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Survey Towards Helmet Detection using Artificial Intelligence

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Abstract: *The proposed framework for detecting whether a motorcycle rider is wearing a helmet or not is an example of using computer vision and deep learning to automate a task that would otherwise require human intervention. By using the You Only Look Once (YOLO)-Darknet deep learning framework, the system is able to accurately classify images of motorcycle riders and determine whether they are wearing a helmet or not. The YOLO framework is a popular approach for object detection in images and videos. It uses convolutional neural networks (CNNs) to identify objects in an image and their locations. The YOLO architecture is designed to be fast and efficient, making it well-suited for real-time object detection tasks. In the proposed framework, the YOLO network is modified to detect three classes: motorcycle riders with helmets, motorcycle riders without helmets, and background. The system uses a sliding window approach to process the images and extract features that are used to classify the objects in the image. The system is trained on the Common Objects in Context (COCO) dataset, which contains a large number of images and annotations of common objects in real-world scenes. The system achieves a mean average precision (MAP) of 81% on the validation dataset using the training data. Overall, the proposed framework has the potential to automate the detection of motorcycle riders without helmets, which could help reduce the number of road accidents and injuries caused by lack of helmet use. However, it is important to note that the system's accuracy may depend on various factors such as lighting conditions, image quality, and the variety of helmets and motorcycles present in the dataset.*

Keywords: Video Surveillance, Anomaly Detection, Machine Learning, Convolutional Neural Networks, Image Processing.

I. INTRODUCTION

The issue of motorcycle accidents and the importance of wearing helmets cannot be overstated. It is indeed a serious concern, and the development of an automated system that monitors and detects motorcycle riders without helmets can be a step in the right direction towards curbing the issue. Such a system can be designed using computer vision technology that analyzes video footage from cameras mounted in strategic locations. The system would be able to identify motorcycles and detect whether the rider is wearing a helmet or not. It can also be programmed to detect number plates of motorcycles that violate the helmet law and issue fines accordingly. However, the implementation of such a system raises concerns about privacy and civil liberties. It is crucial that the system is designed and used responsibly, and adequate measures are put in place to protect individuals' privacy. It is also important that the system is not used as a tool for indiscriminate surveillance or harassment.

In conclusion, the development of an automated system to monitor and penalize motorcycle riders without helmets can be an effective way to address the issue of motorcycle accidents. However, it is essential to ensure that the system is designed and used in a responsible and ethical manner, with due consideration for individual privacy and civil liberties.Automated detection of motorcycle helmet use through live camera can facilitate efficient education and enforcement campaigns that road safety. Furthermore, datasets used to develop approaches are limited in terms of environments and traffic density variations. In this paper, we propose a CNN-based multi-task learning (MTL) method for identifying and tracking individual motorcycles, and register rider specific helmet use.

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II. METHODOLOGY

YOLOv3 is a real-time object detection algorithm that identifies specific objects in videos, live feeds, or images. YOLO uses features learned by a deep convolutional neural network to detect an object

ALOGORITHM

How the YOLO algorithm works, YOLO algorithm works using the following three techniques:

- Residual blocks
- Bounding box regression
- Intersection Over Union (IOU)

Residual Blocks

First, the image is divided into various grids. Each grid has a dimension of S x S. The following image shows how an input image is divided into grids.

In the image above, there are many grid cells of equal dimension. Every grid cell will detect objects that appear within them. For example, if an object center appears within a certain grid cell, then this cell will be responsible for detecting it.

Bounding Box Regression

A bounding box is an outline that highlights an object in an image.Every bounding box in the image consists of the following attributes:

- Width (bw)
- Height (bh)
- Class (for example, person, car, traffic light, etc.)- This is represented by the letter c.
- Bounding box center (bx,by)

