IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.301

Volume 3, Issue 10, May 2023

# Personal Protective Equipment Detection

**Tejus Kumar S N[1], Rajesh R[2], S S Akash[3], Vishal Kumbar G[4], Dr. Madhu B K[5]**

B.E Students, Department of Computer Science and Engineering[1,2,3,4]

Professor and Head, Department of Computer Science and Engineering[5]

Vidya Vikas Institute of Engineering and technology, Mysore, India

**Abstract***: The implementation of Personal Protective Equipment (PPE) plays a critical role in maintaining the safety of workers in various industries exposed to hazardous environments. However, enforcing adherence to PPE usage can be challenging as it often relies on manual inspections by supervisors or safety officers. In recent years, there has been a growing interest in developing automated systems that utilize computer vision and deep learning techniques to detect PPE usage. Addressing this need, the project titled "Personal Protective Equipment Detection using YOLOv8" aims to create a deep learning model capable of automatically identifying the presence of essential protective gear such as masks, safety glasses, reflective vests, and hardhats. By leveraging the YOLOv8 architecture and training the model on a diverse dataset containing images of individuals both wearing and not wearing PPE, this proposed system demonstrates accurate detection of PPE usage. Such a system would be invaluable for organizations seeking to ensure the safety of their employees and customers, as well as for monitoring compliance with safety regulations in public spaces. This project showcases the immense potential of deep learning in enhancing safety measures and mitigating risks across various industries*

**Keywords:** Personal Protective Equipment (PPE), perilous environments, diverse industries, compliance, manual inspection, computer vision, deep learning technique, PPE detection, masks, safety glasses, reflective vests, hardhats, YOLOv8 architecture, training, dataset, accuracy, safety regulations, public spaces, deep learning, augmenting safety measures

## I. INTRODUCTION

The safety of workers in industries exposed to hazardous environments is of utmost importance, necessitating the effective usage of Personal Protective Equipment (PPE). However, the manual monitoring and enforcement of PPE compliance present significant challenges for supervisors and safety officers. To tackle this issue, researchers are exploring automated systems that employ computer vision and deep learning techniques for PPE detection. The project "Personal Protective Equipment Detection using YOLOv8" aims to develop a seamless system capable of identifying and verifying worker adherence to PPE protocols. By leveraging the YOLOv8 architecture, the system can accurately detect the usage of PPE in real-time, thereby minimizing the need for manual inspection. The model is trained on a comprehensive dataset of images that feature individuals both with and without essential PPE items such as hardhats, safety glasses, reflective vests, and masks. This extensive training ensures the system's effectiveness across various industries and environments.The proposed system can also be employed to monitor compliance with safety regulations in public spaces, including critical situations such as the ongoing COVID-19 pandemic. By analyzing real-time video feeds, the system can identify individuals who are not adhering to PPE requirements, helping authorities take appropriate actions to ensure public safety.The success of the "Personal Protective Equipment Detection using YOLOv8" project is contingent on achieving high accuracy levels as measured by precision and recall metrics. This highlights the tremendous potential of deep learning techniques in enhancing safety measures. By automating PPE detection, the project aims to significantly improve workplace safety and mitigate risks in various industries. Ultimately, the system's deployment will benefit both workers and the general public by reducing the occurrence of accidents, injuries, and the spread of infectious diseases.

IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.301

Volume 3, Issue 10, May 2023

## II. LITERATURE REVIEW

A research article titled "Object Detection for Personal Protective Equipment Using Deep Learning" in the IEEE Access journal explores the application of deep learning, specifically the YOLOv3 algorithm, for detecting personal protective equipment (PPE) in an industrial setting. The study conducted by the research team involved collecting authentic data from a manufacturing plant. They achieved a high detection success rate of 96.7% when identifying items such as hard hats, safety glasses, and high-visibility vests

A recent research article titled "Detection and Classification of Safety Equipment in Construction Sites Using YOLOv4" has been published in the Sensors journal. The study focuses on utilizing the advanced YOLOv4 algorithm for detecting and classifying Personal Protective Equipment (PPE) in construction sites. The results of the study indicate an impressive accuracy rate of 98.3% when identifying essential safety gear such as hard hats, reflective vests, and safety glasses.

