A

Major Project

On

BODY STRESS DETECTION USING MACHINE LEARNING AND IoT TECHNOLOGY

(Submitted in partial fulfillment of the requirements for the award of Degree)

BACHELOR OF TECHNOLOGY

in

COMPUTER SCIENCE AND ENGINEERING

by

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the project entitled "**BODY STRESS DETECTION USING MACHINE LEARNING AND IoT TECHNOLOGY**" being submitted by **B. ASHRITHA REDDY (187R1A05J4), M. KIRAN KUMAR (187R1A05L8), B. HRITHIK YADAV (187R1A05Q0)** in partial fulfillment of the requirements for the award of the degree of B. Tech in Computer Science and Engineering of the Jawaharlal Nehru Technological University Hyderabad, is a record of Bonafide work carried out by him/her under our guidance and supervision during the year 2021-22.

The result embodied in this thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

Stress is commonly defined as a feeling of strain and pressure which occurs from any event or thought that makes you feel frustrated, angry, or nervous. In the present situation many people have succumbed to stress especially the adolescent and the working people. Stress increase nowadays leads to many problems like depression, suicide, heart attack and stroke. The current technology, using Galvanic skin response (GSR), Heart rate variability (HRV) Sensor, and Temperature Sensor are being used individually to detect stress. Stress is related to life style; therefore, especially for mobile automated lifestyle counseling and analysis services, the need arises to identify stress automatically during daytime, using physiological data from various sensors.

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1.INTRODUCTION

1. INTRODUCTION

1.1 PROJECT SCOPE

The project titled as "Body Stress Detection Using Machine Learning and IoT Technology" is used to detect the stress level. In this report, the design of Arduino based Body Stress Detection that monitors the Stress level of a human in real time is presented. This system consists of different sensors which measures the stress level based on temperature values, Heart Rate and Resistance of a skin. The measured values are used to determine the stress level of a every individual.

1.2 PROJECT PURPOSE

The project is used to alter us to current, ongoing, and emerging problems; Certain amount of stress is necessary for our lives, but too much stress brings negative consequences such as decrease in level of concentration, mental health issues such as anxiety and depression.

1.3 PROJECT FEATURES

The core features of this project is to develop a continuous stress monitoring system and there by reduce the adverse effects of stress on mental health as well as physical health of a person. The physiological parameters such as Heart rate, Temperature and skin resistance are taken into consideration, since they are directly linked to the sympathetic nervous system which is being activated during the stress response.

2. SYSTEM ANALYSIS

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SYSTEM ANALYSIS

System Analysis is the important phase in the system development process. The System is studied to the minute details and analyzed. The system analyst plays an important role of an interrogator and dwells deep into the working of the present system. In analysis, a detailed study of these operations performed by the system and their relationships within and outside the system is done. A key question considered here is, "what must be done to solve the problem?" The system is viewed as a whole and the inputs to the system are identified. Once analysis is completed the analyst has a firm understanding of what is to be done.

2.1 PROBLEM DEFINITION

A detailed study of the process must be made by various techniques like interviews, questionnaires etc. The data collected by these sources must be scrutinized to arrive at a conclusion. The conclusion is an understanding of how the system functions. This system is called the existing system. Now the existing system is subjected to close study and problem areas are identified. The designer now functions as a problem solver and tries to sort out the difficulties that the user faces. The model is built in such a way that it addresses the difficulties faced by the user. Consider the example, there are two users the first one who needs a model which also allows him to move around in public and the second one who needs a model to be trained only to function inside his house, based on these requirements a model is generated and tested to see if the user is satisfied with application.

2.2 EXISTING SYSTEM

Many studies have been conducted in this field. Alireza Bolhari et al. (2012) have studied workplace stress. Panagiotis Kostopoulous et al. (2016) designed a stress detection system, StayActive, which uses sleep patterns, physical activities and social interactions to detect stress. Enrique Garcia-Ceja et al. (2016) used smartphones as a potential tool to detect behavior that is correlated with stress level.

2.2.1 LIMITATIONS OF EXISTING SYSTEM

- Most of the existing system works was on social networking stress data not on body-based sensor data.
- Stress level is calculated based on tweets posted byusers.

2.3 PROPOSED SYSTEM

The aim of the proposed system is to detect the stress level of a every individual. In this proposed system, the proposed block diagram consists of several sensors (temperature sensor, Heart rate sensor, Galvanic Skin Response sensor) is connected to human body. Using all the sensor data we are going to detect the body stress.

