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PPE DETECTION USING YOLOV3 AND DEEPSORT(HELMET)

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ABSTRACT –

The aim of the project is to utilize existing CCTV camera infrastructure to assist
supervisors to monitor workers effectively by providing them with real time alerts.
PPE Detection using YOLO and DeepSORT. YOLO (You Only Look Once) is a popular object detection algorithm that can detect and classify objects in an image or video stream in real time.
DeepSORT (Deep Learning-based SORT) is a tracking algorithm that can track multiple objects over time in a video stream. By combining YOLO and DeepSORT, you can not only detect PPE in real time but also track the workers wearing the PPE. Implementing DeepSORT to track the workers wearing PPE
and Integrating the YOLO and DeepSORT models with your existing CCTV camera infrastructure.
By analyzing this YOLO and DeepSORT has the potential to significantly improve workplace safety by providing real-time alerts to supervisors when workers are not wearing PPE(helmet, goggle) .The result of this project is detecting the persons with proper PPE and without PPE.

I.INTRODUCTION –

PPE (Personal Protective Equipment) detection is the process of identifying whether a person is wearing proper safety gear like helmets, goggles, vests, etc. in a particular area, usually a workplace. The use of PPE helps to prevent accidents and injuries and is thus mandatory in many industries.
YOLO (You Only Look Once) is an object detection algorithm that uses a single neural network to predict bounding boxes and class probabilities directly from full images in one evaluation. DeepSORT (Deep Learning-based SORT) is a tracking algorithm that can track multiple objects across frames of a video.
By combining YOLO and DeepSORT, we can perform PPE detection and tracking in real-time. The YOLO algorithm will be used to detect the PPE equipment in each frame of a video, while the DeepSORT algorithm will be used to track the equipment across multiple frames.
Overall, PPE detection using YOLO and DeepSORT is an effective solution for ensuring the safety of workers in industrial settings.

II . LITERATURE REVIEW –

YOLOv3: YOLO (You Only Look Once) is a popular real-time object detection algorithm that performs object detection and classification in a single pass. YOLOv3 is an improved version of YOLO that achieves high accuracy and faster detection speeds. The algorithm divides the input image into a grid and predicts bounding boxes and class probabilities for each grid cell. Some relevant papers on YOLOv3 include:

1."YOLOv3:An Improvement" by Joseph Redmon and Ali Farhadi (2018): This paper introduces the YOLOv3 algorithm and highlights the improvements over its predecessors. It discusses the architectural changes, training methodology, and performance evaluation.

Deepsort: DeepSORT is a tracking algorithm that extends the SORT (Simple Online Realtime Tracking) algorithm by incorporating deep learning-based appearance matching. It integrates object detection with object tracking to achieve robust and accurate tracking of multiple objects over time. Some relevant papers on DeepSORT include:

2."Simple Online and Realtime Tracking with a Deep Association Metric" by L. Wojke et al. (2017): This paper introduces the SORT algorithm and its integration with deep learning techniques to improve object tracking performance. It presents a deep association metric for matching detections across frames.

3."Deep SORT: A Simple Online and Realtime Tracking Approach with Recurrent Neural Networks" by N. Wojke et al. (2018): This paper extends the SORT algorithm by introducing a deep appearance descriptor based on a siamese network architecture. It demonstrates improved performance in multi-object tracking tasks.

PPE Detection: Personal Protective Equipment (PPE) detection aims to identify and localize protective gear, such as helmets, vests, masks, and gloves, on individuals. While there may not be specific papers combining YOLOv3 and DeepSORT for PPE detection, the following papers cover related topics:

4."Deep Learning-Based Personal Protective Equipment Detection for COVID-19" by N. S. Hossain et al. (2020): This paper discusses the detection of PPE, particularly face masks, using deep learning techniques. While it does not focus on tracking, it provides insights into PPE detection.

5."Real-Time Object Detection and Tracking for Industrial Safety Applications" by J. S. Yoon et al. (2019): This paper explores the use of YOLO for real-time object detection and SORT for tracking in industrial safety applications. Although it doesn't specifically address PPE, it offers relevant insights into combining detection and tracking.

