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Deep Learning-Based Safety Helmet Detection on Construction Sites

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Abstract: The conventional security protective cap wearing acknowledgment is just founded on the shading, shape, surface and different attributes of the picture, which is extraordinarily impacted by the outer climate, and has the issue of temperamental acknowledgment precision. Considering the above issues, this paper concentrates on the acknowledgment strategy for power development labourer's security head protector dependent on man-made brainpower innovation. Subsequent to pre-processing the development checking picture, for example, turning Gray and denoising, the development work force in the identification picture are found, that is, based on recognizing the development staff region, the head position of the development faculty is found, lastly the wellbeing protective cap wearing acknowledgment is acknowledged by utilizing YOLO calculation. The re-enactment results show that the normal acknowledgment exactness is 95.2%, the acknowledgment impact is steady and has great heartiness.

Keywords: Helmet detection, Construction sites, Deep learning, Accidents

I. INTRODUCTION

Acknowledgment and characterization of moving items is a functioning exploration region and it is for the most part used these days in various applications, for example, human development catching and shrewd transportation frameworks (ITS). These days, the insightful transportation framework has become one of the significant headings of PC vision in designing. Traffic observing and mishap control are the fundamental difficulties in the ITS. As a general rule, the number of two wheels transportation like cruisers increment step by step on the streets, there has been a quick expansion in bikes mishap due to careless, carelessness and surge of bikes riders

The success of digital image pattern recognition and feature extraction using a Convolutional Neural Network (CNN) or Deep Learning was recently acknowledged over the years.As per the mishap measurements delivered by the state organization of work security from 2015 to 2018, among the recorded 78 development mishaps, 53 occasions happened attributable to the way that the specialists didn't wear wellbeing head protectors appropriately, representing 67.95% of the absolute number of problems.Automatically detect whether workers are wearing safety helmet at construction site is significant for safety production. Concerning the problem that the existing safety helmet wearing detection method is difficult to detect the partial occlusion, different size and small object, and the detection accuracy is low.Experiments show that compared with the original Faster RCNN, the detection accuracy is increased by 7%.

Related Research into the Safety Helmets Detection

- At present, previous studies of safety helmets detection can be divided into three parts, sensor-based detection, machine learning-baseddetection, and deep learning-based detection.

Deep Learning-Based Object Detection

- The methods construct convolutional neural networks with different depths to detect safety helmets. Some other strategies such as multiscale training, increasing the number of anchors and introducing the online hard example mining, are added to increase the detection accuracy

II. PROPOSED SYSTEM

- Object Detection with YOLO

- YOLO (You Only Look Once) is a method / way to do object detection. It is the algorithm /strategy behind how the code is going to detect objects in the image.
- YOLO takes entirely different approach. It looks at the entire image only once and goes through the network once and detects objects

