RESILIENT IOT BASED DETECTION SYSTEM FOR OIL AND GAS INDUSTRY

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Abstract — *The objective of the project is to establish an automated system that keeps oil and gas industry workers safe by detecting the risk of explosions. We develop a smart detection system that identifies potential threat zones in real-time. The system will leverage cutting-edge technology to provide timely alerts to nearby workers, offering them crucial time to evacuate or implement essential safety measures prior to a gas or oil explosion. By combining sensors and intelligent algorithms, we aim to enhance safety measures and minimize the impact of potential explosions in the oil and gas industry. MQ 135, Fire, temperature Sensors will monitor various parameters such as gas concentrations, temperature and pressure. Collect processed data from the deployed sensors. Analyze the values to identify patterns and anomalies associated with potential explosion risks. When a potential threat is detected, the system will send alerts to nearby workers through alarms, mobile notifications and voice call to the supervisor of the industry and near by fire station. The oil detection system works by measuring the level of oil. An Flow sensor helps to detect the oil leakage and activates the Alarm.*

Keywords**: MQ135 sensor, pycharm, firebase.**

1. INTRODUCTION

Despite detailed regulations and laws, accidents remain prevalent. According to situation awareness theory, individuals undergo three processes when navigating a dynamic environment: perceiving the environmental situation, comprehending the nature of their circumstances, and making decisions accordingly. The fig 1.1 shows the MQ135 sensor is a type of gas sensor that's commonly used to detect a variety of gases in the air, particularly harmful ones like ammonia, benzene, alcohol, smoke, and carbon dioxide. It's often used in air quality monitoring devices and projects to measure the concentration of these gases.

Fig 1.1 MQ 135 gas sensor

It's relatively inexpensive compared to other gas sensors, making it accessible for hobbyists and small-scale projects. It can detect a variety of gases, providing versatility in applications. It's easy to set up and integrate into projects, requiring minimal expertise in electronics. Provides real-time data on air quality, allowing for timely responses to changes in gas concentrations. Its small size makes it suitable for integration into portable devices and systems. concluding, the MQ135 sensor is a cost-effective and versatile solution for monitoring air quality, making it valuable in applications ranging from indoor air quality monitoring to environmental sensing.

1.1 sensor based with emergency alarm notification for industrial worker

In this project, we proposed an alarm system aimed at enhancing workers' awareness of construction site conditions, thereby improving safety management efficiency and quality. Industrial Control Systems (ICS) encompass integrated infrastructures designed to regulate industrial systems across extensive geographical areas and sites. These infrastructures comprise networks, sensor devices, and controllers, facilitating the automation and efficient operation of industrial tasks and processes. Real-time access to environmental status proves advantageous in various scenarios. Furthermore, recent studies have revealed that identifying environmental patterns leads to markedly reduced energy consumption in numerous smart automation and industrial applications, contrasting with approaches assuming fixed usage patterns

1.2Detecting oil lekage in oil industry using Flow sensor

This project deals detection of various parameters like temperature, humidity, air quality and flame detection And The oil detection system works by measuring the level of oil that flows. An flow sensor will continous detect the flow of oil. When there is a slight different in the flow it immediately sense and activating the alarm. In the oil and gas industries, safety is paramount. To ensure the well-being of workers and protect against potential hazards like explosions, we are developing an innovative solution. Our system will utilize advanced technology to swiftly detect areas with elevated risks of explosion, known as threat zones.

1.3Graph pretection using Ml alogrithm

After the detection of gas from mq135 sensor the values is been stored in the data bases. Which is help to train the ml model and it’s help the wokers that their can w ork safely in that area and moreover any environment changes is been happening to it shows us a clear sign to evacuate the area immediately.

1.4Andriod application for automation of hardware

An android application is been developed and which it helps to control the hardware. Wifi module is been is used in the hardware which helps to connect the hardware with the app and moreover which sends mail notification with the type of gas which is been detected

1.5Hemlet detection for workers safety

Helmet detection for worker safety refers to the use of technology, typically cameras and software, to detect whether workers in industrial settings are wearing helmets or hard hats as required for safety. This technology helps ensure that workers are properly protected from head injuries while they're on the job.

