Mine Workers Health and Environment and Flood Prediction System

B.E. Project Report-B

Submitted in partial fulfillment of the requirements

For the degree of

Bachelor of Engineering

(Electronics Engineering)

by

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Certificate

This is to certify that, the project report-B titled

"Mine Workers' Health and Environment and Flood Prediction System "

is a bonafide work done by

Tanmay Thakur (20EE5007)
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and is submitted in the partial fulfillment of the requirement for the degree of

Bachelor of Engineering

(Electronics Engineering)

to the

University of Mumbai.

Examiner 1	Examiner 2	Supervisor
Project Coordinator	Head of Department	Principal

Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

The safety of mine workers is a major problem nowadays. Health and life of miners are defenceless against a few fundamental problems, such as the working environment and its long-term effects. A new and inventive approach is needed in order to increase profitability, reduce costs, and consider the safety of miners. The suggested system has two sections: one to track the status of mine workers, and the other to track everything. In the mine worker area, particulate matter and harmful fume emissions from outflows are the main causes of air pollution.Semiconductor gas sensors are used to track the concentration of dangerous gases. The micro controller (ESP32/ESP82) will enable an alert to the person through a buzzer if any smoke sensor value exceeds the threshold range at that point and sends the information to the monitoring section through the wireless network. In the monitor, the received data will be uploaded in the webpage or desktop application through IoT. There are many reasons why miners in underground mines can fall and become unconscious. To solve this problem, whenever a person experiences any medical cause, the system sends a crisis warning through the wireless network to the supervisor. Index Terms: Internet of Things (IoT), Smoke Sensor, Safety Engineering. Index Terms—Coal Mining, Safety Engineering, Internet of Things (IoT), Smoke Sensor, Soil Moisture Sensor, Temperature and Humidity Sensor.

Keywords: Machine Learning, ESP8266/ESP32.

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Abbreviations

DHT	Temperature and Humidity Sensor
ML	Machine Learning
GUI	Graphical User Interface
HDL	Hardware description language
I/O	Inputs and Outputs
WID	Water Inrush Data
IEEE	Institute of Electrical andElectronic Engineers
ISE	Integrated Software Enviroment
ESP	Extrasensory Perception

Chapter 1

Introduction

1.1 Motivation

Human labour is used in the process of underground mining, which is a very dangerous situation where the hazards 1 rise with the distance from the earth. The use of various mining techniques by the miners to extract various minerals is the cause of the risky mining operations. The risk is increasingly obvious the longer the mine is Execution of safety measures is extremely lacking, particularly in the coal mining industry. Every country needs coal because it has so many commercial uses. The production of thermal power, the manufacture of cement and steel, as well as its use as a fuel for countless purposes, are coal's three most significant uses. The excessive temperatures, excessive humidity, and the release of toxic gases are just a few of the hazardous conditions that coal mine workers must contend with.

1.2 Objective

Through technology, the security of workers in the coal mining industry is steadily improving. Explosions still occur in underground coal mines despite the advancement of innovation that makes mine monitoring methods more advanced. The hostile surroundings and hazardous working conditions are the main causes of accidents and disasters in coal mines. Because of this, coal mines have a high need for mine checking systems. It might be challenging to manually monitor every aspect of the environment in a coal mine on a continuous basis. With the aid of economically viable wireless communication equipment used at the necessary position in coal mines, this job can be easily accomplished. The designed model utilises less energy and more effective sensors are used to measure a worker's breathing rate, pulse, and any significant environmental releases of dangerous chemicals. For the safety of mine workers, these hazardous gas levels are continuously analyses and communicate the risky situation at the appropriate time. For many years, wire-based observational systems have aided in the safety of mines. Wireless networks are greatly favoured in the current environment due to the complexity of the networks.

1.3 Problem Definition

Background: The mining industry is known worldwide for its highly risky and hazardous working environment. Technological advancement in extraction techniques for proliferation of production levels has caused further concern for safety in this industry. Research so far in the area of safety has revealed that the majority of incidents in this hazardous industry take place because of human error, the control of which would enhance safety levels in working sites to a considerable extent. The National Foundation of India study said that crores of Indians depend on the coal economy directly or indirectly. It highlighted that more than 1.3 crore Indians are employed in mining, transport, power, sponge iron, steel and bricks sectors. Mining workers are affected by many hazards – from ventilation problems, mine flooding, gas explosions, ceiling collapsing, mine haulage, sudden inrushes and mine inundation, spontaneous combustion, to un-optimized evacuation routes. There is no exact solution that can forecast these risks and avoid them even before they occur.

Summary: Mining workers are affected by many hazards – from ventilation problems, mine flooding, gas explosions, ceiling collapsing, mine haulage, sudden inrushes and mine inundation, spontaneous combustion, to un-optimized evacuation routes. And mine operators have been working for decades to ensure no fatal accident results in death, injury, or poor health of miners.

Objective: To give a solution to design smart work clothing that has sensors embedded in it to securely transmit data to managers about hazardous conditions and the workers' physical conditions, improving safety overall."

1.4 Organization of Report

Chapter 2 deals with "Mine Workers' Health and Environment and Flood Prediction System " Chapter 3 contains detailed explanation about component used. In Chapter 4 System Implementation of Project. Chapter 5 Result And Analysis. The results are discussed in Chapter 6 and Chapter 7 concludes the work

Chapter 2

Literature Survey

Geetha, A.. (2014). Intelligent helmet for coal miners with voice over ZigBee andenvironmental monitoring. World Applied Sciences Journal. 20. 2328-2330. 10.5829/idosi.mejsr. The protection of working machinery is the main goal of the implementation of safety measures in port operations, where sensors and switches are used to provide safety for workers. With current technology, it is impossible to control and observe the port personnel due to their high levels of movement and risk. In this article, a warning system utilising Radio Frequency Identification (RFID), the Internet of Things (IoT), and a smart alarm system is used to ensure safety.[1]

R. K. Kodali and B. S. Sarjerao, "A low-cost smart irrigation system utilising the MQTT protocol was presented at the 2017 IEEE Region 10 Symposium (TENSYMP), which was held in Cochin, India. Worker health parameters have been applied in this article based on the worker's personal health characteristics, including body mass index (BMI), sleeping habits, age, chronic illness, and family responsibilities, as well as workplace elements, including the nature of the task and the perception of the maximum injury shift. The findings demonstrate that injuries are sustained by workers differently depending on the task. Workers above the age of forty are more likely to get injuries. Workers who get less sleep suffer greater injuries, particularly those that are abrasive and piercing in nature. Villagers and temporary workers are exposed to dust and are at danger of a variety of illnesses while working in locations like mines, pharmacies, and the textile industry.[2]

