A

Project Report

on

SMART BP AND STRESS DETECTION

Submitted in partial fulfillment for the requirements for the award of the degree of

BACHELOR OF ENGINEERING

in

INFORMATION TECHNOLOGY

By

CH.Harika **(245118737013)**

M.Sirisha **(245119737015)**

K.Sai Kiran **(245119737011)**

Under the guidance of

G.Ushasri

Assistant Professor

Department of IT

MATURI VENKATA SUBBA RAO ENGINEERING COLLEGE

(An Autonomous Institution)

Department of Information Technology,

(Affiliated to Osmania University, Hyderabad)

Nadergul, Hyderabad, TELANGANA – 501510

Academic year: 2022-23

MATURI VENKATA SUBBA RAO(MVSR)
ENGINEERING COLLEGE

(An Autonomous Institution)

(Affiliated to Osmania University, Hyderabad, Recognized by AICTE)

Nadergul, Saroornagar Mandal, Hyderabad-501510

DEPARTMENT OF INFORMATION TECHNOLOGY

CERTIFICATE

*This is to certify that the project work entitled "**Smart BP and Stress Detection**" is a bonafide work carried out by **Ms. Chippa Harika(2451-19-737-013), Ms. Manthoju Shirisha(2451-19-737-015), Mr. Konduru Sai Kiran(2451-19-737-011)** in fulfillment of the requirements for the award of degree of **Bachelor of Engineering** in **Information Technology** from **Maturi Venkata Subba Rao Engineering College,** affiliated to OSMANIA UNIVERSITY, Hyderabad, during the Academic Year 2022-23. under our guidance and supervision.*

The results embodied in this report have not been submitted to any other university or institute for the award of any degree or diploma.

Signature of Project Coordinator

Signature of Guide

Signature of Head, ITD

Signature of External Examiner

DECLARATION

This is to certify that the work reported in the present project entitled “Smart BP and Stress Detection” is a record of bonafide work done by us in the Department of Information Technology, Maturi Venkata Subba Rao Engineering College, Osmania University. The reports are based on the project work done entirely by us and not copied from any other source.

The results embodied in this project report have not been submitted to any other University or Institute for the award of any degree or diploma to the best of our knowledge and belief.

Roll Number	Student Name	Signature of the student
(2451-19-737-013)	Chippa Harika	
(2451-19-737-015)	Manthoju Shirisha	
(2451-19-737-011)	Konduru Sai Kiran	

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Chippa Harika (2451-19-737-013)

Manthoju Shirisha (2451-19-737-015)

Konduru Sai Kiran (2451-19-737-011)

Maturi Venkata Subba Rao Engineering College

Department of Information Technology

COURSE NAME: Project Work II

COURSE CODE: PW861IT

VISION

To impart technical education to produce competent and socially responsible engineers in the field of Information Technology.

MISSION

a. To make teaching learning process effective and stimulating.
b. To provide adequate fundamental knowledge of sciences and Information Technology with positive attitude.
c. To create an environment that enhances skills and technologies required for industry.
d. To encourage creativity and innovation for solving real world problems.
e. To cultivate professional ethics in students and inculcate a sense of responsibility towards society.

PROGRAM EDUCATIONAL OBJECTIVES(PEOS)

The Program Educational Objectives of undergraduate program in Information Technology are to prepare graduates who will:

I. Apply knowledge of mathematics and Information Technology to analyze, design and implement solutions for real world problems in core or in multidisciplinary areas.

II. Communicate effectively, work in a team, practice professional ethics and apply knowledge of computing technologies for societal development.

III. Engage in Professional development or postgraduate education to be a life-long learner.

(A)PROGRAM OUTCOMES(POs)

At the end of the program the students (Engineering Graduates) will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principle and apply 6 these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Lifelong learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

(B) PROGRAM SPECIFIC OUTCOMES (PSOs)

1. **Hardware design:** An ability to analyse, design, simulate and implement computer hardware / software and use basic analogue/digital circuits, VLSI design for various computing and communication system applications.
2. **Software design**: An ability to analyse a problem, design algorithm, identify and define the computing requirements appropriate to its solution and implement the same.

COURSE OBJECTIVES AND OUTCOMES

Course Objectives

1. To enhance practical & Professional skills.
2. To familiarize the tools and techniques of symmetric literature survey and documentation.
3. To expose students to industry practices and teamwork.
4. To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes

On successful completion of this course student will be

1. Define a problem of the recent advancements with applications towards society.
2. Outline requirements and perform requirement analysis for solving the problem.
3. Design and develop a software and/or hardware, based solutions within the scope of project using contemporary technologies and tools.
4. Test and deploy the applications for use.
5. Develop the Project as a team and demonstrate the application, with effective written and oral communications

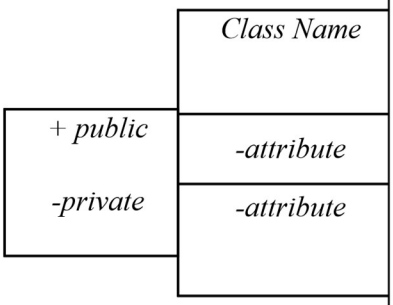
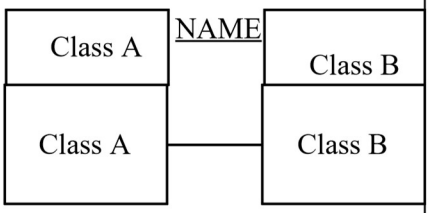
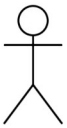
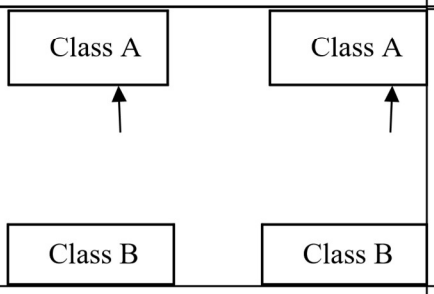
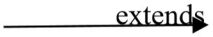
ABSTRACT

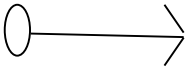
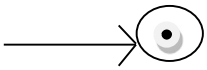
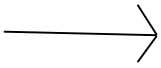
The effects of stress are causing rigorous damage to the mental as well as physical state of humans. It is very difficult to identify whether a person is in stress. The person may look healthier physically but may not be in a state of good health due to the stress within the body. It is very essential to monitor stress levels regularly which help in diagnosis of any abnormalities in the body that may lead to chronic illness in future. The Wireless networks based on IOT (Internet of Things) provides wide range of opportunities to monitor stress levels regularly and transmit the information to the concerned for immediate action. A model is designed and developed to detect the stress levels using various sensors such as heartbeat rate, blood pressure (BP), body temperature. Further based on the values of these sensors, the levels of stress is calculated and the information is transmitted using IOT.

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS

S.NO	NOTATION NAME	NOTATION	DESCRIPTION
1.	Class		Represents a collection of similar entities grouped together.
2.	Association		Association represents static relationships between classes. Role represents the way the two classes see each other.
3.	Actor		It aggregates several classes into a single class.
4.	Aggregation		Interaction between the system and external environment
6.	Relation (extends)		Extends relationship is used when one use case is similar to another use case but does a bit more.
7.	Communication		Communication between various use cases.

8.	State		State of the processes.
9.	Initial State		Initial state of the object
10.	Final state		Final state of the object
11.	Control flow		Represents various control flow between the states

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CHAPTER 1
INTRODUCTION

Stress is the feeling of mental or physical tension, which negatively affects a person's mind and well-being. It is a normal human reaction that often arises due to challenges or difficulties. Headache, tiredness, disturbed sleep schedule, higher than normal blood pressure, aging, heart illness, obesity, etc., are common symptoms of stress. If a person is under stress for a long time, it can affect the mind and body, causing health issues. With technology evolving constantly, smartwatches have adopted new stress measurement techniques like Heart rate variability (HRV) and Electro Dermal Activity (EDA) with an easy access to mobile features. HRV is the measure of the variation of time between each heartbeat. A person who has a low HRV is likely under stress. An EDA sensor, found in some smartwatches, monitors tension by electrically altering the amount of sweat on our skin.

It has been suggested that individuals who experience repeated or prolonged stress exhibit blunted biological stress responses when compared to the general population. Thus, when assessing whether a ubiquitous stress response exists, it is important to stratify based on resting levels in the absence of stress. Research has shown that stress that causes symptomatic responses requires early intervention in order to mitigate possible associated mental health decline and personal risks. Given this, real-time monitoring of stress may provide immediate biofeedback to the individual and allow for early self-intervention. A normal Systolic Blood Pressure (SBP) is below 120 mmHg and a normal Diastolic Blood Pressure (DBP) is lower than 80 mmHg. Raised Blood Pressure (BP) throughout its range is the most significant cause of death and disability in the world. So design of stress detection and health monitoring technology that could help people to understand their state of mind and body is very essential.

1.1 Problem Statement

To build a model that sense heart rate variability, Skin Conductance and temperature using sensors for measuring the stress and BP levels of an individual.

1.2 Objectives

● To build a model that sense heart rate variability, Skin Conductance and temperature using sensors for measuring the stress and BP levels of an individual.

1.3 Problem Specification

● This model is designed to monitor the heartbeat rate, blood pressure, temperature and skin conductance using various sensors which will be uploaded to the cloud through WIFI module. Then the data is used for evaluation of stress levels .

1.4 Applications

- The project involving Arduino UNO, 16×2 LCD and Heartbeat rate Sensor Module and Temperature sensor module , Galvonic sensor module is designed here which can be used to evaluate the stress levels of a person,
- This project can be used as an alternative to Smart Watches.

1.5. Existing System

IOT based wearable health care devices and fitness bands are available that uses heart rate variability to measure stress level. The heart rate can show variation in most cases. For example, people may have higher heart rate when standing than when sitting. Hence using heart rate as an indicator to detect mental stress may lead to misclassification.

Drawbacks:

- Using only heart rate to detect stress resulting in misclassification. The stress detected is not accurate enough when compared to laboratory values. more recent algorithms is needed.

1.6 Proposed System

In the proposed system, a model is designed to monitor the heartbeat rate, blood pressure, temperature and skin conductance using various sensors which will be uploaded to the cloud through WIFI module. Then the data is used for evaluation of stress levels .

CHAPTER 2

LITERATURE SURVEY

2.1 Introduction

Literature survey is the most important step in software development process. Before developing the tool it is necessary to determine the time factor, economy n company strength. Once these things r satisfied, ten next steps are to determine which operating system and language can be used for developing the tool. Once the programmers start building the tool the programmers need lot of external support. This support can be obtained from senior programmers, from book or from websites. Before building the system the above consideration r taken into account for developing the proposed system.

1) **Stress Watch: The Use of Heart Rate and Heart Rate Variability to Detect Stress: A Pilot Study Using Smart Watch Wearables**

Authors: Chalmers.T, Hickey.B.A, Newton.P,Lin,C.-T.; Sibbritt.D; McLAchlan,CA.S,; Clifton-Bligh.R; Morley.J; Lal. S

Stress is an inherent part of the normal human experience. Although, for the most part, this stress response is advantageous, chronic, heightened, or inappropriate stress responses can have deleterious effects on the human body.. Thus, when assessing whether a ubiquitous stress response exists, it is important to stratify based on resting levels in the absence of stress. Research has shown that stress that causes symptomatic responses requires early intervention in order to mitigate possible associated mental health decline and personal risks. Given this, real-time monitoring of stress may provide immediate biofeedback to the individual and allow for early self-intervention. This study also aimed to assess whether baseline stress levels may affect the changes seen in heart rate variability at baseline and following stress tasks. A total of 30 student doctor participants and 30 participants from the general population were recruited for the study. The Trier Stress Test was utilized to induce stress, with resting and stress phase ECGs recorded, as well as inter-second heart rate (recorded using a FitBit). Although the present study failed to identify ubiquitous patterns of HRV and HR changes during stress, it did identify novel changes in these parameters between resting and stress states. This study has shown that the utilization of HRV as a measure of stress should be calculated with consideration of resting (baseline) anxiety and stress states in order to ensure an accurate measure of the effects of additive acute stress.

2) **Early Stress Detection and Analysis using EEG signals in Machine Learning Framework.**

Authors : Jharna Agrawal1 , Manish Gupta2 , and Hitendra Garg.

In this context, this paper posits a comparative analysis of the above-described methods of stress detection and accentuates on stress detection methodology using EEG signals, as EEG is a perfect non-invasive tool, widely used in clinical and research domains. The fractal dimension (FD) method, which is an indicator of curve irregularities, has been used in the detection of stress for feature extraction, applying three FD algorithms viz. Higuchi, Katz and Permutation Entropy. For classification, this study aims to apply and compare a number of classic machine learning algorithms based on accuracy, precision and sensitivity. This paper also presents a novel architecture, based on EEG analysis in MATLAB, fractal dimension used for feature extraction along with Machine Learning processes for classification i.e., Random Forest and Artificial Neural Network which is useful for early-stage stress detection, analyzing different stress levels viz. mild, moderate and high accuracy and providing ways for people to cope with stress in order to enhance their performance.