2.LITERATURE SURVEY

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In their publication entitled "Generating Anomaly Detection Datasets in Industrial Control Systems," Kumar, R.R., Randazzo, and colleagues (2020) present a methodology for creating reliable anomaly detection datasets in ICS. The methodology involves four steps: selecting attacks, deploying attacks, capturing traffic, and computing features. The proposed approach has been applied to generate the Electra Dataset, designed primarily for evaluating cybersecurity techniques in electric traction substations used in the oil and gas industry. Utilizing the Electra dataset, the authors train multiple Machine Learning and Deep Learning models to detect anomalies in ICS. Results from the experiments demonstrate high precision in the models, thereby affirming the suitability of the dataset for deployment in production systems.
The paper titled "IoT-Based Liquefied Petroleum Gas (LPG) Leakage Detection System," authored by Md. Jubayer Rahman in 2023, presents a Smart Liquefied Petroleum Gas Leakage Detector system utilizing the

Internet of Things (IoT) framework with the ESP8266 NodeMCU Module. The system integrates an MQ-6 sensor, IR flame sensor, solenoid valve, buzzer, and the Blynk application for gas level monitoring and control.
The paper titled "Online Short-Circuit Protection Strategy for Electric Powerpack in Electric Oil Pump Applications," authored by Noh, Y., and Kim, W. in the 2021 IEEE Access, introduces a novel approach to online short-circuit protection. This method enables real-time control of the optimal fault threshold, adjusting to variations in temperature and load conditions. The study investigates fluctuations in short-circuit current (SCC), analyzing its protection range and qualification time through worst-case analysis. To establish the optimal fault threshold, the SCC waveform is estimated via circuit analysis, and a technique for estimating Rdso(Tj), the cause of SCC fluctuation, is proposed based on simulation and experimental data. Subsequently, optimal thresholds are determined according to Rdso(Tj), and the proposed methods are experimentally validated. The results indicate that the SCC can be predicted and managed within the protection range using this new protection method.

The paper titled "Development of an Experimental Configuration for Real-Time Fault Diagnosis of Induction Machines using IoT and Machine Learning: Advancing Industry 4.0," authored by Tran, M.Q., Elsisi, M., and collaborators in the 2021 IEEE Access, introduces a novel IoT architecture leveraging machine learning techniques to mitigate cyber-attacks and ensure reliable and secure online monitoring of induction motor status. Advanced machine learning methods are employed to accurately detect both cyber-attacks and motor status. The proposed infrastructure validates motor status through communication channels and internet connectivity, offering cost-effective and simplified network integration.

The paper titled "A Study on Workload, Sleep Quality, and Work Fatigue among Workers in the Oil and Gas and Palm Plantations Industry," authored by Kumar, R. R., Randazzo, et al., was published in the 2020 IEEE Access journal. The research was carried out between March and November 2020, involving a total sample of 222 individuals employed in the oil and gas industry and oil palm plantations in Jambi Province.

The paper titled "Unmanned Aerial Systems for the Oil and Gas Industry," authored by Peter Warrian, was published in the 2020 IEEE Access journal. The paper discusses the use of UAV (Unmanned Aerial Vehicle) technology for monitoring various activities within the oil and gas industry to ensure proper execution and identify any potential issues.

The paper titled "Improving Individual Worker Risk Awareness: A Location-Based Safety Check System for Real-Time Hazard Warnings in Work-Zones," authored by Younggi Hong, was published in the 2023 IEEE Access journal. The research introduced a real-time safety verification system engineered to autonomously categorize workers' acknowledgment of hazards and facilitate supervisors in approving work procedures within high-risk environments.

3. EXISTING SYSTEM

In the past, safety monitoring and automation systems were usually tailored for specific monitoring tasks, limiting their versatility. However, modern applications demand more than just interconnected back-end systems. To address this, a laser micro projector was developed utilizing a 2D micro electro mechanical system (MEMS) mirror, enabling the projection of a clear image onto a motorcyclist's field of view. Despite advancements, this approach introduces complexity in hardware, resulting in high costs and maintenance requirements. Moreover, accessibility for users is limited. Nevertheless, these systems offer the potential to customize safety alarming levels and adjust monitoring and control. rules to enhance overall safety measures.

