) it's necessary to send a bearing signal along with the measured information once a heart failure is detected and therefore the buzzer is activated. The management signal should alter the GPS, explain to the applying to send Associate in Nursing SMS containing the measured information and therefore the position of the patient to the medical emergency and therefore the patient's emergency contacts to get Associate in Nursing motorcar and alert their relatives.
- The device should be miniaturized to facilitate its use and scale back its weight so as to form it industrial for public use.
- Portable battery for the device to produce the energy needed by the sensors and different instrumentality.

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APPENDICES

NodeMCU(ESP8266)

```
#include <SoftwareSerial.h>

#define BLYNK_PRINT Serial

#include <ESP8266WiFi.h>

#include <LiquidCrystal_I2C.h>

#include <BlynkSimpleEsp8266.h>

#include "AdafruitIO_WiFi.h"

#define IO_USERNAME  "pro7495"

#define IO_KEY       "dc831a431a754d5fa89a5d086109a0dc"

#define WIFI_SSID       "Rasheduzzaman"

#define WIFI_PASS       "rasheduzzaman"

SoftwareSerial NodeMCU(D5, D6);

LiquidCrystal_I2C lcd(0x3F, 16, 2);

int bPin = D8;

int rPin = D3;

int gPin = D4;

int val;
```

```
const int numReadings = 10;

int readings[numReadings];

int readIndex = 0;

int total = 0;

int average = 0;

int inputPin = A0;

char auth[] = "rOzLiWPvrC3F_jRGxD_0d1_VdGwhNNhq";

AdafruitIO_WiFi io(IO_USERNAME, IO_KEY, WIFI_SSID, WIFI_PASS);

AdafruitIO_Feed *bpm = io.feed("heartBeat");

AdafruitIO_Feed *temperature = io.feed("temperature");

void setup() {

  Serial.begin(9600);

  NodeMCU.begin(4800);

  pinMode(rPin, OUTPUT);

  pinMode(gPin, OUTPUT);

  pinMode(bPin, OUTPUT);

  pinMode(inputPin, INPUT);

  for (int thisReading = 0; thisReading < numReadings; thisReading++) {

    readings[thisReading] = 0;

  }

  lcd.begin(16, 2);

  lcd.init();
```

```
  lcd.backlight();
  Blynk.begin(auth, WIFI_SSID, WIFI_PASS);
  io.connect();
  while (io.status() < AIO_CONNECTED)
  {
    Serial.print(".");
    delay(500);
  }
}
void loop() {
  io.run();
  total = total - readings[readIndex];
  readings[readIndex] = analogRead(inputPin);
  total = total + readings[readIndex];
  readIndex = readIndex + 1;
  if (readIndex >= numReadings) {
    readIndex = 0;
  }
  average = total / numReadings;
  int hr = average / 8;
  bpm->save(hr);
  Blynk.virtualWrite(V0, hr);
```

```
 lcd.clear();
 lcd.setCursor(0, 0);
 lcd.print("Pulse: ");
 lcd.print(hr);
 lcd.print("bpm");
 if (hr > 125) {
   Blynk.tweet("Patient's pulse rate is so high.");
   Blynk.email("Subject", "Patient's pulse rate is so high.");
   Blynk.notify("Patient's pulse rate is so high.");
   digitalWrite(gPin, LOW);
   digitalWrite(rPin, HIGH);
   digitalWrite(bPin, HIGH);
 }
 else {
   digitalWrite(bPin, LOW);
   digitalWrite(rPin, LOW);
   digitalWrite(gPin, HIGH);
 }
 while (NodeMCU.available() > 0) {
   val = NodeMCU.parseFloat();
   if (NodeMCU.read() == '\n') {
     Serial.println(val);
```

```
      temperature->save(val);
      Blynk.virtualWrite(V1, "Temperature(C)");
      Blynk.virtualWrite(V2, val);
      lcd.setCursor(0, 1);
      lcd.print("Temp: ");
      lcd.print(val);
      lcd.print((char)223);
      lcd.print("C");
    }
  }
  Blynk.run();
  delay(5000);
}
```

Arduino Uno

```
#include <SoftwareSerial.h>
SoftwareSerial ArduinoUno(6, 5);
void setup() {
  Serial.begin(9600);
  ArduinoUno.begin(4800);
  pinMode(6, INPUT);
  pinMode(5, OUTPUT);
```

```
}
void loop() {
  float temp = analogRead(A0);
  temp = (temp * 0.49);
  ArduinoUno.print(temp);
  ArduinoUno.println("\n");
  delay(5000);
}
```