3) **A comparative analysis of machine learning methods for emotion recognition using EEG and peripheral physiological signals**

Authors: Doma, V. and Pirouz, M.,

Emotion recognition using brain signals has the potential to change the way we identify and treat some health conditions. Electroencephalogram (EEG) signals from the brain give us a more diverse insight on emotional states that one may not be able to express. Brainwave EEG signals can reflect the changes in electrical potential resulting from communications networks between neurons. This research involves analyzing the epoch data from EEG sensor channels and performing comparative analysis of multiple machine learning techniques [namely Support Vector Machine (SVM), K-nearest neighbor, Linear Discriminant Analysis, Logistic Regression and Decision Trees each of these models] were tested with and without principal component analysis (PCA) for dimensionality reduction. Grid search was also utilized for hyper-parameter tuning for each of the tested machine learning models over Spark cluster for lowered execution time. The DEAP Dataset was used in this study, which is a multimodal dataset for the analysis of human affective states. The predictions were based on the labels given by the participants for each of the 40 1-min long excerpts of music. music. Participants rated each video in terms of the level of arousal, valence, like/dislike, dominance and familiarity. The binary class classifiers were trained on the time segmented, 15 s intervals of epoch data, individually for each of the 4 classes. For each of the time segments and “a binary training class” a different classification model converges to a better accuracy and recall than others. The results prove that different classification models must be used to identify different emotional states.

4) Continuous stress detection using the sensors of commercial smartwatch

Authors: Siirtola, Pekka.

Stress detection is becoming a popular field in machine learning and this study focuses on recognizing stress using the sensors of commercially available smartwatches. In most of the previous studies, stress detection is based on partly or fully on electrodermal activity sensor (EDA). However, if the final aim of the study is to build a smartwatch application, using EDA signal is problematic as the smartwatches currently in the market do not include sensor to measure EDA signal. Therefore, this study surveys what sensors the smartwatches currently in the market include, and which of them 3rd party developers have access to. Moreover, it is studied how accurately stress can be detected user-independently using different sensor combinations. In addition, it is studied how detection rates vary between study subjects and what kind of effect window size has to the recognition rates. All of the experiments are based on publicly available WESAD dataset. The results show that, indeed, EDA signal is not necessary when detecting stress user-independently, and therefore, commercial smartwatches can be used for recognizing stress when the used window length is big enough. However, it is also noted that recognition rate varies a lot between the study subjects.

5) Smartphone / smartwatch-based cuffless blood pressure measurement

Authors: Hae Young Lee,Dong-Ju Lee.et.al

Smartphone technology has spread rapidly around the globe. According to a report released by the Korea Information Society Development Institute, about 95% of Koreans aged more than 30 years old owned smartphones. Recently, blood pressure (BP) measurement using a photoplethysmography-based smartphone algorithm paired with the smartwatch is continuously evolving. In this document, the Korean Society of Hypertension intends to remark the current results of smartphone / smartwatch-based BP measurement and recommend optimal BP measurement methods using a smartphone device. We aim to increase the likelihood of success in implementing these new technologies into improved hypertension awareness, diagnosis, and control.

6) Smart Wearable Band for Stress Detection.

Authors: Zubair M., Yoon C., Kim H.

Sometimes mental stress needs to be control as it results in different dangerous suffering. Timely mental stress detection can help to prevent stress related health problems. The aim of this paper is to design an IoT base wearable, cost effective and low power smart band for health care that detect mental stress based on skin conductance. This band can monitor user's mental stress continuously and transmit the stress related data wirelessly to user's smart phone. It not only help the users in better understanding their stress patterns but also provide the physician with reliable data for a much better treatment. Inputs to this device are various signals from different sensors. By intelligently analyzing the correlation between these signals using machine learning algorithm, this band predicts that whether the subject is suffering from stress or not.

S.No	Author Name	Title of Project	Method Used for stress test	Problem Indentified	Limitations
1	Chalmers.T; Hickey.B.A; Newton.P; Lin,C.-T.; Sibbritt.D; McLAchlan,CA .S.; CliftonBligh.R; Morley.J; Lal. S	Stress Watch: The use of Heart Rate Variability to Detect Stress: A Pilot study Using Smart Watch Wearables.	1.AVG BP (Omron IA1B, Japan) 2. 42-item Depression Anxiety Stress Scale (DASS) 3. Trier Social Stress Test (TSST) 4. Kubios HRV Premium software (HRV)	Failure of identifying ubiquitous patterns of HRV and HR changes during stress .	Since medical students are more adapted to lab environments the data collected was ef fected.
2	Jharna Agrawal1 , Manish Gupta2 , and Hitendra Garg	Early Stress Detection and Analysis using EEG signals in Machine Learning Framew ork.	stress detection methodology using EEG signals, used FD algorithms viz. Higuchi, Katz and Permutation Entropy for irregularities. Random Forest and Artificial Neural Network for classification.	To find out the best way for detecting stress at an early stage to prevent stress becoming persistent and proposing strategies to stop causing irreversible damages.	Due to Low spatial resolution and elevated noise results are not accurate. It requires further practical valida tion.
3	Doma, V. and Pirouz, M.,	A comparative analysis of machine learning methods for emotion recognition using EEG and peripheral physiological signals	DEAP dataset, learning techniques [namely Support Vector Machine (SVM), K-nearest neighbor, Linear Discriminant Analysis, Logistic Regression and Decision Trees each of these models] were tested with and without principal component analysis (PCA).	The motivation behind performing the comparative analysis was to check if it is possible to find a correct combination of techniques that can achieve comparable results with more complex techniques	Improvement in accuracy or in efficiency could possibly be achieved with more data
4	Siirtola, Pekka.	Continuous stress detection using the sensors of commercial smartwatch	WESAD dataset, Firebase Database, SVM classifier	The objective of the project is to help the user with necessary warnings when they are stressed during a task performed.	The stress detected is not accurate enough when compared to laboratory values. more recent

					algorithms is needed.
5	Hae Young Lee,Dong-Ju Lee.et.al	Smartphone / smartwatch-based cuffless blood pressure measurement	photoplethysmographybased smartphone algorithm	To recommend optimal BP measurement methods using a smartphone device	The smartwatchbased BP measurement is not yet ready for clinical usage
6	Zubair M., Yoon C., Kim H.	Smart Wearable Band for Stress Detection.	EDA, Accelerometer, Bluetooth	Using only heart rate to detect stress resulting in misclassification.	It only uses one parameter for the prediction.

CHAPTER 3
SYSTEM REQUIREMENTS SPECIFICATIONS

3.1 Software Requirements

Python 4.9

Embedded C

OS: Windows 10 or above/macOs /Linux

Arduino IDE

Html: Front end of application

Css: Modified version editing front end

Java Script : Dynamic version of front end

Solidity: Creation of Smart contracts

3.2 Hardware Requirements

8 GB RAM

Hard disk 256GB and above

Intel core i5 11th gen or above processor or AMD Ryzen 5 or above processor

Arduino UNO (embedded C)

ESP 32 Wifi Module

LM-35 Sensor

Pulse sensor

16*2 LCD

GSR sensor

CHAPTER 4

SYSTEM DESIGN

4.1 ARCHITECTURE

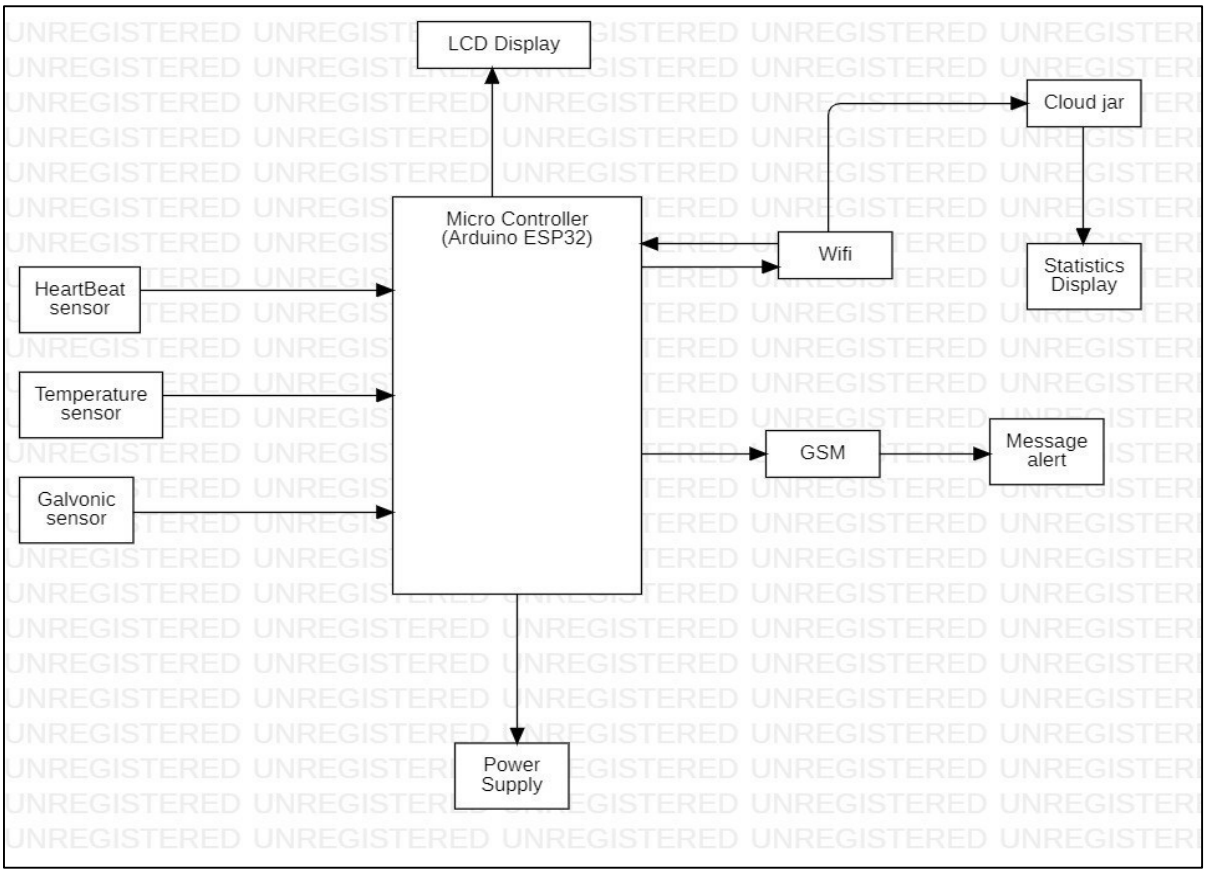

Figure 4.1 System Architecture

4.2 UML DIAGRAMS

UML stands for Unified Modeling Language. UML is a standardized general-purpose modeling language in the field of object-oriented software engineering. The standard is managed, and was created by, the Object Management Group.

The goal is for UML to become a common language for creating models of object-oriented computer software. In its current form UML is comprised of two major components: A Meta-model and a notation. In the future, some form of method or process may also be added to; or associated with,
UML.

The Unified Modeling Language is a standard language for specifying, Visualization, Constructing and documenting the artifacts of software system, as well as for business modeling and other nonsoftware systems.

The UML represents a collection of best engineering practices that have proven successful in the modeling of large and complex systems.

The UML is a very important part of developing objects-oriented software and the software development process. The UML uses mostly graphical notations to express the design of software projects.

4.2.1. USE CASE DIAGRAM

Use case diagrams are a set of use cases, actors, and their relationships. They represent the use case view of a system.
A use case represents a particular functionality of a system. The Device has many actors, Sensors,User display ,Arduino device. Common modules for these actors are login and view the values and observe the variations.

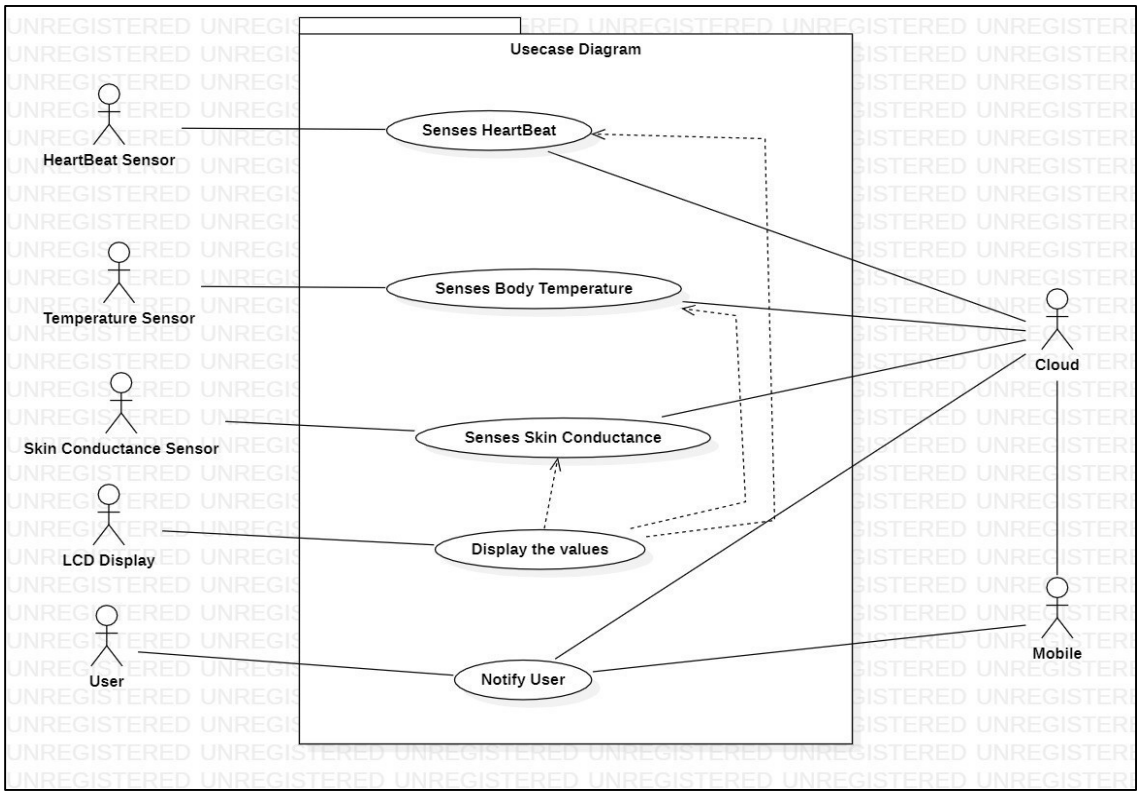

Figure 4.2.1 Use Case Diagram

4.2.2. SEQUENCE DIAGRAM

A sequence diagram in Unified Modelling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. Sequence diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.