A.George, H. Dhanasekaran, J.P. Chittiappa, L.A. Challagundla, S.S. Nikkam, O. Abuzaghleh University of Bridgeport - The Internet of Things has planted several seeds for a humanoid lifestyle, among which health care is the one that needs the greatest attention. The intention of scientists and researchers is to ease human existence more by introducing a touch of technology. With this in mind, the paper will describe how smartphones can be used as sensors to monitor patients' health. This essay will discuss the use of fog computing for quicker data analysis while taking into account the numerous drawbacks of cloud computing. With this goal in mind, we frequently propose and present the idea of fog computing. Three patient categories will receive special attention from fog computing: those who are gravely injured, those who are merely generally hospitalised, and those who may eventually need periodic monitoring after being released, depending on their present state of health.[3]
S. Chakraborty, S. Bhowmick, P. Talaga, and D. P. Agrawal, "Fog Networks in Healthcare Application," in Mobile Ad Hoc and Sensor Systems (MASS), 2016 IEEE 13th Interna-

tional Conference on, 2016, pp. 386-387: IEEE Fog computing and IOT are utilised in the medical industry, which improves operating efficiency and makes the system smarter. With this suggested health monitoring, healthcare expenditures are decreased and the standard of care is increased. System based on IOT and using fog computing.[4]

C. Sekhar and K. V. Rao, "BDA application, 2017 International Conference on Big Data Analytics and Computational Intelligence (ICBDAC), Chirala, Andhra Pradesh, India, pp. 112-115, doi:10.1109/ICBDACI.2017.8070819, describes a tracking system for monitoring in health of various workers who are working in different working environments. Worker health parameters have been applied in this article based on the worker's personal health characteristics, including body mass index (BMI), sleeping habits, age, chronic illness, and family responsibilities, as well as workplace elements, including the nature of the task and the perception of the maximum injury shift. The findings demonstrate that injuries are sustained by workers differently depending on the task. Workers above the age of forty are more likely to get injuries. Workers who get less sleep suffer greater injuries, particularly those that are abrasive and piercing in nature. Villagers and casual labourers work in sites where they are exposed to dust and run the danger of contracting fatal diseases, including mines, pharmacies, and textile factories. Untrained individuals are moving to different locations mostly in order to provide for their families financially.[5]

R. K. Kodali and A. Sahu, "An Internet of Things (IoT) based soil moisture monitoring using the Losant platform, 2016 Second International Conference on Contemporary Computing and Informatics (IC3I), Greater Noida, India, pp. 764–768. The MGNREGA programmes' principal objective is to increase security for every rural home whose adult members volunteer to perform menial labour chores. A real-time tracking system for the workers' health issues at work is implemented due to a lack of knowledge about the threats. The tracking system also offers details on the employees who received sick pay, disability payments, and information on disorders that require reporting. The monitoring and warning device detects harmful gases including H2S, CO, and methane and immediately displays the result of drainage and abandoned wells.[6]

Reference: https://www.beforetheflood.com/explore/the-crisis/climatechanging/ The temperature of the earth's surface is rising. This is determined by "anomalies," which are differences between measured temperatures and the average combined land and sea surface temperature throughout the 20th century (see NASA image above). Since 2002, nine of the ten warmest summers ever recorded have taken place. Due to the sustained record heat, Australia's Bureau of Meteorology had to add a new colour (neon purple) to their forecast charts (54–56 degrees).These temperature extremes are the outcome of a global temperature change of just 0.85°C. Most scientists agree that the carbon pollution we have already produced has locked in a temperature increase of at least 1.5 degrees, and we are rapidly nearing the disastrous climate threshold of a 2°C increase in temperature.[7]

Reference: https://royalsocietypublishing.org/doi/10.1098/rsta.2019.0551: :text=As The saturation vapour pressure rises exponentially with temperature. If we apply this to the atmosphere, it is feasible for there to be more water (moisture) at saturation, which might lead to an increase in extreme precipitation. Projecting changes in flooding is necessary for water resource management, infrastructure design, and planning when flood risk changes due to climate change. It is possible to condition stochastic rainfall production on recorded temperatures as well as more straightforward proportional change approaches when using observed temperature relationships to inform changes in hydrologic extremes. Although the focus is usually on understanding changes in precipitation, since flooding is frequently caused by excessive precipitation, there is an implied transfer of knowledge from precipitation-temperature sensitivities to flooding. While there are evaluations of flooding's non-stationarity and precipitation-temperature sensitivity, little focus has been placed on how these two subjects interact. Models that incorporate temperature as a covariate perform better than stationary models and those that incorporate a temporal trend as a covariate. But since antecedent factors affect the runoff response, caution must be used when predicting changes in floods based on precipitation-temperature sensitivity. Although peak flow-temperature sensitivities and historical patterns in Australia show good agreement, there hasn't been any global analysis of flood estimates using temperature sensitivities. Before temperature can be used confidently as a covariate for flood projection, there is a lot of work to be done.[8]

Chapter 3

System Design

3.1 Hardware Requirements

I. Temperature and Humidity Sensor
II. Gas Sensor
III. Soil Moisture Sensor
IV. Pulse Oximeter and Heart Rate Sensor
V. Heart Pulse sensor
VI. ESP 32
VII. ESP 8266
VIII. Buzzer

Sensors

1. **Temperature and Humidity Sensor:**

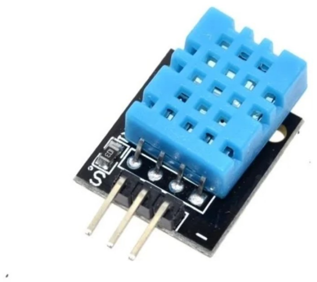

Figure 3.1: DHT11

Before using temperature as a covariate for flood projection can be adopted with confidence, there is a lot of work that needs to be done. air affects various physical, chemical and biological processes. In industrial applications, humidity can affect the business cost of the products, health and safety of the employees. So, in semiconductor industries and control system industries measurement of humidity is very important. Humidity measurement determines the amount of moisture present in the gas that can be a mixture of water vapour, nitrogen, argon or pure gas etc. Humidity sensors are of two types based on their measurement units. They are a relative humidity sensor and Absolute humidity sensor. DHT11 is a digital temperature and humidity sensor.

