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ijircce@gmail.com



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## International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

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# Workplace Fire and Safety Gear Monitoring System

**Mrs. Surekha Pinnapati M.Tech, Vaishnavi R S, Renuka Manjunath Mane**

Assistant Professor, Department of CSE, Sri Taralabalu Jagadguru Institute of Technology, Ranebennur,  
Karnataka, India

UG Students [VLSI], Department of CSE, Sri Taralabalu Jagadguru Institute of Technology, Ranebennur,  
Karnataka, India

**ABSTRACT:** This project integrates real-time fire detection and personal protective equipment (PPE) monitoring to enhance workplace safety. The system uses computer vision techniques to identify fire hazards and monitor compliance with safety gear requirements. The fire detection component utilizes a Haar Cascade classifier trained on fire detection data to identify flames in real-time through a live video feed. Upon detecting fire, an alarm sound is triggered to alert safety personnel. Simultaneously, the PPE monitoring system uses a YOLO-based object detection model to identify various safety equipment, such as hardhats, masks, and safety vests, within a video. It categorizes the detected objects as compliant or non-compliant based on their presence and displays relevant bounding boxes with color-coded indicators (green for compliance, red for non-compliance). The system processes each video frame, extracting object details and confidence levels, and provides continuous monitoring with real-time feedback on PPE adherence. By combining fire detection with PPE monitoring, this project creates a comprehensive safety system for workplaces, reducing risks, ensuring regulatory compliance, and fostering a safer environment for employees.

**KEYWORDS:** Workplace Safety, Fire Detection, Safety Gear Monitoring, Real-Time Monitoring, etc.

## I.INTRODUCTION

Ensuring workplace safety is paramount in any industrial or commercial environment, and the development of a software-based Workplace Fire and Safety Gear Monitoring System addresses this critical need. This system is designed to monitor and ensure the proper use of safety gear and detect fire hazards in real-time, leveraging modern software technologies for robust and accurate monitoring. Utilizing advanced sensors and data analytics, the system can provide timely alerts and comprehensive reports, enhancing overall safety compliance. Developed with a focus on user-friendliness and accessibility, the system is tailored to function seamlessly on various devices, including desktops, tablets, and mobile phones. This ensures that safety managers and personnel can monitor and respond to safety incidents from anywhere, at any time. In today's fast-paced and ever-evolving work environments, traditional safety monitoring methods are becoming insufficient. A software-based monitoring system offers immediate advantages by providing real-time updates and engaging features that facilitate quick responses and continuous improvement in safety standards. By breaking free from geographical and temporal constraints, this system aims to create a safer workplace, ensuring that employees are always protected and that safety regulations are consistently met.

## II.SYSTEM MODEL AND ASSUMPTIONS

The system model integrates video capture, fire detection, PPE monitoring, and alert mechanisms into a real-time monitoring solution. The system processes video frames to identify hazards (fire) and safety compliance (PPE) while providing immediate visual, auditory, and textual outputs. The fire detection component uses the Haar Cascade model to accurately identify fire regions, while the YOLO model detects and classifies PPE items, ensuring workers are compliant with safety regulations. The system then annotates the video feed with bounding boxes, labels, and confidence scores, offering real-time feedback to users. If a fire is detected, an alarm sound is triggered, and the event is logged, ensuring immediate attention. The assumptions ensure that the hardware, models, and environmental conditions are optimal for the system to function accurately and effectively, ensuring reliable operation under real-world conditions. This design aims to enhance workplace safety by providing automated alerts, enabling swift action to prevent hazards and ensure compliance with safety protocols.





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### III.EFFICIENT COMMUNICATION

In an efficient workplace fire and safety gear monitoring system, the integration of fire detection and personal protective equipment (PPE) monitoring enhances overall safety. The system combines two core components: fire detection using a cascade classifier for real-time flame recognition, and PPE compliance monitoring using a YOLO-based object detection model for identifying workers' safety gear. When a fire is detected, an immediate alarm triggers, alerting personnel to evacuate, while real-time object detection ensures that workers are wearing the required safety equipment, such as hardhats, masks, and safety vests. This synergy allows for prompt responses to emergencies, ensuring that workers are not only aware of the fire but are also properly equipped for their safety. The fire alarm system uses sound alerts to notify people, while the PPE detection system visually marks non-compliance, displaying it on the screen in real-time with color-coded indicators (red for non-compliance and green for compliance). This seamless communication between fire detection and PPE monitoring is vital for ensuring both immediate safety during fires and long-term safety adherence in the workplace.

### IV.SECURITY

The system provides real-time monitoring, enabling swift detection and response to both fire incidents and safety violations, ensuring a high level of workplace security. Video frames are processed locally, which safeguards data integrity and reliability by eliminating the need for external transmission and reducing the risk of potential data breaches. The system generates alerts for fire detection or non-compliance with safety gear requirements, which can be logged and shared with authorized personnel for documentation and appropriate action. By combining fire detection and PPE compliance monitoring into a unified framework, the system adopts a proactive approach to workplace safety. This integration minimizes the likelihood of accidents, promotes adherence to safety protocols, and ensures a safer and more secure working environment for all employees.