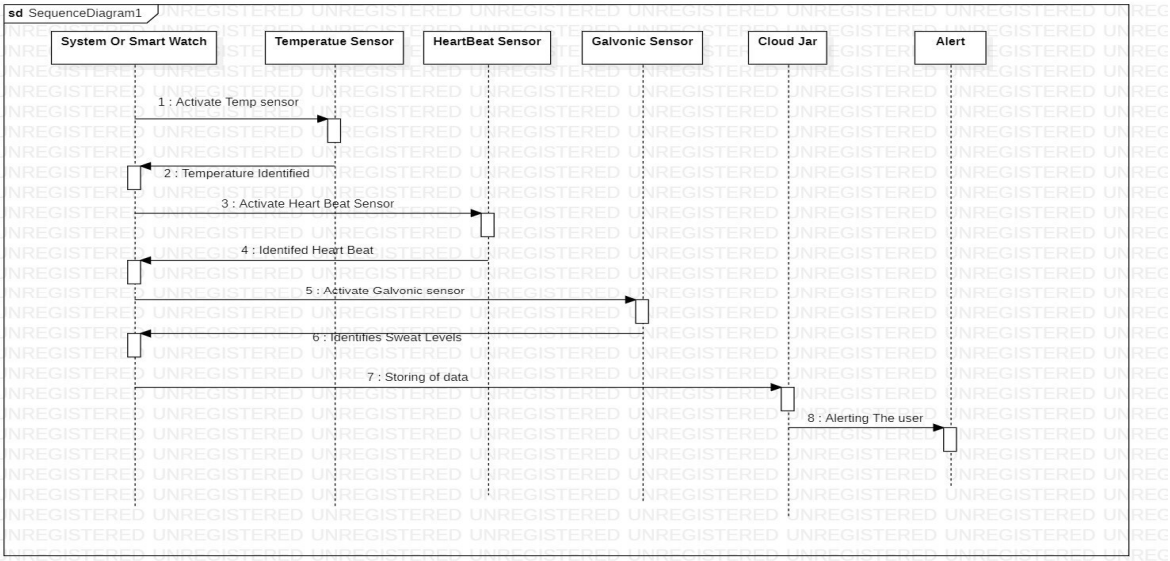

Figure 4.2.2 Sequence Diagram

4.2.3. DEPLOYMENT DIAGRAM

Deployment diagram represents the deployment view of a system. It is related to the component diagram. Because the components are deployed using the deployment diagrams. A deployment diagram consists of nodes. Nodes are nothing but physical hardware's used to deploy the application.

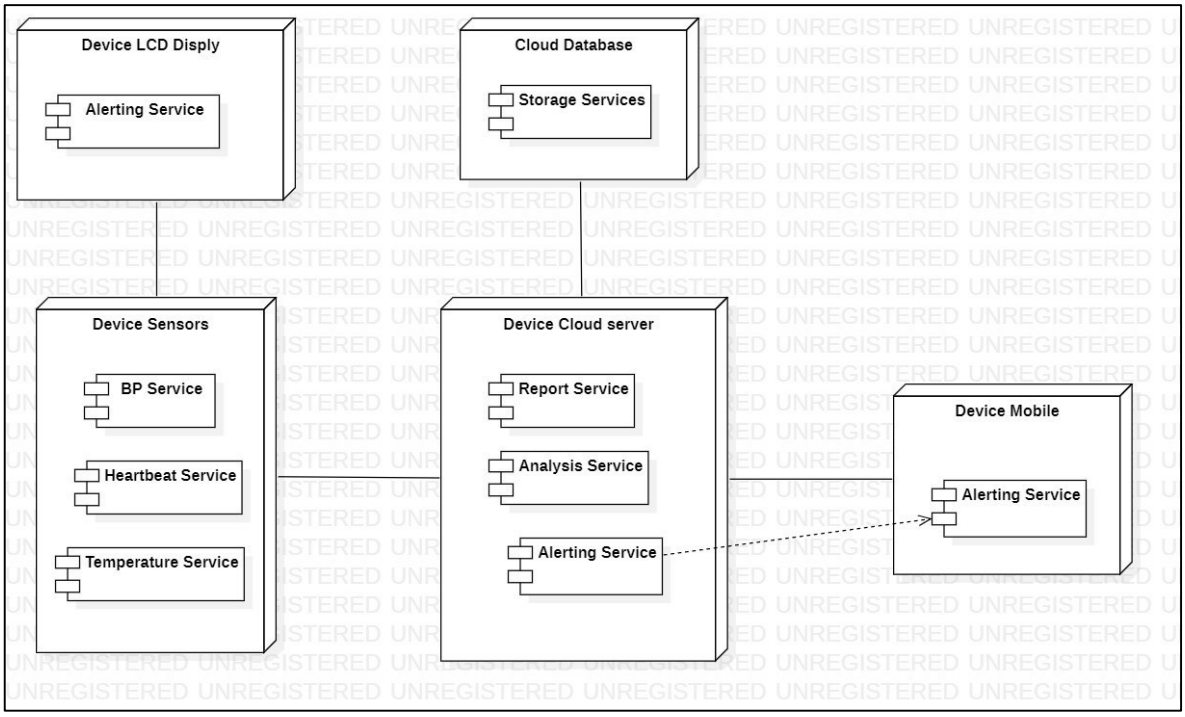

Figure 4.2.3 Deployment Diagram

4.2.4. ACTIVITY DIAGRAM

Activity diagram describes the flow of control in a system. It consists of activities and links. The flow can be sequential, concurrent, or branched. Activities are nothing but the functions of a system.

Numbers of activity diagrams are prepared to capture the entire flow in a system.

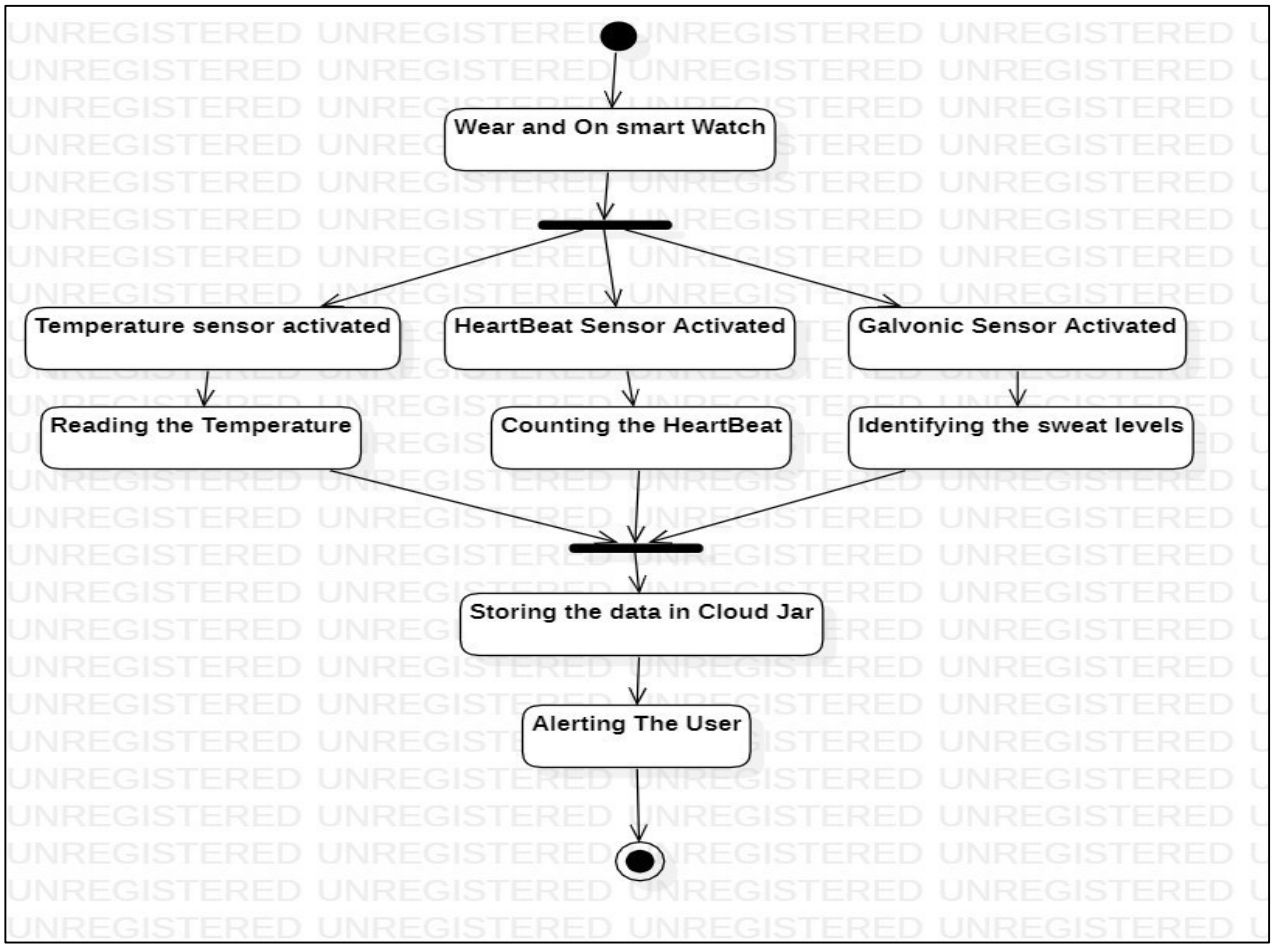

Figure 4.2.4 Activity Diagram

4.2.5 Data Flow Diagram

A data flow diagram (DFD) maps out the flow of information for any process or system. It uses defined symbols like rectangles, circles and arrows, plus short text labels, to show data inputs, outputs, storage points and the routes between each destination.

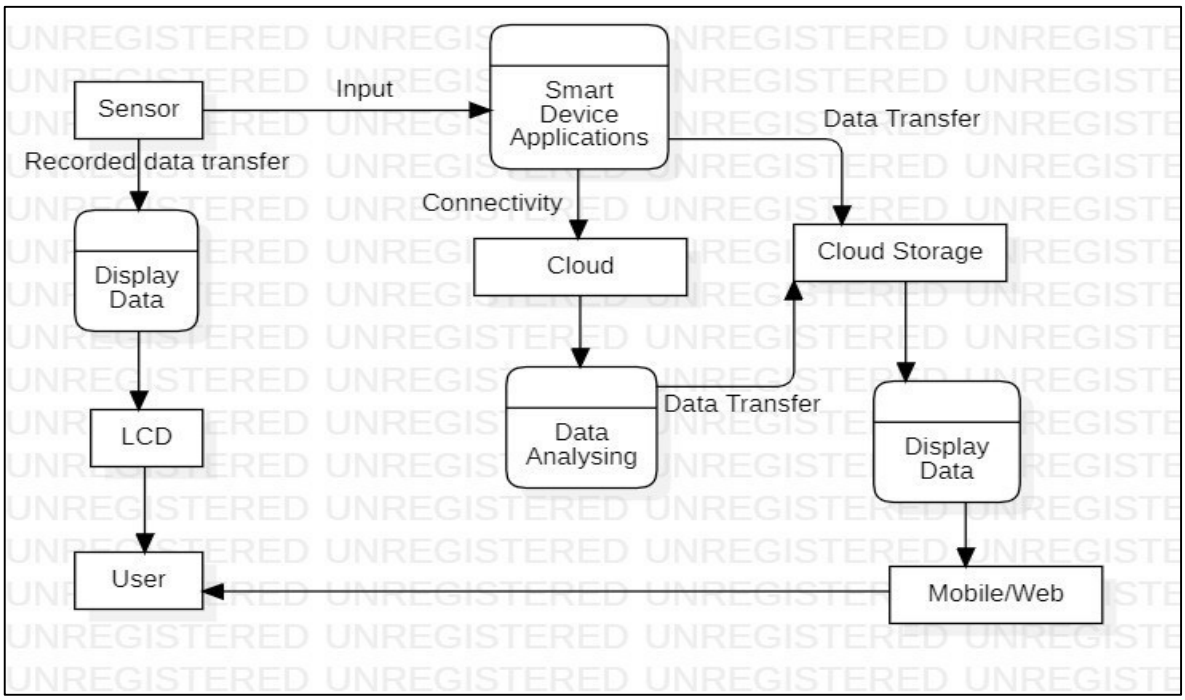

Figure 4.2.5 Data Flow Diagram

4.2.6 ER Diagram

An entity relationship diagram (ERD) is a representation of data within a domain. It consists of entities as well as relationships between entities. An entity can be a tangible, physical object such as a school or student, or a concept such as a reply or a transaction.

