Industrial Internet of Things (IoT)-Based Automatic Fire Detection, Monitoring, and Control

Kiran P V , H M Shamitha , Venumadhava M

Asst. Professor, Assoc. Prof, Asst. Professor

pv.kiran1977@gmail.com , shamitha.hm@gmail.com , venudsp@gmail.com

Department of ECE, Proudhadevaraya Institute of Technology, Abheraj Baldota Rd, Indiranagar, Hosapete, Karnataka-583225

ABSTRACT

Because of the high risk of catastrophic incidents and the complexity of industrial activities, guaranteeing fire safety is an ongoing problem. The inadequacy of real-time knowledge and preemptive steps to adequately minimise hazards is a common problem with traditional fire detection and monitoring systems. Internet of Things (IoT) integration, on the other hand, has changed the game by providing hitherto unseen possibilities for automated industrial fire monitoring, control, and detection. Every user may utilise this wireless industrial safety security system with fire sensors because of the way the project is designed. The system is entirely managed by the Node MCU Single Board Computer based on Arduino. The node microcontroller unit (MCU) will keep a constant eye on all the sensors, and if it detects fire, it will notify the internet of things (IoT) web server using its built-in wifi module. In response, the DC water pump will turn on to sprinkle water, and an alarm bell will sound to notify the staff.

INTRODUCTION

Nowadays, fire incidents have become a critical issue, which must be dealt with on time without any unnecessary delay to avoid the loss in lives and belongings. It is considered a fire situation when the monitored temperature exceeds 50 Degree C. In critical places such as hospitals, schools, and banks, personnel's arrival time to come for help in fire hazards is around 15 minutes. The statistics show that there are 475,500 structural fires annually in the United States, causing 2,950 civilian deaths, 12,775 civilian injuries, and $7.9billion in property

damage. According to the National Fire Protection Association (NFPA), two-third of U.S. household fires occur in premises with no working smoke alarms, alarms with no proper maintenance, or misplaced alarms. The appropriate allocation of fire alarms with a proactive warning could save lives and reduce property losses. Particularly, there are many types of fire alarms as heat detectors and smoke detectors. studying these types helps to decide which type is more suitable for home or store. For instance, heat detectors are classic options. when the temperature reaches a certain level. Thus, it is more suitable for applications that rapid response is not required or in an environment where smoke detectors cannot be placed like frozen areas. Heat detectors have a lower false alarm rate but still slower in response because the temperature rises slowly. With all these lacks, smoke detectors remain better than heat detectors.

LITERATURE SURVEY

1.Automatic fire detection, monitoring and controlling in industry using iot

This paper provides an overview of the state-of-the-art IoT-based fire safety systems in industrial environments. It discusses the key components, such as sensors, actuators, and communication networks, and reviews various approaches to automatic fire detection, monitoring, and control using IoT technology.

2. Advances in Sensor Technologies for Fire Detection

This review focuses on the advancements in sensor technologies for fire detection in industrial settings. It explores the characteristics and capabilities of different types of sensors, including temperature, smoke, gas, and flame detectors, and discusses their applications in IoT-enabled fire safety systems.

3. Remote Monitoring and Control Systems for Industrial Fire Safety

This paper explores the design and implementation of remote monitoring and control systems for industrial fire safety using IoT technology. It reviews existing solutions and methodologies for remote data acquisition, visualization, and decision support, highlighting their benefits and limitations.

3. Cybersecurity Challenges in IoT-Based Fire Safety Systems

This literature survey investigates the cybersecurity challenges associated with IoT-based fire safety systems in industrial environments. It discusses potential threats, vulnerabilities, and

attack vectors, and reviews existing countermeasures and best practices for securing IoT devices and networks against cyber threats.

4. Integration of IoT and Building Automation Systems for Fire Safety

This review examines the integration of IoT technology with building automation systems (BAS) for comprehensive fire safety management in industrial facilities. It discusses the synergies between IoT-enabled fire detection, monitoring, and control systems and BAS, and evaluates their impact on overall system performance and efficiency.

PROPOSED SYSTEM

The proposed methodology involves utilizing IoT (Internet of Things) technology along with the Blynk app, NodeMCU (a microcontroller), and a DC pump. This setup can be used for more proactive fire detection, monitoring, and controlling.

