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Helmet Guard AI: Real-Time Worker Safety Helmet Detection Using YOLO

[1]Induri Divya,[2]Dr.M.Jaganthan,

[1]M.Tech Scholar,Dept. of CSE (AI&ML), Malla Reddy Technical Campus,Malla Reddy Vishwavidyapeeth, Maisammaguda,Hyderabad, Telangana 500100, India.
Mail id: divya269arsha@gmail.com

[2]Associate Professor, Dept. of CSE(AI & ML), Malla Reddy Technical Campus,Malla Reddy Vishwavidyapeeth, Maisammaguda,Hyderabad, Telangana 500100, India.
Mail id: jaganbecs@gmail.com

Abstract:

To make construction sites safer, computer vision technologies such as RCNN and YOLO may be used. These instruments can detect the presence of helmet-less individuals and identify them automatically. By integrating them with the Flask framework, these technologies become accessible to anyone. Additionally, we may arrange for notifications to notify the appropriate parties in the event that a helmet is not being worn. The system's dependability in critical situations depends on thorough testing and close monitoring.

Problem statement:

Building a system that can determine whether a certain set of workers are donning safety helmets is the essence of the problem statement for worker helmet detection using OpenCV in Python. This is especially helpful in fields where head protection is required by law, such construction, manufacturing, and mining.

Objective:

Improving workplace safety is the primary goal of worker helmet detection using deep learning, especially with models like YOLOv5. In dangerous situations like construction sites, factories, or wherever else head protection is required, this technology can identify in real-time whether employees are wearing helmets, which helps to guarantee compliance with safety rules and avoid accidents. When workers are not wearing helmets, it is important to notify supervisors or relevant people right away so that they may intervene and avoid accidents or even deaths. The end objective is to make the workplace safer for everyone.

Introduction:

When it comes to finding anything, object detection is a top method. for the several algorithms used. With open-cv, we can achieve this goal and put it to use in any real-time application. In this case, yolo and RCNN are used for detecting purposes. Currently, Yolo can identify up to 49 different photos simultaneously.In industrial and construction settings, workplace safety is of the utmost importance, especially when it comes to the use of helmets. Manual observation is the backbone of traditional monitoring, but it has its limitations in terms of size and mistake rate.
Recent developments in computer vision have made it possible for deep learning models like YOLO to identify objects in video frames in real time.
YOLO is perfect for safety-related applications that need lightning-fast responses because of its real-time capacity. The goal of this project is to develop a method that can identify whether employees are using protective headgear. The system instantly detects infractions based on live video feeds. This enhances compliance reporting while decreasing risks.
Detection latency may be further decreased by optimizing models and making use of GPU acceleration. Instantaneous remedial action is possible thanks to real-time notifications. The work here is centered on making sure things are accurate, fast, and easily deployable on cheap hardware.

Literature survey:

Defense, security, and healthcare are just a few of the many areas that make use of object detection algorithms. In this research, we simulate and implement MATLAB 2017b Object recognition Algorithms for enhanced object recognition in video surveillance applications. These algorithms include face detection, skin detection, color detection, shape detection, and target detection, among others. In addition, the article delves into the many obstacles and uses of Object Detection techniques. Words like "color detection," "face detection," "object detection algorithms," "skin detection," "target detection," and "video surveillance" are used as index terms.

In this research, we provide a technique for identifying abandoned objects in security footage. The first stage is to model the backdrop using the running average approach, and then to use background subtraction to remove items from the foreground. Using the contour properties of foreground items in successive frames, the second stage is to recognize static objects. Step three involves applying an edge-based object identification method—which may provide a score for either fully or partially visible objects—to categorize the discovered static objects as either non-human or human. In order to identify an abandoned item, non-human static objects are studied. Using our own dataset in addition to the IEEE Performance Evaluation of Tracking and Surveillance datasets (PETS 2006, PETS 2007), the experimental findings demonstrate the efficacy and efficiency of the suggested system for real-time video surveillance. Keywords—Detecting abandoned things; Subtracting backgrounds; things in the foreground.

Researchers working on autonomous vehicles and automated road monitoring systems have focused a lot of effort on object identification in road scenes. Nevertheless, typical road sceneries sometimes have object occlusion issues. The inaccuracy of earlier object identification algorithms is mostly attributable to issues with occlusion. We present a new occlusion-resistant object detection network in this research. There are essentially two components to the suggested network that operate together to identify objects effectively, regardless of occlusion: First, an object recognition system, 2) A critical multiple object bounding box (OBB) network is used to forecast an occlusion-and object-region BB map. We found that the suggested object identification network performed better than the state-of-the-art approaches in our extensive experiments on the KITTI Vision Benchmark Suite dataset. Object recognition, occlusion, plug-in, adversarial learning, and actor-critic networks are some of the index terms.