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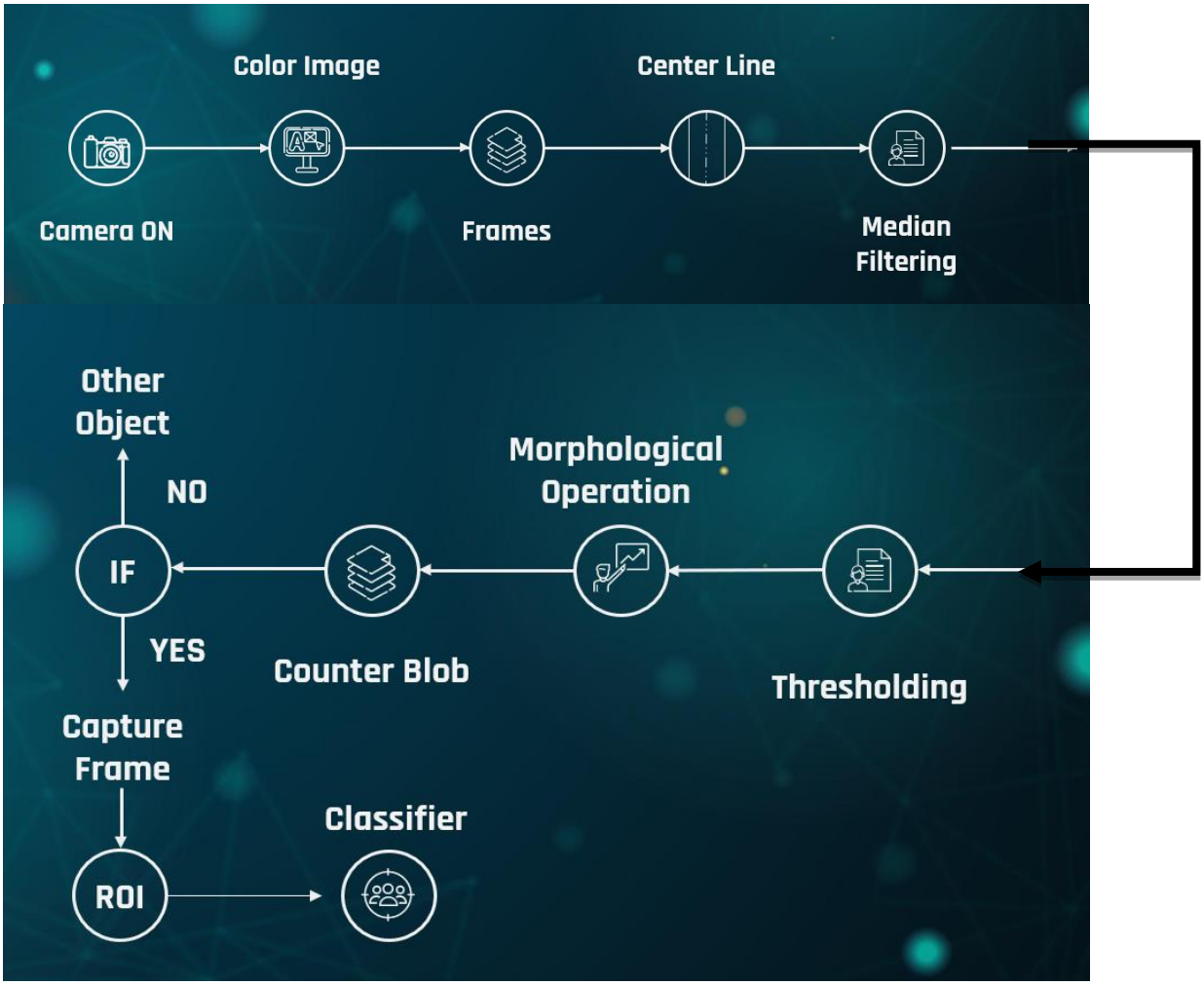
- Even we can use tensor flow to detect the helmet in the image.

- Object Detection with OpenCV and Python

- DNN (Deep Neural Network) module was initially part of opencv_contrib repo. It has been moved to the master branch of opencv repo last year, giving users the ability to run inference on pre-trained deep learning models within OpenCV itself.
- Initially only Caffe and Torch models were supported. Over the period support for different frameworks/libraries like TensorFlow is being added.



III. METHODOLOGY

- In recent years, several studies were performed to analyze traffic on public roads, including the detection, classification and counting of vehicles and helmet detection.
- The study is divided into two stages:

1. Vehicle or person segmentation and classification
2. The detection of helmet use

- The MLP classification algorithm was used to classify the images into two classes: with helmet or without helmet.

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1. **Vehicle or person segmentation and classification**

By using YOLO we are going to classify different object.

The stage of segmentation and classification comprises of three stages.

- Detection of background.
- Segmentation of moving object .
- Person and vehicle classification.