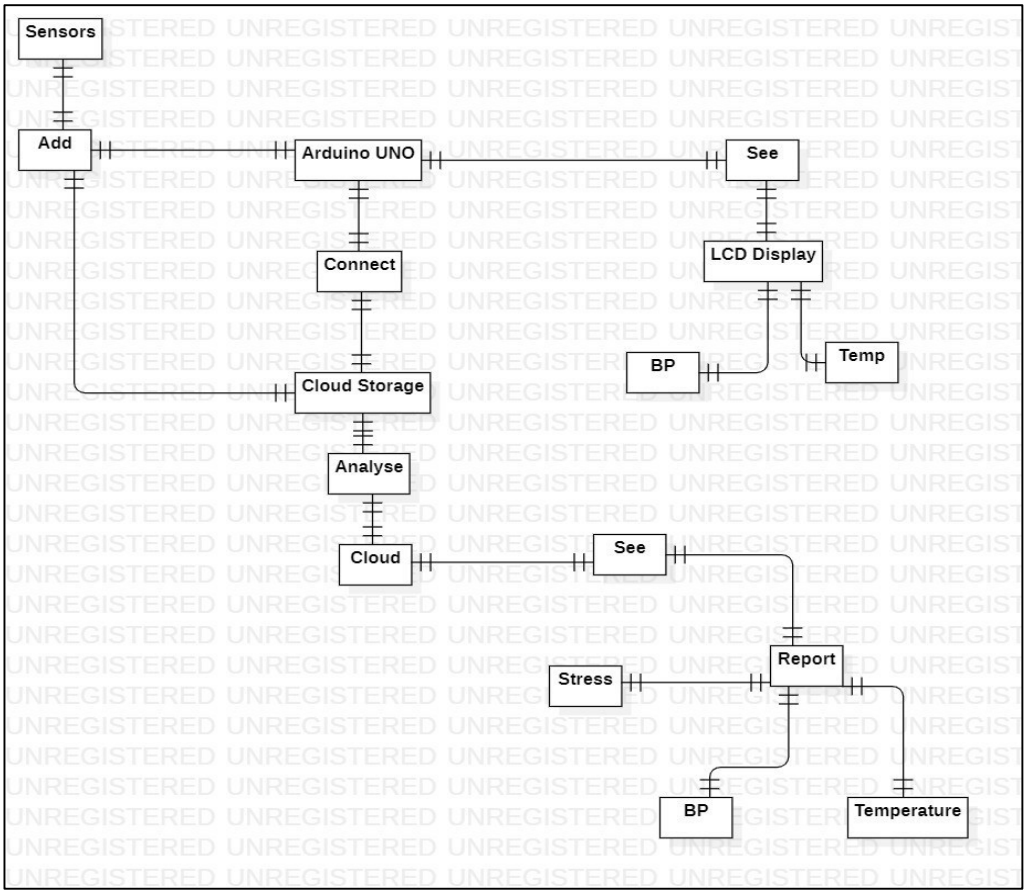

Figure 4.2.6 ER Diagram

CHAPTER 5
IMPLEMENTATION

Arduino UNO

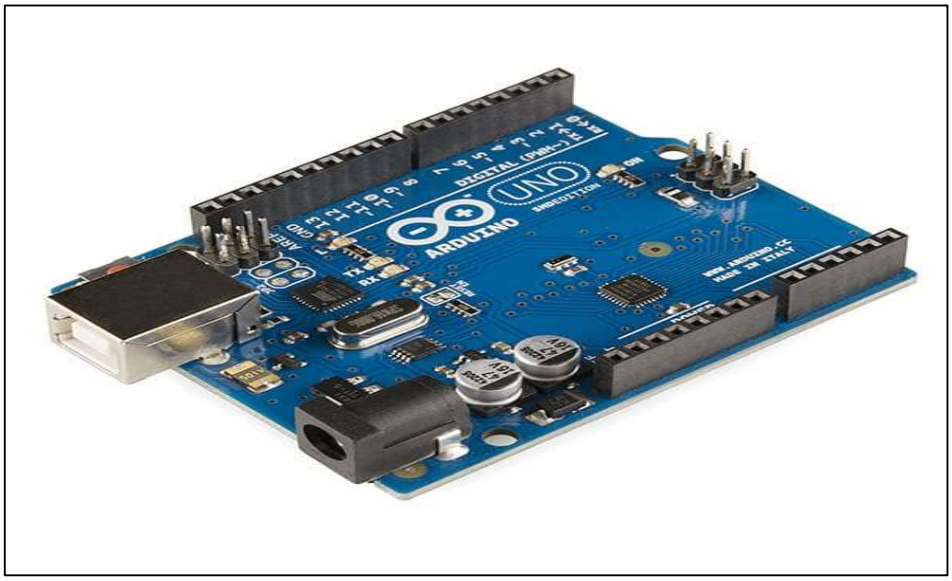

Figure 5.1 Arduino UNO

The Arduino UNO is a microcontroller of ATmega328contains 14 pins. The Arduino board does not have capacity to execute code by itself accompanied by any external power supply. The Arduino board has inbuilt program whether it is working or not. The Arduino board has very easy compatible interface design for communicating accompanied by the sensors and it needs only 5v supply.

GSM (Global System for Mobile Communication)

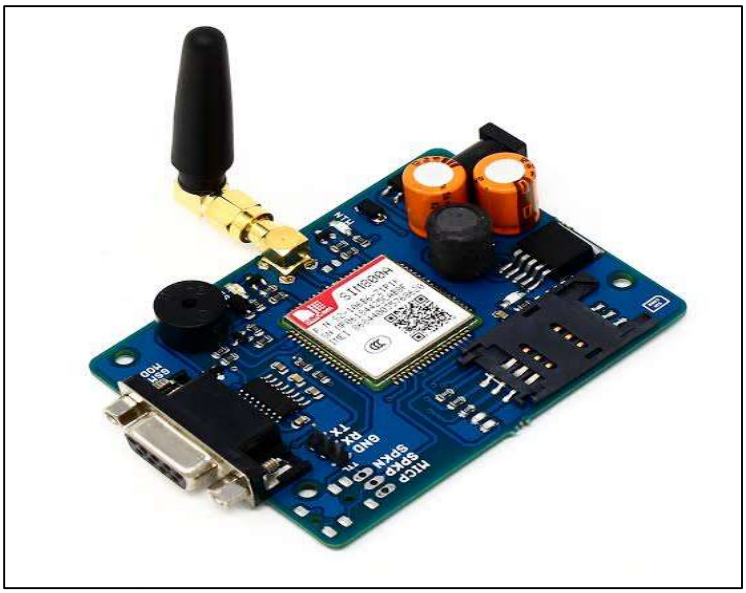

Figure 5.2 GSM

A GSM module has a RS32 interface for serial communication with an outside fringe. It regulates a simple transporter flag to encounter computerized info and demodulates to interpret the transparent data. GSM is an open and digital cellular technology for transmitting mobile voice and data services. A GSM digitalizes and reduces the data, then sends it down through a channel with two different streams of client data, each in it has own particular time slot.

GSR Sensor

Figure 5.3 GSR Sensor

The GSR sensor measures the varying levels of the skin conducting the electric current. Higher levels of perspiration on the skin lead to a greater conductance of electrical currents. A higher level of conductivity of the skin after an event can therefore be interpreted as either positive or negative emotional arousal.

LM35 Temperature Sensor

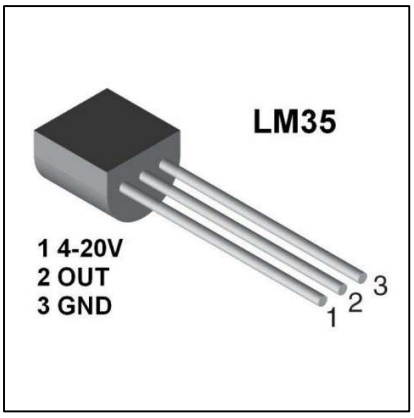

Figure 5.4 LM35 Temperature sensor

LM35 is a temperature measuring device having an analog output voltage proportional to the temperature. It provides output voltage in Centigrade (Celsius). It does not require any external calibration circuitry. The sensitivity of LM35 is 10 mV/degree Celsius. As temperature increases, output voltage also increases.

HeartBeat Sensor

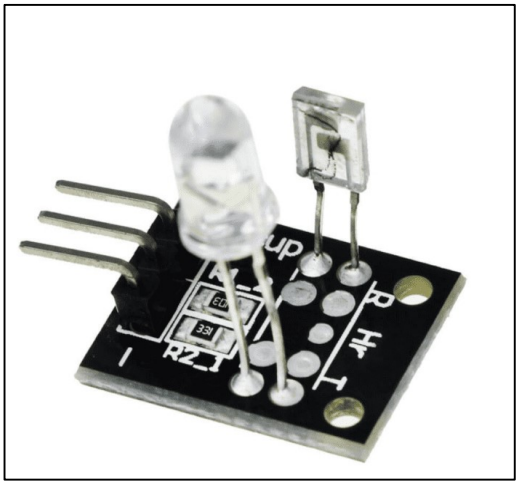

Figure 5.5 LM35 HeartBeat Sensor

The KY-039 Finger Heartbeat Detection Sensor is a sensor that can detect a person's pulse or heartbeat. It is a small, portable sensor that easily connects to an Arduino or other microcontroller to read and analyse heart rate.

16x2 LCD Display

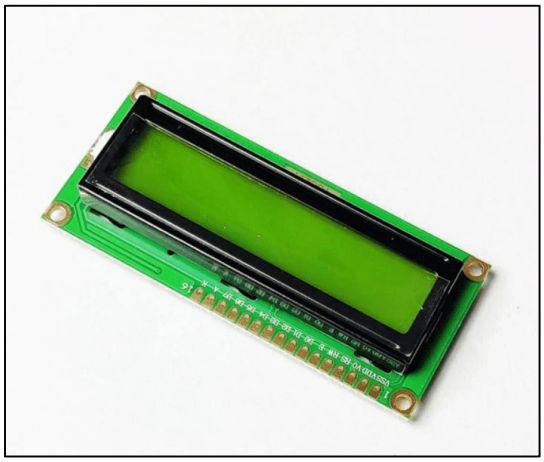

Figure 5.6 16x2 LED Display

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols.

ESP8266 Wifi Module

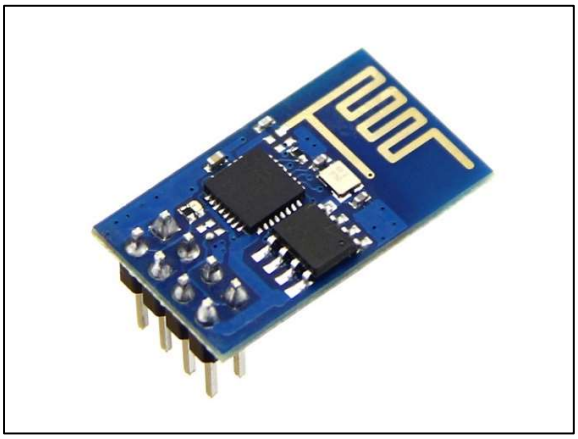

Figure 5.8 ESP8266 WIfi Module

The ESP8266 is inbuilt Wi-Fi module incorporated in SOC with transfer control protocol and internet convention stack that can provide controller to access WI-FI. For the wireless communication ESP8266 WiFi module is used for sending the data from the Arduino to the thingspeak server.

Jumper Wires

Figure 5.9 Jumper wires

A jump wire is an electrical wire, or group of them in a cable, with a connector or pin at each end, which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

Software Used :

Arduino IDE : This software can also be used Aurdino UNO by installing the required libraries. Arduino IDE is an open-source software, designed by Arduino.cc and mainly used for writing, compiling & uploading code to almost all Arduino Modules. It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process. It is available for all operating systems i.e. MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role in debugging, editing and compiling the code. Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code. The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board. The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module. This environment supports both C and C++ languages.

5.2 ENVIRONMENTAL SETUP:

Step 1 − First you must have your Arduino board (you can choose your favorite board) and a USB cable. In case you use Arduino UNO, Arduino Duemilanove, Nano, Arduino Mega 2560, or Diecimila, you will need a standard USB cable (A plug to B plug), the kind you would connect to a USB printer as shown in the following image.

Figure 5.10

Step 2 − Download Arduino IDE Software.

You can get different versions of Arduino IDE from the Download page on the Arduino Official website. You must select your software, which is compatible with your operating system (Windows, IOS, or Linux). After your file download is complete, unzip the file.