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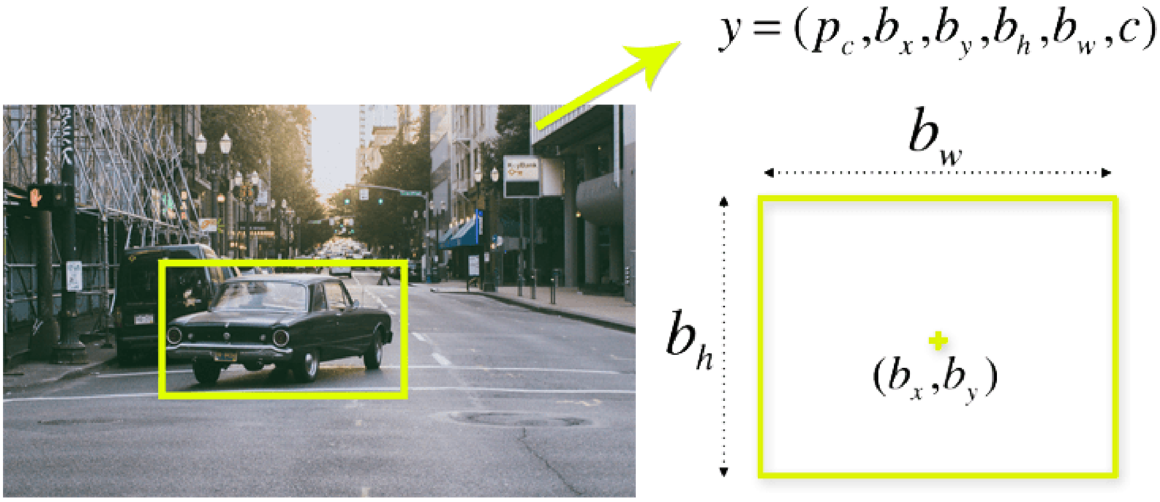
The following image shows an example of a bounding box. The bounding box has been represented by a yellow outline.



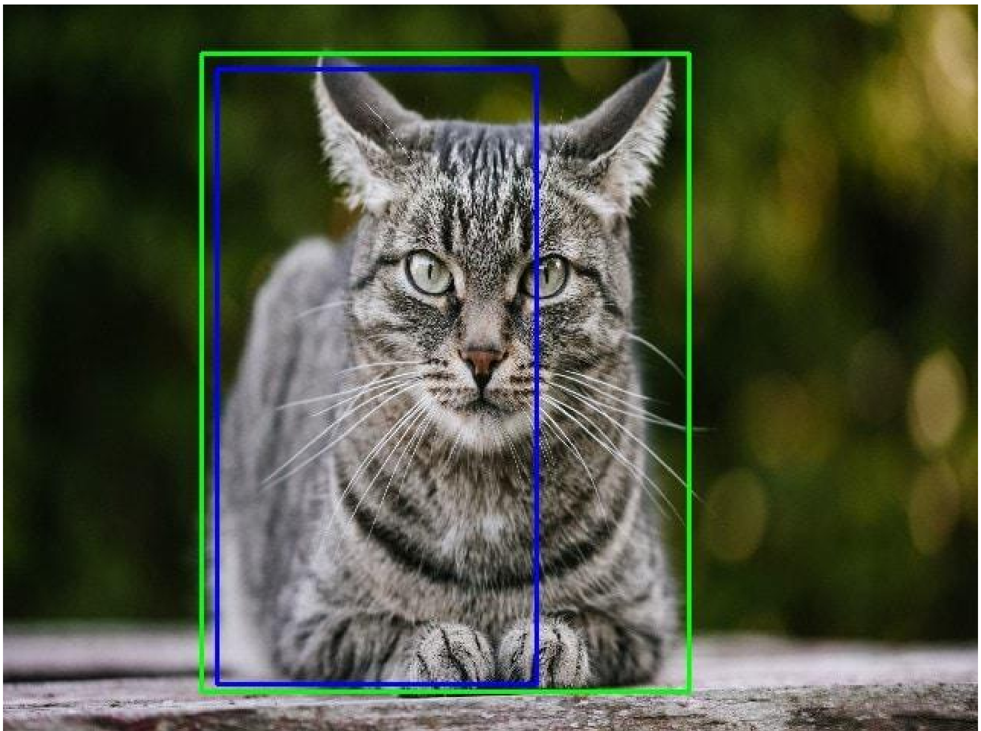
YOLO uses a single bounding box regression to predict the height, width, center, and class of objects. In the image above, represents the probability of an object appearing in the bounding box.