Defense, security, and healthcare are just a few of the many areas that make use of object detection algorithms. In this research, we simulate and implement MATLAB 2017b Object recognition Algorithms for enhanced object recognition in video surveillance applications. These algorithms include face detection, skin detection, color detection, shape detection, and target detection, among others. In addition, the article delves into the many obstacles and uses of Object Detection techniques. Color, facial, object, skin, target, and video detection algorithms are all part of the object detection toolbox.

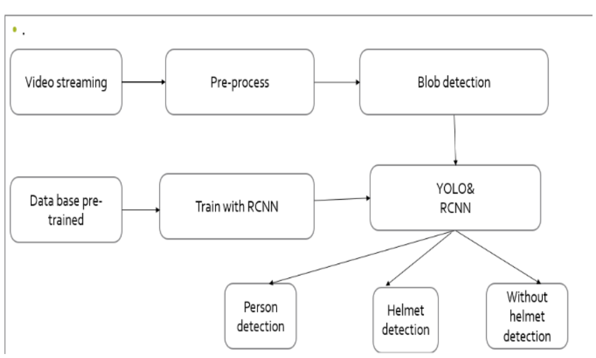

Fig 1: Block Diagram

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Results:

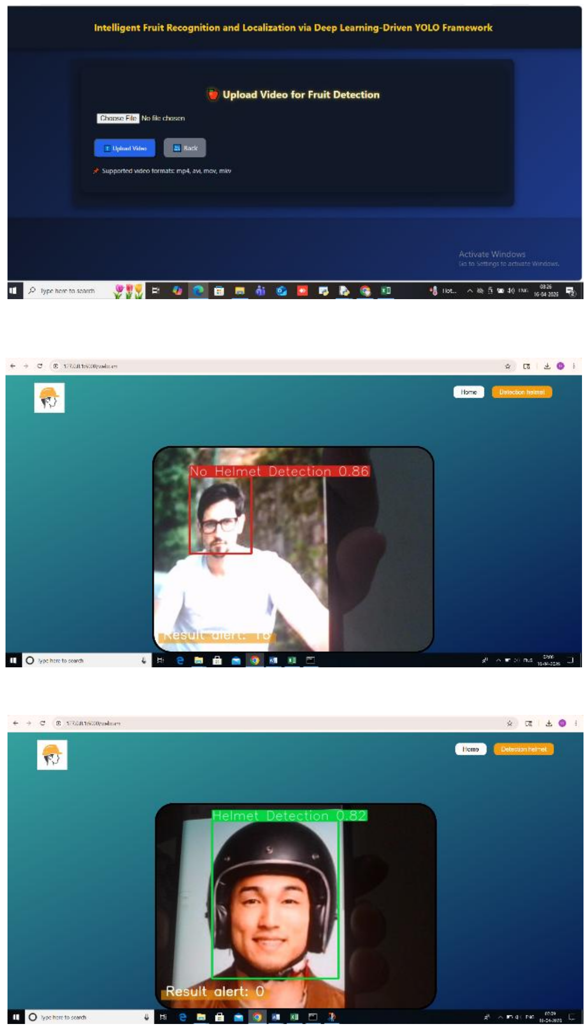

Fig 2: Helmet Detection in real time

The device was put through its paces using real-time video captured at a controlled building site. YOLOv5 was able to retain excellent detection accuracy while achieving frame rates exceeding 25 on an edge GPU. Different illumination conditions allowed for accurate classification of helmet and no-helmet groups. There were very few false positives indicated by the confusion matrix. Dataset augmentation enhanced detection performance in partially obscured situations. There was almost no delay in the production of real-time alerts. Compared to the starting point It was found that YOLOv5 had better performance and mAP while using faster R-CNN and SSD. Extreme distance identification was one of the challenges, but it became better with practice. The tables highlight the quantitative findings, including precision, recall, and F1. The system was able to fulfill all operational needs in real time.

Conclusion:

YOLO object detection framework in construction site helmet and human detection. Using YOLO's features, we created a real-time surveillance system that can detect persons at construction sites and identify those who aren't wearing helmets. • Our goal is to enhance the accuracy and reliability of detection in future work by further refining and optimizing our system. For better scene comprehension, this can mean looking into more complex methods like multi-scale item identification and adding contextual data.