Fig. Removing Background

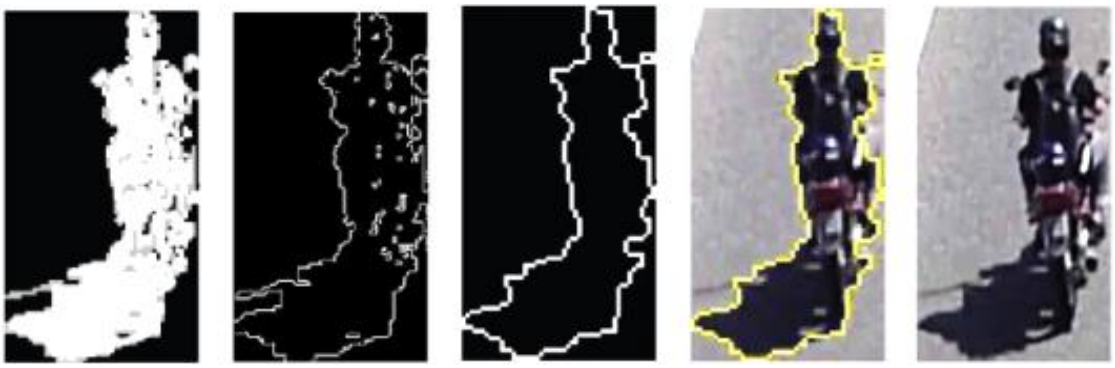

Fig. Segmentation of moving object

2. The detection of helmet use

The stage of segmentation and classification comprises of three stages.

- Determining the Rol.
- Extraction of the attributes.
- Image Classification.

Training Process:

The entire preparing work was carried out on the cloud preparing stage, Didi Yun, with a 24 GB Tesla P40 designs card. Later the preparation, both nearby PC CPU and cloud-based GPU stages were utilized to test the exhibition of various organization techniques. The CHV dataset was parted into three bits for preparing, approval, and testing dependent on the level of 80%, 10%, and 10% separately.

Additionally, YOLO v5 was trained in a PyTorch environment constructed by Ultralytics. The training process was similar to YOLO v3/4 and the hyperparameters. The training process contains three steps. Step 1: select the desired model and set the configure file according to the targeted objects; Step 2: adopt the pre-trained weights that provide initial parameters inside the networks and accelerate the training process; Step 3: set the training parameters and start the training process. The stochastic gradient descent (SGD) was adopted with an initial learning rate of 0.001. The max batch was calculated from classes × 2000 [4] (12,000 in this study).

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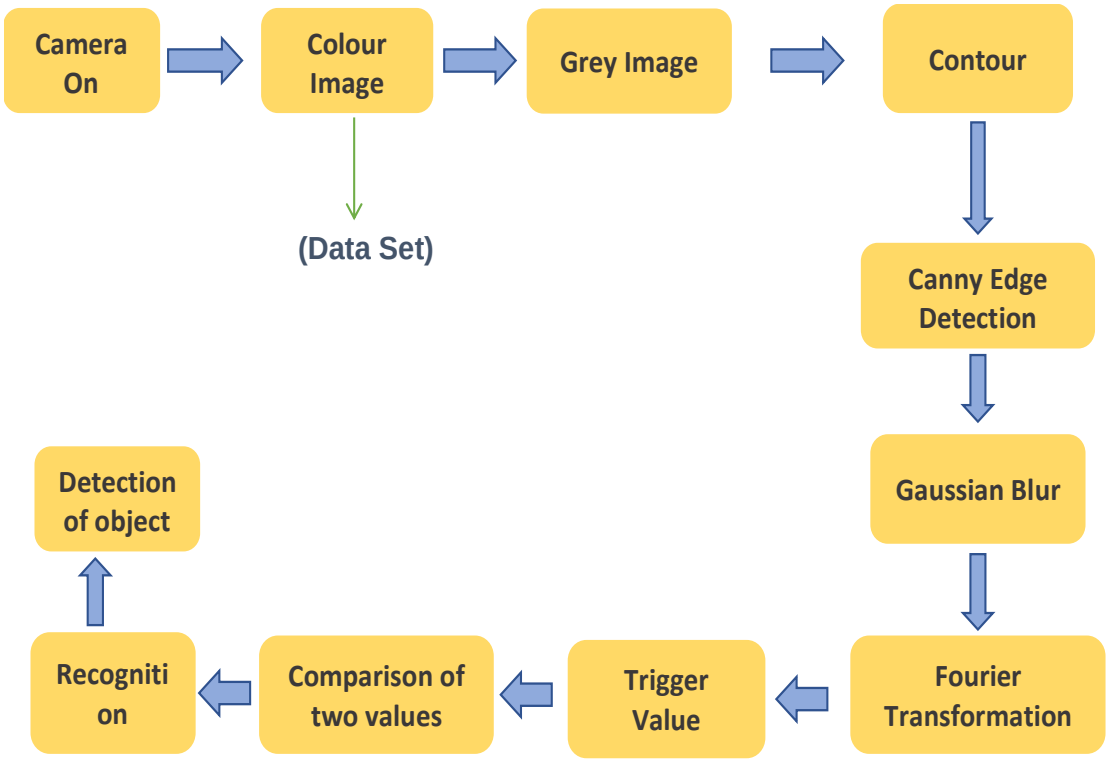