2.3.1 ADVANTAGES OF THE PROPOSED SYSTEM

The system is very simple in design and to implement. The system requires very low system resources and the system will work in almost all configurations. It has got following features:

1. Data is collected from real time sensors which is connected to the human body.
2. Depending on the data collected from various sensors one can detect the body stress.
3. This project results in providing the stress level of a every individual.

2.4 FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the user.

Three key considerations involved in the feasibility analysis are

- Economic Feasibility
- Technical Feasibility
- Social Feasibility

2.4.1 ECONOMIC FEASIBILITY

The developing system must be justified by cost and benefit. Criteria to ensure that effort is concentrated on a project, which will give the user the best quality of life possible. One of the factors, which affect the development of a new system, is the cost it would require.

The following are some of the important financial questions asked during preliminary investigation:

- The costs conduct a full system investigation.
- The cost of the hardware and software.
- The benefits in the form of reduced costs or fewer costly errors.

Since the system is developed as part of project work, there is no manual cost to spend for the proposed system. Also, all the resources are already available, it gives an indication that the system is economically possible for development.

2.4.2 TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

2.4.3 BEHAVIORAL FEASIBILITY

This includes the following questions:

- Is there sufficient support for the users?
- Will the proposed system cause harm?

The project would be beneficial because it satisfies the objectives when developed and installed. All behavioral aspects are considered carefully and conclude that the project is behaviorally feasible.

2.5 HARDWARE & SOFTWARE REQUIREMENTS

2.5.1 HARDWARE REQUIREMENTS:

Hardware interfaces specifies the logical characteristics of each interface between the software product and the hardware components of the system. The following are some hardware requirements.

- Sensors : Heart rate sensor - for measuring Heart rate (BPM),
  GSR sensor - is used to know sweat gland activity (microsiemens)
  Temperature Sensor-is used to measure temperature (Degree Celsius).
- Hard Disk : 100GB

2.5.2 SOFTWARE REQUIREMENTS:

Software Requirements specifies the logical characteristics of each interface and software components of the system. The following are some software requirements,

- Operating System : Windows 7 & above.
- Software : Arduino 1.8.19 version.
- Coding Language : Python IDLE 3.10.1 version.
- Database : Mysql.

3. ARCHITECTURE

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3.1 PROJECT ARCHITECTURE

This project architecture describes how the application is going to function. This describes how the system is going to work and how the sensors get the values which is used to measure stress level.