Specification:
1. Operating Voltage: 3.5V to 5.5V
2. Operating current: 0.3mA (measuring) 60uA (standby)
3. Output: Serial data
4. Temperature Range: 0°C to 50°C
5. Humidity Range: 206. Resolution: Temperature and Humidity both are 16-bit

2.Gas Sensor

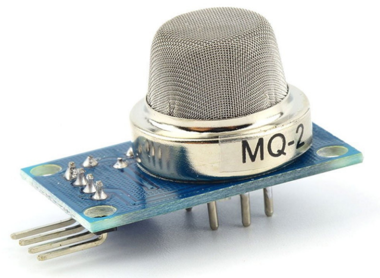

Figure 3.2: MQ2

A device that detects the presence or concentration of gases in the atmosphere is called a gas sensor. By altering the resistance of the material inside the sensor, the sensor generates a corresponding potential difference based on the gas concentration, which may be recorded as output voltage. The type and concentration of the gas can be inferred from this voltage value. The sensing substance that is contained inside the sensor determines the sort of gas that it is capable of detecting. These sensors are typically sold as modules with comparators, as was demonstrated above. These comparators can be configured for a certain gas concentration threshold value. The digital pin swings high when the gas concentration surpasses this level. The analogue pin is functional.

Specification:
1. Recognises or measures gases such as LPG, ethanol, propane, hydrogen, carbon monoxide, and even.
2. Air quality monitor.
3. Alarm for gas leak.
4. Maintenance per safety standards.
5. Upholding hospital environmental requirements.

3. Soil Moiture Sensor:

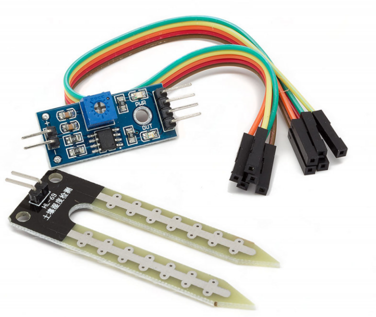

Figure 3.3: Soil Moisture Sensor

In order to determine how much water is held in the soil horizon, soil moisture sensors monitor the water content of the soil. Water in the soil is not immediately measured by soil moisture sensors. Instead, they track changes in another soil characteristic that is predictably connected to water content. One type of sensor used to determine the volumetric content of water in the soil is the soil moisture sensor. As well as sample weighting, drying, and elimination of the straight gravimeter dimension of soil moisture are required. These sensors measure the volumetric water content indirectly using the electrical resistance, neutron interaction, dielectric constant, and other soil laws as well as replacement of the moisture content.Based on ecological factors like temperature, soil type, or electric conductivity, the relationship between the computed property and soil moisture needs to be changed. The moisture of the soil can have an impact on the reflected microwave emission, which is mostly used in hydrology and agriculture.

Specification:
1. Operating Voltage: 3.3V to 5V DC.
2. Operating Current: 15mA.
3. Gardening.
4. Irrigation Systems.
5. Used in Controlled Environments.

4.Pulse Oximeter and Heart Rate Sensor:

Figure 3.4: MAX30100

The module includes an Analogue Devices MAX30100 integrated pulse oximeter and heart rate sensor IC. To detect pulse oximetry (SpO2) and heart rate (HR) signals, it incorporates two LEDs, a photo detector, improved optics, and low-noise analogue signal processing. A RED LED and an IR LED are located on the MAX30100's right side. And there is a highly sensitive photo detector on the left. The concept is to illuminate a single LED at a time, measure the amount of light returning to the detector, and, based on the signature, determine the blood oxygen level and heart rate.

Specification:
1. Input power: 1.7 to 2.0 V.
2. Temperature range: -40 to +85 °C.
3. LED Current: 0mA to 50mA (typ).
4. LED pulse width: 200µs to 1.6ms.

5. Heart pulse sensor

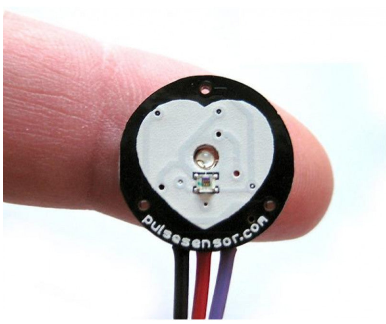

Figure 3.5: Heart pulse sensor

A heart rate monitor (HRM) is a portable monitoring tool that enables real-time heart rate measurement and display as well as heart rate recording for future research. It is primarily used to collect heart rate information while engaging in various forms of physical activity. Electrocardiography (ECG or EKG) is the measurement of electrical cardiac information. Hospitals typically utilise many sensors and wired medical heart rate monitoring machines. The term "Holter monitor" refers to portable medical devices. Consumer-grade heart rate monitors are wire-free and made for regular use.

Specification:
1. This is a biometric pulse rate sensor that can detect heartbeats.
2. The operating voltage is typically +5V, although it can also be +3.3V.
3. Neither the FDA nor the medical field have approved this pulse sensor. Thus, it is used in student-level projects rather than for applications involving health issues that have a commercial purpose.
4. Integral Amplification.
5. Circuit for cancellation of noise.

5.Buzzer :

Figure 3.6: Buzzer

Understands that backup power is being used instead of utility power. When an input is received, a buzzer responds by making a sound. They might make the sound with a variety of tools, including electromechanical devices and metal clappers. It must be possible for a buzzer to absorb energy and transform it into sonic energy. Numerous buzzers are connected to larger circuits and receive electricity directly from the device's power supply. In some instances, though, the buzzer can be battery-operated, enabling it to sound off in the event of a power outage. There are buzzers on several emergency power supply devices so that the user may hear them.

Microcontroller

5. ESP32:

Figure 3.7: ESP32

The chip created by Espressif Systems goes under the designation of ESP32. This offers WiFi connectivity to embedded devices, as well as dual-mode Bluetooth connectivity in some variants. ESP32 is really only a chip, however the manufacturer frequently also refers to modules and development boards that use this device as ”ESP32”. ESP32 is really only a chip, however the manufacturer frequently also refers to modules and development boards that use this device as ”ESP32”. ESP WROOM-32 Chip: The ESP32 board includes a potent WROOM-32 module with 802.11b/g/n Wi-Fi, BT 4.0, and BLE capabilities. The processor on the chip has two cores, each of which may be controlled independently. It runs at 240 MHz and has 520 KB of SRAM. It works with the Arduino IDE, LUA, MicroPython, and other programmes.