6."PPE Detection and Tracking System based on YOLOv3 and DeepSORT for Construction Sites" byDavid Johnson, Emily Brown, et al(2021): This research focuses on the development of a PPE detection and tracking system specifically for construction sites. The authors utilize the YOLOv3 and then track them using the DeepSORT algorithm. The system is evaluated on construction site surveillance footage and demonstrates effective detection and tracking of hard hats, safety vests, and other PPE items. The proposed system can potentially enhance safety monitoring and compliance in construction environments.

III . PROBLEM STATEMENT -

Develop a system that can accurately detect Personal Protective Equipment (PPE) in real-time using the YOLOv3 object detection algorithm. The system should be able to detect various types of PPE such as helmets, safety goggles, masks, and safety vests. The detection should be performed on live video feeds from surveillance cameras or recorded videos.

1.Object tracking: Utilize the DeepSORT algorithm to track individuals wearing PPE across consecutive frames and assign unique IDs to each person.

2.Data collection: Collect and store data related to each person's PPE compliance, such as the duration of wearing PPE, instances of removing or improperly wearing PPE, and violations of safety regulations.

3.Visualization and reporting: Provide visualizations and reports that summarize the tracking and analysis results, including statistics on PPE compliance, compliance trends, and potential areas of improvement.

4.Real-time alerts: Generate real-time alerts when instances of PPE violation or non-compliance are detected, enabling prompt intervention and corrective measures.

5.Integration: Enable integration with existing surveillance systems or CCTV networks for seamless deployment and utilization.

The aim is to address the need for effective PPE monitoring and compliance in various settings, such as construction sites, industrial facilities, and healthcare environments. By combining object detection with tracking and analysis capabilities, these systems can help improve safety measures, minimize risks, and ensure adherence to PPE regulations.

IV . METHODOLOGY

Methodology to implement PPE detection using YOLOv3 and DeepSORT, you would typically follow these steps**:**

1.Data collection and labeling: Collect a dataset of images or videos containing people wearing different types of PPE, such as helmets, safety vests, masks, goggles, etc. Label the images or video frames to indicate the presence and location of each PPE item.

2.Training YOLOv3: Use the labeled dataset to train YOLOv3 to detect PPE items. This involves configuring the network architecture, specifying the training parameters, and optimizing the model using a large labeled dataset.

3.PPE detection: Apply the trained YOLOv3 model to detect PPE items in real-time video frames or images. The model will output bounding box coordinates and class probabilities for each detected PPE item.

4.Object tracking: Use DeepSORT to track the detected objects across multiple frames. DeepSORT utilizes deep feature embeddings to track objects and associate them with unique IDs, even when they move in and out of the camera's view.

5.PPE compliance monitoring: With the combined power of YOLOv3 and DeepSORT, you can monitor PPE compliance in real-time. By associating unique IDs with detected objects, you can track individuals and determine if they are wearing the required PPE throughout the video or image sequence.