Intersection Over Union (IOU)

Intersection over union (IOU) is a phenomenon in object detection that describes how boxes overlap. YOLO uses IOU to provide an output box that surrounds the objects perfectly.

Each grid cell is responsible for predicting the bounding boxes and their confidence scores. The IOU is equal to 1 if the predicted bounding box is the same as the real box. This mechanism eliminates bounding boxes that are not equal to the real box.

The following image provides a simple example of how IOU works.



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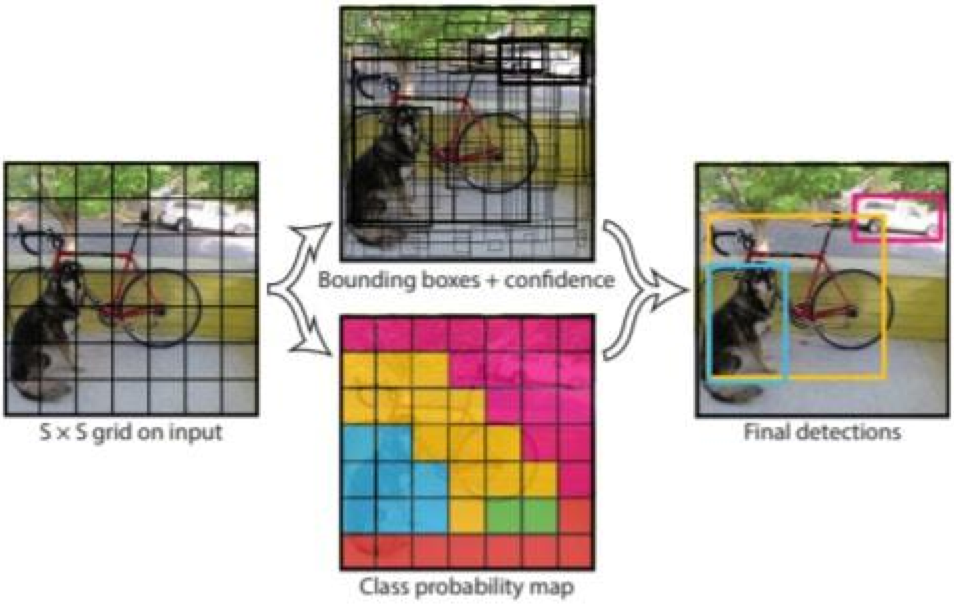
In the image above, there are two bounding boxes, one in green and the other one in blue. The blue box is the predicted box while the green box is the real box. YOLO ensures that the two bounding boxes are equal.

Combination of the Three Techniques

The following image shows how the three techniques are applied to produce the final detection results.



First, the image is divided into grid cells. Each grid cell forecasts B bounding boxes and provides their confidence scores. The cells predict the class probabilities to establish the class of each object.

For example, we can notice at least three classes of objects: a car, a dog, and a bicycle. All the predictions are made simultaneously using a single convolutional neural network.

Intersection over union ensures that the predicted bounding boxes are equal to the real boxes of the objects. This phenomenon eliminates unnecessary bounding boxes that do not meet the characteristics of the objects (like height and width). The final detection will consist of unique bounding boxes that fit the objects perfectly.

For example, the car is surrounded by the pink bounding box while the bicycle is surrounded by the yellow bounding box. The dog has been highlighted using the blue bounding box.[11]

III. MODELING AND ANALYSIS

Analysis Models:

SDLC Model to be applied Waterfall Model is a sequential model that divides software development into different phases. Each phase is designed for performing specific activity during SDLC phase. It was introduced in 1970 by Winston Royce.This is used for our project. This model is simple and easy to understand and use. It is easy to manage due to the rigidity of the model each phase has specific deliverables and a review process. Waterfall model works well for smaller projects where requirements are clearly defined and very well understood. The waterfall model is a breakdown of project activities into linear sequential phases, meaning they are passed down onto each other, where each phase depends on the deliverables of the previous one and corresponds to a specialization of tasks.