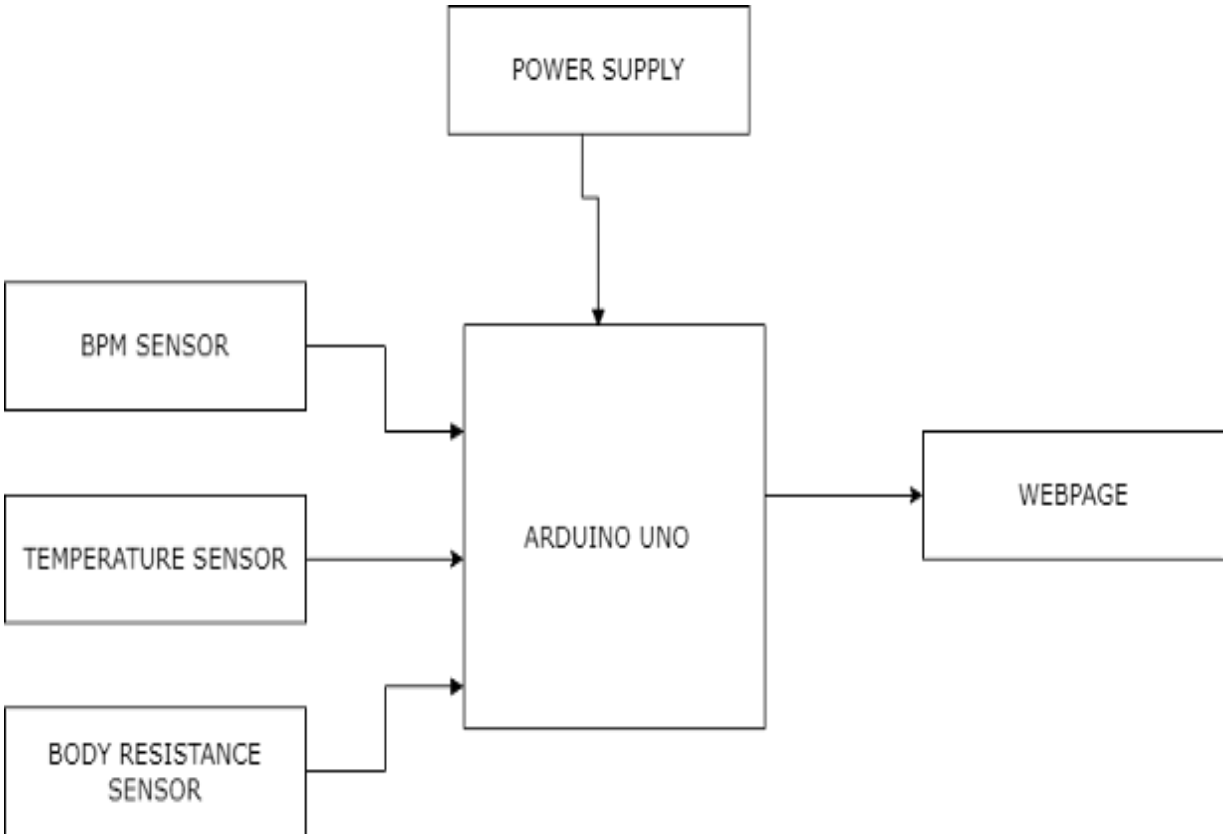


Fig. 3.1 Architecture Diagram of Body stress detection using Machine Learning and IoT Technology

3.2 MODULES DESCRIPTION

3.2.1 Temperature Sensor Module

- A temperature sensor is a device used to measure temperature. This can be air temperature, liquid temperature or the temperature of solid matter. There are different types of temperature sensors available and they each use different technologies and principles to take the temperature measurement.

3.2.2 GSR and Heartrate Sensor Module

- Galvanic Skin Response Sensor – Used to measure sweat gland activity. Galvanic Skin Response (GSR) measures changes in sweat gland activity on the skin.
- Heartrate Sensor - An optical heart rate sensor measures pulse waves, which are changes in the volume of a blood vessel that occur when the heart pumps blood.