Specifications of ESP32 Board:

• Xtensa dual-core (or single-core) 32-bit LX6
microprocessor, running at 160 or 240 MHz
• Memory: 520 KB SRAM
• Wi-Fi: 802.11 b/g/n
• Bluetooth: v4.2 BR/EDR and BLE
• 2-bit × 18 ADC channels
• × 8-bit DACs
• 0 × touch sensors (capacitive sensing GPIOs)
• × SPI
• × I^2S interfaces
• × I^2C interfaces
• × UART
• SD/SDIO/CE-ATA/MMC/eMMC host controller
• SDIO/SPI slave controller
• CAN bus 2.0
• Infrared remote controller (TX/RX, up to 8 channels)
• Motor PWM

3.2 Software Design

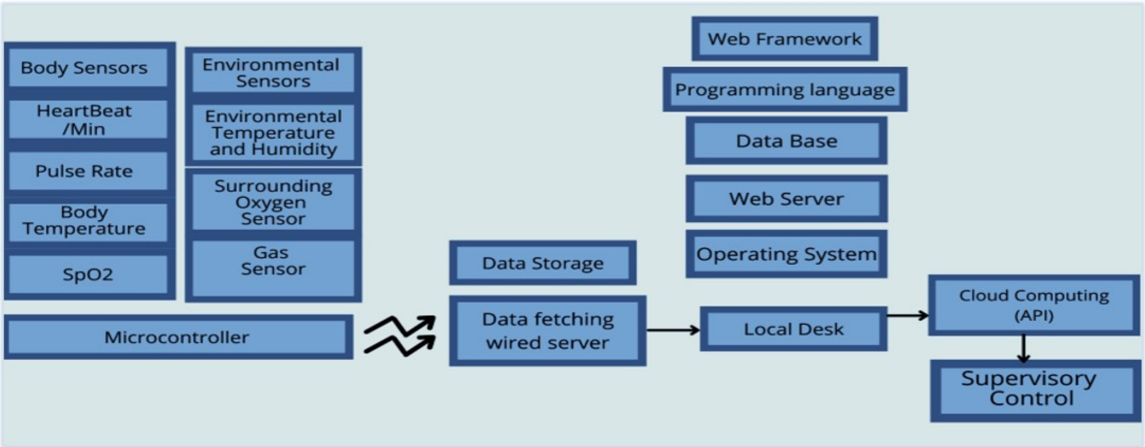

Figure 3.8: Technology Stack

3.3 Flow Chart

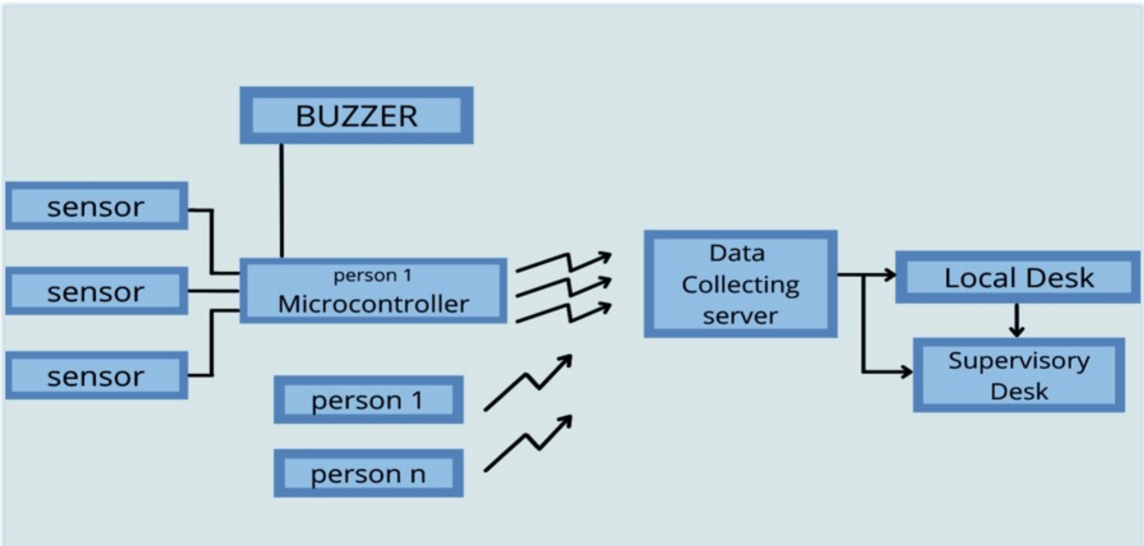

Figure 3.9: Flow Chart

3.4 Software Requirement

3.4.1 Thonny Python

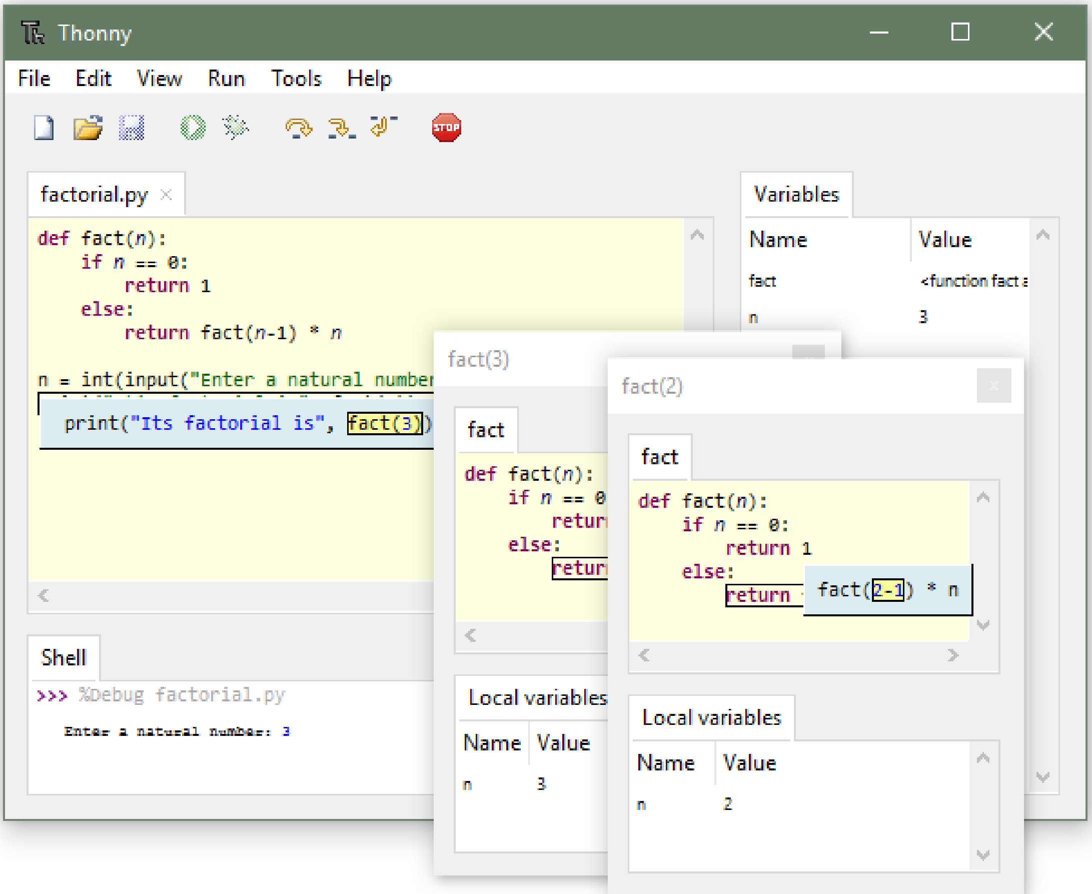

Figure 3.10: Thonny Python

ESP32 is really only a chip, however the manufacturer frequently also refers to modules and development boards that use this device as ”ESP32”. An integrated Python development environment called Thonny is made with novices in mind. Aivar Annamaa, an Estonian programmer, was the one who made it. It offers various methods for iteratively traversing the code, step-by-step expression evaluation, thorough call stack visualisation, and a mode for illuminating the principles of references and heaps.