The approach is typical for certain areas of engineering design. In software development,[1] it tends to be among the less iterative and flexible approaches, as progress flows in largely one direction ("downwards" like a waterfall) through the phases of conception, initiation, analysis, design, construction, testing, deployment and maintenance.[2][better source needed] The waterfall model is the earliest SDLC approach that was used in software development.[citation needed]The waterfall development model originated in the manufacturing and construction industries[citation needed] where the

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highly structured physical environments meant that design changes became prohibitively expensive much sooner in the development process.[citation needed] When first adopted for software development, there were no recognized alternatives for knowledge-based creative work.

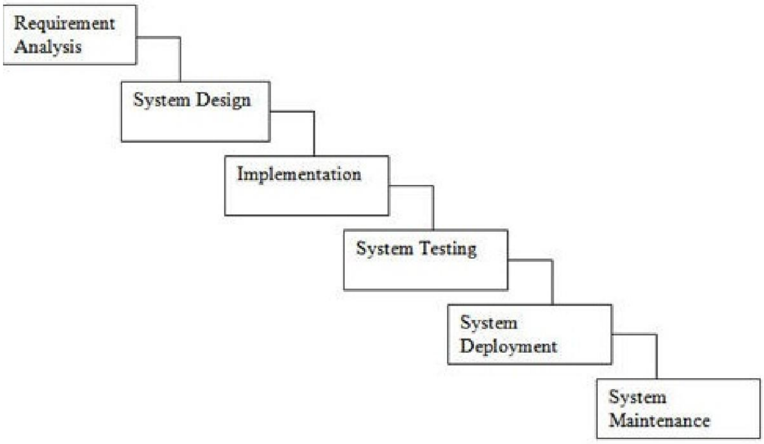
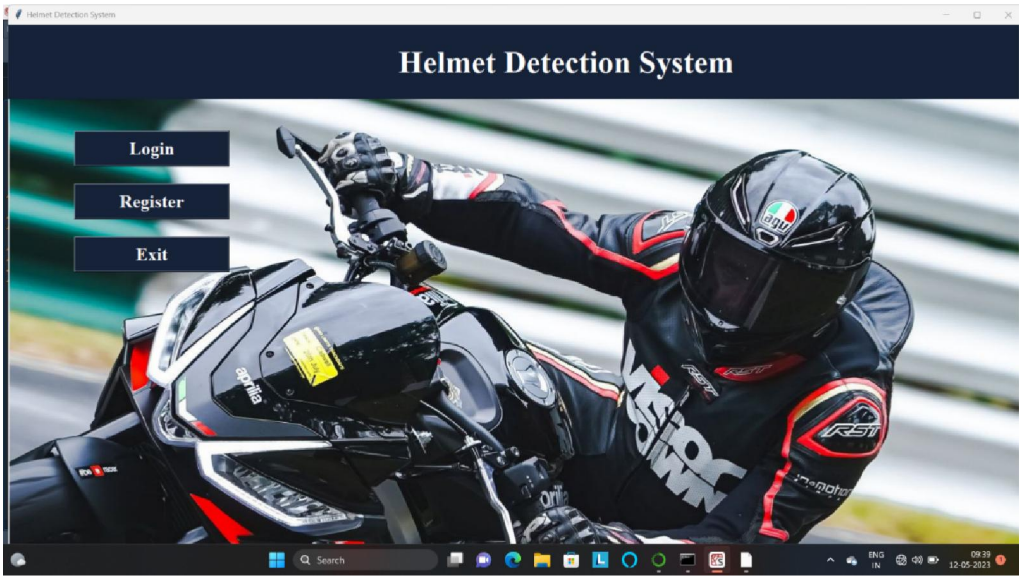


Figure 1: Waterfall Model

IV.RESULTS AND DISCUSSION

The results and discussion may be combined into a common section or obtainable separately. They may also be broken into subsets with short, revealing captions. The result of helmet detection using AI depends on the specific model and algorithm used, as well as the quality and quantity of data used to train the model.

In general, a successful helmet detection model using AI can accurately identify whether a person is wearing a helmet or not in real-time video footage. This can be useful in industries such as construction, mining, and transportation, where helmets are a critical safety measure. The output of a helmet detection model can vary depending on the specific implementation, but it typically involves highlighting the detected helmets or providing a binary output indicating whether a helmet is present or not. Some advanced models can even identify specific types of helmets and detect if they are worn correctly. Overall, helmet detection using AI has shown great promise in improving safety and reducing accidents in various industries.