3.2 USE CASE DIAGRAM

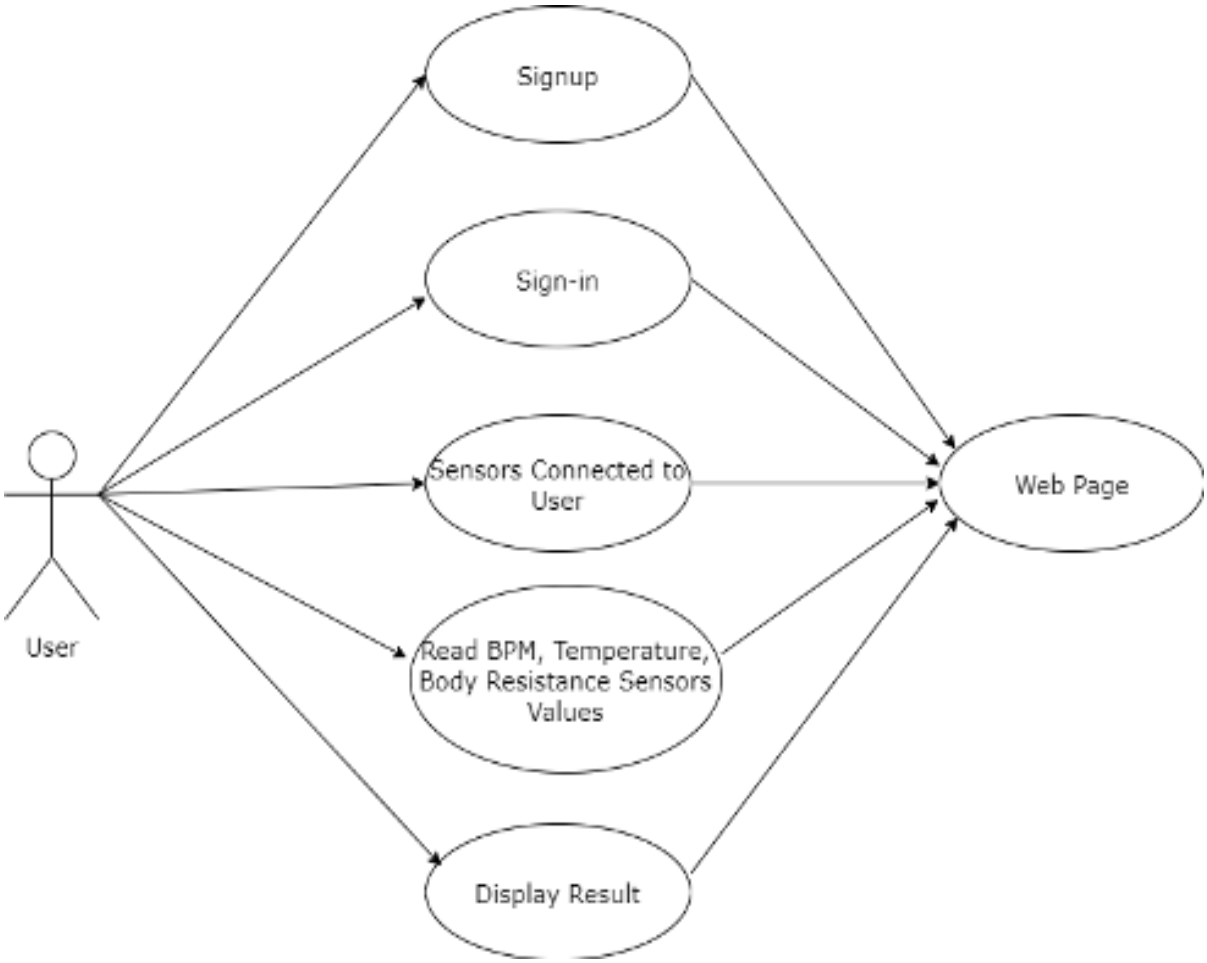


Fig. 3.3 Use Case Diagram for Body Stress Detection.

3.3 CLASS DIAGRAM

Class Diagram is a collection of classes and object.

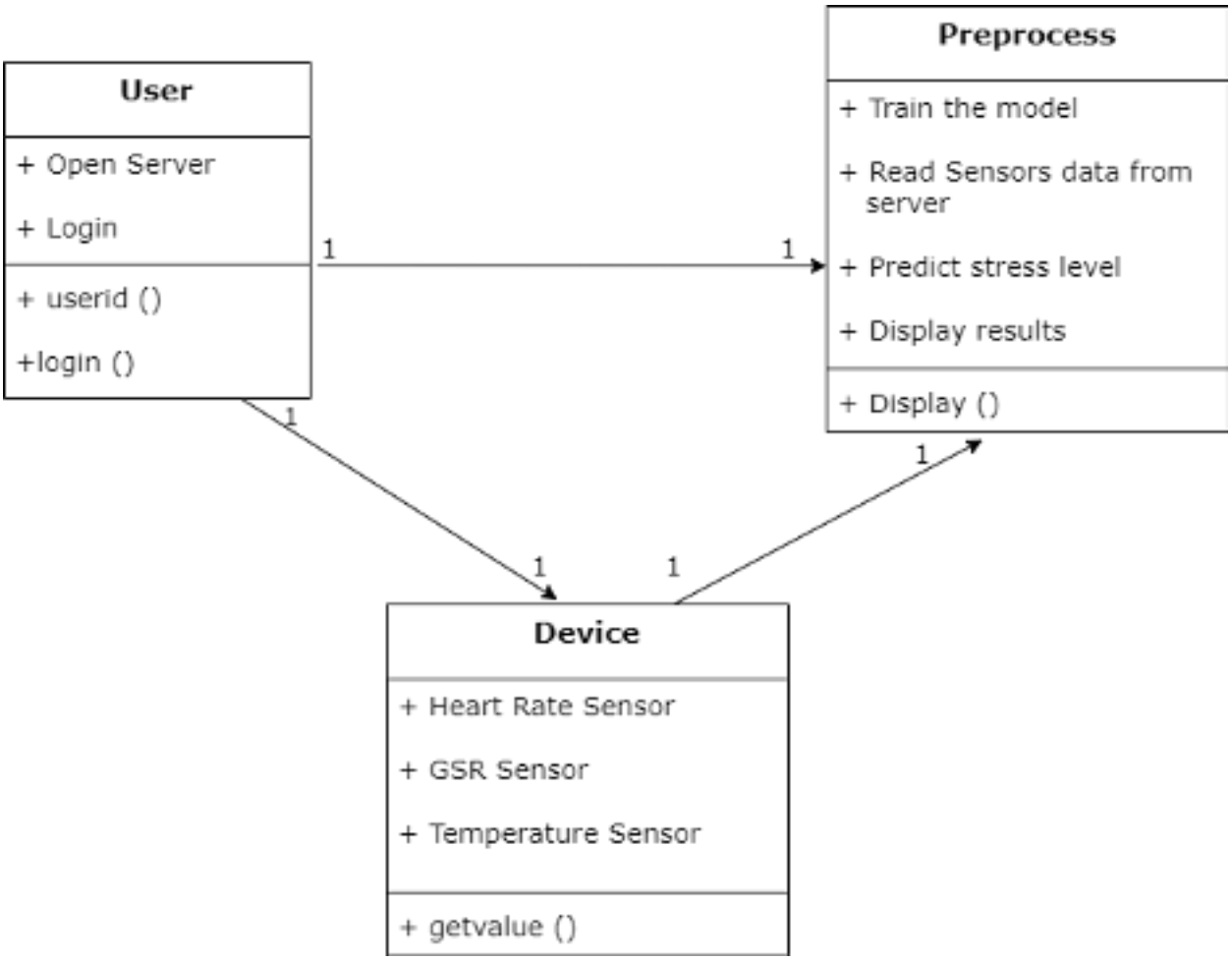


Fig. 3.4 Class Diagram for Body Stress Detection.