4. PROPOSED SYSTEM

Data collection in this research comprises two main phases. Firstly, hazards are identified on the construction site, serving as a foundational step for sensor deployment. Secondly, raw data from sensors is

gathered and analyzed. Hazard data is sourced from literature, construction codes, industry guidance, and relevant laws. Based on this information, the response process operates in two ways: alerts are sent to workers in danger, and data packages are forwarded to managers for further analysis. Existing safety.monitoring and control systems that prioritize real-time data collection prove valuable.
Structurally, the lightweight mashup architecture is divided into two components: Safety Monitoring and Worker Helmet Detection via Computer Vision.
In fig 4.1 the overall system architecture is been shown with the help of arduino nano micro-controller and atmega328 processor we can able to connect all the senors and by the use of arduino ide software we can able to embedded the code in to the hardware And once the leakage of the gas is been detected by the use of computer the message sent to the mail of the supervisor and to receiver arduino board to warn the workers.

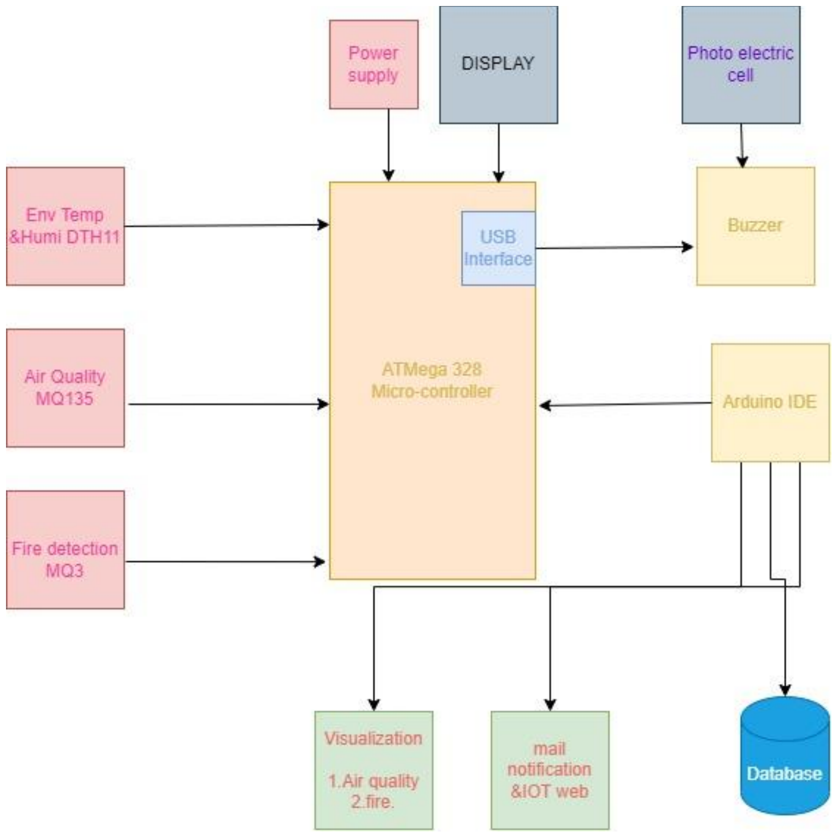

Fig 4.1 System architecture

4.1 MODULE DESCRIPTION

4.1.1 Senor based automation detection system:

On the First step of interacting with this system, the fig 4.1.1 shows us using mq135 sensor will able to detect the harm full gases.after the gas is been getting detected. The values is been getting stored in the firebase. After which is been getting used to detect the graph which makes the workers feel safe to work and for oil the leakage the flow sensor is been used and it continuous monitor the flow of oil and it keeps the record of oil which is been flowed and if the values is been changed then alarm will be activated. You place the MQ135 sensor in the area where you want to detect gases, such as in a room or near a potential source of pollution. The sensor contains a special material that reacts when it comes into contact with specific gases, like ammonia, carbon dioxide, or smoke. When the sensor detects these gases, it produces a small electrical signal that varies depending on the concentration of the gas. You can connect the sensor to a microcontroller or a circuit that interprets this electrical signal. The microcontroller or circuit can then analyze the signal to determine the presence and concentration of the gas. Depending on your setup, you can use this information to trigger alarms, display readings, or take other actions to alert you to the presence of harmful gases. Overall, the MQ135 gas sensor helps monitor air quality by detecting certain gases, providing valuable information for maintaining a safe and healthy environment. The fire sensor is a device that detects the presence of flames or high temperatures. When it senses fire or heat, it triggers an alarm or activates safety measures to alert people and prevent further damage. The humidity sensor measures the amount of moisture or humidity in the air. It helps monitor and control humidity levels in a particular environment. If humidity levels become too high or too low, the sensor can trigger actions like turning on or off a humidifier or dehumidifier to maintain optimal conditions.