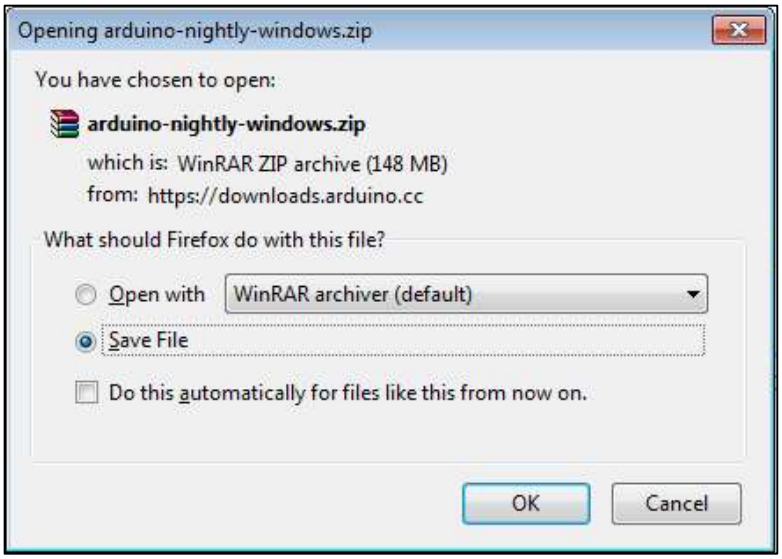

Figure 5.11

Step 3 − Power up your board.

The Arduino Uno, Mega, Duemilanove and Arduino Nano automatically draw power from either, the USB connection to the computer or an external power supply. If you are using an Arduino Diecimila, you have to make sure that the board is configured to draw power from the USB connection. The power source is selected with a jumper, a small piece of plastic that fits onto two of the three pins between the USB and power jacks. Check that it is on the two pins closest to the USB port.

Connect the Arduino board to your computer using the USB cable. The green power LED (labeled PWR) should glow.

Step 4 − Launch Arduino IDE.

After your Arduino IDE software is downloaded, you need to unzip the folder. Inside the folder, you can find the application icon with an infinity label (application.exe). Double-click the icon to start the IDE.

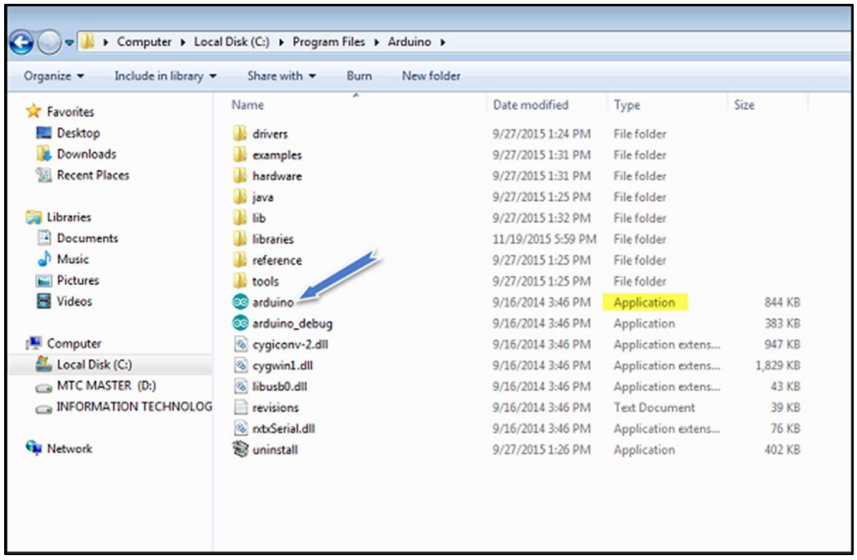

Figure 5.12

Step 5 − Open your first project.

Once the software starts, you have two options −

- Create a new project.
- Open an existing project example.

To create a new project, select File → **New**.

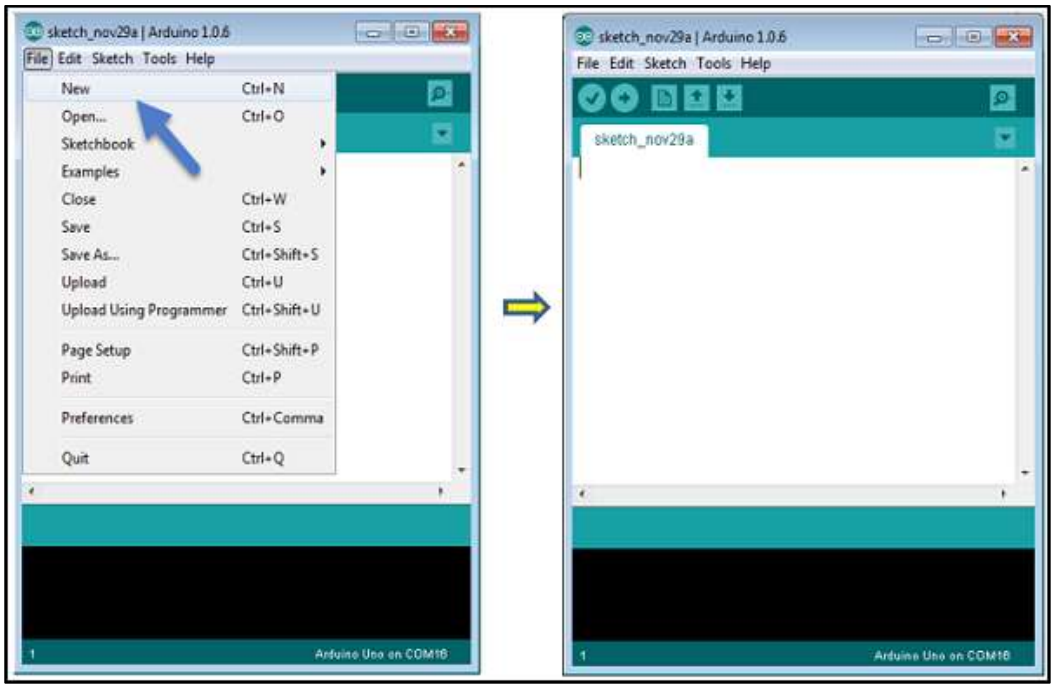

Figure 5.13

Step 6 − Select your Arduino board.

To avoid any error while uploading your program to the board, you must select the correct Arduino board name, which matches with the board connected to your computer.

Go to Tools → Board and select your board.

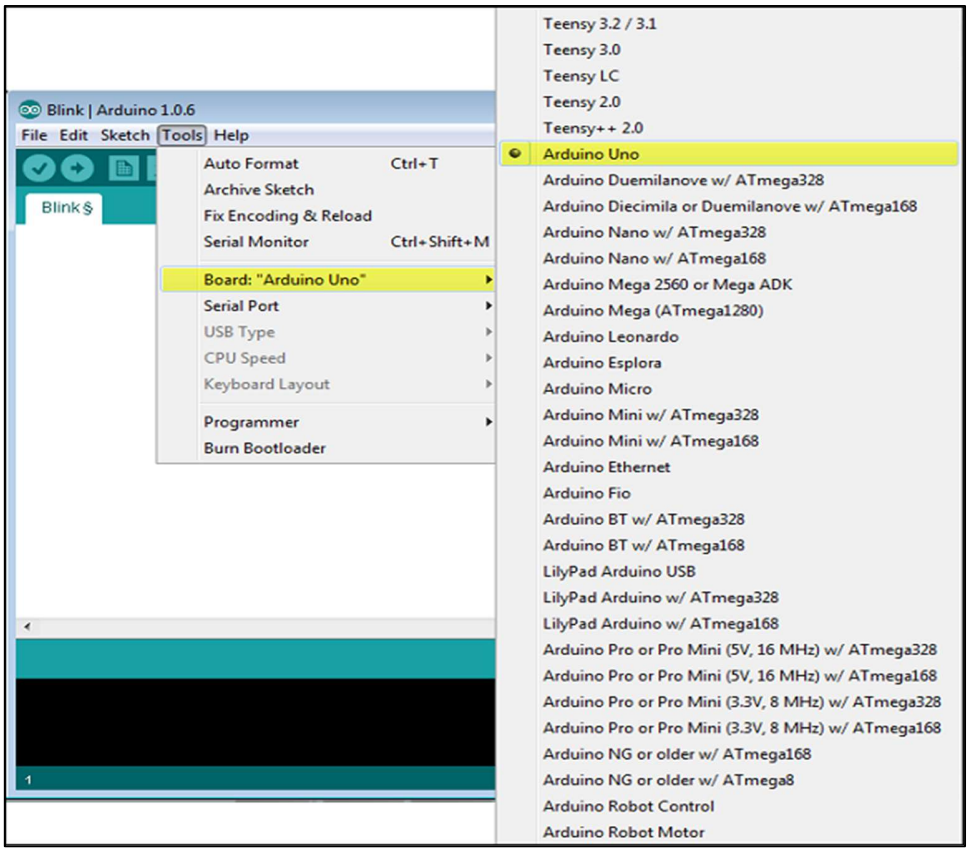

Figure 5.14

Step 7 − Select your serial port.

Select the serial device of the Arduino board. Go to **Tools → Serial Port** menu. This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial ports). To find out, you can disconnect your Arduino board and re-open the menu, the entry that disappears should be of the Arduino board. Reconnect the board and select that serial port.

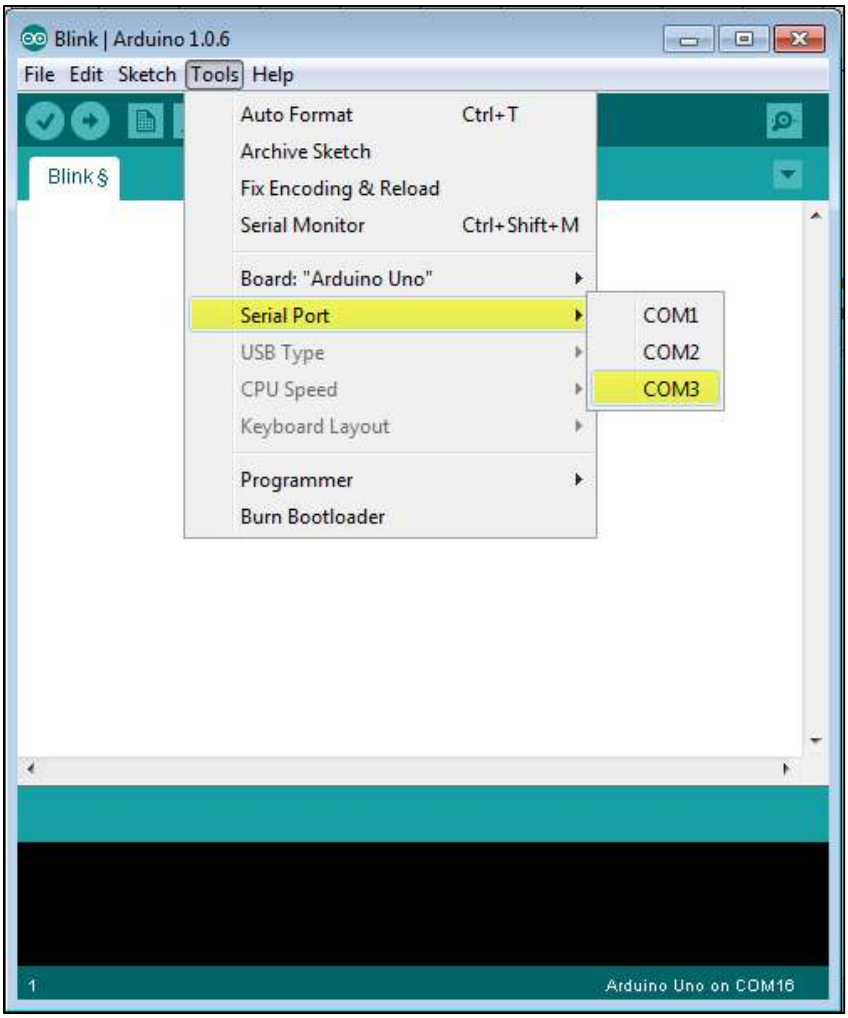

Figure 5.15

Step 8 − Upload the program to your board.

Before explaining how we can upload our program to the board, we must demonstrate the function of each symbol appearing in the Arduino IDE toolbar.

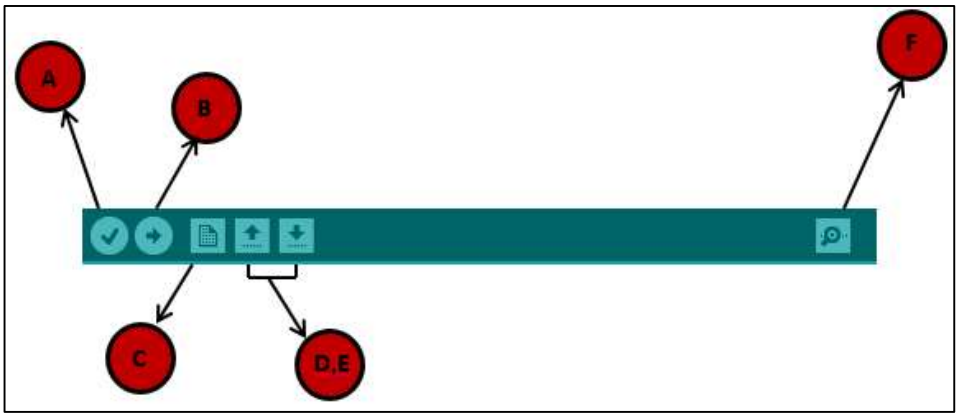

Figure 5.16

A − Used to check if there is any compilation error.

