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Enhanced Factory Safety System using IoT

Mr. Charan. K. A[1], Dr. Annusharma[2], Mr. Deeraj. C[3]
Department of Master of Computer Applications[1,2,3]
Raja Rajeswari College of Engineering, Bengaluru, Karnataka, India
charanjaala@gmil.com and annumca01@gmail.com and deerajsimha@gmail.com

Abstract: *This project showcases the design and development of a comprehensive factory safety system utilizing gas, fire, and water sensors incorporated into ESP32 boards. It uses IoT technology to improve workplace safety in industrial settings by offering real-time monitoring and early identification of potential threats. Quick response and mitigation of emergency scenarios are made possible by the ESP32 board's connectivity and data processing capabilities, which provide seamless communication between sensors and central control systems. Scalability, adaptability, and interoperability with existing industrial automation systems enable the system to be easily extended and integrated. The system's ability to identify and respond to hazards is enhanced by sensor fusion techniques, machine learning algorithms, and advanced analytics. Furthermore, augmented reality interfaces. In conclusion, a safer workplace, regulatory compliance, operational effectiveness, and continuous advancements in industrial safety standards are all supported by the proactive approach known as the Factory Safety System*

Keywords: Factory Safety System

I. INTRODUCTION

One significant advancement in ensuring worker welfare and protecting industrial assets is the integration of Internet of Things (IoT) technology into FACTORY SAFETY SYSTEMS. The goal of this project is to put in place a comprehensive safety monitoring system that swiftly and accurately detects possible hazards by using a range of sensors, including gas, water level, and fire sensors. Industrial operators and safety officials can make quick and informed decisions because to these sensors' ability to communicate real-time data over the Internet of Things to a Centralized control system. Proactive measures to lessen risks before they escalate can be taken thanks to the system's proactive monitoring functions, which also speed up emergency response times. In this instance, the fire and gas sensors are the main devices that detect dangers early on. In addition to the sensor, a buzzer alarm is installed to sound an alert whenever a hazard is detected. All industry personnel receive an alert messagevia wifi technology. By doing this, the system helps to prevent significant events that mightcause serious errors.

II. LITERATURE REVIEW

Mohammed M. Mabkhot, Abdulrahman M. Al-Ahmari ,Bashir Salah and Hisham Alkhalefah. The paper Describes a survey and perspective on the requirements of the smart factory system. What is required of a flexible manufacturing system and what makes a smartindustrial system are both covered in this paper.[1]

N.Savitha and Dr.S.Malathi. This article describes the fire safety measures that companiesneed to implement in order to leverage IOT technology to prevent fire incidents. [2]

Dr. Savita Sonoli, Akash H, Bhargavi Y, Gudiputi Dharani, Avinashgouda A Hiregoudar. This paper describes IOT technologies for detecting and monitoring hazardous gas emissions from the surrounding environment.[3]

Pal-Stefan Murvay, Ioan Silea. The document explains where the gas leaks most frequently,how to find them, and how to pinpoint the location.[4]

Sudip Misra,Chandana Roy ,Thilo Sauter, Anandarup Mukherjee,Jhareswar Maiti.This surveydescribes that how the IIOT is helpful in creating the safety management systems for providing the enhanced safety measures.[5]

Ibtehal Mahfoodh Muhammad Al Hasani, Syed Imran Ali Kazmi, Reehan Ali Shah, Raza Hasan a Saqib Hussain. The study paper proposes to develop a "IOT based Fire Alerting Smart System" for smart buildings by combining IOT devices, including sensors, other auxiliary equipment, and fire alarm systems (smoke burn with high-temperature sensors). Themessage includes the fire's location and time. [6]

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Hariveena. Ch , K. Anitha, Potharaju Ramesh. This research study outlines a model for employing IoT devices to identify fires and prevent them at the outset.[7]

Gazi Zahirul Islam, Md. Mobarak Hossain, Md. Faruk, Fernaz Narin Nur, Nayeem Hasan, Khalid Mahbub Khan, Zerin Nasrin Tumpa. The project's objective is to create an intelligent Internet of things system with fire and gas leak detection capabilities. It explains how to link a number of parts, including solenoid valves, gas sensors, flame sensors, and GSM modules, to reduce the impacts of gas leaks by turning on exhaust fans, cutting gas lines, releasing fire extinguisher balls, and warning users.[8]

Bader Farhan Alshammari, Muhammad Tajammal Chughtai. This research offers an Internet of Things (IoT)-based industrial monitoring system design. A data cloud houses the information that the gas sensor (MQ-5) collected. Gas leaks can be detected by the sensor in the majority of atmospheric circumstances. [9]

Piyush Mahale, Sarang Panse, Pratiksha Rajule. The article highlights the benefits of Internet of Things (IoT)-based gadgets for measuring water levels over manual methods, with particular attention to the former's reduced environmental impact and improved energy efficiency. It compares manual and IoT-based methods for a full analysis of various monitoring systems and equipment, and it proposes a new IoT-based gadgets for measuring water levels that employs machine-to-machine connection for intelligent data processing.Reference .[10]

III. EXISTING SYSTEM

Based largely on human inspections and sensor-triggered alerts, the current Factory Safety System follows conventional safety protocols. While there is some security offered by these technologies, they lack real-time monitoring capabilities and are not coordinated across several threat kinds. In response to new threats, autonomous functioning of gas, fire, and water sensors may cause isolated reactions and potential delays. Additionally, it is typically difficult to collect and analyze data, which hinders the system's ability to provide insightful recommendations for proactive safety management. After all is said and done, the current system is neither sophisticated or integrated enough to completely ensure worker safety in industrial environments and successfully remove hazards.