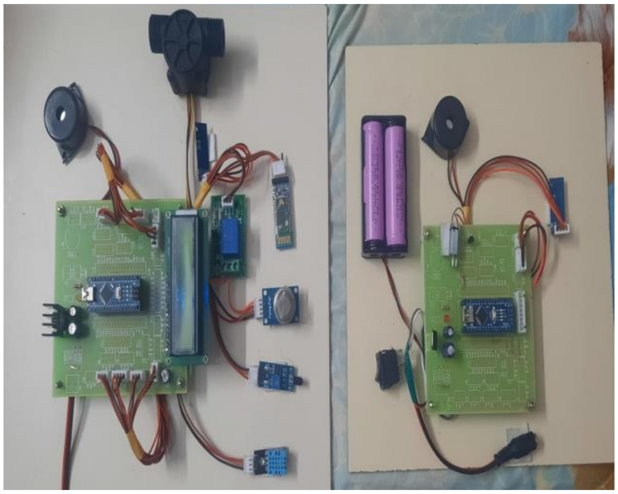

Fig 4.1.1 Final model

4.1.2 Automation through Bluetooth and helmet detection by pycharm :

The Fig 4.1.2 using relay hardware the sensor can be controlled by app which makes the process more smother and if some exploation is been happened then we can easily off the hardware. In some days the workers may forget their helmet due to rush in the work. which may cause life risk for the workers for that using python. We develop a helmet detector which helps to detect the helmet in case if workers did not wear the helmet. It detect by camera and by the receiver hardware it inform to the workers.

Fig 4.1.2 Serial Bluetooth

4.1.3 Authentication:

On the Third step of interacting with this system. The fig 4.1.3 application the user’s login into the oil and gas Dashboard after registering with their Credentials (Email and Password). User’s credentials are stored onto the cloud database i.e. rebase offers a secure and user-friendly solution for app sign-in. Through Firebase Authentication, developers can enable email and password login support.

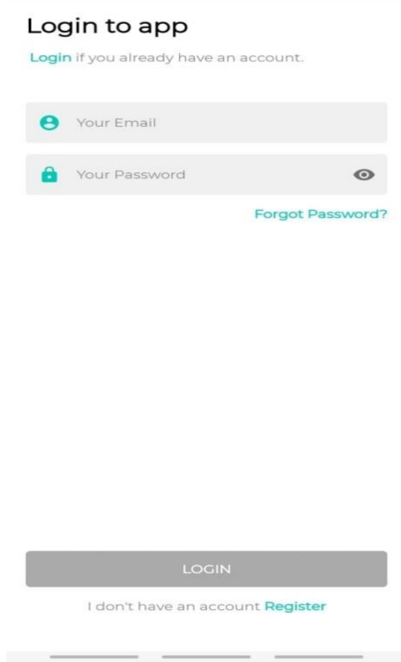

Fig 4.1.3 Login page

4.1.4 Wokers demand:

The fig 4.1.4 shows the workers can share their point of view so that the industry management can able to do the necessary actions for the workers safety.This is one of the interesting thing in the app. In this mode the people can their thoughts. Let's take an example as one of our workers get's uncomfortable in their working zone.In our app their can share their struggle there are faced. So that the management can able to came up with an solution.

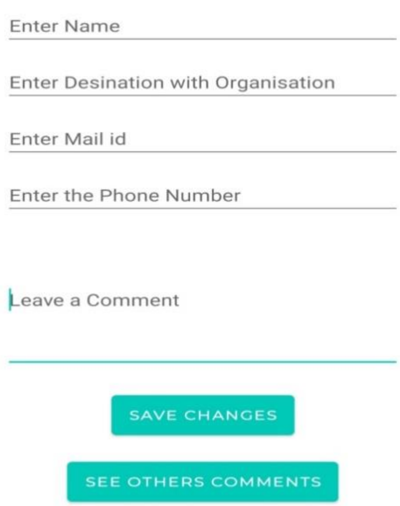

Fig 4.1.4 Report page

4.1.5 Database:

The fig 4.1.5 Firebase is like a toolbox for developers building apps. It provides a bunch of pre-built tools and services to make developing apps easier, faster, and more efficient. Think of it as a set of Lego blocks that you can use to build your app. Instead of starting from scratch, Firebase gives you things like user authentication (so users can sign in securely), a real-time database (so your app can sync data instantly across devices), cloud storage (to store files like images or videos), and many other features.