This project aims to leverage IoT devices, such as sensors, actuators, and communication networks, to create a comprehensive system for fire detection, monitoring, and control in industrial environments. The system will be designed to detect potential fire hazards in real-time, monitor environmental conditions conducive to fire outbreaks, and automatically initiate appropriate responses to mitigate the risk of fire.
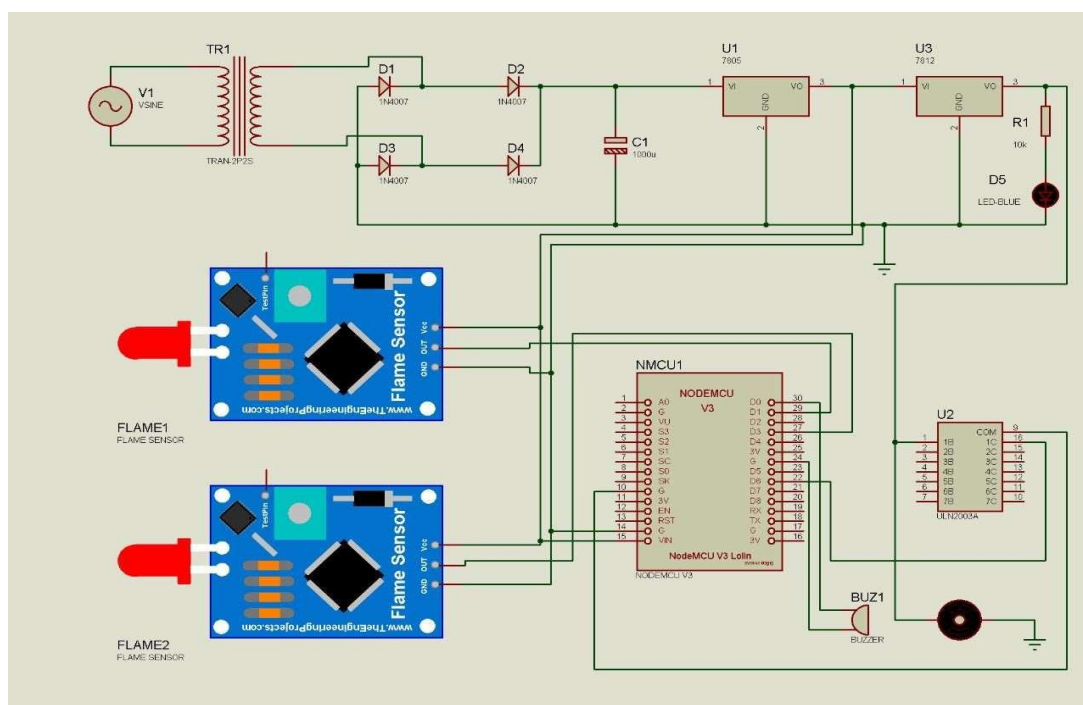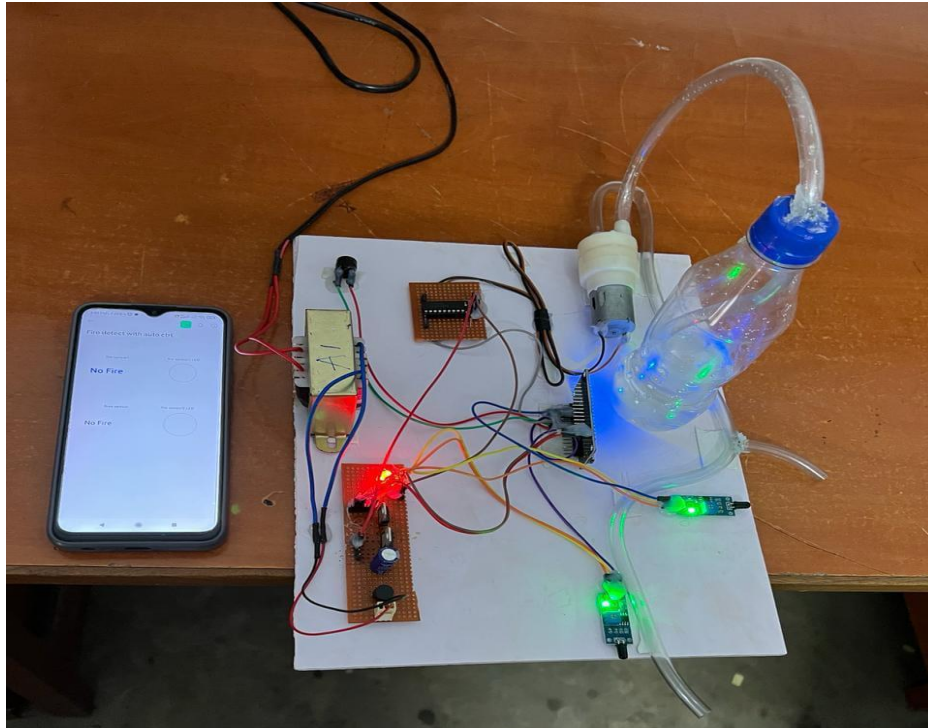
Figure.2 Schematic Diagram