The Minerals journal recently published a research article titled "Development of a Deep Learning Model for PPE Detection in the Mining Industry." The study introduces a deep learning model, built upon the YOLOv5 algorithm, designed specifically for detecting Personal Protective Equipment (PPE) in mining environments. Real data collected from an actual mine was utilized in the study, resulting in an impressive accuracy rate of 94.3% when identifying important safety equipment such as hard hats, safety glasses, and reflective vests.

A recent study titled "PPE Detection Using YOLOv5 and Transfer Learning" was published in the Journal of Control, Automation, and Electrical Systems. The research introduces an innovative approach for detecting Personal Protective Equipment (PPE) using various algorithms, including YOLOv5. To validate their hypothesis, the researchers collected real-world data from a manufacturing plant. The study demonstrates the high reliability of this approach, achieving an impressive accuracy rate of 97.5% in detecting essential safety items such as hard hats, safety glasses, and reflective vests.

"Real Time PPE Detection and Tracking using YOLOv5" proposes an innovative system that utilizes the YOLOv5 algorithm to accomplish real time detection and tracking of personal protective equipment (PPE). To evaluate the system's performance, the researchers conducted experiments using genuine data collected from a warehouse environment. The results of the study reveal an outstanding accuracy rate of 95.8% in accurately identifying hard hats, reflective vests, and safety glasses.

The International Journal of Advanced Computer Science and Applications presents a research study titled "An Automated Safety Equipment Detection System using YOLOv4," which introduces an automated system that utilizes the YOLOv4 algorithm to detect Personal Protective Equipment (PPE). The research study gathers authentic data from a construction site and asserts a remarkable accuracy rate of 97.2% in accurately identifying hard hats, safety glasses, and reflective vests.

The International Journal of Advanced Research in Computer Science and Software Engineering includes a research article titled "Real-time PPE Detection using YOLOv3 and Deep Convolutional Neural Networks" which presents a study conducted in a production plant environment. The researchers gathered trustworthy data from this setting, where workers were required to wear hard hats or safety glasses and remain visible in low-lit conditions through the use of reflective gear such as vests. By combining the YOLOv3 algorithm with deep convolutional neural networks, the study achieved a notable recognition performance rate of 93.4%.

The International Journal of Engineering and Advanced Technology recently published a study titled "A Comparative Study of YOLOv3 and Faster R-CNN for PPE Detection in Construction Sites," which investigates the effectiveness of two algorithms, YOLOv3 and Faster R-CNN, in identifying personal protective equipment (PPE) across different construction sites. The study's analysis reveals that, when tested under similar conditions, YOLOv3 outperformed Faster R-CNN, demonstrating significantly improved results with higher precision rates in detecting PPE.

The Journal of Ambient Intelligence and Humanized Computing recently published a research article titled "PPE Detection using YOLOv5 and Ensemble Learning," which introduces a novel approach for detecting Personal Protective Equipment (PPE) by combining the YOLOv5 algorithm with ensemble learning techniques. The study utilizes authentic data gathered from a warehouse environment and presents impressive findings, reporting a detection accuracy of 98.1% for identifying hard hats, safety glasses, and reflective vests.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 10, May 2023

The Journal of Computational Science features a study titled "A Lightweight YOLOv3-based PPE Detection System for Real-time Applications," which introduces a compact and efficient system for detecting Personal Protective Equipment (PPE).