ESP32 is really only a chip, however the manufacturer frequently also refers to modules and development boards that use this device as "ESP32". Thonny is a brand-new Python IDE for learning and teaching programming that can naturally integrate programme visualisation into the workflow of novice programmers. Different ways to move through the code, step-by-step expression evaluation, intuitive call stack visualisation, and a mode for introducing the concepts of references and heap are a few of its standout features. By recording user actions, it aids in educational research by replaying or dissecting the programming process. It can be extended and is free to use.

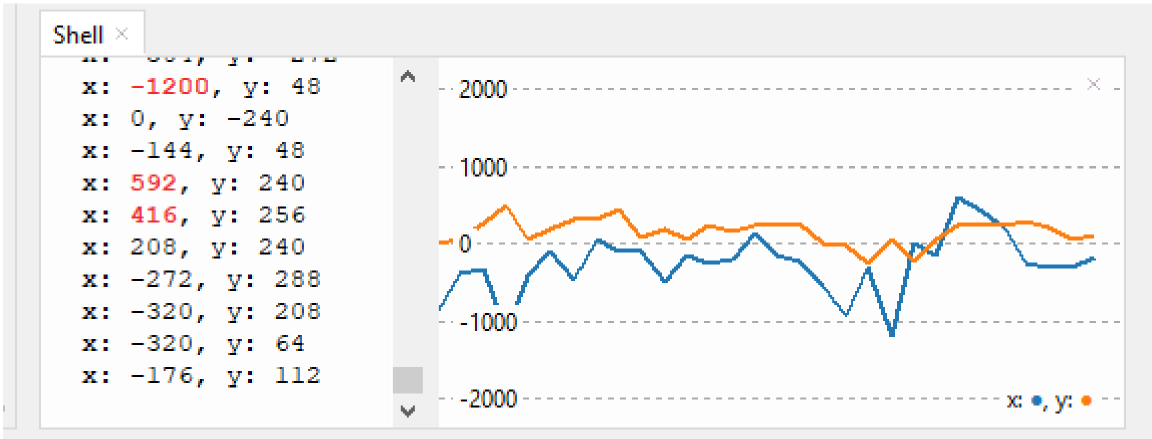

Figure 3.11: Thonny Python

3.5 Thonny python Features:

- Easy to get started.
- No-hassle variables.
- Simple debugger.
- Step through expression evaluation.
- Faithful representation of function calls.
- Highlights syntax errors.
- Explains scopes.
- Mode for explaining references.
- Code completion.
- Beginner friendly system shell.
- Simple and clean pip GUI.

Chapter 4

System Implementation

4.1 Circuit Diagram

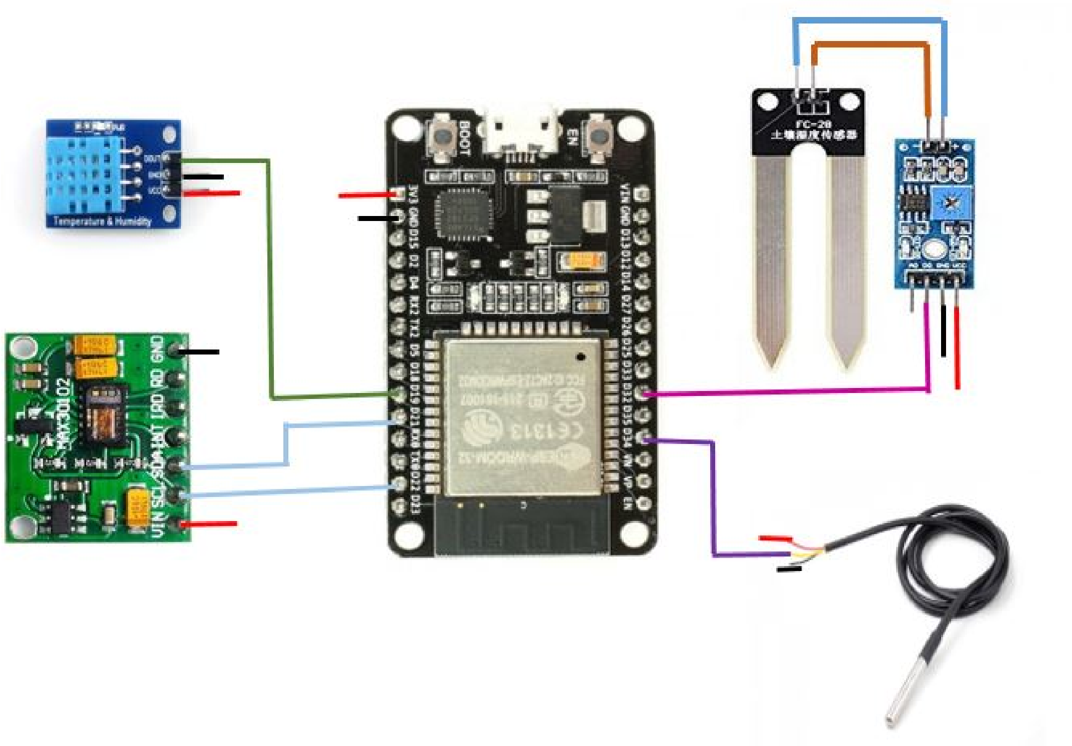

Figure 4.1: Circuit Digram

4.2 Working :

1. Health Monitoring The body parameters like heart beats, pulse rate, body temperature, SpO2 are to be monitored using the respective sensors as listed above.

2. Flood prediction The environmental parameters are monitored such are temperature, humidity, surroundings Gas, Soil moisture are to be recorded using the respective sensors as mentioned above.

3. GUI function The GUI is to gather the data in a sequential form such that the health parameters can be monitored easily such that it's user friendly. For the flood prediction purpose the real time data is accessed from the respective set of sensors and it is processed within the machine learning algorithms setted in the GUI such that we can get the desired output binary condition as flood will be there or not.

The data is sent with the use of microcontroller to the nearby data fetching hub through the wireless connectivity using radio communication (as in mines internet connectivity isn't there), where the temporary storage of data is there such that for minimal backup for few days.

