INTRODUCTION

Industrial disaster management is the process of any disaster occurrence and implementing security systems so that people are alerted at early so that they can prepare themselves from the upcoming disaster. The goal of such technology is to protect both the workers and the general public as well as to protect the environment from any risks caused by industrial enterprises to the people located in and around the area. We have developed a method to interface multiple devices in order to collect information using an Arduino microcontroller. When any abnormalities occur, there will also be an indication through LED lights and buzzers. Gathered information can also be displayed on a screen for easy interpretation during timely analysis.

PROBLEM DEFINITION

There are many ways to look at problems of this size; the most pertinent being embedded reporting which allows both the capacity to avert potential hazards while also providing a new perspective on how to effectively utilize data analytics during the reporting stage have the capability to almost completely eradicate the jeopardy of industrial disasters going forward. A delay in the restoration of an affected area will worsen the conditions, therefore, replacing the traditional means, which have proven to be lacks courtesy of being inadequate, unreliable and slow, requires an IoT based disaster management system which, in a logical and multi layered approach, monitors every aspect and occurrence of an industrial environment ensuring not only safety but an effective post analysis of an incident as well. The outcome of the report will ensure the full utilization of IoT based sensors allowing us to mitigate further risks to both people and the environment.

1.1 AIMS AND OBJECTIVE

- **Enhance safety:** By using the various sensors in this disaster management system it would increase the level of security in the industries and factories, thereby focusing on crucial parameters including gas leakage, leakage of radioactive substance, structural damages, and other environmental factors. In such a way potential risks and risks can be reduced together with their threat levels.
- **Early warning system:** Use IoT sensors to continuously observe industrial activities performed by companies over a period of time so that any deviation from standard or any catastrophic situation can be detected immediately. The goal is to find any disasters and help the people to alert them in advance to allow for measures to be taken to reduce any of the risk or to prevent it altogether.

- **Rapid response and rescue operations**: Enhancing the alert systems by using other warning methods including buzzers and LED blinking among other things to enable stakeholders to stay alerted on critical events or situations. All these measurements aim to enhance the response and safeguard all the people who are affected and also to reduce the damage.

1.2 SCOPE

- By assisting and simplifying the assessment process, the algorithm of risk analysis, as a system, integrates all necessary data that characterizes the environment of the enterprise, including availability of hazardous substances, malfunction of the equipment or failures in manufacturing processes, natural disasters and human error.
- The mechanism for industrial disaster management integrates emergency services which may include the fire department, medical care, and local authorities. There is active integration of activities such as coordination, resource sharing and relevant information exchange for emergency purposes.
- Alerts and warnings are generated by the system whenever abnormal conditions or risks are found and these alerts & warnings are sent out in real-time. These modern technologies enable people to receive a variety of alerts, including visual cues, sound alarms, text messages, and emails.

CHAPTER 2

LITRATURE SURVEY

LITRATURE SURVEY

[1] **“Sensor-based Early Warning System for Industrial Disaster Management” by Lixing:** This paper describes a sensor-based early warning system for hazardous events within an industrial sector. This technique employs a variety of sensors which have been scattered throughout the dangerous industrial sites in order to measure temperature, pressure, gas concentration, and vibration. With the assistance of modern technologies, the previously acquired data is timely processed to discover anything that deviates from the norm. When a hazard is identified, appropriate steering mechanisms such as alarms and call for notifications and intervention are activated. The article addresses the case study related to the practical use of the early warning system as well as the architecture and components of the new early warning system. It also highlights the key aspects of robust sensor selection, data acquisition, and intelligent data processing techniques. the main goal of the research is substantiation of the design and application of spatially distributed sensor-based early warning system aimed at building resilience in industrial infrastructures through AI and sensor technology. The researchers argue that, based on the case study, the sensor-based early warning system exhibits great potential in establishing timely warnings and detecting anomalies thereby improving the safety and resilience characteristics of industrial apparatuses. As a final note, the article discusses potential possibilities of improving the sensor-based early warning systems and integrating them with existing frameworks industrial disaster management while also stressing the importance of studying this problem more deeply.

[2] **" Sensor-based Industrial Disaster Management Systems: Challenges and Opportunities"**:

This paper provides a comprehensive review of the challenges and opportunities associated with sensor-based industrial disaster management systems. The advantages of the technologies are mentioned, such as constant monitoring, reactivity in the form of alarms and support for decisions undertaken on the basis of the gathered data. The major concern is around data collection, integrating tools, enabling the tools to communicate, then maintaining reliability.

CHAPTER 3
METHODOLOGY

METHODOLOGY

3.1 BRIEF DESCRIPTION

Industrial disaster management is the process of identifying potential hazards, implementing safety measures, and developing response plans to ensure preventative and mitigating actions can be initiated. The goal of such technology is to protect both the workers and the general public as well as to protect the environment from any risks caused by industrial enterprises to the people located in and around the area. We have developed a method to interface multiple devices in order to collect information using an Arduino microcontroller. When discrepancies occur, there is also an indication via LED lights and buzzers. Gathered information can also be displayed on a screen for easy interpretation during timely analysis.