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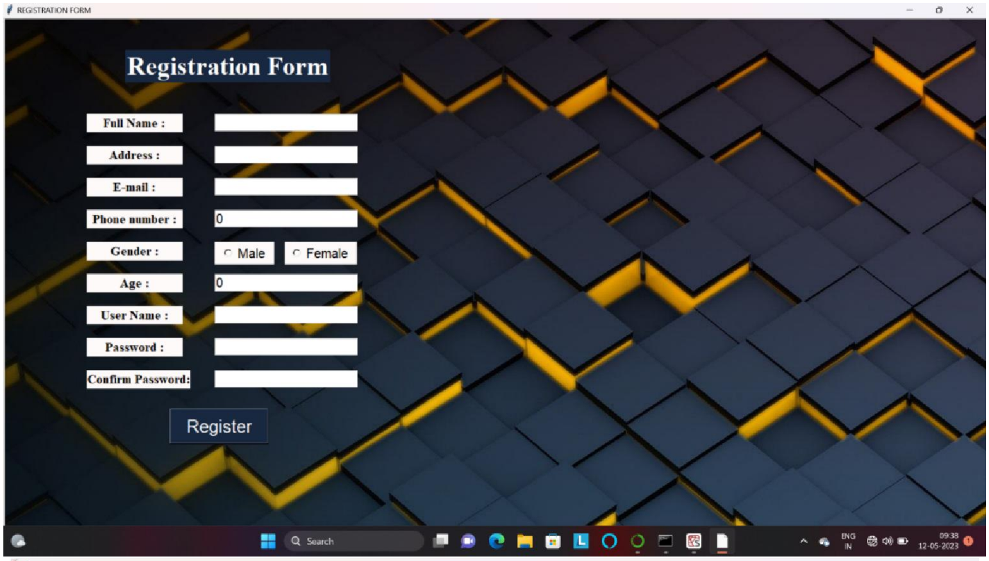