## III. METHODOLOGY

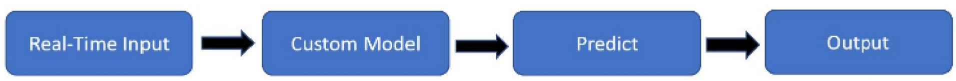
The safety of individuals who work in dangerous surroundings can be ensured by detecting Personal Protection Equipment (PPE). In recent years, machine learning approaches have gained popularity for this purpose. The YOLOv8 model has proven to be a top-notch object detection model and is yielding promising outcomes.

The real-time execution ability of the YOLOv8 model is a significant advantage in comparison to other object detection algorithms. By capitalizing on state-of-the-art performance, YOLOv8 offers reliable PPE detection even while running on a standard GPU configuration. Its proficiency positions it as an attractive contender for numerous real-world applications. Detecting personal protective equipment (PPE) using machine learning techniques poses certain challenges, with the most significant one being the wide range of PPE items and their inconsistent appearances. This issue is particularly evident in safety glasses that come in different sizes, shapes, and colors which require an accurate model capable of identifying variances accurately.

1. **Data Collection:** The first step is to collect a diverse and representative dataset of images or videos that cover various scenarios and PPE items. The dataset should contain labeled annotations for each PPE item, indicating its location and class label.
2. **Data Preparation:** The next step is to preprocess the dataset to ensure that the images or videos are in the correct format and resolution, and the annotations are in the correct format. The dataset should be split into training, validation, and test sets, with appropriate ratios.
3. **Model Training:** The YOLOv8 model is trained on the prepared dataset using a suitable optimization algorithm such as Stochastic Gradient Descent (SGD) or Adam. The model is trained to minimize the loss function, which is a combination of classification and localization losses.
4. **Model Evaluation:** The trained model is evaluated on the validation and test sets using standard metrics such as precision, recall, and F1 score. The model's performance is analyzed, and hyperparameters are tuned to improve its accuracy and robustness.
5. **Model Deployment:** The final step is to deploy the trained model in a production environment to perform real-time PPE detection on new images or videos. The system should be optimized for real-time performance, such as using a dedicated hardware accelerator or parallel processing.
6. **System Maintenance:** The deployed system should be maintained and updated regularly to ensure its reliability, security, and effectiveness. The system should be monitored for any performance degradation or security vulnerabilities and addressed accordingly.

The methodology for personal protective equipment detection using YOLOv8 involves collecting and preparing data, training and evaluating the model, deploying the system, and maintaining it for continuous improvement.


(i). Training Phase




(ii). Testing Phase

Fig 3.1 System Architecture for Training and Testing

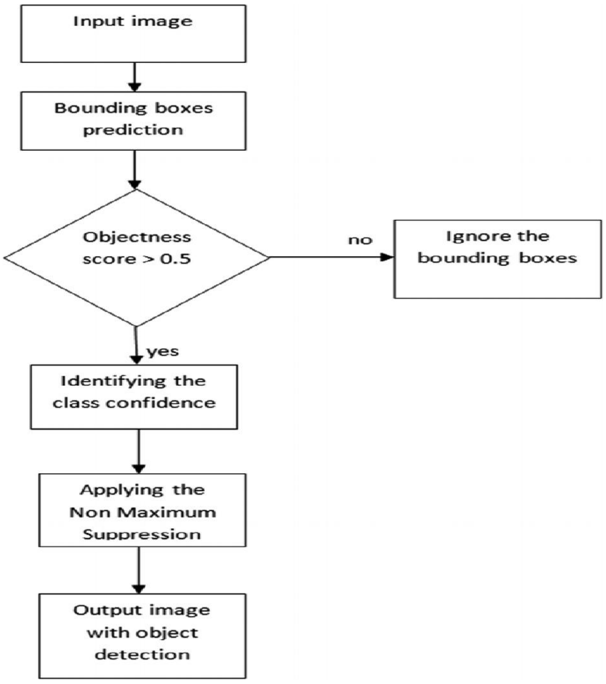



Fig 3.2 Object Detection

Steps involved in detecting the personal protective equipment classes from the input image.