B − Used to upload a program to the Arduino board.

C − Shortcut used to create a new sketch.

D − Used to directly open one of the example sketch.

E − Used to save your sketch.

F − Serial monitor used to receive serial data from the board and send the serial data to the board.

Now, simply click the "Upload" button in the environment. Wait a few seconds; you will see the RX and TX LEDs on the board, flashing. If the upload is successful, the message "Done uploading" will appear in the status bar.

5.3 Module Description

- Sensing pulse and other vitals using various sensors and display.

  A model is designed to detect the heart rate variability, skin conductance and temperature using Heart Beat sensor, GSR (Galvonic skin response) Sensor, LM35 Temperature Sensor respectively. The readings will be taken for every 30 seconds interval of time.

- Uploading to the cloud through WIFI module.

  Once we have taken the input from the person through sensors, the information is uploaded and saved to the projects factory server (projectsfactoryserver.com) through WIFI module for every 30 seconds. The uploaded data will be available in the form of tables and graphs for visuvalization.

- Analysis of stress levels of the person and delivery. The microcontroller for further processing and storing.

  If gsr(200-500) and temp(32) and hr(72)

  then the person has no stress ("normal")

  If gsr(<200) and temp(33-40) and hr(73-80)

  then the person has low stress ("Stressed")

  If gsr(<100) and temp(>40) and hr(>80)

  then the person has high stress ("visit doctor")

- The microcontroller informs the person by sending SMS to the mobile using the GSM module every minute when in contact with sensors.

  Based on the values from the sensors the status of a person will be displayed on the screen. If the values are having huge difference with respect to thrushold values.

CHAPTER 6
RESULTS (SCREENSHOTS)

The proposed model has been tested and the values are recorded and are uploaded to the thingspeak server by using wifi module and the message will be sent to the user through GSM module. Figure shows the values of the all three sensors.

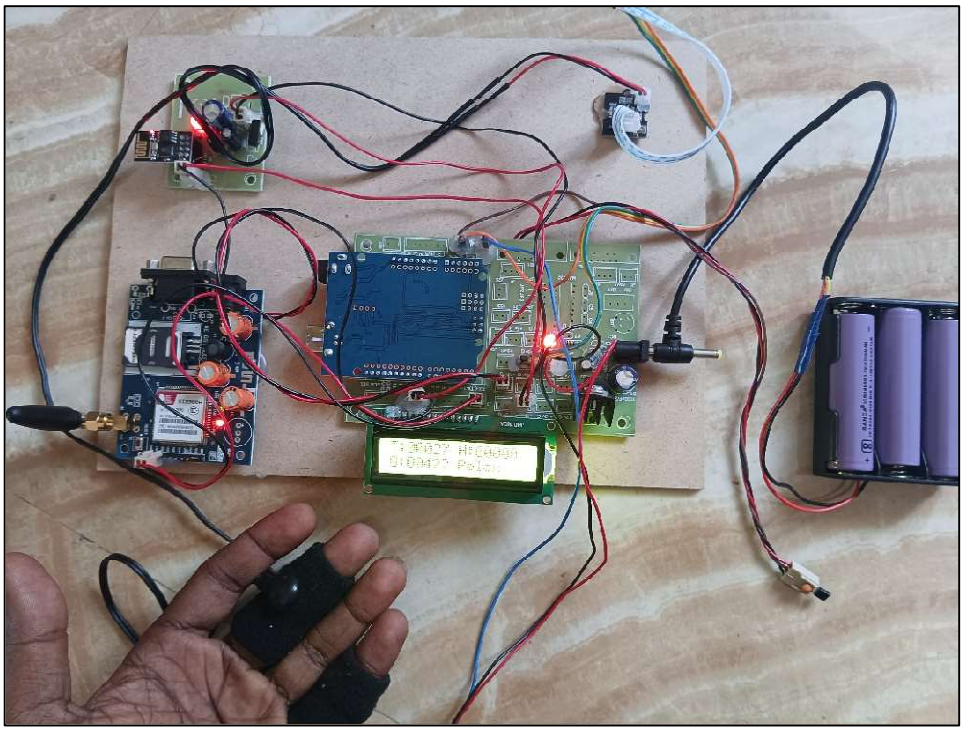

Figure 6.1 Hardware setup of the model

Figure- 6.1. shows the setup of the hardware model of the Bp and stress detection system. This figure shows the connection between all the components.

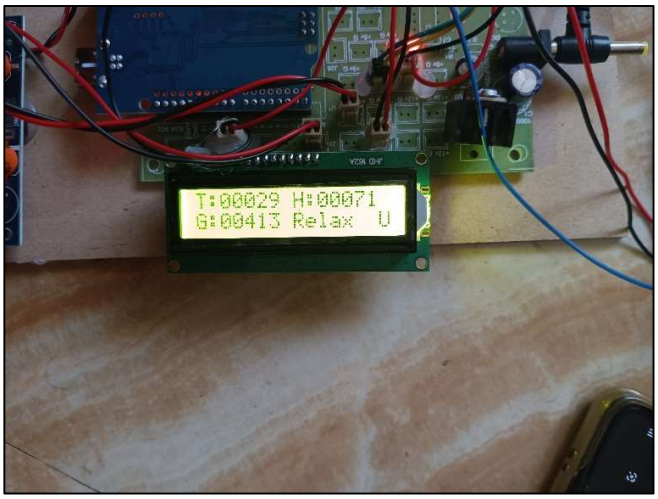

Figure 6.2 Displaying values of the sensors

Figure shows the values of the all three sensors and the state of a person in a relaxed situation.In the figure The display shows the values of Temperature,HeartBeat, and the GSR values and the state of a person.”U” defines that the data is uploading into the server.

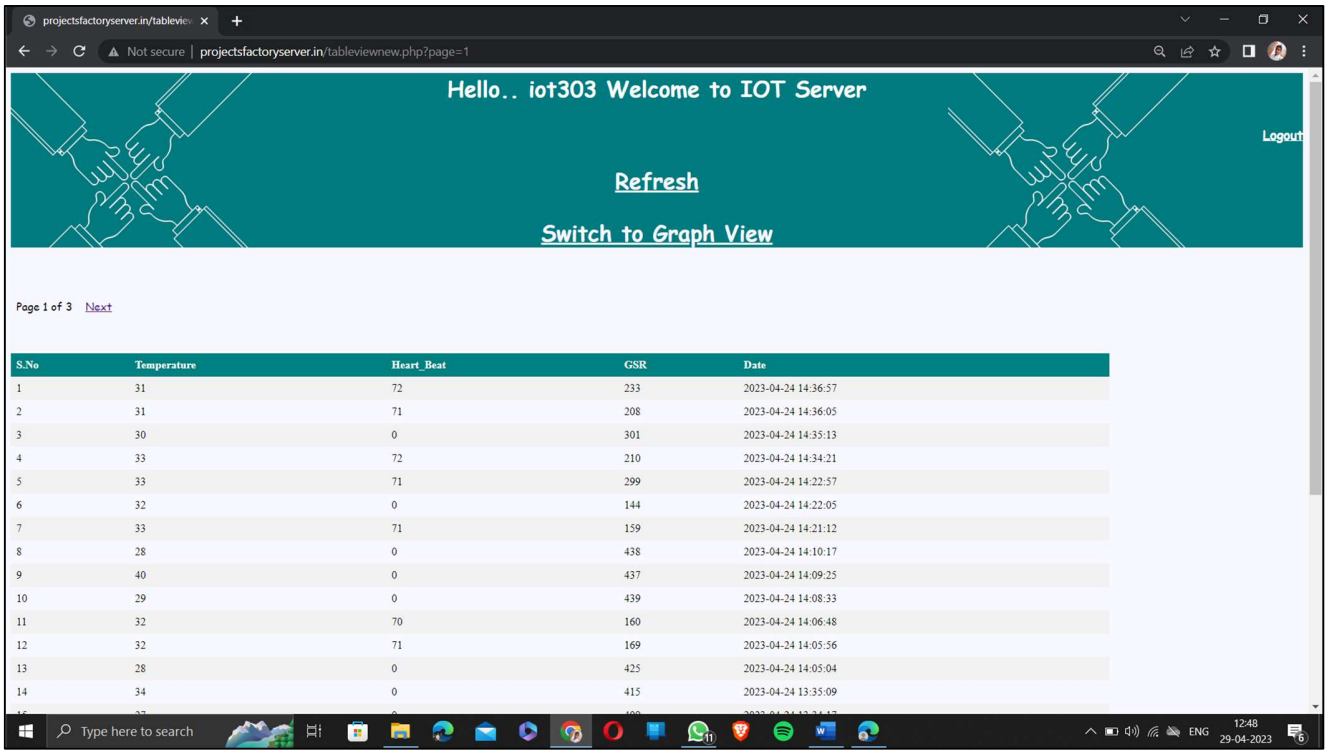

Figure 6.3 Table values in the server

The Figure shows the data uploaded in the server in the table format.

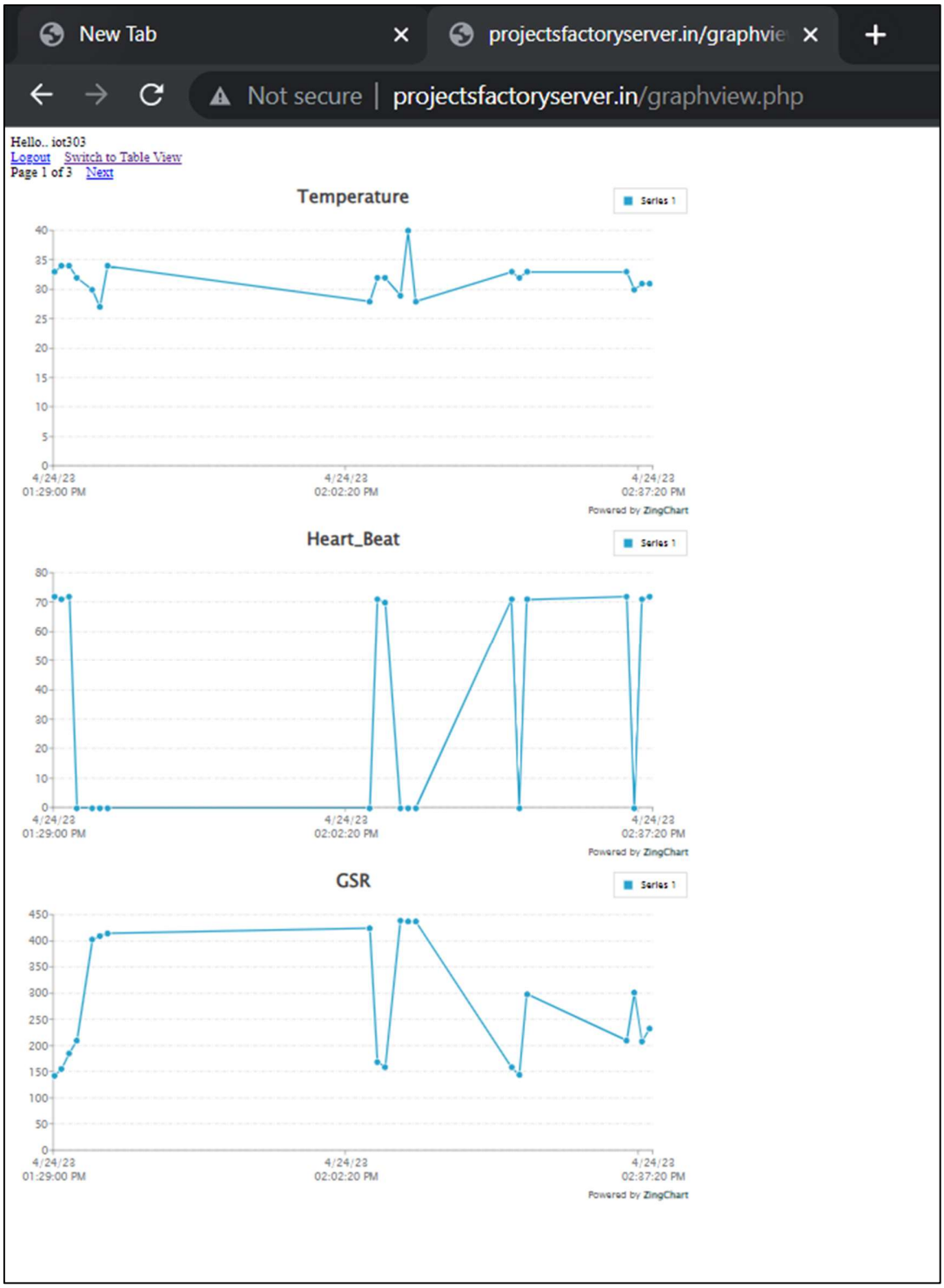

Figure 6.4 Graphical representation of the values

This Figure 6.4 shows the Graphical representation of the data from the sensors.

Figure 6.5 Alert text message to the phone

This figure shows the Alert message that received to the registered phone number.