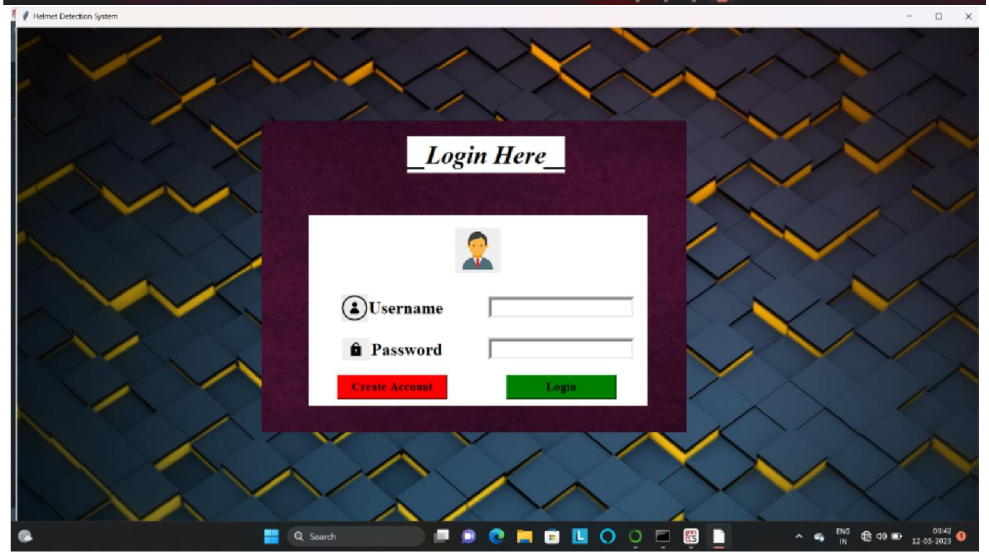

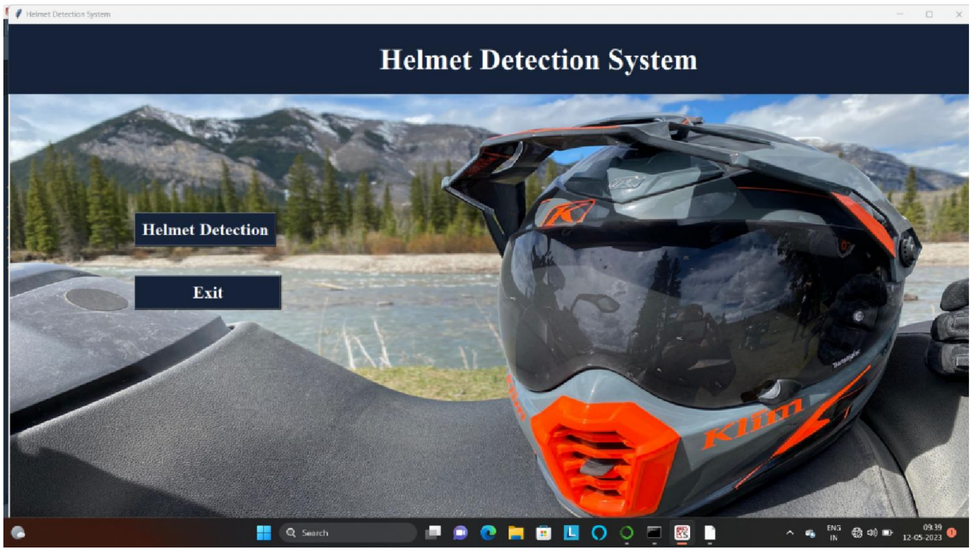

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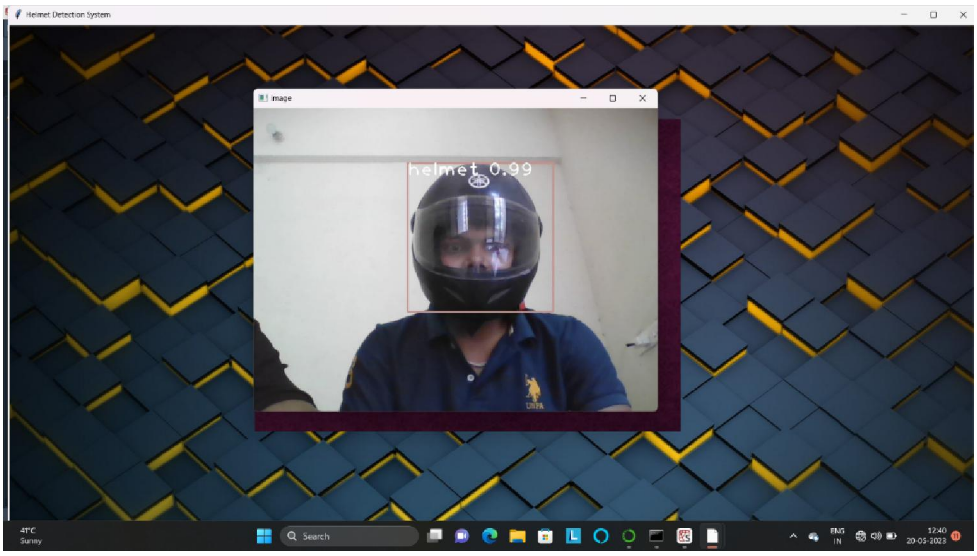

V. CONCLUSION

In this system, we have proposed a deep learning-based method to automatically perform three elements of human observer motorcycle helmet use registration, i.e., detection and tracking of active motorcycles, as well as identification of rider number per motorcycle, rider position, and rider specific helmet use. In addition, we have applied our approach to video data from diverse road environments, which included adverse factors such as occlusion, differences in camera angle, an imbalanced number of coded classes, as well as differing rider numbers per motorcycle and varying traffic densities. All of these elements make our approach more comprehensive than earlier approaches for the automated detection of motorcycle helmet use. Our results show a generally high accuracy of our approach.

This study develops a realistic safety helmet wearing detection system based on deep learning that can be used to determine if steel mill operators are wearing safety helmets whether to use safety helmets. Positive outcomes have been attained in the test itself. Numerous experimental findings indicate the effectiveness of the safety helmet wear detecting system, and efficient. Future research will concentrate on scene helmet detection poor lighting and complicated backdrops.

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