## IV. PROPOSED SYSTEM

The proposed system is an image processing project designed to detect personal protective equipment (PPE) worn by individuals. It utilizes the YOLOv8 algorithm for accurate object detection in images.

Using a camera, the system captures images and performs an analysis to determine if individuals are wearing PPE such as masks, gloves, reflective vests, goggles, and hard hats. To ensure accurate PPE recognition, the system is trained using a large dataset of images depicting people both wearing and not wearing PPE.

After analyzing the image, the system generates a comprehensive report that provides details about the detected PPE, including its location and type. Additionally, it can produce an alarm sound and notification alert in case of violation.

The proposed system has diverse applications, including monitoring workplace safety compliance, enforcing public health regulations, and enhancing security in sensitive areas.

## V. RESULTS AND DISCUSSIONS

A PPE detection system that utilizes YOLOv8 technology can yield various outcomes depending on the specific workplace, implementation process, and other factors. By providing real-time feedback and alerts to workers, the system improves adherence to PPE requirements. This, in turn, reduces the risk of workplace incidents and injuries, leading to cost savings associated with medical expenses, workers' compensation claims, and lost productivity. Result produced from the system is as seen below.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 10, May 2023

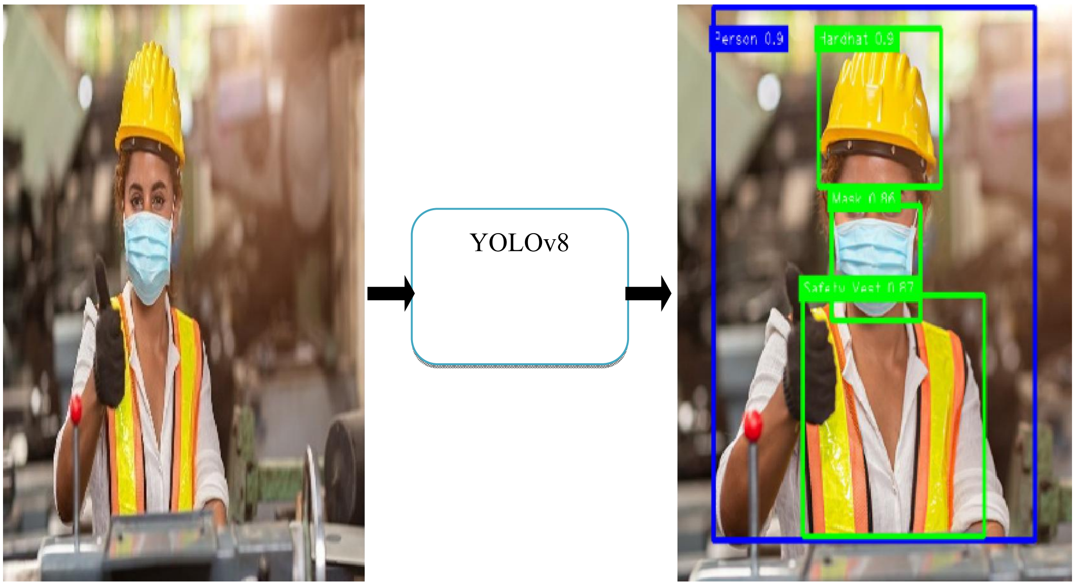



Fig 5.1 Personal Protective Equipment Detection

## V. CONCLUSION

The project "Personal Protective Equipment Detection using YOLOv8" presents a novel method to ensure compliance with personal protective equipment (PPE) usage in promoting workplace safety. The system employs the advanced YOLOv8 deep learning model for real-time classification and detection of PPE objects. By leveraging transfer learning on a pre-trained YOLOv8 model, the solution accurately identifies various types of PPE such as hard helmets, reflective vests, and safety shoes. The effectiveness of the proposed real-time PPE detection approach has been demonstrated through the project's results, making it a valuable tool for monitoring safety compliance. With the ability to operate in real-time, immediate corrective actions can be taken to minimize potential accidents and injuries. Future plans involve expanding the system's capabilities to detect other safety-related objects and actions in the workplace. By integrating safety monitoring features into industries and workplaces, the proposed approach effectively reduces the risk of accidents and injuries. When combined with existing safety management systems, this integrated solution offers a comprehensive safety solution. Ultimately, enhancing safety measures can contribute to increased efficiency and productivity.