3.1.1 Requirements:

- MQ2, MQ135(Gas sensor)
- ADXL 345(structural failure sensor)
- DHT22
- LED
- BUZZER
- Arduino Uno
- ESP8266
- Lora Trans receiver
- Arduino IDE with included libraries
- Blynk Dashboard

3.1.2 Hardware Description:

MQ2:

The MQ2 sensor is designed to operate as a gas sensor, specifically for industrial use which helps detect gases such as liquefied petroleum gas (LPG), propulsion gas, methane, hydrogen and smoke. The device is able to measure the concentrations of poisonous gases by evaluating the change in resistance value.

MQ135:

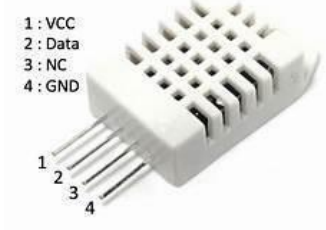
The MQ135 sensor is a gas sensor widely employed for the monitoring of air quality, and in particular the harmful effects of ammonia, nitrogen oxides (NOx), benzene and carbon dioxide (CO_2) gas emissions. Any gas sensor working on the basis of metal oxide semiconductors has as one of its components a tin dioxide (SnO_2) sensing element, which is what the MQ135 consist of.

ADXL345:

The ADXL345 is an industrial triaxial acceleration sensor that works across various levels of measurement including acceleration, tilt, and motion detection across the three axes of X, Y, and Z, ensuring high precision measurements of the various rotations. It is an accelerometer which has a 3D resolution with high accuracy specifications.

DHT22:

The DHT22 is a sensor that conveys data such as temperature and humidity. The device is quite useful in industrial spaces, particularly in environments where careful control over temperature and humidity is needed. DHT22 employs a thermistor and a capacitive element to measure humidity and temperature respectively.



BUZZER:

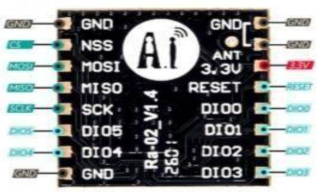
A buzzer is an electronic audio signalling device that is installed to issue a continuous or intermittent sound when an electric current is applied. It is generally used in factories and industries for alarm purpose and to give any alerts or notifications. The buzzing device contains an electromechanical transducer responsible for producing sound waves using electrical energy.

ARDUINO UNO:

The Arduino Uno, characterized as a microcontroller board based on ATmega328P Microcontroller, is among the best-known development boards. It is a multidimensional hardware platform that is widely utilized in the education sector and for industrial prototyping and development activities. Arduino Uno can be connected to all sorts of devices including LEDs, and motors. The Arduino board generally includes common features like digital Input and Output pins, power pins, and communication interface system. Constructed upon on an Atmel 8-bit AVR microcontroller, the board also supports 5V operating voltage and has six Pulse Width Modulation output pins for controlling various devices such as motors and sensors.

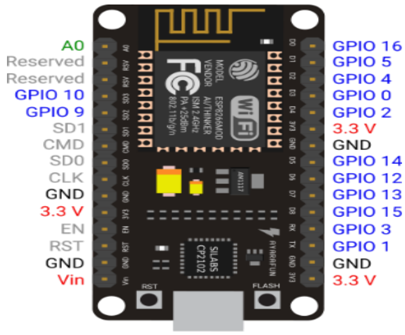
LORA TRANSRECIVER:

LoRa transceiver allows for long-distance communication to take place while utilizing minimal power and serves to the needs of a wide array of IoT applications, in particular the ones that can actually use communication across long distances. Transceiver modules make use of the Semtech SX127x series LoRa radio transceiver chips. These modules do not operate by themselves as they require extra components and circuits that help in supporting communication and controlling purposes.



ESP8266:

The range of devices that combine a microcontroller with WIFI modules is increasing and introducing the world to low-cost ways of adding wireless communication to IOT applications while there has been a considerable rise in the usage of ESP8266 as a result. As for the SoC ESP8266, the module has a built-in Wi Fi transceiver, 32-bit microcontroller and interfaces with peripherals. It works with voltage of 3.3 volts and comes in several models, for example, ESP 01, ESP 12E and ESP 12F. It has dedicated GPIO (General Purpose Input/Output) ports which can act as digital inputs or outputs, and interfaces to devices or sensors by I2C, SPI, or UART.