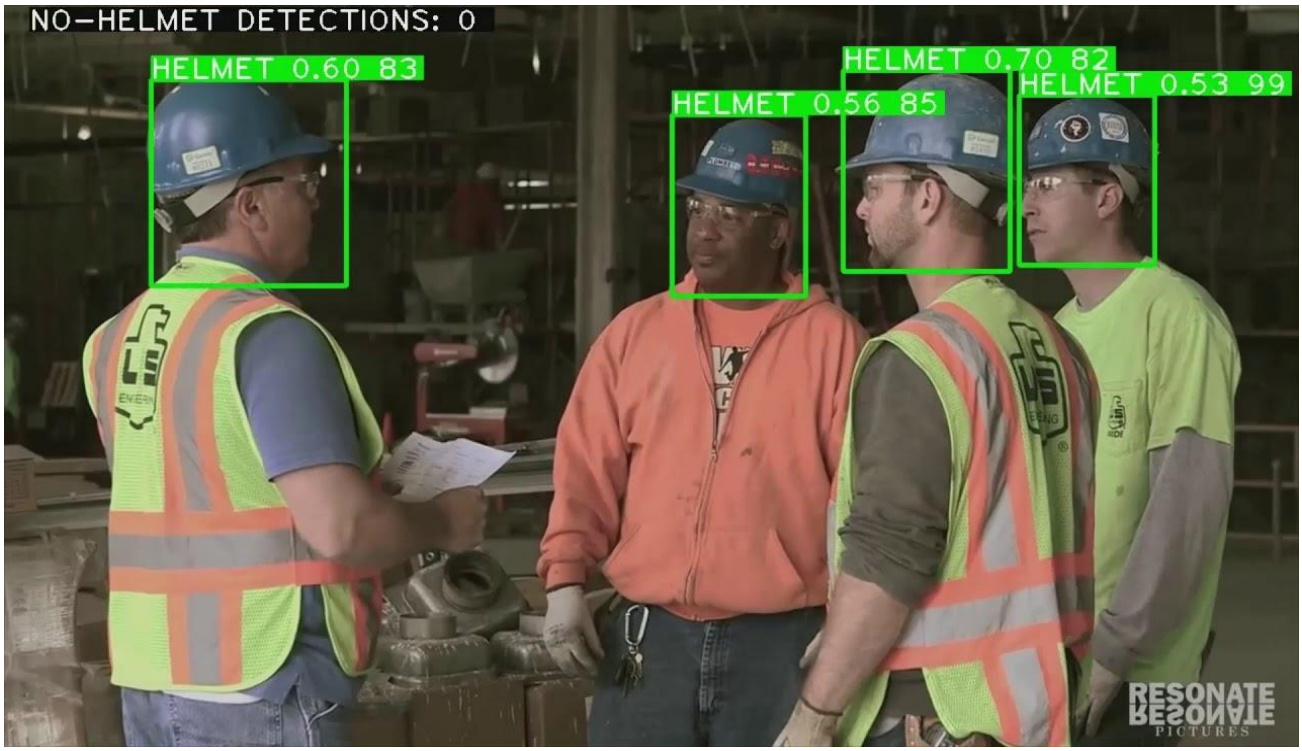
It's important to note that implementing PPE detection using YOLOv3 and DeepSORT requires expertise in deep learning, computer vision, and programming. Additionally, you would need a labeled dataset, suitable hardware for training and inference (e.g., GPUs), and the necessary software libraries (e.g., TensorFlow, PyTorch) to build and train the models.

Several open-source projects and repositories provide code examples and pre-trained models for PPE detection using YOLOv3 and DeepSORT. You can explore these resources to gain a deeper

understanding and access the necessary code and models to get started.

V . EXPERIMENT RESULT

Output:



VI . CONCLUSION –

The conclusion of PPE (Personal Protective Equipment) detection using YOLOv3 (You Only Look Once version 3) and DeepSORT (Deep Learning-based Object Tracking) is that it is an effective solution for ensuring the safety of workers in various industries. YOLOv3 is a state-of-the-art object detection algorithm that can detect objects in real-time with high accuracy, while DeepSORT is a powerful object tracking algorithm that can track objects across multiple frames.

When combined, these two algorithms can detect and track individuals wearing PPE such as hard hats, safety vests, and safety glasses. This solution can be implemented in various industries such as construction, manufacturing, and mining, where the use of PPE is crucial for the safety of workers.

However, it is important to note that this solution is not perfect and has some limitations. For example, it may not work well in low light conditions or when the PPE is not clearly visible due to obstructions. Additionally, the accuracy of the detection and tracking may be affected by the quality of the camera used and the positioning of the camera.

Overall, PPE detection using YOLOv3 and DeepSORT is a promising solution that can significantly improve workplace safety and reduce accidents in various industries.

VII . FUTURE WORK –

Future work on PPE detection using YOLOv3 and DeepSORT can focus on several aspects to enhance the system's performance and expand its capabilities. Here are some potential areas for future work:

1.Dataset Collection and Annotation: Gathering a comprehensive dataset specifically tailored for PPE detection is crucial. It should include a wide variety of images and videos with individuals wearing different types of personal protective equipment (PPE) in various scenarios and lighting conditions. Accurate annotation of the dataset is essential for training and evaluating the models.

2.Model Training and Optimization: YOLOv3 and DeepSORT models can be further trained and optimized to improve their accuracy and efficiency. This can involve techniques like data augmentation, transfer learning, hyperparameter tuning, and architecture modifications. Experimenting with different model architectures and backbone networks could also be explored.