CHAPTER 7

CONCLUSION

Smart stress detection system is designed and developed using Arduino. The system successfully and accurately detects the stress levels using various sensors such as heartbeat rate, body temperature and skin conductance values. Based on the values of these sensors, the levels of stress is calculated and the information is transmitted using IOT to the concerned persons mobile for necessary action. The developed model is more flexible and consuming less power. It is very useful for personal monitoring and is very useful in taking care of disabled persons. This work can be extended by using ECG sensor,EEG sensor, Muscle sensor etc and this model can be built on a SOC device.

CHAPTER 8
REFERENCES

- Chalmers, T.; Hickey, B.A.; Newton, P.; Lin, C.-T.; Sibbritt, D.; McLachlan, C.S.; Clifton-Bligh, R.; Morley, J.; Lal, S. Stress Watch: The Use of Heart Rate and Heart Rate Variability to Detect Stress: A Pilot Study Using Smart Watch Wearables.
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- Jharna Agrawal1 , Manish Gupta2 , and Hitendra Garg3,2021. Early Stress Detection and Analysis using EEG signals in Machine Learning Framework. 1116 (2021)
  012134
- Doma, V. and Pirouz, M., 2020. A comparative analysis of machine learning methods for emotion recognition using EEG and peripheral physiological signals.Journal of Big Data, 7(1), pp.1-21.
- Siirtola, Pekka. (2019). “Continuous stress detection using the sensors of commercial smartwatch.” 1198-1201. 10.1145/3341162.3344831.
- Hae lee,Dou Ju Lee.et.al,Smartphone / smartwatch-based cuffless blood pressure measurement : a position paper from the Korean Society of Hypertension

Appendix

```
 #include <LiquidCrystal.h>
LiquidCrystal lcd(6,7,5,4,3,2);

#include <SoftwareSerial.h>
SoftwareSerial mySerial(8,9);

int rtr1=0;

int heart   = 10;
int buzzer  = 13;



int hbtc=0,hbtc1=0,rtrl=0;

float tempc=0,tempf=0;

char rcv,pastnumber[11];


int ii=0,rchkr=0;

char res[130];

void serialFlush()
{
  while(Serial.available() > 0)
  {
    char t = Serial.read();
  }
}

void myserialFlush()
{
  while(mySerial.available() > 0)
  {
    char t = mySerial.read();
  }
}


char check(char* ex,int timeout)
{
  int i=0;
  int j = 0,k=0;
  while (1)
  {
```

```
    sl:
    if(mySerial.available() > 0)
    {
      res[i] = mySerial.read();
      if(res[i] == 0x0a || res[i]=='>' || i == 100)
      {
        res[i] = 0;break;
      }
      i++;
    }
    j++;
    if(j == 30000)
    {
      k++;
     // Serial.println("kk");
      j = 0;
    }
    if(k > timeout)
    {
      //Serial.println("timeout");
      return 1;
     }
  }//while 1
  if(!strncmp(ex,res,strlen(ex)))
  {
   // Serial.println("ok..");
    return 0;
   }
  else
  {
   // Serial.print("Wrong  ");
   // Serial.println(res);
    i=0;
    goto sl;
   }
}



int sts1=0;
char buff[200];
void upload(unsigned int s1,String s2,String s3);
char readserver(void);
void clearserver(void);

const char* ssid = "iotserver";
const char* password = "iotserver123";
```

```
void okcheck()
{
  unsigned char rcr;
  do{
      rcr = Serial.read();
    }while(rcr != 'K');
}

int sti=0;
String inputString = "";         // a string to hold incoming data
boolean stringComplete = false;  // whether the string is complete


void beep()
{
  digitalWrite(buzzer,                  LOW);delay(2000);digitalWrite(buzzer,
HIGH);delay(500);
}
void setup()
{
  char ret;

  Serial.begin(9600);
  mySerial.begin(115200);

  pinMode(buzzer, OUTPUT);
  pinMode(heart, INPUT);

  digitalWrite(buzzer, HIGH);

  //6.  IOT smart dustbin
  lcd.begin(16,2);
  lcd.clear();
  lcd.setCursor(0, 0);lcd.print("    Welcome  ");
     delay(2500);


   wifiinit();
  delay(2500);

   lcd.clear();
   lcd.setCursor(0,0);
   lcd.print("T:");//2,0
   lcd.setCursor(8,0);
   lcd.print("H:");//10,0

   lcd.setCursor(0,1);
   lcd.print("GSR:");//4,1
 rtrl=0;
```

```
}

char bf3[50];
int g=0,f=0,count=0,lc=0;

int cntlmk=0,cntlmk1=0;
char moss[15];
char rains[20];

int hbv=0,hbv1=0;

String gsr_string="";
float gsrv=0.0;

void loop()
{
  tempc = analogRead(A0);
  tempc = (tempc*0.48828125);
        //lcd.setCursor(2,1);convertl(tempc);
  lcd.setCursor(2,0);convertl(tempc);
  /*
  if(tempc > 40)
    {
      beep();
      upload(tempc,hbtc1,gsr_string);

    }
    */
       hbv = analogRead(A5);
      if(hbv > 100)
        {
         if(rtrl == 1){hbtc1=67;}
         if(rtrl == 2){hbtc1=69;}
         if(rtrl == 3){hbtc1=68;}
         if(rtrl == 4){hbtc1=72;}
         if(rtrl == 5){hbtc1=74;}
         if(rtrl == 6){hbtc1=68;}
         if(rtrl == 7){hbtc1=75;}
         if(rtrl == 8){hbtc1=68;}
         if(rtrl == 9){rtrl=0;hbtc1=73;}

        }
      else
        {
          rtr1=0;
          hbtc1=0;
        }

         lcd.setCursor(10,0);convertl(hbtc1);
```

```
          gsrv = analogRead(A1);//
          lcd.setCursor(4,1);convertl(gsrv);lcd.print(" uS  ");
         // gsr_string = "";
         // gsr_string = String(gsrv) + "uS";

          delay(800);
if(gsrv>200 && gsrv<500)
{
lcd.setCursor(4,1);lcd.print(" Normal  ");
}
if(gsrv<200 && gsrv>700)
{
lcd.setCursor(4,1);lcd.print(" Stressed  ");
}
          cntlmk++;
          if(cntlmk >= 20)
            {cntlmk=0;

            if(hbtc1 >= 60)
              {      cntlmk1++;
               if(cntlmk1 == 1){hbtc1 = 69 + (hbtc1/23);}
               if(cntlmk1 == 2){hbtc1 = 68 + (hbtc1/23);}
               if(cntlmk1 == 3){hbtc1 = 70 + (hbtc1/23);}
               if(cntlmk1 == 4){hbtc1 = 71 + (hbtc1/23);}
               if(cntlmk1 == 5){hbtc1 = 73 + (hbtc1/23);}
               if(cntlmk1 == 6){hbtc1 = 70 + (hbtc1/23);}
               if(cntlmk1 == 7){hbtc1 = 72 + (hbtc1/23);}
               if(cntlmk1 == 8){hbtc1 = 67 + (hbtc1/23);}
               if(cntlmk1 == 9){cntlmk1=0;hbtc1 = 72 + (hbtc1/23);}

              }
                lcd.setCursor(10,0);convertl(hbtc1);
            Serial.write("AT+CMGS=\"");
   Serial.write(pastnumber);
   Serial.write("\"\r\n"); delay(3000);
   Serial.write("T:\r\n");
   Serial.write(tempc);
   Serial.write("H:\r\n");
   Serial.write(hbtc1);
   Serial.write("GSR:\r\n");
   Serial.write(gsrv);
   Serial.write(0x1A);
   delay(4000);  delay(4000);

               upload(tempc,hbtc1,gsrv);

          }
```

```
}

char bf2[50];
void upload(int s1,int s2,int s3)
{
  delay(2000);
  lcd.setCursor(15, 1);lcd.print("U");
  myserialFlush();
  mySerial.println("AT+CIPSTART=4,\"TCP\",\"projectsfactoryserver.in\",80");

  //http://projectsfactoryserver.in/storedata.php?name=pf5&s1=25&s2=35
  //sprintf(buff,"GET
http://embeddedspot.top/iot/storedata.php?name=iot139&s1=%u&s2=%u&s3=%u\r\n\
r\n",s1,s2);

      delay(8000);

//https://projectsfactoryserver.in/storedata.php?name=iotgps&lat=17.167898&l
an=79.785643
      memset(buff,0,strlen(buff));
      sprintf(buff,"GET
http://projectsfactoryserver.in/storedata.php?name=iot303&s1=%u&s2=%u&s3=%u\
r\n\r\n",s1,s2,s3);

              mySerial.println("AT+CIPCLOSE");
       lcd.setCursor(15, 1);lcd.print(" ");
}

char readserver(void)
{
  char t;
  delay(2000);
  lcd.setCursor(15, 1);lcd.print("R");
  myserialFlush();
  mySerial.println("AT+CIPSTART=4,\"TCP\",\"projectsfactoryserver.in\",80");

  //http://projectsfactoryserver.in/last.php?name=amvi001L

      delay(8000);
      memset(buff,0,strlen(buff));
      sprintf(buff,"GET
http://projectsfactoryserver.in/last.php?name=iot6L\r\n\r\n");
      myserialFlush();
      sprintf(bf2,"AT+CIPSEND=4,%u",strlen(buff));
      mySerial.println(bf2);

         delay(5000);
```

```
          myserialFlush();
          mySerial.print(buff);

        //read status
         while(1)
         {
            while(!mySerial.available());
             t = mySerial.read();
            // Serial.print(t);
             if(t == '*' || t == '#')
             {
               if(t == '#')return 0;
               while(!mySerial.available());
                t = mySerial.read();
                 myserialFlush();
                return t;
             }
         }
               delay(2000);

        mySerial.println("AT+CIPCLOSE");
        lcd.setCursor(15, 1);lcd.print(" ");
        delay(2000);
return t;
}

void clearserver(void)
{
  delay(2000);
  lcd.setCursor(15, 1);lcd.print("C");
  myserialFlush();
  mySerial.println("AT+CIPSTART=4,\"TCP\",\"projectsfactoryserver.in\",80");

  //sprintf(buff,"GET
http://projectsfactoryserver.in/storedata.php?name=iot1&s10=0\r\n\r\n");
       delay(8000);
       memset(buff,0,strlen(buff));
       sprintf(buff,"GET
http://projectsfactoryserver.in/storedata.php?name=iot6&s10=0\r\n\r\n");
       myserialFlush();
       sprintf(bf2,"AT+CIPSEND=4,%u",strlen(buff));
       mySerial.println(bf2);

          delay(5000);


          myserialFlush();
          mySerial.print(buff);
```

```
          delay(2000);
          myserialFlush();



       mySerial.println("AT+CIPCLOSE");
       lcd.setCursor(15, 1);lcd.print(" ");
       delay(2000);
}


void wifiinit()
{
 char ret;
  st:
  mySerial.println("ATE0");
  ret  = check((char*)"OK",50);
  mySerial.println("AT");
  ret  = check((char*)"OK",50);
 cagain:

  myserialFlush();
  mySerial.print("AT+CWJAP=\"");
  mySerial.print(ssid);
  mySerial.print("\",\"");
  mySerial.print(password);
  mySerial.println("\"");
  if(check((char*)"OK",300))goto cagain;
  mySerial.println("AT+CIPMUX=1");
  delay(1000);


  lcd.clear();lcd.setCursor(0, 0);lcd.print("WIFI READY");
}

int readSerial(char result[])
{
  int i = 0;
  while (1)
  {
    while (Serial.available() > 0)
    {
      char inChar = Serial.read();
      if (inChar == '\n')
         {
          result[i] = '\0';
          Serial.flush();
          return 0;
         }
```

```
      if (inChar != '\r')
         {
          result[i] = inChar;
          i++;
         }
    }
  }
}

void gsminit()
{
  Serial.write("AT\r\n");                    okcheck();
  Serial.write("ATE0\r\n");                  okcheck();
  Serial.write("AT+CMGF=1\r\n");             okcheck();
 Serial.write("AT+CNMI=1,2,0,0\r\n");       okcheck();
  Serial.write("AT+CSMP=17,167,0,0\r\n");    okcheck();

  lcd.clear();
  lcd.print("SEND MSG STORE");
  lcd.setCursor(0,1);
  lcd.print("MOBILE NUMBER");
  do{
     rcv = Serial.read();
    }while(rcv == '*');
     readSerial(pastnumber);pastnumber[10] = '\0';

  lcd.clear();
  lcd.print(pastnumber);

    delay(4000);  delay(4000);
    Serial.write("AT+CMGS=\"");
    Serial.write(pastnumber);
    Serial.write("\"\r\n"); delay(3000);
    Serial.write("Reg\r\n");
    Serial.write(0x1A);
    delay(4000);  delay(4000);
}


void convertl(unsigned int value)
{
  unsigned int a,b,c,d,e,f,g,h;

      a=value/10000;
      b=value%10000;
      c=b/1000;
      d=b%1000;
      e=d/100;
      f=d%100;
```

```
      g=f/10;
      h=f%10;


      a=a|0x30;
      c=c|0x30;
      e=e|0x30;
      g=g|0x30;
      h=h|0x30;


   lcd.write(a);
   lcd.write(c);
   lcd.write(e);
   lcd.write(g);
   lcd.write(h);
}
void convertk(unsigned int value)
{
  unsigned int a,b,c,d,e,f,g,h;

      a=value/10000;
      b=value%10000;
      c=b/1000;
      d=b%1000;
      e=d/100;
      f=d%100;
      g=f/10;
      h=f%10;


      a=a|0x30;
      c=c|0x30;
      e=e|0x30;
      g=g|0x30;
      h=h|0x30;


  // lcd.write(a);
  // lcd.write(c);
  // lcd.write(e);
   lcd.write(g);
   lcd.write(h);
}
```

MVSR Engineering College, Dept. of IT

COURSE NAME:PROJECTWORK II
COURSE CODE: PW861IT

Course Objectives:

1. To enhance practical & Professional skills.
2. To familiarize the tools and techniques of symmetric literature survey and documentation.
3. To expose students to industry practices and teamwork.
4. To encourage students to work with innovative and entrepreneurial ideas.