SOFTWARE REQUIREMENTS:

ARDUINO INTEGRATED DEVELOPMENT ENVIRONMENT (IDE):

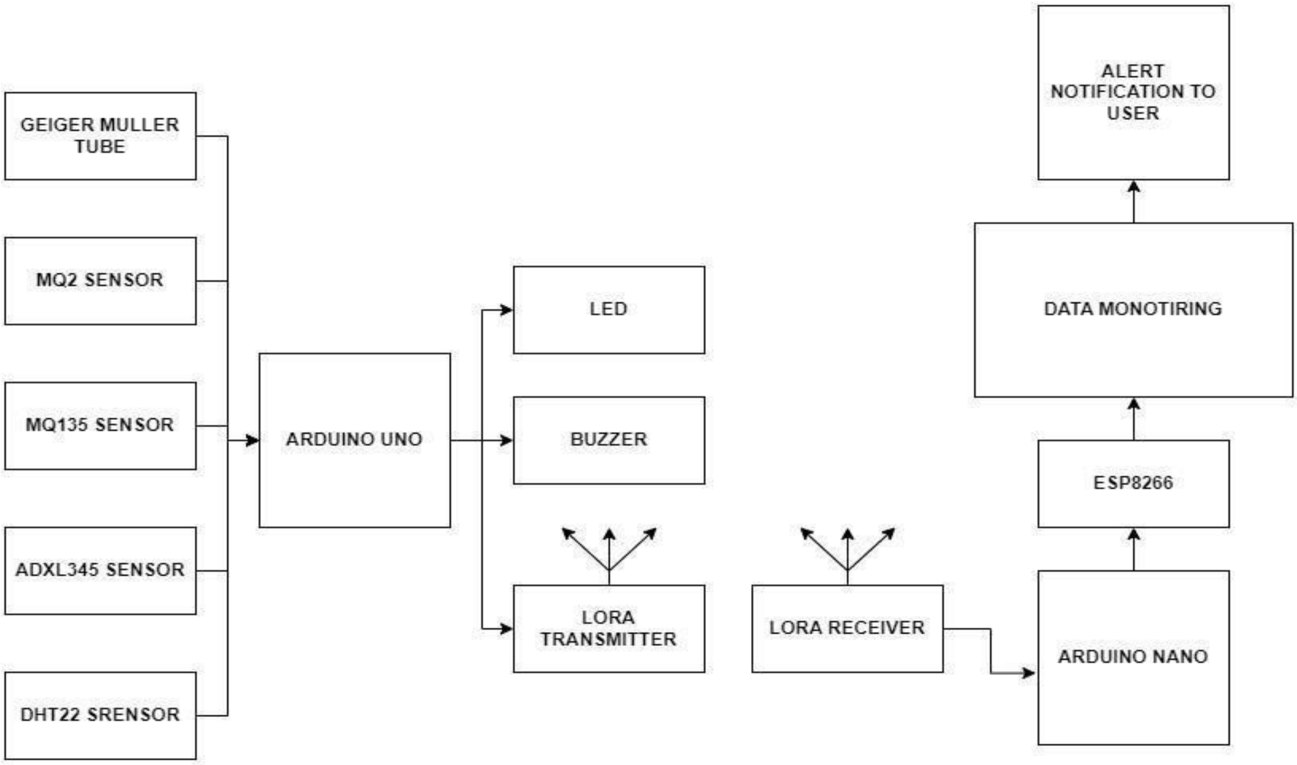
The Arduino IDE has an embedded editor where code is written, a message area and text console, and a standard tool bar with functional buttons. It interfaces with the Arduino to send programs and control all the sensors interfaced to the Arduino microcontroller.

BLYNK SOFTWARE:

Blynk is a IOT platform for iOS or Android smartphones users so that they can control functioning of the Arduino UNO, NANO boards through internet. This application is used to create a virtual and a graphical interface by compiling and giving the appropriate readings of the sensors which are connected to the microcontroller boards through different format/widgets.

3.2 BLOCK DIAGRAM

The block diagram of the Industrial Disaster Management (IDM) system starts by collecting all the data from different sensors at the initial stage. Such data is then relayed to the communication section in the wireless communication process. Following that, the system is further deployed to monitor and analyse the data, and ultimately, there is an alert system to the public or employees if an emergency case arises.