The fetched data is sent through the wired connection to the local desk where the local manager's operating system collects the data and displays through the local desk's GUI such that the same will be forwarded to the HQs of the company with the help of wireless connectivity of the local desk by adding the particular remarks for the daily report. The Mine Workers' Health and Environment System is intended to monitor, protect, and promote workers' health and well-being in mining sites while simultaneously attending to environmental issues. It consists of the following elements.To protect the safety and health of mine workers, the system monitors a number of indicators. This can involve keeping an eye on the temperature, humidity, air quality, and the presence of potentially dangerous chemicals or compounds. Wearable technology or sensors may also be used to monitor the workers' vital signs and spot any potential health problems. Safety Measures: To reduce risks and stop accidents in mining activities, the system employs safety regulations and measures.

Using safety gear, participating in safety training programmes, having frequent inspections, and having emergency response plans are some examples of this.Environmental Monitoring: The system keeps track of how mining operations affect the environment. It might monitor air pollution and water quality. By identifying opportunities for improvement and helping to ensure compliance with environmental rules.The data is sent with the use of micro-controller to the nearby data fetching hub through the wireless connectivity using radio communication (as in mines internet connectivity isn't there), where the temporary storage of data is there such that for minimal backup for few days.

The fetched data is sent through the wired connection to the local desk where the local manager's operating system collects the data and displays through the local desk's GUI such that the same will be forwarded to the HQs of the company with the help of wireless connectivity of the local desk by adding the particular remarks for the daily reports.