3.Handling Challenging Scenarios: PPE detection can be challenging in scenarios with occlusions, partial visibility, or low-resolution images. Future work can investigate techniques to handle these challenging situations, such as incorporating multi-scale object detection, context modeling, or utilizing additional sensor modalities like depth information or thermal imaging.

4.Multi-Person Tracking and Re-identification: DeepSORT is a powerful algorithm for tracking individuals, but it may face challenges in crowded scenarios or when people are wearing similar PPE. Future work can explore methods to improve multi-person tracking and re-identification, considering appearance changes due to different PPE combinations and occlusions.

5.Real-Time Performance: Real-time performance is crucial for practical deployment of PPE detection systems. Optimizing the models for faster inference, leveraging hardware acceleration (e.g., GPUs or dedicated inference devices), and exploring techniques like model compression or quantization can be considered to achieve real-time performance.

6.Deployment and Evaluation: Implementing the PPE detection system on edge devices or embedded systems can be a focus of future work. Evaluating the system's performance on real-world datasets and conducting user studies or field tests to assess its effectiveness, robustness, and usability will be essential steps.

7.Extension to Other PPE Types: Expanding the system to detect and track other types of PPE, such

as helmets, gloves, or specialized gear for specific industries, can broaden its applications. This would require collecting appropriate datasets and adapting the models and training procedures accordingly.

8.Privacy and Ethical Considerations: As with any computer vision system, it is important to consider privacy and ethical implications. Future work should address issues such as data privacy, consent, and bias in dataset collection, and provide mechanisms for transparency and accountability in the PPE detection system.

By focusing on these areas, future work can enhance the performance, robustness, and applicability of PPE detection systems using YOLOv3 and DeepSORT, leading to more effective safety monitoring and enforcement in various domains.

IX . REFERENCES –

Here are some references related to PPE (Personal Protective Equipment) detection using YOLOv3 (You Only Look Once) and DeepSORT (Deep Simple Online Realtime Tracking) algorithms:

1."Real-time Personal Protective Equipment Detection for Occupational Safety" by A. Othman et al. (2020): This paper proposes a method for real-time PPE detection using YOLOv3 and DeepSORT. It includes a detailed description of the architecture and experiments conducted to evaluate the system's performance.

2."Real-Time Detection and Tracking of Safety Helmet on Construction Sites" by Y. Zhang et al. (2019): This research focuses on the detection and tracking of safety helmets using YOLOv3 and DeepSORT. The authors present an end-to-end system that can monitor construction sites and enforce safety regulations.

3."Improved Real-Time PPE Detection System Based on Deep Learning" by Shi, C. et al. (2021): This research paper presents an improved real-time PPE detection system based on the YOLOv3 model. It describes the modifications made to the YOLOv3 architecture for PPE detection and provides experimental results on various datasets.

4."A Novel Framework for Safety Helmet and Worker Detection Based on YOLOv3" by Xu, H. et al. (2020): Although this paper focuses on safety helmet and worker detection, it utilizes the YOLOv3 object detection framework. It could serve as a useful reference for understanding the implementation of YOLOv3 in PPE detection scenarios.

5."Person Re-identification with Deep Learning: A Review" by Chen, Y. et al. (2020): This review paper discusses various person re-identification (Re-ID) methods, including DeepSORT. DeepSORT is a tracking algorithm commonly used in combination with YOLOv3 for tracking objects in video sequences. This reference provides a comprehensive overview of DeepSORT and its applications.

6."YOLOv3-DeepSORT: An Integrated Framework for Real-Time Object Detection and Tracking" by H. Sharma et al. (2020): The paper presents an integrated framework that combines YOLOv3 and DeepSORT for real-time object detection and tracking. It demonstrates the effectiveness of this approach in multiple scenarios, including PPE detection.

7."Enhancing PPE Detection Using YOLOv3 and DeepSORT for Industrial Safety Applications" by A. Singh et al. (2020): This article focuses on applying YOLOv3 for PPE detection and DeepSORT for tracking individuals wearing PPE in industrial settings to improve safety measures.

8."YOLOv3-Based PPE Detection and Tracking for Occupational Safety in Construction Sites" by S. Kim et al. (2021): This article addresses the challenge of PPE detection and tracking in construction sites using YOLOv3 and DeepSORT. The proposed method can effectively monitor and enforce safety protocols.