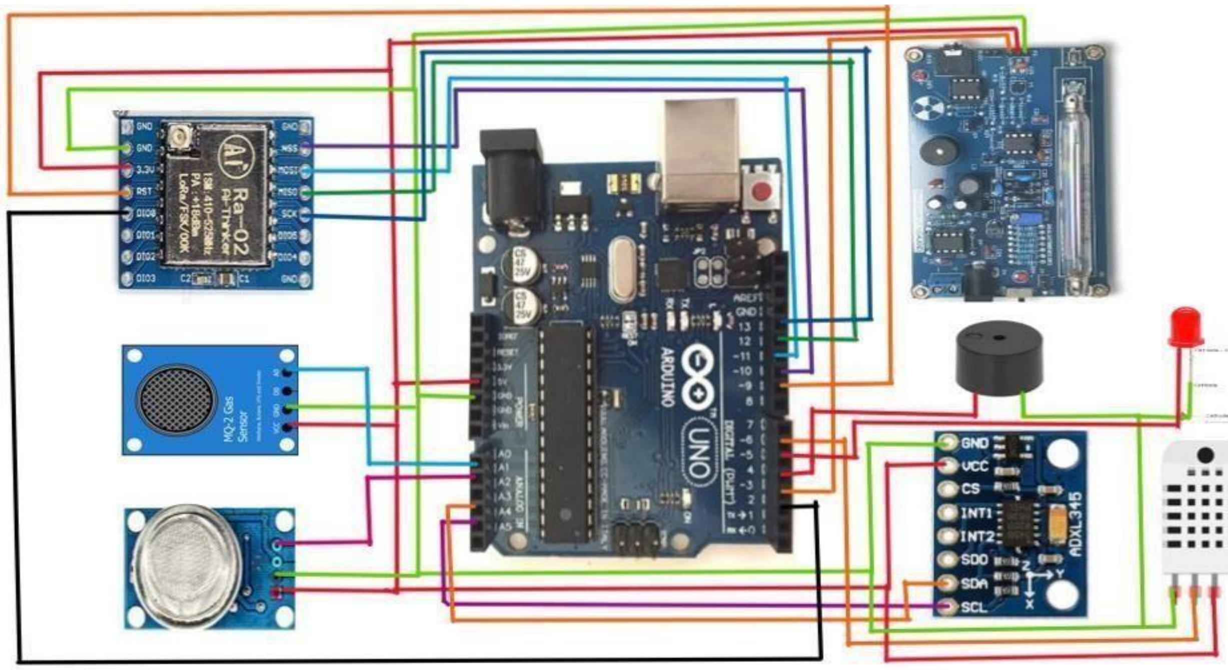
3.3 IMPLEMENTATION

The goal of this project is to design a system that prevents from and mitigates the effects of catastrophic events that occur in an industry. The receiving part receives data from the transmitting part, which has two components, one of which is the receiving part of data. This data is then displayed on the dashboard as information. In terms of hardware this system consists of MQ2, MQ135, ADXL345, DHT22, Arduino Uno and battery among other parts, The software tools include Arduino IDE and Visual studio code.

- From the above figure, connect the MQ2, MQ135, ADXL345, DHT22 to the Arduino UNO board which acts as a microcontroller. Do the wiring with respect to all the instructions mentioned in the sensors data sheet. Fix the LoRa transmitter circuit in the Arduino Uno board. After that connect the LoRa receiver module to another breadboard so that it can receive all the transmitted data from the transmitter module.
- Install Arduino IDE and ensure that all the required libraries for MQ2, MQ135, ADXL345, DHT22 and LoRa modules operations are installed. Program for the gas, structural failure, and dht22 sensors are created using Arduino IDE software. The data then is able to be sent wirelessly to LoRa receiver from the LoRa transmitter module.

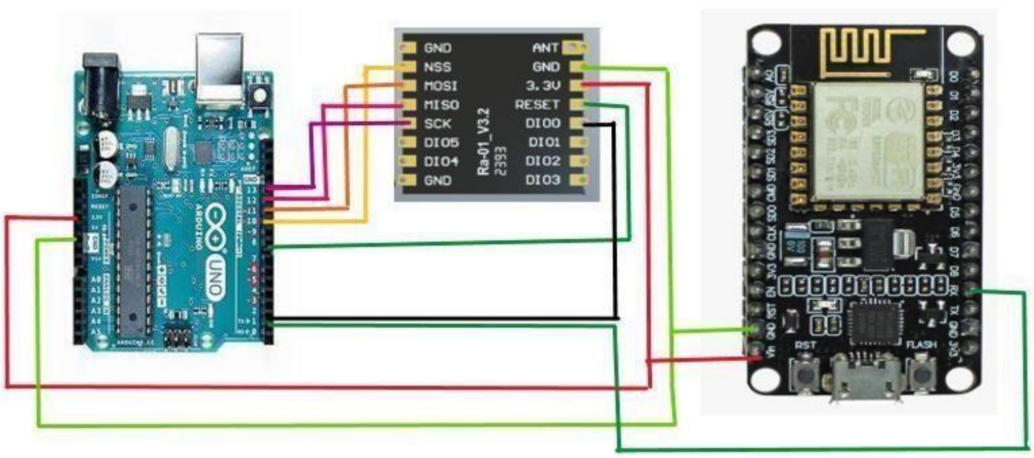
- Transfer the designed Arduino codes to the respective boards and check whether the data is being sent and received as required. Check whether the sensors are receiving appropriate voltages for their smooth working. Ensure that you make required changes to the software program or to the hardware circuit if there are any errors.

3.4 HARDWARE SETUP



TRANSMITTER

The transmitting part consists of an Arduino UNO microcontroller, MQ2, MQ135, ADXL345, DHT22, and LoRa transmitter module. All the sensors are initialized using the Arduino IDE software program, and then the acquired data from the sensors is communicated using the LoRa transmitter module.



RECEIVER

The receiving part consists of an Arduino Uno, SX1278 LoRa receiver, Wi-Fi ESP8266 as shown in the fig. It can also be noted that the Arduino IDE software initializes the LoRa module and the transmitter's signals are received using the LoRa receiver. After that the data is received, it is sent to a computer system to be visualized.