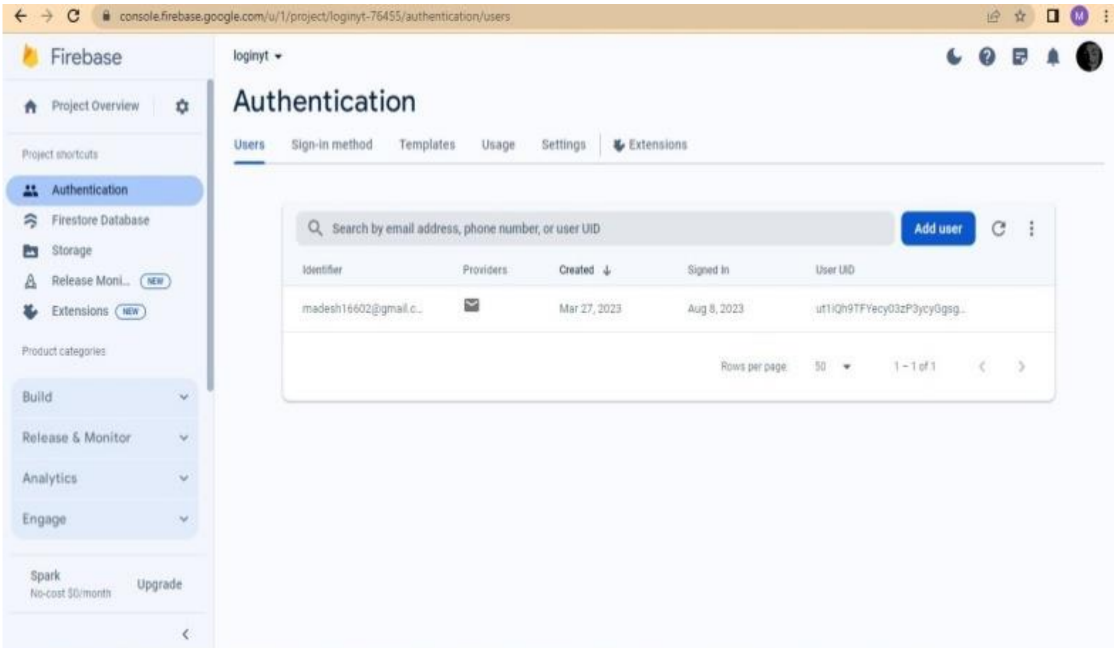

Fig 4.1.5 Firebase

5. RESULT AND DISCUSSION

The system successfully identifies threat zones by analyzing real-time data from deployed sensors. Through advanced algorithms, areas with elevated risks of explosion, such as high gas concentrations or abnormal temperatures, are accurately pinpointed.

Upon detection of potential threats, the system promptly issues early warnings to nearby workers. Alerts are disseminated through sirens, alarms, and mobile notifications, ensuring that workers are promptly informed and can take necessary precautions.

The system demonstrates high accuracy in threat detection, minimizing false alarms and ensuring reliability. Continuous monitoring and fine-tuning of algorithms contribute to maintaining system performance and adaptability to changing conditions.

The user-friendly interface facilitates easy monitoring and control of the system by workers. Intuitive design elements enhance usability and ensure that workers can quickly understand and respond to warnings.

The system's implementation in real-world oil and gas facilities has proven successful, contributing to enhanced safety protocols. Case studies demonstrate the system's effectiveness in mitigating potential risks and minimizing the impact of incidents on workers and infrastructure.

Despite the system's overall success, challenges such as sensor calibration, environmental variability, and system maintenance require ongoing attention. Future improvements may include the integration of additional sensor technologies, optimization of algorithms, and enhancement of communication networks.

6. CONCLUSION

In conclusion, our developed explosion risk detection system has shown promising results in identifying threat zones and issuing early warnings to nearby workers in the oil and gas industries. By addressing challenges and leveraging advancements in technology, we continue to strive for further improvements to ensure the safety and well-being of workers in hazardous environments.

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