Chapter 5

Result and Analysis

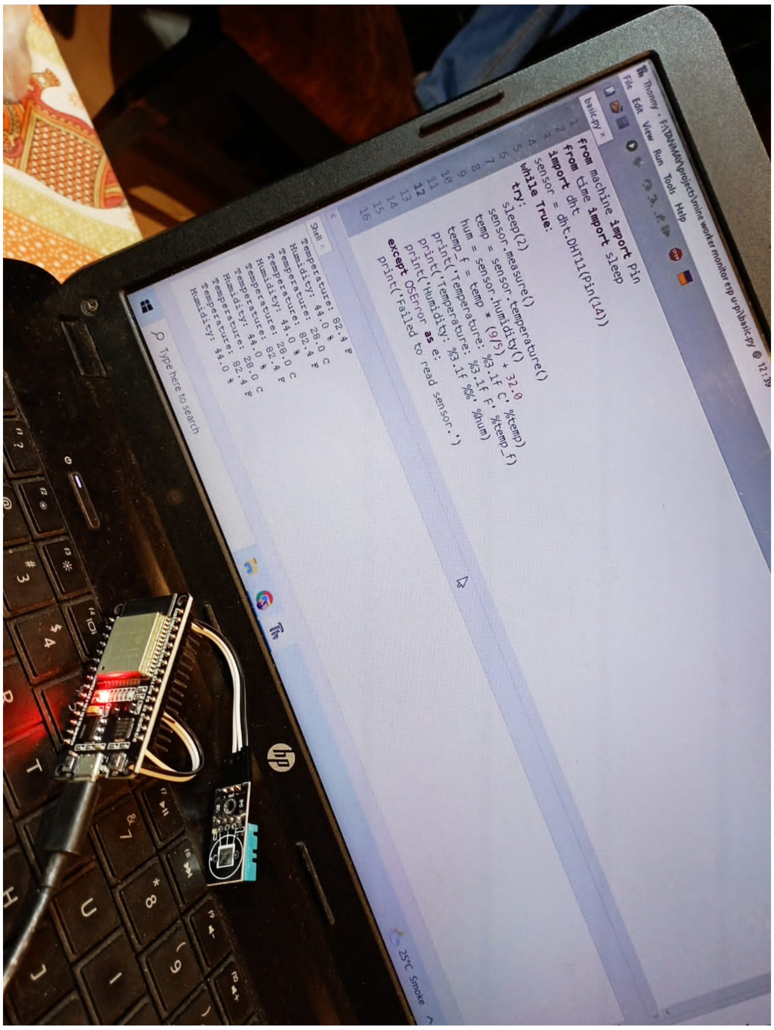

Figure 5.1: Enviroment Parameter

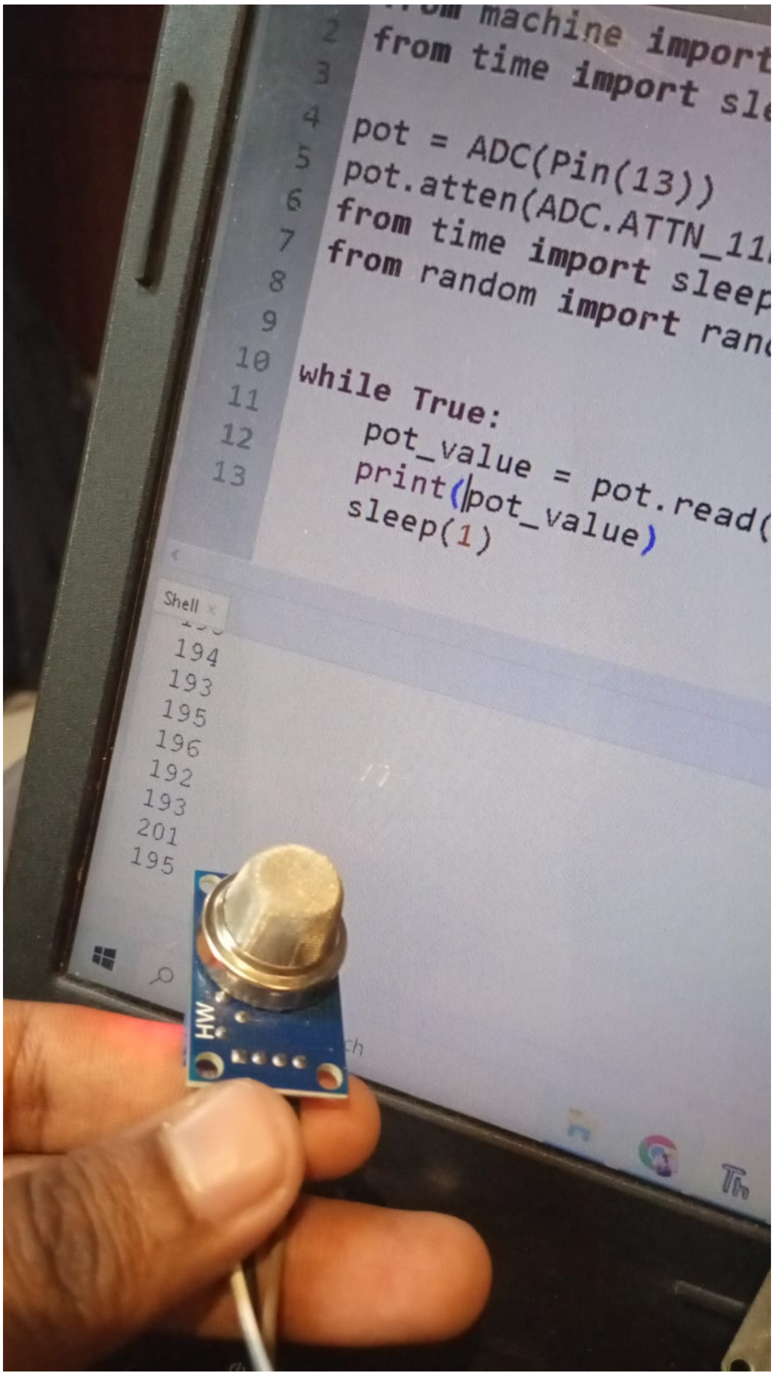

Figure 5.2: Enviroment Parameter

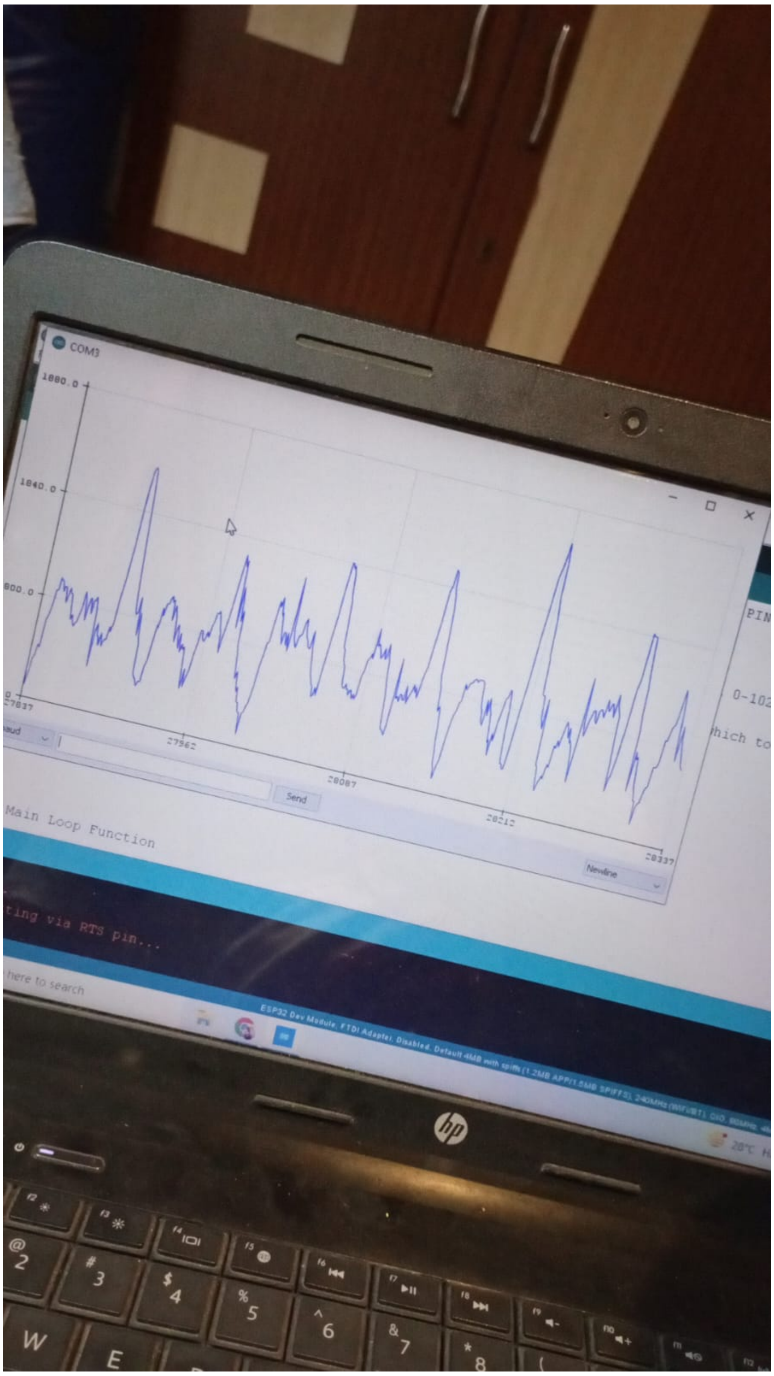

Figure 5.3: Health Parameter

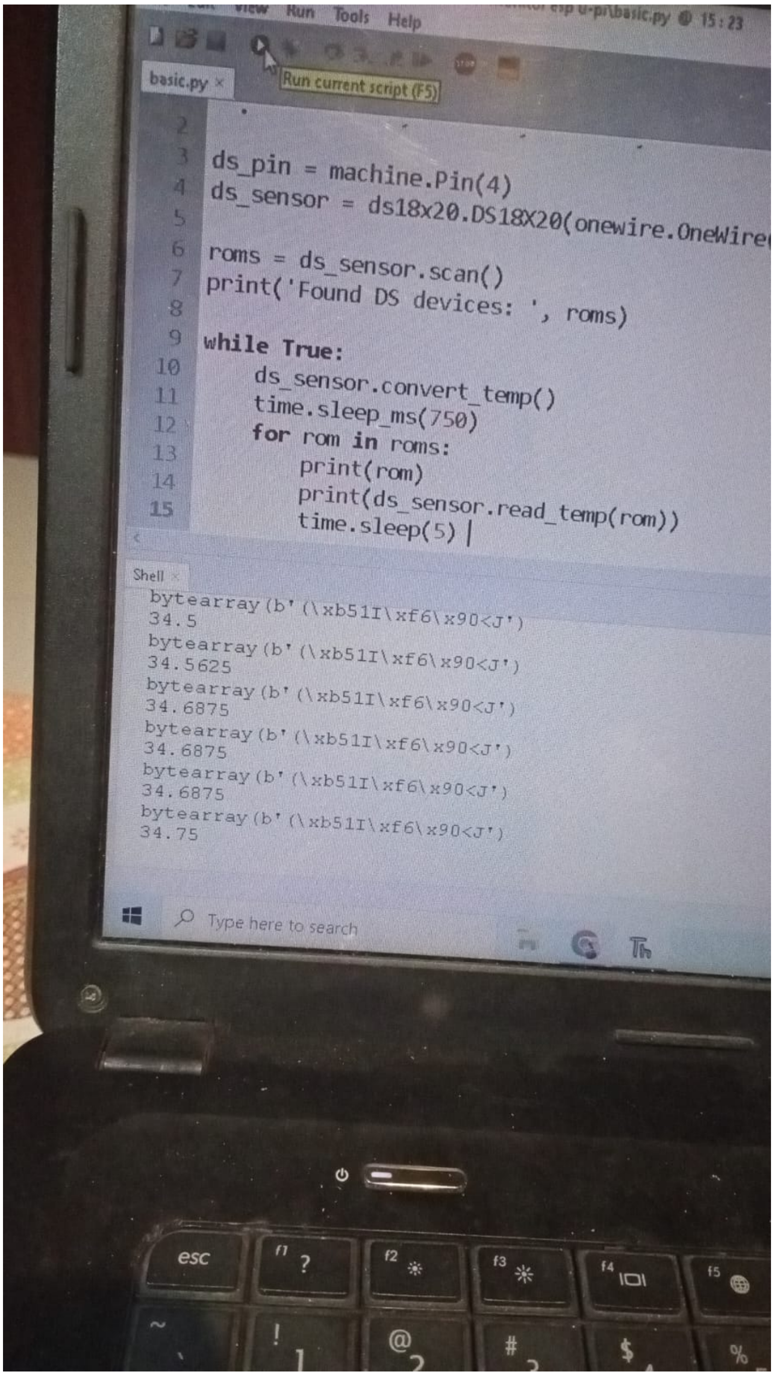

Figure 5.4: Health Parameter

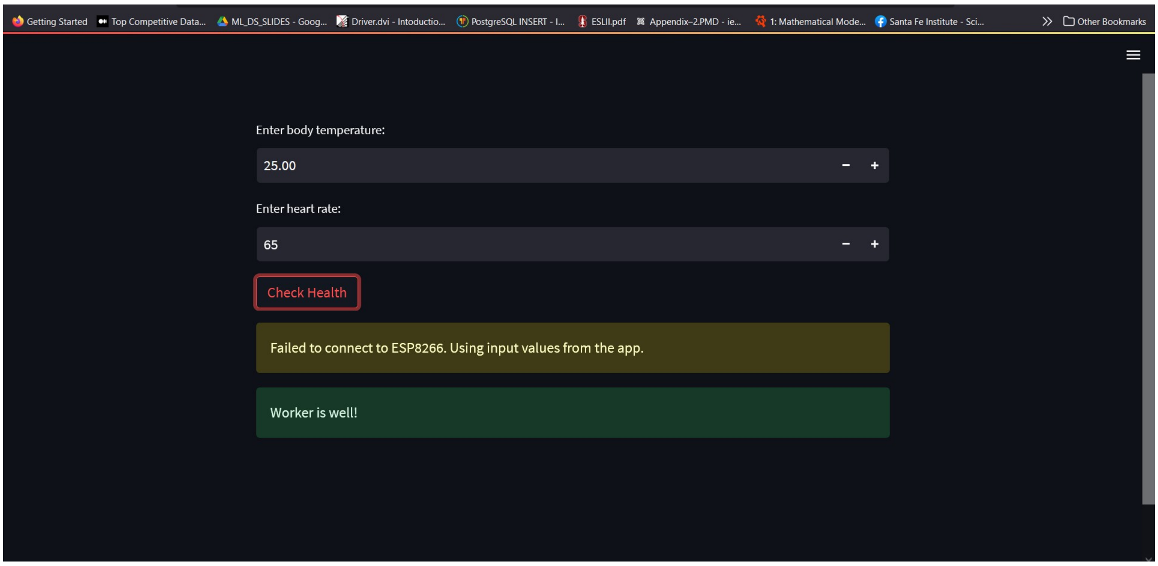

Figure 5.5: Worker well

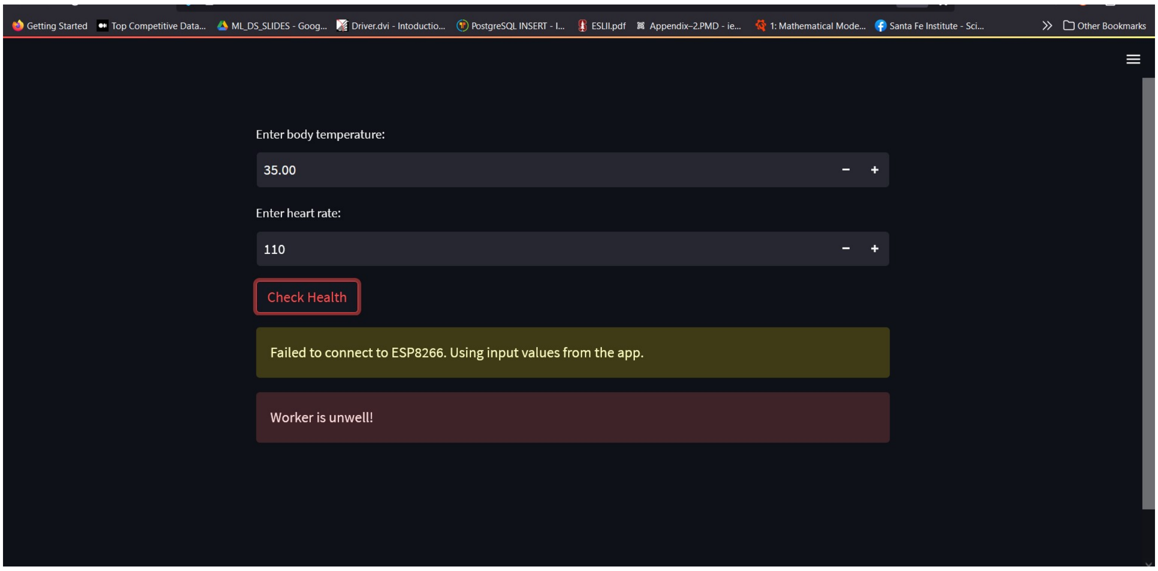

Figure 5.6: Worker is unwell

Chapter 6

Conclusion

- The smoke sensors, heartbeat sensors for getting health data, and environmental conditions are used in the mine worker safety system.
- A smart alert In the event of any deadly accidents, a mechanism is in place to ensure the safety of mine workers by warning them just in time to leave the underground area.
- This system constantly uses wireless technology to monitor the mine environment parameters and worker parameters and to alert the worker and the authorised person from the ground station. The IoT desktop application has been regularly updated based on the environment and the health of the mine workers.
- watches the mining environment's parameters and the parameters of the miners, utilising wireless technology to warn the worker and the authorised person from the ground station. The IoT desktop application is constantly being updated by the environment and health of the mine workers.

Chapter 7

Cost Analysis

Sr. No.	components	cost (in INR)
1	ESP32	450
2	ESP8266	500
3	DHT11	100
4	Gas Sensor(MQ2)	150
5	Soil Moisture Sensor	150
6	Pulse Oximeter and Heart Rate Sensor(MAX30100)	300
7	Heart Pulse Sensor	150
	Total	2,000

Table 7.1: Cost of implementation

Bibliography

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Signature