3.4 DATA ACQUISITION FROM THE SENSORS

- The method of initializing sensors is the process that requires connecting the sensors to an Arduino board and later uploading the correct test code for the sensors in Arduino ide software.
- There are appropriate sensors that are picked to cater for the activities that have been outlined in our project. Arduino boards can attach several different sensors.
- Sensors are typically attached to the Arduino board with the use of power cables. Sensors include the GND and VCC power source pins, which are connected appropriately to the Arduino UNO board. The data pin of the sensor connects to either the digital or analog pins of the board.
- The code that is uploaded into the Arduino should first disable the calibration or the connecting protocols if necessary. If the sensor which are been used accept the I2P or SPI protocols, then they are configured accordingly. You should always use the manual available with the sensor to determine the exact requirements.
- If the sensor is built primarily for interfacing with an Arduino board, then it should come with some relevant libraries and a basic function to pull data from it. If not, then the user may need to pull the relevant data in libraries, for further processes. Data pulled can be of two types, analog or digital, both types are sensor dependent.

3.5 WIRELESS COMMUNICATION

- Start off by connecting the module to the Arduino board, If the embedded LoRa module supports communication with embedded pins, you should connect them as well. You should also look for and install the LoRa library from the Library Manager.
- Configuring the transmitting Arduino module is done by writing the relevant code into your software. Alongside with the above details, the module will be tuned with a particular frequency, bandwidth, and varying parameters.

- Configure another Arduino board as the LoRa receiver. Connect the LoRa receiver module to the Arduino UNO board if it is not done. Write the program that would enable the Arduino configured as the receiver for LoRa communication. Responsibilities of the code includes, setting up and starting the LoRa modules and finding the frequency, bandwidth, and other varying parametersof the module.
- The code to be executed for receiving on the Arduino receiver is quite distinct. In this case, the module is set to receive mode while packets are awaited. Your application will determine whether you want to visualize the received information or perform some form of computation on it.

3.6 DATA MONITORING

- App's Blynk acts as the IoT cloud server. It ensures that the data is saved and made available in android mobile when necessary for further visualization. This helps in finding people during any emergency situations.
- The Blynk IoT dashboard has all of the data from the sensors which has not stopped being analysed since the last readings. This means that if the attached sensors record any shifts in values, those shifts will be reflected on the Blynk dashboard. This process integrates real-time variance from the normal conditions of the application with the dashboard.
- In our case Temperature, Humidity, Gas sensors data are considered.

3.7 ALERT SYSTEM

- An appropriate threshold is set against the data gathered from the sensors and the data collected is thoroughly analysed. Any reading from a sensor which surpasses a certain bound immediately activates an alert mechanism designed to protect the industrial system. This alert process generally includes various components such as LED blinking, buzzer sounding, and email notifications alerts.
- LED Blinking: Excessive readings from a sensor lead to activating an anomaly indicator which is connected to Arduino and is able to blink an LED when its time.
- Buzzer Activation: Coupled with blinking LEDs, a buzzer can also be used to give an auditory alert. When certain conditions are met by the Arduino, the buzzer serves to catch attention in case when the industrial system running has critical conditions. The importance of the situation can be communicated through a early sound and sound pattern produced by the Buzzer.

- Email Notifications: An email server can also serve as an outlet where the Arduino can direct email notifications whenever a built threshold is exceeded. Arduino code can be programmed in such a way that it can send any email notification alert. Whenever a sensor surpasses its specified limit, the Arduino can send an email to the required personnel or security team.

3.8 HARDWARE DEVELOPMENT

Connect the LoRa transmitter module to one Arduino UNO board, and Connect the LoRa receiver module to another Arduino UNO board and make the appropriate connections. MQ2, MQ135, ADXL345, DHT22, are to be connected to the Arduino Uno board as shown in the fig. Ensure to follow each of the sensors wiring diagrams.

3.9 SOFTWARE DEVELOPMENT

Follow the steps to set up the Arduino IDE and add other required libraries for MQ2, MQ135, ADXL345, DHT22 and also the LoRa modules. Write a code for the Arduino uno board for all the modules interfaced with gas sensor, structural failures sensor, dht22 sensor etc and send the data wirelessly through the transmitter.

3.10 DATA RECEPTION AND PROCESSING

Develop a code for the Arduino board so that, the board will process the data sent by the transmitter circuit. Then, from the data received, find the parameters required for your project, for example, how far did it rotate, what was the temperature and what was the pressure etc parameters that were given to the code.

3.11 TESTING AND REFINEMENT

Upload the Arduino code into the UNO boards and verify whether the info is sent and received properly. Carry out required test on the PC in order to check its accuracy under different testing conditions. Make the required hardware(circuit) or software (Programme) changes that are necessary for proper functioning of the entire circuits.

CHAPTER 4
RESULTS AND OBSERVATION

4. RESULTS AND OBSERVATIONS

4.1 BLYNK DASHBOARD

Blynk software allows us to monitor all the parameters in their website dashboards or through their mobile apps.