3.4 SEQUENCE DIAGRAM

The sequence diagram shows the sequence in which different tasks are being carried out by the actors.

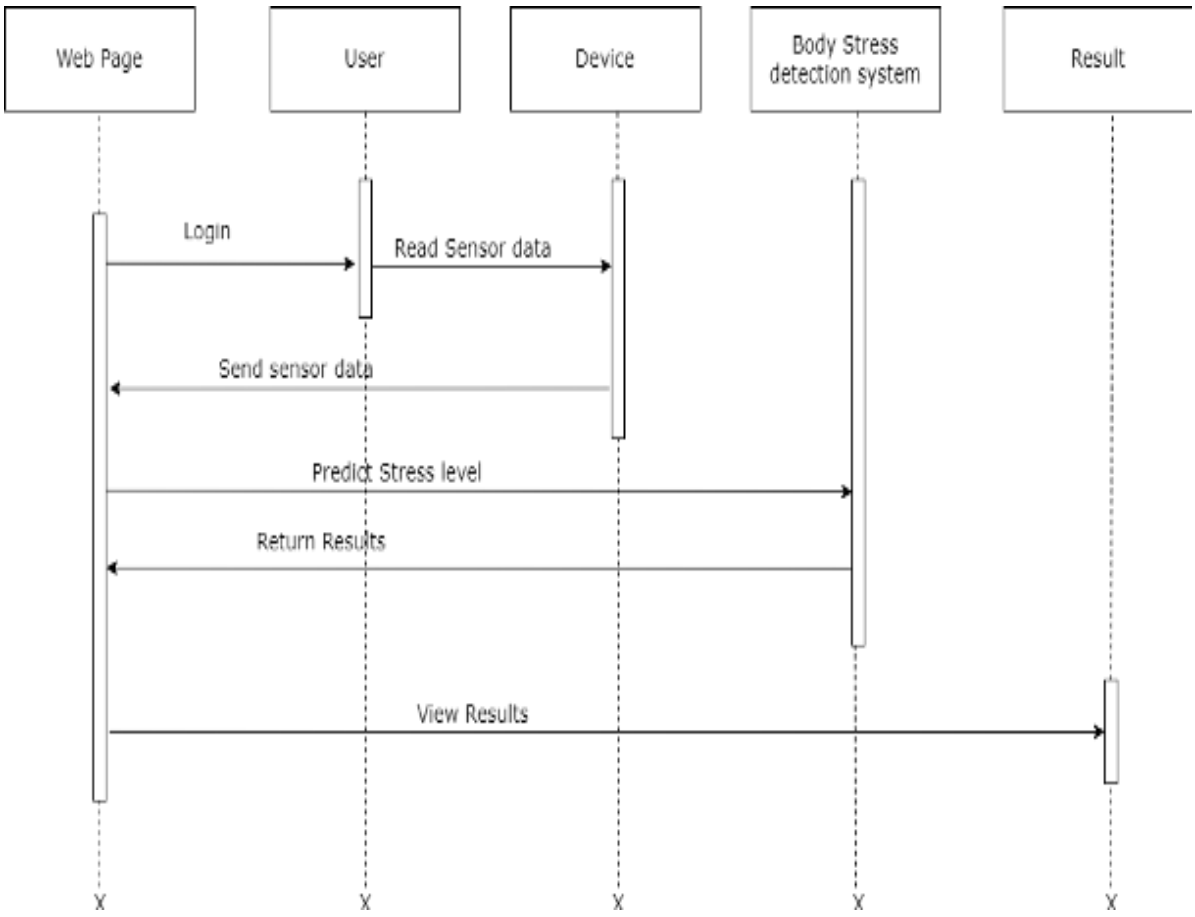


Fig.3.5 Sequence Diagram for Body Stress Detection.

3.5 ACTIVITY DIAGRAM

It describes the flow of activity states.