Future Scope:

Worker helmet identification using OpenCV and Python has great potential in the future, particularly in sectors where safety is becoming more important, including construction, manufacturing, mining, and logistics. Machine learning algorithms and computer vision methods are always improving, which means that safety gear, including helmets, may be detected even more accurately in the future. One aspect of this is creating object identification models using deep learning that can adapt to different kinds of illumination, occlusions, and helmets. Worker helmet detection has the potential to be linked with more comprehensive safety rules and systems in the workplace. To ensure compliance with safety requirements, for instance, alerts or notifications may be sent off when it is recognized that a worker is not wearing the appropriate head protection.

References:

[1] Shan, C., Liu, H., and Yu, Y. (2023). "Research on Improved Algorithm for Helmet Detection Based on YOLOv5," Scientific Reports, vol. 13, Article 18056.

[2] Deng, L., Zhou, J., and Liu, Q. (2024). "Helmet Net: An Improved YOLOv8 Algorithm for Helmet Wearing Detection," International Journal of Networked and Distributed Computing, vol. 12, pp. 329–343.

[3] Liu, Y., Jiang, B., He, H., Chen, Z., and Xu, Z. (2024). "Helmet Wearing Detection Algorithm Based on Improved YOLOv5," Scientific Reports, vol. 14, Article 8768.

[4] Sun, L., Li, H., and Wang, L. (2024). "HWD-YOLO: A Vision-Based Helmet Wearing Detection Method," Computers, Materials & Continua, vol. 80, no. 3, pp. 4543–4560.

[5] Hu, L., and Ren, J. (2023). "YOLO-LHD: Lightweight Helmet Detection Model for Industrial Applications," Frontiers in Built Environment, vol. 9, Article 1288445.

[6] Zhang, L., Chen, Q., and Liu, M. (2022). "YOLO-Based Helmet Detection for Industrial Safety," IEEE Access, vol. 9, pp. 118786–118795.

[7] Kumar, S., Yadav, R., and Singh, P. (2021). "Helmet Detection Using YOLOv4 for Industrial Safety," International Journal of Emerging Technologies, vol. 11, no. 4, pp. 66–72.

[8] Verma, S., Tiwari, A., and Mishra, R. (2021). "Deep Learning Approach for Helmet Detection Using YOLO," International Journal of Computer Science Trends, vol. 9, no. 5, pp. 101–108.

[9] Singh, R., Kumar, V., and Sharma, P. (2022). "Worker Safety Monitoring Using YOLO-Based Detection," International Journal of Engineering Research, vol. 10, no. 2, pp. 89–95.

[10] Patel, N., Shah, R., and Mehta, D. (2021). "YOLO-Based Surveillance System for Helmet Detection," International Journal of Smart Systems, vol. 8, no. 3, pp. 132–140.

[11] Gupta, P., Agarwal, R., and Singh, M. (2022). "Real-Time Safety Helmet Detection Using YOLO," Journal of Industrial Safety Engineering, vol. 6, no. 2, pp. 77–84.

[12] Aboah, A., Wang, B., Bagci, U., and Adu-Gyamfi, Y. (2023). "Real-Time Multi-Class Helmet Detection Using YOLOv8," arXiv Preprint, arXiv:2304.08256.

[13] Shen, S., and Yang, J. (2024). "Attention-Based YOLO for Safety Helmet Detection," arXiv Preprint, arXiv:2405.02591.

[14] Vaikunth, M., Dejey, D., Vishaal, C., and Balamurali, S. (2024). "Hybrid YOLO Pipelines for Helmet Detection," arXiv Preprint, arXiv:2412.19467.

[15] Soltanikazemi, E., Dhakal, A., Hatuwal, B., Toubal, I., Aboah, A., and Palaniappan, K. (2023). "Real-Time Helmet Violation Detection Using YOLOv5," arXiv Preprint, arXiv:2304.09248.

[16] Li, Y., Zhang, H., and Wang, X. (2020). "Real-Time Helmet Detection Based on YOLOv3," International Journal of Computer Vision Applications, vol. 12, no. 3, pp. 45–52.

[17] Khan, A., Ali, S., and Ahmed, R. (2022). "Helmet Detection Using YOLOv5 for Smart Surveillance," International Journal of Advanced Computer Science, vol. 13, no. 4, pp. 210–218.

[18] Sharma, D., Verma, A., and Gupta, S. (2023). "YOLOv5-Based Real-Time Helmet Detection System," Journal of Artificial Intelligence Research, vol. 15, no. 1, pp. 55–63.

[19] Meena, R., Joshi, K., and Sharma, N. (2022). "Smart Helmet Detection Using YOLO," International Journal of Smart Applications, vol. 9, no. 2, pp. 56–63.

[20] Agarwal, S., Gupta, N., and Jain, R. (2022). "Industrial Safety Monitoring Using YOLO-Based Helmet Detection," International Journal of Advanced Research in Artificial Intelligence, vol. 6, no. 3, pp. 88–95.