IV. PROPOSED SYSTEM

The proposed approach is significantly outperformed existing by the Factory Safety System, which transforms worker safety in industrial settings using state-of-the-art IoT technology. Real-time monitoring and early threat identification are made feasible by the ESP32 chip in conjunction with gas, fire, and water sensors. By facilitating prompt, coordinated responses to new threats, this seamless integration lowers the likelihood of accidents and disruptions to operations. The system's ability to recognize dangers and take preemptive action is enhanced by sensor fusion techniques, machine learning algorithms, and advanced analytics. Strong cybersecurity procedures, cloud integration, and augmented reality interfaces further ensure improved situational awareness, data management, and protection. By leveraging data-driven insights and connectivity to support operational efficiency, regulatory compliance, and continuous improvement of industrial safety procedures, the proposed system seeks to elevate workplace safety standards.

V. IMPLEMENTATION

To establish a full FACTORY SAFETY SYSTEM, gas, fire, and water level sensors must be coupled with a Telegram bot for alerting. Select the appropriate sensors first. For example, water level can be monitored using ultrasonic sensors, fire may be detected using flame sensors, and gas can be detected using gas sensors from the MQ series. These sensors will be connected to an Arduino Uno or ESP32 microcontroller board, which will also be in charge of a warning buzzer. In addition, create a Telegram bot with the Telegram BotFather and obtain its token to allow message transmission. The microcontroller and sensors should then be linked in line with the datasheets for each sensor, and threshold levels should be set to sound alarms. Write code that will monitor sensor data periodically and alert users when thresholds are exceeded. Implementing debouncing methods can help prevent false alarms.

Integrate the microcontroller code with the Telegram Bot API so that alerts may be sent to the bot on Telegram. This means drafting relevant alerts with the incident's kind and location included.

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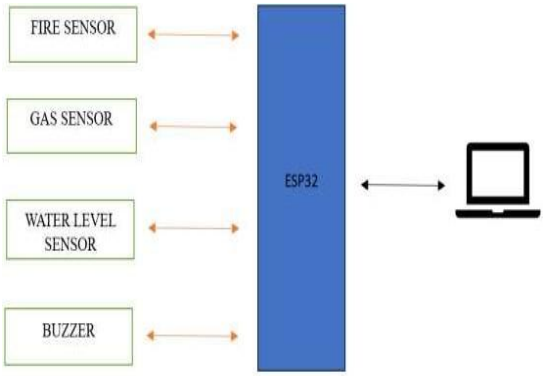
Consider including command handling in the Telegram bot to allow for distant involvement. This would allow users to react to notifications or check the status of sensors. After thorough testing, install the system in the factory to ensure proper operation. With routine testing and upkeep, the system stays dependable and effective. By integrating Telegram bots with sensor. data collection to provide real-time notifications to authorized workers, the safety system makes sure that the workplace is safer. This enables quick reactions to potential dangers.



VI. RESULTS

We conducted a few trials to confirm the system's operation and evaluate its effectiveness. Arange of pilot experiments are conducted to comprehend the outcomes of the developed system.

Fig 2.1

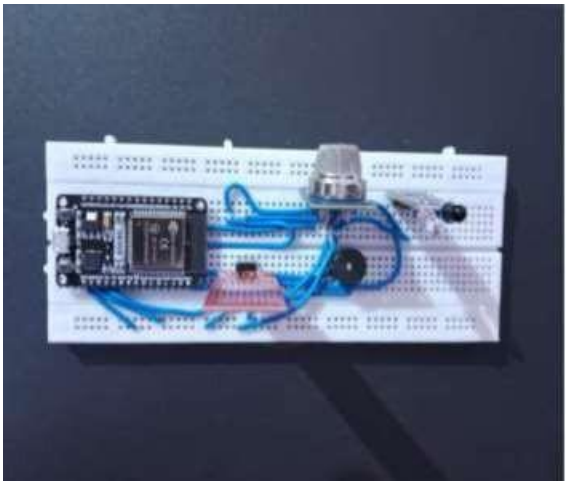


Fig 2.2

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VII. CONCLUSION

In conclusion, an all-encompassing method for ensuring workplace safety in industrial settings is offered by the Factory Safety System, which combines gas, fire, and water sensors with the ESP32 board. By providing real-time monitoring and early detection of potential threats including gas leaks, fires, and water leaksThis solution increases overall operating efficiency and reduces accident risk by utilizing IoT technologies. The ESP32 board's connectivity and data processing powers facilitate seamless communication between sensors and central control systems, accelerating response times and facilitating emergency mitigation measures. Through data analysis, remote accessibility, and continuous monitoring, this technology helps plant management to proactively manage safety standards, eliminate hazards, and prioritize the well-being of employees. In summary, implementing an IoT-based Factory Safety System provides an effective, scalable, and cost-effective means of ensuring a safer working environment in industrial facilities.

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