Table 1: Course Outcomes - Cognitive levels
Cognitive Levels: R-Remember; U-Understand; Ap-Apply; An=Analyze; E-Evluate; C-Create

Course code	Statement Student will be able to	Cognitive Level	PO / PSO addressed
PW861.1	Define a problem of the recent advancements with applications towards society.	An	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PSO1,PSO2
PW861.2	Outline requirements and perform requirement analysis for solving the problem.	An	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PSO1,PSO2
PW861.3	Design and develop a software and/or hardware based solution within the scope of project using contemporary technologies and tools.	AP, E, An	PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO8,PSO1,PSO2
PW861.4	Test and deploy the applications for use.	AP ,E, An	PO8,PO9,PO10,PO11,PO12,PSO1,PSO2
PW861.5	Develop the Project as a team and Demonstrate the application, with effective written and oral communications.	C	PO8,PO9,PO10,PO11,PO12,PSO1,PSO2

Table:2 CO's

Course Code	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
No. of PIs addressed by course for a given PO	**4**	4	**4**	**4**	**4**	**4**	**4**	**5**	**5**	**7**	**4**	**6**	**5**	**6**
CO1	2	2	2	1	3	1	1	1	3	3	1	2	1	3
CO2	3	2	3	2	3	1	1	1	3	3	3	2	2	3
CO3	3	3	3	2	3	1	1	3	3	3	3	2	2	3
CO4								3	3	3	3	2	2	2
CO5								1	3	3	3	2	2	3

Table 3: Justification for CO-PO/PSO Level – through number of sessions

	PO1		PO2		PO3		PO4		PO5		PO6		PO7		PO8		PO9		PO10		PO1
PW861IT	%	Level	%	Level	%	Level	%	Level	%	Level	%	Level	%	Level	%	Level	%	Level	%	Level	%
CO1	50	3	50	2	50	2	25	1	50	3	25	1	25	1	20	1	50	3	50	3	25
CO2	75	3	50	2	75	3	50	2	50	3	25	1	25	1	20	1	50	3	50	3	75
CO3	75	3	75	3	75	3	50	2	50	3	25	1	25	1	50	3	50	3	75	3	75
CO4	50														50	3	50	3	75	3	75
CO5	50														20	1	50	3	50	3	75
No of Cos mapped & total	3	9	3	7	3	11	3	8	3	9	3	3	3	3	5	9	5	15	5	15	5
Average of Level	9/3=3		7/3=2.3		8/3=2.6		8/3=2.6		9/3=3		3/3=1		3/3=1		**9/5=1.8**		15/5=3		15/5=3		**13/5=**
Rounded average level	**3**		**2**		**3**		**3**		**3**		**1**		**1**		**2**		**3**		**3**		**3**

Table 4: Calculation of CO-PO/PSO correlation levels

PW861IT	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1	3	1	1	1	3	3	1	1	1	3
CO2	3	2	3	2	3	1	1	1	3	3	3	1	3	3
CO3	3	3	3	2	3	1	1	3	3	3	3	1	3	3
CO4								3	3	3	3	1	1	3
CO5								1	3	3	3	1	2	3
PW861IT	**3**	**2**	**3**	**3**	**3**	**1**	**1**	**2**	**3**	**3**	**3**	**1**	**2**	**3**

Table 5: PO/PSO addressed by the Project

Project Name	Domain	In-house/ Industry	PO/PSO addressed	Internal Guide
Smart BP and Stress Detection	IOT	In house		G. Ushasri,Assistant professot, Dept. of IT

Table 6: Rubrics Evaluation

PO/PSO	PO1,PO2,PO6,PO7				PO3	PO4,PO5, PSO1	PO4,PO5, PSO2	PO8	PO9				PO10			PO11	PO12
Rubrics	R1				R2	R3	R4	R5	R6				R7			R8	R9
Roll. No.	CI	CII	CIII	Total	CIV	CV	CVI	CVII	CVIII	CIX	CX	Total	CXI	CXII	Total	CXIII	CIV
	4	4	4	12	4	4	4	4	4	4	4	12	4	4	8	4	4

Rubrics for project

Focus Areas:

1. **Problem Formulation (PO1,PO2, PO6, PO7)**
2. **Project Design (PO3)**
3. **Build (PO4,PO5, PSO1)**
4. **Test & Deploy (PO4, PO5, PSO2)**
5. **Ethical responsibility (PO8)**
6. **Team Skills (PO9)**
7. **Project Presentation (P10)**
8. **Project management (PO11)**
9. **Lifelong Learning (PO12)**

Focus Areas	Criterion [c]	Exemplary 4	Satisfactory 3	Developing 2	Unsatisfactory 1
Problem Formulation (PO1,PO2, PO6, PO7)	**I - Identify/Define Problem** Ability to identify a suitable problem and define the project objectives.	Demonstrates a skillful ability to identify / articulate a problem and the objectives are well defined and prioritized.	Demonstrates ability to Identify / articulate a problem and All major objectives are identified.	Demonstrates some ability to identify / articulate a problem that is partially connected to the issues and most major objectives are identified but one or two minor ones are missing or priorities are not established.	Demonstrates minimal or no ability to identify / articulate a problem and many major objectives are not identified.
	II - Collection of Background Information: Ability to gather background Information (existing knowledge, research, and/or indications of the problem)	Collects sufficient relevant background information from appropriate sources, and is able to identify pertinant/critical information;	Collects sufficient relevant background information from appropriate sources;	Collects some relevant background information from appropriate Sources.	Minimal or no ability to collect relevant background information
	III- Define scope of the problem Ability to identify problem scope suitable to the degree considering the impact on society and environment	Demonstrates a skillful ability to define the scope of problem accurately mentioning the relevant fields of engineering precisely. Considers, explains and evaluates the impact of engineering interventions on society and environment.	Demonstrates ability to define problem scope mentioning the relevant fields of engineering broadly. Considers and explains the impact of engineering interventions on society and environment	Demonstrates some ability to define problem scope mentioning some of the relevant fields. Some consideration of the impact of engineering interventions on society and environment.	Demonstrates minimal or no ability to define problem scope and fails to mention relevant fields of engineering. Minimal or no consideration of the impact of engineering interventions on society and environment
Project Design (PO3)	**IV- Understanding the Design Process and Problem Solving:** Ability to explain the design process including the importance of needs, specifications, concept generation and to develop an approach to solve a problem.	Demonstrates a comprehensive ability to understand and explain a design process. Considers multiple approaches to solving a problem, and can articulate reason for choosing solution	Demonstrates an ability to understand and explain a design process. Considers multiple approaches to solving a problem, which is justified and considers consequences.	Demonstrates some ability to understand and explain a design process. Considers a few approaches to solving a problem; doesn't always consider consequences.	Demonstrates minimal or no ability to understand and explain a design process. Considers a single approach to solving a problem. Does not consider consequences.

Focus Areas	Criterion [c]	Exemplary 4	Satisfactory 3	Developing 2	Unsatisfactory 1
Build (PO4,PO5, PSO1)	**V- Implementing Design Strategy:** Ability to execute a solution taking into consideration design requirements using appropriate tool (software/hardware);	Demonstrates a skillful ability to execute a solution taking into consideration all design requirements using the most relevant tool.	Demonstrates an ability to execute a solution taking into consideration design requirements using relevant tool.	Demonstrates some ability to execute a solution but not using most relevant tool.	Demonstrates minimal or no ability to execute a solution. Solution does not directly attend to the problem.
Test & Deploy (PO4, PO5, PSO2)	**VI- Evaluating Final Design:** To evaluate/confirm the functioning of the final design. To deploy the project on the target environment	Demonstrates a skillful ability to evaluate/confirm the functioning of the final design skillfully, with deliberation for further Improvement after deployment.	Demonstrates an ability to evaluate/confirm the functioning of the final design. The evaluation is complete and has sufficient depth.	Ability to evaluate/confirm the functioning of the final design, but the evaluation lacks depth and/or is incomplete.	Demonstrates minimal or no ability to evaluate/confirm the functioning of the final design.
Ethical responsibility (PO8)	**VII - Proper Use of Others' Work:** Ability to recognize, understand and apply proper ethical use of intellectual property, copyrighted materials, and research.	Always recognizes and applies proper ethical use of intellectual property, copyrighted materials, and others' research.	Recognizes and applies proper ethical use of intellectual property, copyrighted materials, and others' research.	Some recognition and application of proper ethical use of intellectual property, copyrighted materials, and others' research.	Minimal or no recognition and/or application of proper ethical use of intellectual property, Copyrighted materials, or others' research.
Team Skills (PO9)	**VIII - Individual Work Contributions and Time Management:** Ability to carry out individual Responsibilities and manage time (estimate, prioritize, establish deadlines/ milestones, follow timeline, plan for contingencies, adapt to change).	Designated jobs are accomplished by deadline; completed work is carefully and meticulously prepared and meets all requirements.	Designated jobs are accomplished by deadline; completed work meets requirements.	Designated jobs are accomplished by deadline; completed work meets most requirements.	Some Designated jobs are accomplished by deadline; completed work meets some requirements.
	IX - Leadership Skills: Ability to lead a team. (i) Mentors and accepts mentoring from others. (ii) Demonstrates capacity for initiative while respecting others' roles. (iii) Facilitates others' involvment. (iv) Evaluates team Effectiveness and plans for improvements	Exemplifies leadership skills.	Demonstrates leadership skills.	Demonstrates some leadership skills at times.	Demonstrates minimal or no Leadership skills.
	X - Working with Others: Ability to listen to, collaborate with, and champion the efforts of others.	Skillfully listens to, collaborates with, and champions the efforts of others.	Listens to, collaborates with, and champions the efforts of others.	Sometimes listens to, collaborates with, and champions others' efforts.	Rarely listens to, collaborates with, or champions others' efforts.

Project Presentation (P10)	**XI - Technical Writing Skills** Ability to communicate the main idea with clarity. Ability to use illustrations properly to support ideas (citations, position on page etc)	Main idea is clearly and precisely stated. Materials are seamlessly arranged in a logical sequence Illustrations are skillfully used to support ideas	Main idea is understandable. Material moves logically forward, Illustrations are properly used to support ideas	Main idea is somewhat Understandable. Material has some logical order and is somewhat coherent or easy to follow. Illustrations are for the most part properly used to support ideas	Main idea is difficult to understand. Material has little logical order, and is often unclear, incoherent. Illustrations are used, but minimally support ideas. (not properly cited etc)
	XII - Communication Skills for Oral Reports Ability to present strong key ideas and supporting details with clarity and concision. Maintain contact with audience, and ability to complete in the allotted time	Presentation logically and skillfully structured. Key ideas are compelling, and articulated with exceptional clarity and concision. Introduction, supporting details and summary are clearly evident and memorable, and ascertain the credibility of the speaker Presentation fits perfectly within time constraint.	Presentation has clear structure and is easy to follow. Key ideas are clearly and concisely articulated, and are interesting. There is sufficient detail to ascertain speaker's authority, and presentation includes an introduction and summary. Presentation fits within time constraint, though presenter might have to subtly rush or slow down.	Presentation has some structure. Key ideas generally identifiable, although not very remarkable. Introduction, supporting details and/or summary may be too broad, too detailed or missing. Credibility of the speaker may be questionable at times. Presentation does not quite fit within time constraint; presenter has to rush or slow down at end	Presentation rambles. Not organized; key ideas are difficult to identify, and are unremarkable. No clear introduction, supporting details and summary. Speaker has no credibility. Presentation is unsuitablably short or unreasonably long.
Project management (PO11)	**XIII - Monitoring and Controlling the Project**	Monitors timelines and progress toward project goals on a daily basis. Provides accurate, complete reports of project progress.	Monitors timelines and progress toward project goals most of the time. Provides relatively accurate, complete reports of project progress with only minor errors or omissions	Seldom monitors timelines and progress toward project goals. Provides relatively accurate, yet clearly incomplete, reports of project progress	Does not monitor timelines and progress toward project goals. Provides inaccurate, incomplete reports of project progress
Lifelong Learning (PO12)	**XI V - Extend Scope of Work:** Ability to extend the project through implementation in other study areas	Demonstrates a skillful ability to explore a subject/topic thoroughly, discusses the road map to extend the project in other areas.	Demonstrates an ability to explore a subject/topic, and shows possible areas in which project can be extended	Demonstrates some ability to explore a subject/topic, providing some knowledge of areas in which project can be extended	Demonstrates minimal or no ability to explore a subject/topic, and does not discuss future work clearly mentioning other areas