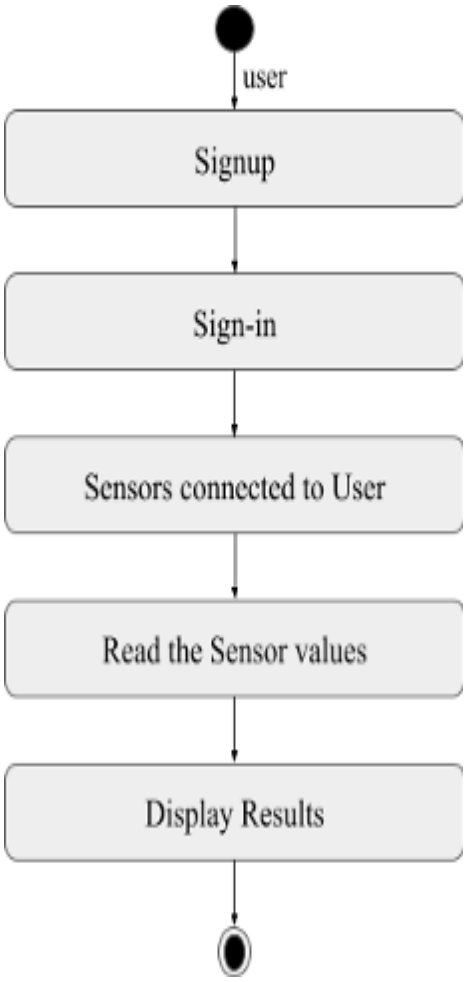


Fig. 3.6 Activity Diagram for Body Stress Detection.

4. IMPLEMENTATION

4. IMPLEMENTATION

4.1 SAMPLE CODE

```
#define USE_ARDUINO_INTERRUPTS true
#include <OneWire.h>
#include <DallasTemperature.h>
#include <ArduinoJson.h>
#include <PulseSensorPlayground.h>
#define ONE_WIRE_BUS 5
#define resProbe A0
const int PulseWire = A1;
int Threshold = 720;
int period = 1000;
unsigned long time_now = 0;
long pulse = 0;
OneWire oneWire(ONE_WIRE_BUS);
DallasTemperature sensors(&oneWire);
PulseSensorPlayground pulseSensor;
DynamicJsonDocument doc(1024);
 String data="{\"BPM\":0.0,\"Temp\":0.0,\"SR\":0}";
 JsonObject obj;
  String output ="";
void setup(void)
{
 Serial.begin(9600);
 pinMode(resProbe,INPUT);
 sensors.begin();
 deserializeJson(doc, data);
 obj = doc.as<JsonObject>();
 pulseSensor.analogInput(PulseWire);
 pulseSensor.setThreshold(Threshold);
 if (pulseSensor.begin()) {
   ;
     }
  }
void loop(void)
{
 int skinR = 1023-analogRead(resProbe);
 skinR = map(skinR,0,1024,0,500);
 float myBPM = pulseSensor.getBeatsPerMinute();
 myBPM = myBPM/2.85;
 if(myBPM < 56)myBPM = 0;
```

```
if(myBPM > 160)myBPM = 160;
if (pulseSensor.sawStartOfBeat())pulse = myBPM;
sensors.requestTemperatures();
obj[String("Temp")] = sensors.getTempCByIndex(0);
obj[String("BPM")] = pulse;
obj[String("SR")] =skinR;
output ="";
serializeJson(doc,  output);
if(millis() >= time_now +period){
      time_now += period;
      Serial.println(output);
  }
pulse = 0;
delay(20);
}
int period = 2000;
unsigned long time_now = 0;
int pushButton = 3;
long pulse = 0;
bool st = false;
// the setup routine runs once when you press reset:
void setup() {
  // initialize serial communication at 9600 bits per second:
  Serial.begin(9600);
  // make the pushbutton's pin an input:
  pinMode(pushButton, INPUT);
}
// the loop routine runs over and over again forever:
void loop() {
Serial.print("BPM : ");
Serial.print(pulse);
Serial.println("/ 1 Min");
time_now =  millis();
pulse = 0;
     while(millis() < time_now + period){
//       if(digitalRead(pushButton)==0){
//         st = true;
//       }
//       else{
//         if(st){
//         pulse +=1;
//       }
//       st = false;
//       }
if(digitalRead(pushButton)==0){
```