The Blynk IoT dashboard displays the on-spot data from the sensors, which includes, gas sensors (giving ppm value), the accelerometer sensor/motion detection sensor (providing X, Y.Z plane values) and the temperature and humidity sensor.

This complete display of data allows for live monitoring of gaseous concentrations, abnormal environmental conditions, difference in radiation levels, and frequent changes in temperature/humidity values, enabling early identification of upcoming hazards within the industries and factories. The web dashboard provides live as well as continuous monitoring of the sensor readings, and also provide any response to the abnormal readings/conditions.

IMAGE OS THE BLYNK DASHBOARD:

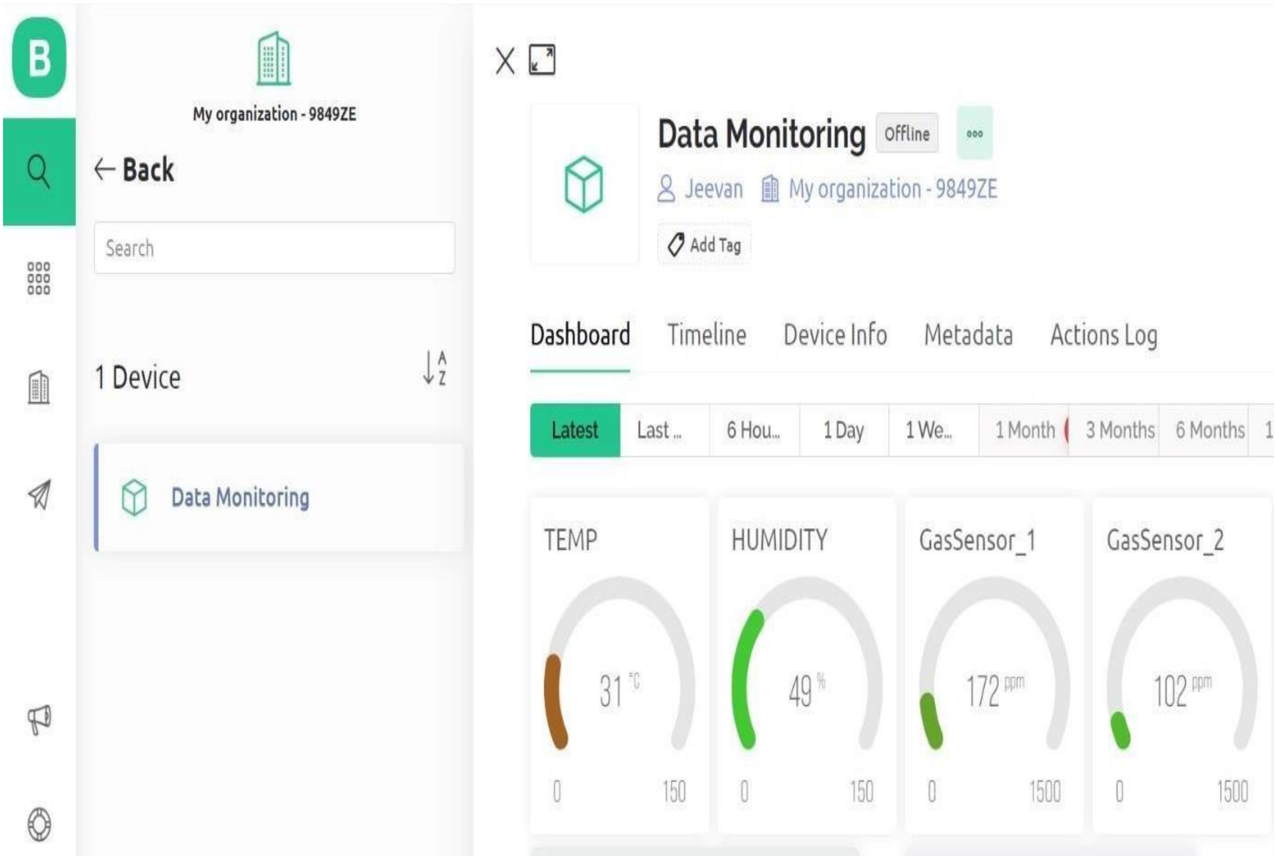
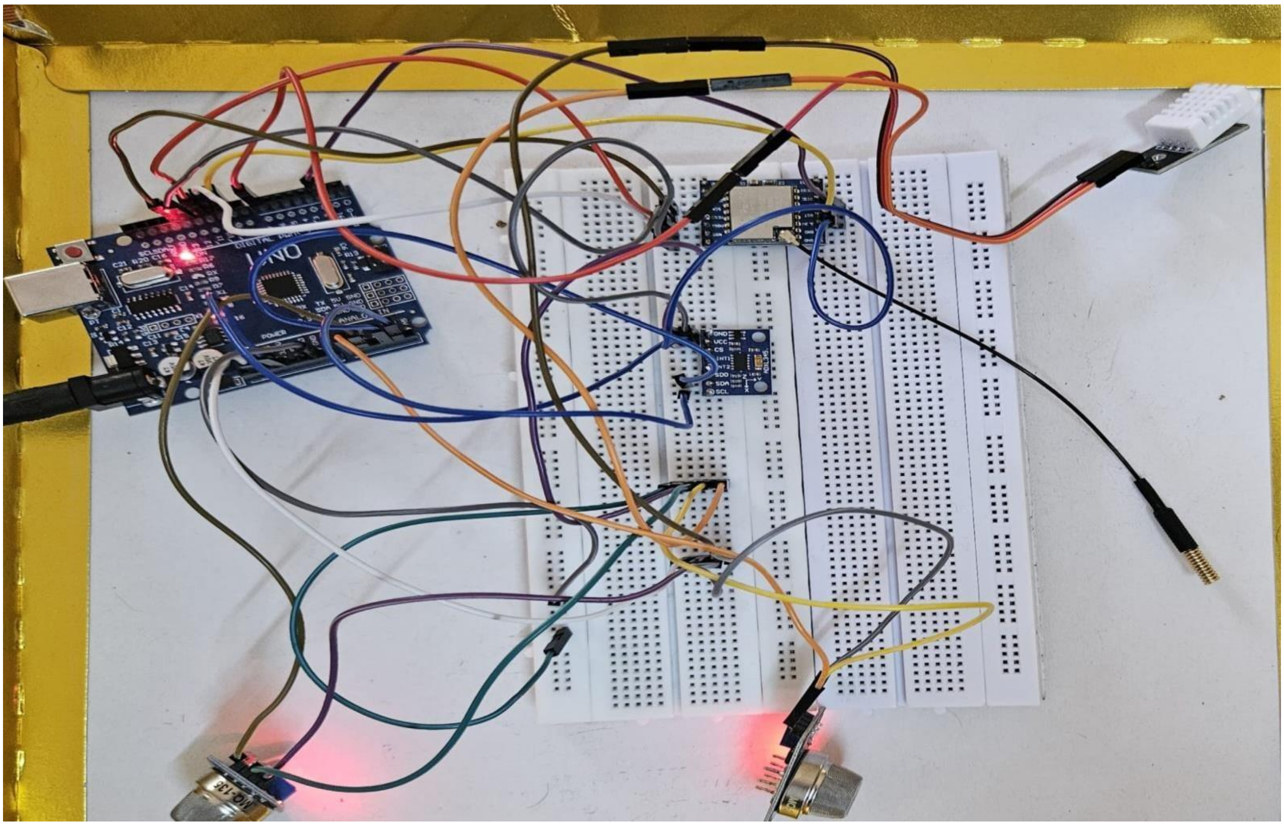
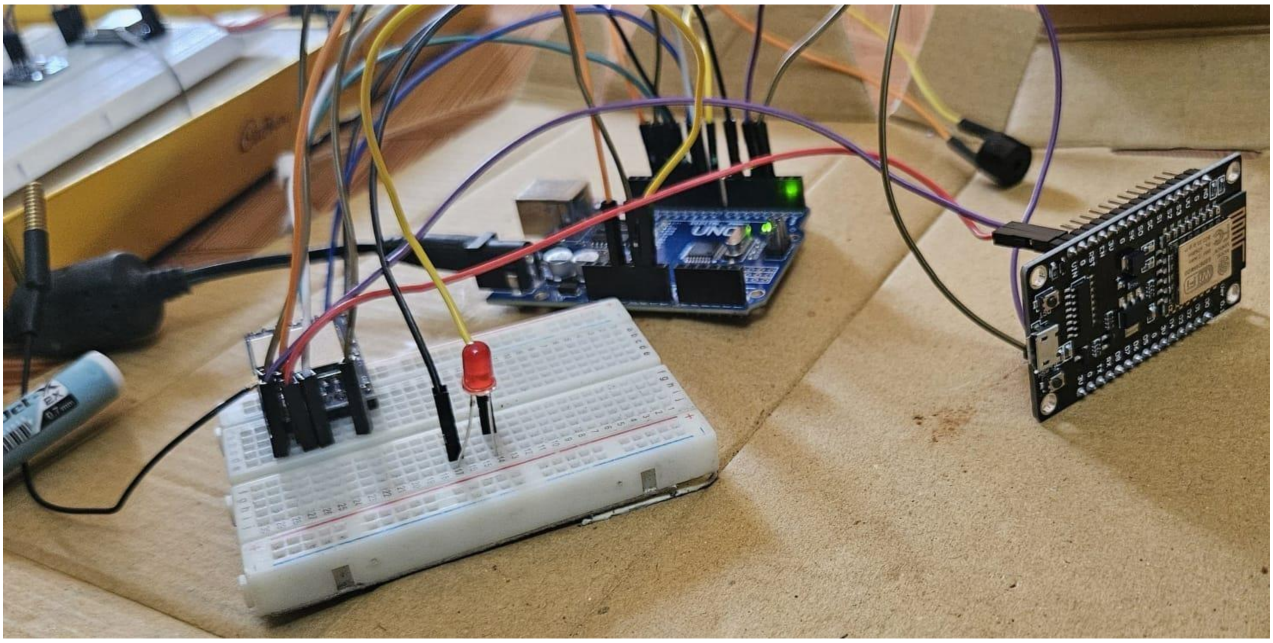