RESULTS

Figure.3   Photocopy of Project

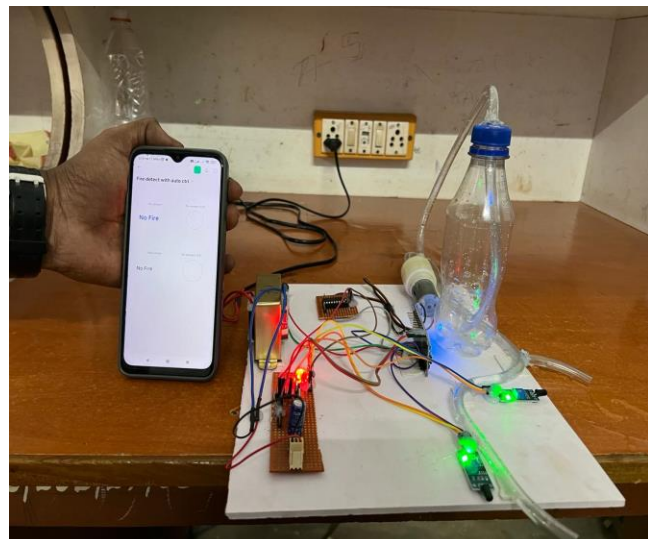Figure.4 Photocopy of Blynk App

Figure.5 Photocopy of No fire at initial stage
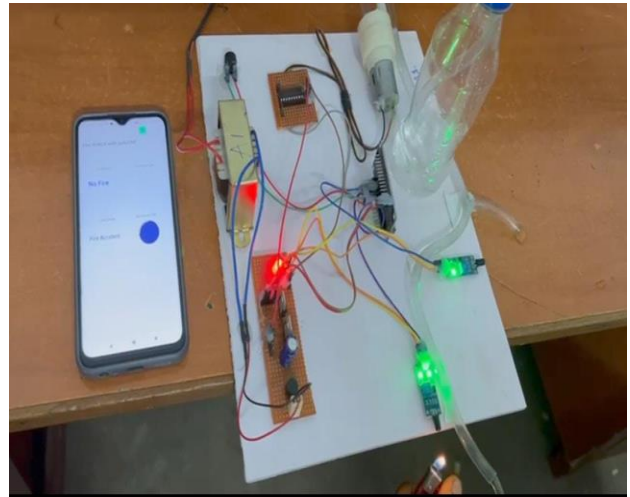
Figure.6 Fire at IR1

Figure.7 Fire at IR2

CONCLUSION

The adoption of IoT technology in industrial fire safety systems marks a significant advancement, offering a comprehensive approach to fire detection, monitoring, and controlling. By leveraging interconnected devices and data-driven insights, industries can enhance their ability to prevent, detect, and respond to fire incidents effectively. The integration of IoT brings about several key benefits . IoT-enabled sensors provide continuous monitoring of environmental conditions, allowing for early detection of fire hazards. This real-time monitoring capability ensures prompt response to potential threats, minimizing the risk of fire-related damages and injuries.

FUTURE SCOPE

Advanced Sensor Technologies: Continued advancements in sensor technologies will lead to the development of more sophisticated and reliable fire detection sensors. Sensors capable of detecting various fire-related parameters, such as temperature, smoke density, and gas emissions, with higher accuracy and sensitivity will further enhance early warning capabilities.

Artificial Intelligence and Machine Learning: Integration of artificial intelligence (AI) and machine learning (ML) algorithms with IoT systems will enable predictive analytics and proactive risk management. AI-driven algorithms can analyze historical data, identify emerging fire patterns, and predict potential fire incidents, allowing for preemptive measures to be taken to mitigate risks.

Edge Computing and Fog Computing: The adoption of edge computing and fog computing technologies will enable data processing and analysis to be performed closer to the source of data generation. This decentralized approach reduces latency, improves response times, and enhances the scalability of IoT fire safety systems, particularly in environments with limited network bandwidth or connectivity.

Smart Building Integration: Integration of IoT fire safety systems with smart building technologies will enable more holistic and coordinated fire safety management. By leveraging interconnected building systems, such as lighting, ventilation, and access control, industries can optimize emergency response strategies and minimize the impact of fire incidents on occupants and assets.

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