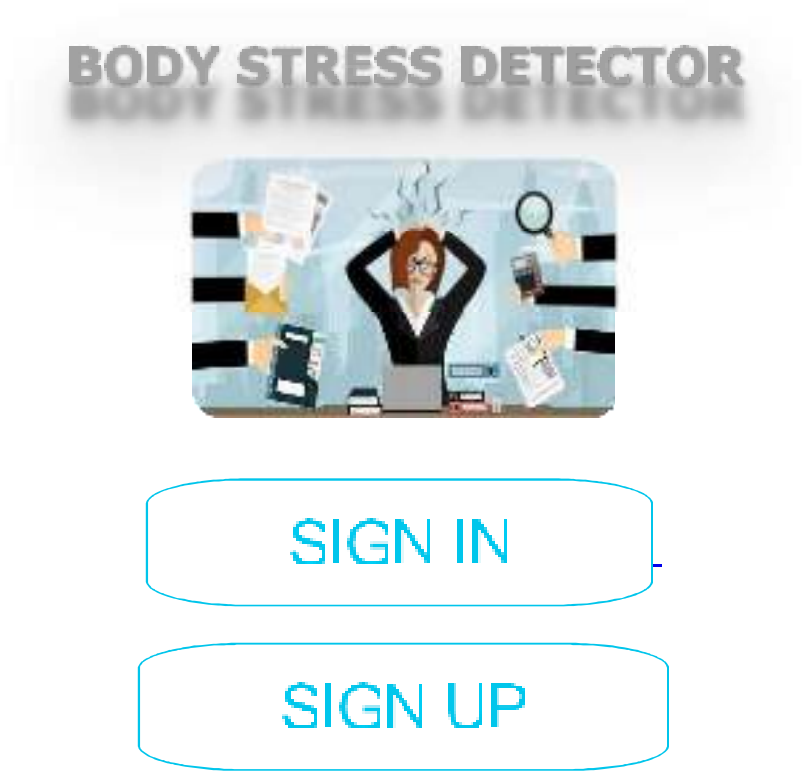
```
pulse +=1;
delay(2);
while(digitalRead(pushButton)==0);
}
  }

 int time = 60/(period/1000);
 Serial.print("BPM : ");
 Serial.print(pulse);
 Serial.println("/ 3 Sec");
 if(pulse > 10)pulse = 0;
 pulse = pulse*(time);
 }
```

5. SCREENSHOTS

5. SCREENSHOTS

5.1 Main Page

The below picture is depicting the model Body Stress Detection, consists of several sensors (Temperature sensor, Heartrate sensor, Body Resistance sensor) which is connected to core controller.



Screenshot 5.1: Main page of Body Stress Detection.

5.2 Login Page

The below picture is depicting the Login page. It is a web page or an entry page to a website that requires user identification and authentication, regularly performed by entering a username and password combination.

Screenshot 5.2: Login Page

5.3 Stress prediction with sensor values

The below picture shows that the high stress is detected using sensors like Temperature sensor, Heartrate Sensor and Skin resistance Sensor.

Screenshot 5.3: Stress prediction with sensor values

5.4 Stress prediction with sensor values

The below picture is depicting that there is no stress after processing the sensor values.

Screenshot 5.4: Stress prediction with sensor values.

5.5 Results of Three Types of Stress

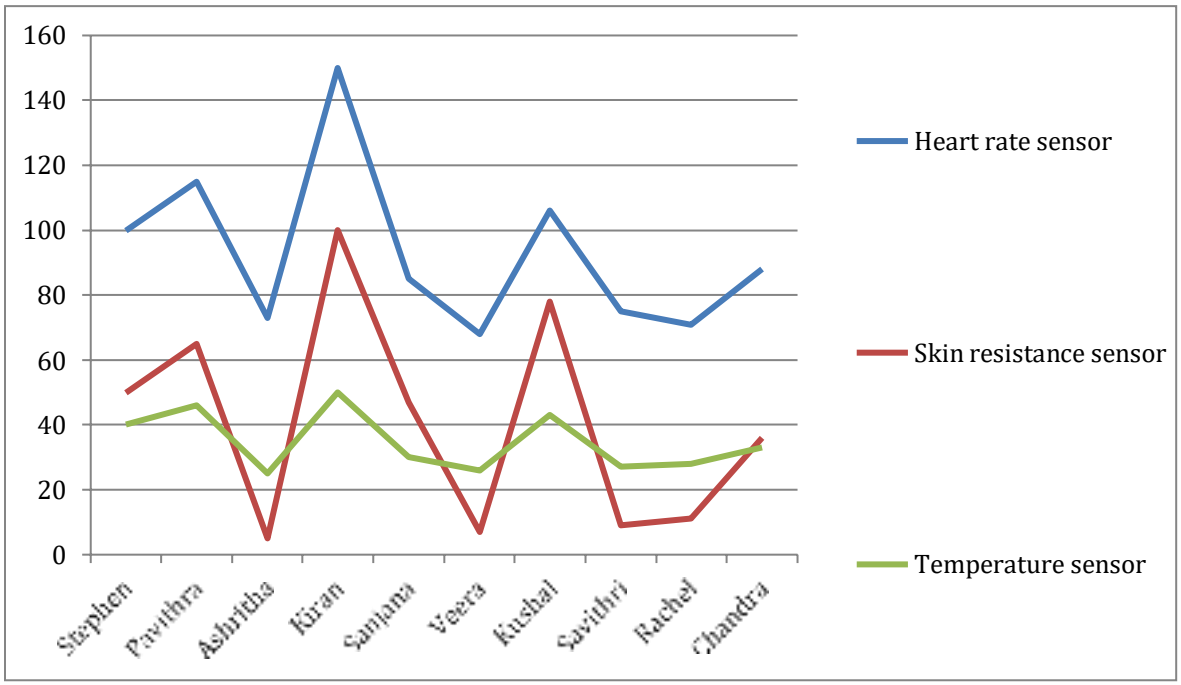
Heart rate sensor; (60-80=no stress), (80-100=moderate stress), (100-160=high stress)
Skin resistance sensor ;(1-15=no stress), (16-50=moderate stress), (50-100=high stress)
Temperature sensor ;(25-27=no stress), (28-35=moderate stress), (35-50=high stress)