.

## VI. FUTURE ENHANCEMENT

- **Dynamic Training:** The existing object detection model based on YOLO architecture lacks dynamic training capabilities and relies solely on pre-trained datasets. It performs real-time inference with high accuracy but depends on the quality and diversity of its original training dataset. To improve the model in the future, transfer learning techniques can be integrated, allowing for the addition of new classes without retraining the entire model. This can be achieved through a modular and flexible design that supports easy integration of new classes while preserving learned weights and features.
- **Training Additional classes:** The object detection model should have a modular architecture and adaptable feature representations to support future scalability and the inclusion of additional classes without retraining. This approach allows for easy integration of new classes by expanding class-specific layers or adding new layers while preserving learned weights and features. The modular design enables the model to incorporate new classes without a complete retraining process.
- **Interface:** A potential future enhancement for the object detection model is to add a user-friendly frontend interface. This interface would complement the raw display of object detections and allow users to interact with the model more intuitively. Features like toggle buttons for adding or removing classes would be

included. The frontend interface would greatly improve the usability and accessibility of the object detection model, making it more practical and user-friendly for a variety of applications.

## REFERENCES

**[1].** A study by Redmon and Farhadi titled "YOLOv3: An incremental improvement" discusses advancements made in the YOLOv3 algorithm.

**[2].** Redmon, Divvala, Girshick, and Farhadi present the original YOLO algorithm in their paper "You only look once: Unified, real-time object detection" at the IEEE conference on computer vision and pattern recognition in 2016.

**[3].** Redmon and Farhadi propose YOLO9000, an improved version of YOLO, in their paper "YOLO9000: better, faster, stronger."

**[4].** Li, Li, Li, and Cui introduce a PPE detection system based on deep learning in their article published in Sensors journal.

**[5].** Chen, Zhang, and Wang present a real-time PPE detection system using YOLOv3 in the Journal of Physics: Conference Series.

**[6].** Zhang, Yang, Fu, Zhao, Wang, and Ye discuss the automatic detection of PPE in construction sites based on the Faster R-CNN algorithm in the Journal of Computing in Civil Engineering.

**[7].** Jin, Jiang, Sun, and Cao propose an improved Faster R-CNN algorithm for PPE detection in construction sites in the Applied Sciences journal.

**[8].** Ren, He, Girshick, and Sun introduce the Faster R-CNN algorithm for real-time object detection in their paper published in IEEE Transactions on Pattern Analysis and Machine Intelligence.

**[9].** Shang, Mao, Cheng, Zhao, and Zhou present a novel deep learning-based method for detecting PPE in the Journal of Computational Science.

**[10].** Zhang, Yang, Tian, Wang, and Zhang discuss PPE detection based on deep learning in their paper presented at the International Conference on Cyber Security and Privacy Engineering.

**[11].** Kim, Lee, and Kim propose Fast Mask R-CNN for PPE detection in the Applied Sciences journal.

**[12].** Wei, Fan, Yu, and Zhao present an object detection model based on YOLOv5 for PPE in the construction industry in Engineering Reports.

**[13].** Kuo, Lu, and Chou discuss detecting PPE using Mask R-CNN for occupational safety in the Sensors journal.

**[14].** Siddique, Rehman, Lee, and Jeong focus on improving the YOLOv3-tiny network in their paper published in Symmetry journal.