### V. RESULT AND DISCUSSION

In the fig 1, it shows the Fire is Detected



Fig. 1 Fire Is Detected



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The fig 1, shows a sequence of four frames capturing the progression of a fire in a room over time. Each frame is marked with a timestamp and the confidence percentage of fire detection.

```
PS C:\Users\manem\OneDrive\Desktop\REAL-TIME-FIRE-DETECTION-main\REAL-TIME-FIRE-DETECTION-main> & 'c:\Users\manem\AppData\Local\Programs\Python\Python312\python.exe' 'c:\Users\manem\.vscode\extensions\ms-python.debugpy-2024.14.0-win32-x64\bundled\libs\debugpy\adapter\..\debugpy\launcher' '54822' '--' 'c:\Users\manem\OneDrive\Desktop\REAL-TIME-FIRE-DETECTION-main\REAL-TIME-FIRE-DETECTION-main\fire_safety.py'  
pygame 2.6.1 (SDL 2.28.4, Python 3.12.4)  
Hello from the pygame community. https://www.pygame.org/contribute.html  
Fire alarm initiated
```

Fig. 2 fire alarm initiated

In the fig 2, shows a command line interface where a Python script named "fire\_safety.py" is running. The output indicates that the pygame library has been initialized and a fire alarm has been triggered.

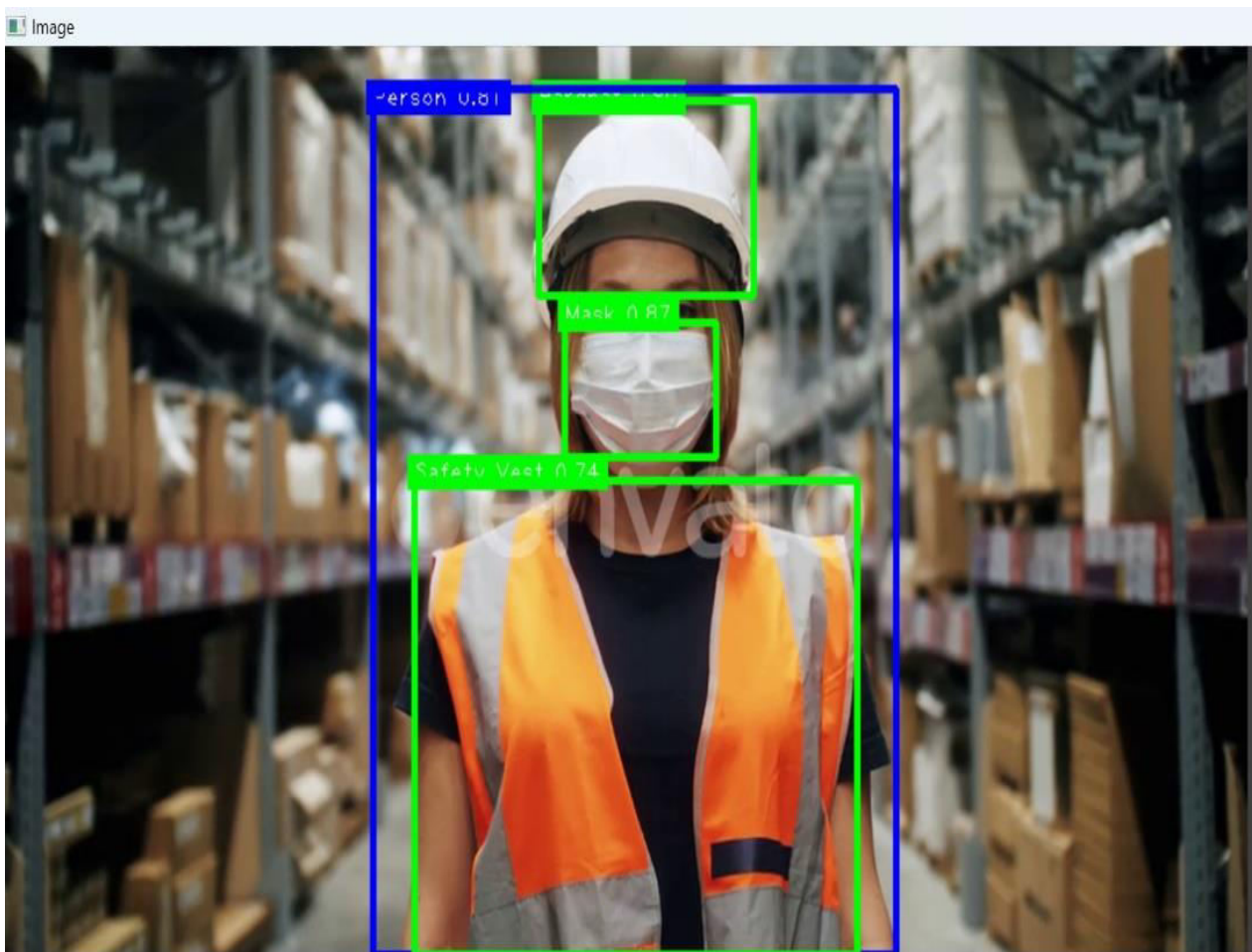


Fig .3 PPE Compliance Detection in Warehouse



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In Fig 3 shows a person in a warehouse wearing a hardhat and a safety vest. The image is annotated with bounding boxes and labels indicating the detected objects, specifically highlighting the hardhat and safety vest, demonstrating the system's ability to ensure PPE compliance.

### VI.CONCLUSION

The Workplace Fire and Safety Gear Monitoring System is an advanced, multi-faceted approach to improving safety in high-risk environments. By combining fire detection with PPE monitoring, the system ensures that both immediate hazards (like fires) and potential safety violations (such as missing hard hats or safety vests) are addressed in real time. This integrated system increases worker safety, enhances emergency response times, and helps organizations comply with safety regulations more effectively. Furthermore, the real-time detection of fire and safety gear compliance can significantly reduce the likelihood of workplace accidents and injuries, ultimately fostering a safer work environment. With potential for integration with other safety technologies (such as fire suppression systems or automated emergency response mechanisms), this system can evolve to provide even more comprehensive safety management, ensuring the well-being of workers in the most hazardous work environments. In summary, this system provides a proactive safety solution by monitoring both the environmental and personal safety aspects of a workplace, delivering real-time alerts and interventions that significantly reduce risks and enhance overall safety.

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