Table 1: Representing the different types of Stress

Name of the test taker	Heart rate sensor	Skin resistance sensor	Temperature sensor	Stress levels
Stephen	100	50	40	High stress
Pavithra	115	65	46	High stress
Ashritha	73	5	25	No stress
Kiran	150	100	50	High stress
Sanjana	85	47	30	Moderate stress
Veera	68	7	26	No stress
Kushal	106	78	43	High stress
Savithri	75	9	27	No stress
Rachel	71	11	28	No stress
Chandra	88	36	33	Moderate stress

GRAPHICAL REPRESENTATION:

The below line graph is representing the Stress of various persons by reading the various sensor values.



Graph 1: Graphical Representation of different types of stress values.

6. TESTING

6. TESTING

6.1 INTRODUCTION TO TESTING

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, subassemblies, assemblies and/or a finished product. It is the process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of tests. Each test type addresses the specific testing requirement.

6.2 TYPES OF TESTING

6.2.1 UNIT TESTING

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

6.2.2 INTEGRATION TESTING

Integration tests are designed to test integrated software components to determine if they actually run as one program. Testing is event driven and is more concerned with the basic outcome of screens or fields. Integration tests demonstrate that although the components were individually satisfied, as shown by successfully unit testing, the combination of components is correct and consistent. Integration testing is specifically aimed at exposing the problems that arise from the combination of components.

6.2.3 FUNCTIONAL TESTING

Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals.

Functional testing is centered on the following items:

Valid Input : identified classes of valid input must be accepted.

Invalid Input : identified classes of invalid input must be rejected.

Functions : identified functions must be exercised.

Output : identified classes of application outputs must be exercised.

Systems/Procedures: interfacing systems or procedures must be invoked.

Organization and preparation of functional tests is focused on requirements, key functions, or special test cases. In addition, systematic coverage pertaining to identify Business process flows; data fields, predefined processes.

6.3 TEST CASES

6.3.1 Stress Detection

Test case ID	Test case name	Purpose	Test Case	Output
1	Detection of high stress of the test taker.	To detect the high stress.	The Arduino takes the input in the form of sensor values	An output of High stress is detected.
2	Detection of moderate stress of the test taker.	To detect the moderate stress.	The Arduino takes the input in the form of sensor values	An output of moderate stress is detected
3	Detection of no stress of the test taker.	To detect the no stress.	The Arduino takes the input in the form of sensor values	An output of no stress is detected.

7. CONCLUSION

7. CONCLUSION & FUTURE ENHANCEMENTS

7.1 PROJECT CONCLUSION

Physical activity acts as a de-stress agent on human stress. Therefore, by increasing the amount of physical activity in daily life, one can reduce his/her stress levels. Sleep shortage and insomnia are common signs of stress. Our study shows the time in bed is a significant and positive indicator of stress. The stress level is determined by the amount of sleep a person is getting in a day, but not on the number of awakenings. Similarly, working hours are a significant and negative indicator of stress. This means stress generated due to working hours depends on how a person handles his/her workload. Next, the average bpm indicates any fluctuations in heart rate, which is a significant and positive indicator of stress. Finally, the body mass index (BMI) is a significant and positive indicator of stress. Therefore, changes in heart rate and an increase in BMI increase the stress levels of individuals.

7.2 FUTURE ENHANCEMENTS

For future work, it would be interesting to enhance this work into the development of a stress detection model by the addition of other physiological parameters, including an activity recognition system and application of machine learning techniques.

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8. BIBLIOGRAPHY

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www.epa.ie

8.3 GitHub Link

https://github.com/AshrithaReddy25/BodyStressDetectionUsingMachineLearningAndIoTTechnology.