IV. WORKING & ARCHITECTURE

We are basically using this project specially in construction sites and to protect any accident which can takes place during time of construction.
So the first steps we are taking is to detect a helmet on the person working on construction sites.

Different Layers
Two YOLO v3 models with varied layers are tested. In theory, the model with more layers has a stronger ability to detect small objects. However, the results show that the YOLO v3 (3 layers)'s mAP is only slightly higher than YOLO v3 (5 layers)'s. Four classes of AP (person, vest, blue, red) in YOLO v3 (three layers) is also larger than the five-layer classes. Additionally, due to the extra two layers, the five-layers' weight is slightly higher

Different Train Size
The default training image size is 416 × 416. In theory, more details can be learned during the training process when feeding large-size images. In this experiment, the training image size is increased by 42% to 608 × 608. It is observed that there is little difference after changing the image size. They almost have the same mAP and processing time.

Where Are Wrong Detections?
To explore the model's performance in more depth, it is necessary to see their incorrect detections, which could provide future directions for improvement. YOLO v5x, the best correctness one, is selected to analyze the incorrect detections. The confusion matrix of YOLO v5x is presented

Advantages
YOLOv2 still has the advantage of fast speed. However, its backbone network is not deep enough, it is difficult to recognize more abstract image semantic features, and the bounding box predicted by each grid cell is too less, which is not effective in predicting targets with large-scale changes.
Introduces the residual structure, and establishes a deeper Darknet-53. And compared to YOLOv2, the down sampling method of the pooling layer is canceled, but the feature map is down sampled by adjusting the step size of the convolutional layer to obtain more fine-grained features. The advantages of YOLO based single-stage detector are the ability of real-time processing and detecting small instances, especially for face detection.
Application

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The fundamental use of head protector identification is in rush hour gridlock streets where mishaps are more. Despite the fact that different measures are taken by government, it isn't followed effectively by the motorcyclists, so a few shrewd strategies ought to be utilized. The target of this review is to foster a continuous application for location of LP for non-helmeted motorcyclist utilizing the single convolutional neural organizations.A centroid following technique with a reference line is likewise proposed to wipe out the quantity of bogus up-sides produced by the helmeted bikers when they leave the video outlines.

V. CONCLUSION

This paper proposed a method for detecting the wearing of safety helmets by the workers based on convolutional neural networks.The model uses the Yolo algorithm to detect safety helmets. Then, a dataset of 80 dataset containing various helmets is built and divided into three parts to train and test the model.
The YOLO and TensorFlow framework is chosen to train the model. After the training and testing process, the mean average precision (mAP) of the detection model is stable and the helmet detection model is built.
The experiment results demonstrate that the method can be used to detect the safety helmets worn by the construction workers at the construction site.

From the outcomes displayed above it is apparent that the YOLO object location is appropriate for continuous handling and had the option to precisely characterize and confine all the itemclasses. The proposed start to finish model was createdeffectively and has every one of the abilities to be robotized and sent for observing. For removing the number plates a few methods are utilized by considering various cases like numerous riders without protective caps and intended to deal with the greater part of the cases. Every one of the libraries and programming utilized in our undertaking are open source and consequently is truly adaptablealso cost proficient. The undertaking was mostly worked to address theissue of non-effective traffic the executives. Henceforth at theend of it we can say that whenever conveyed by any traffic the board offices, it would make their occupation more straightforwardwhat's more effective.

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