IMAGE OF THE HARDWARE COMPNENTS:

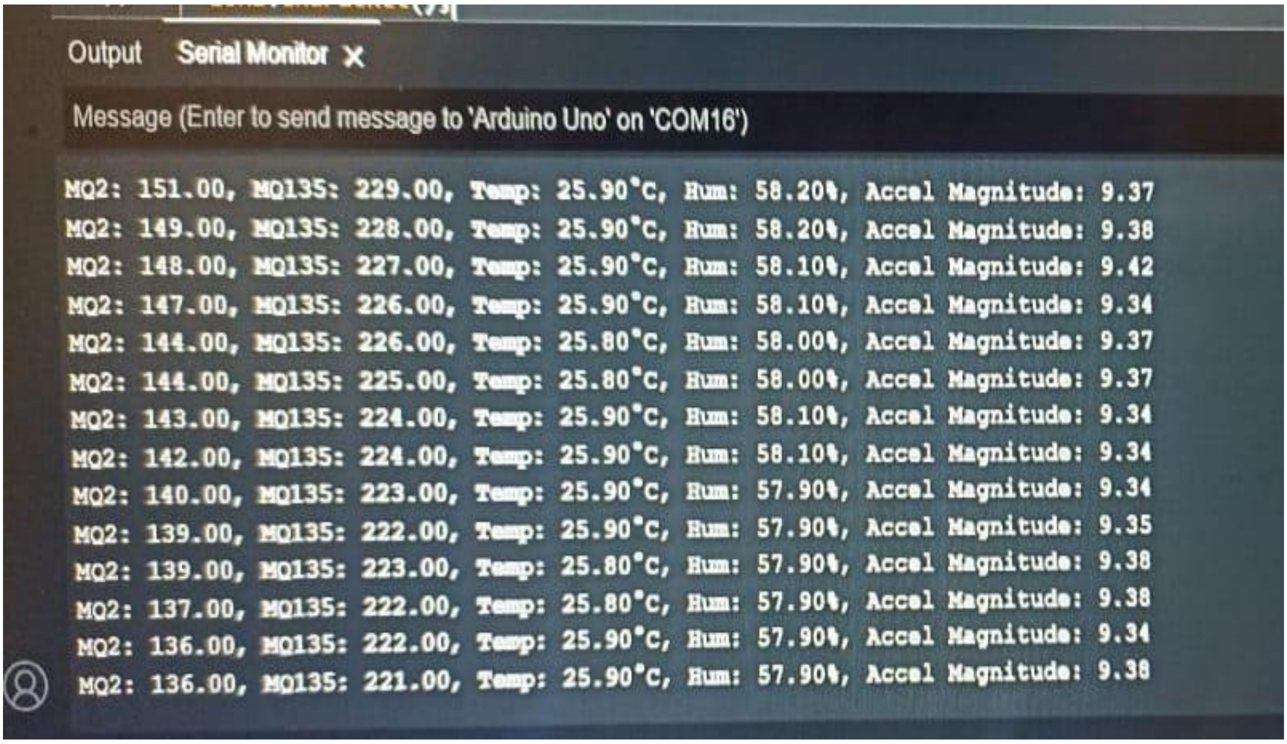


TRANSMITTER



RECEIVER

IMAGE OF THE SENSOR READINGS:



CHAPTER 5
CONCLUSION

CONCLUSION

- Environment monitoring consists of specific attributes like temperature, pressure, gas emissions, nuclear radiation and tilt angle which can also be measured remotely through sensor technology, and when used in combination with time-critical data and sensor-based monitoring systems, these can be crucial for the timely detection of irregularities, anomalies, or dangerous events. Such systems greatly assist in responding to various dangerous situations, and, if necessary, in taking preventive action. This has wide range of applications in various technical fields and has become a very important requirement for the safety purpose and protection of industrial and factory workers.
- These sensors are used in conjunction with threat alert systems, which ensure an automatic and intelligent alerting network for notifying the right people at the right time in the event there is an eminent threat or hazard.
- With these developments, the scope and effectiveness of disaster detection are sure to be boosted in the future, making it a critical aspect of different sectors as it is an emerging technology, with the requisite identification resources especially for industrial applications.

REFERENCE

[1] "Sensor-based Early Warning System for Industrial Disaster Management" by Lixing.

[2] "Sensor-based Industrial Disaster Management Systems: Challenges and Opportunities" by Zhang.

[3] "Smart Industrial Disaster Management System using Wireless Sensor Network. "By G. Shanmugapriya and S. Arumugam.