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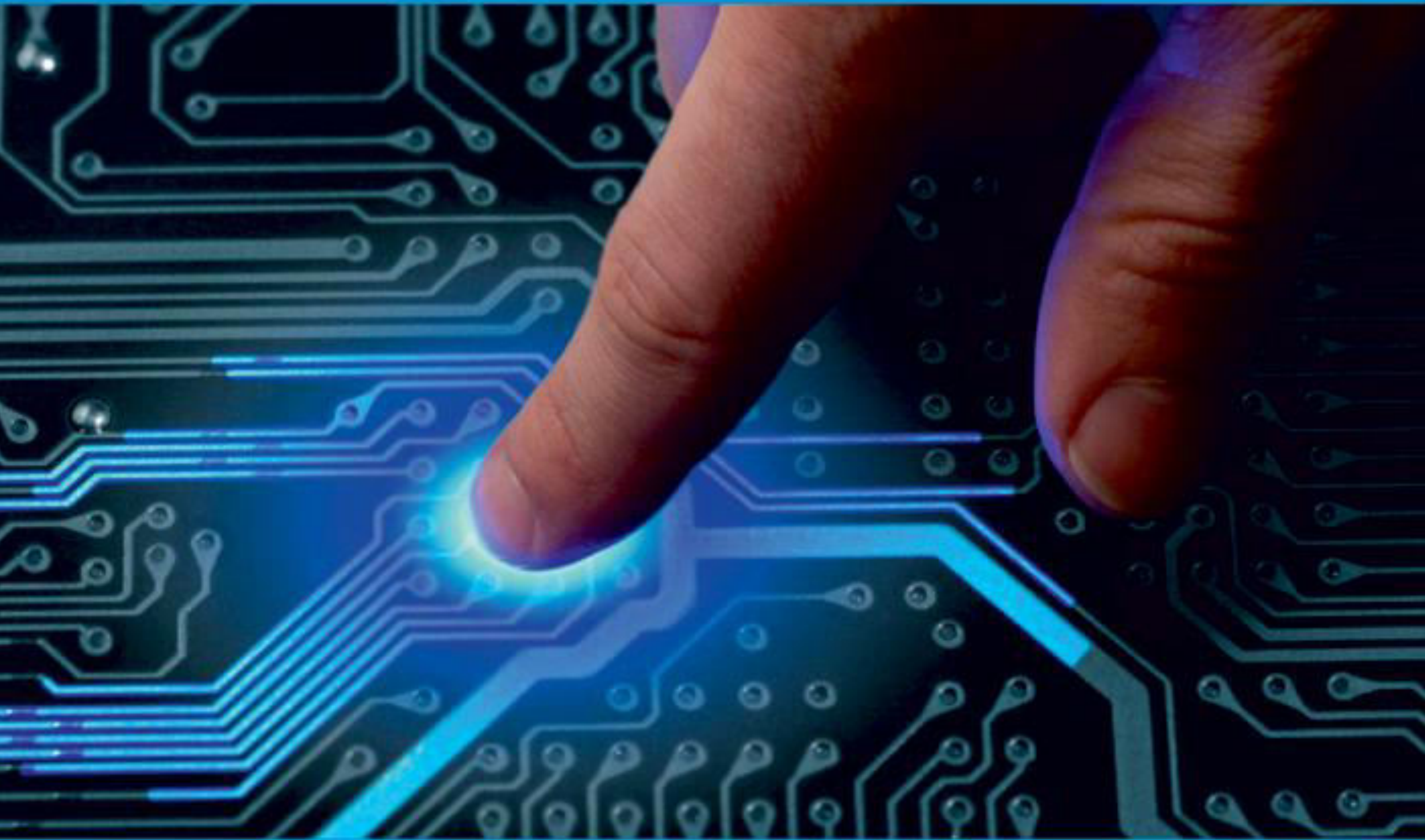

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Advanced Workplace Security Through Helmet Detection and Facial Authorization

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ABSTRACT: Visual examination of the workplace and in-time reminder to the failure of wearing a safety helmet is of particular importance to avoid injuries of workers at the construction site. Video monitoring systems provide a large amount of unstructured image data on-site for this purpose, however, requiring a computer vision-based automatic solution for real-time detection. Although a growing body of literature has developed many deep learning-based models to detect helmet for the traffic surveillance aspect, an appropriate solution for the industry application is less discussed in view of the complex scene on the construction site. In this regard, we develop a deep learning-based method for the real-time detection of a safety helmet at the construction site. The presented method uses the SSD-MobileNet algorithm that is based on convolutional neural networks. A dataset containing 3261 images of safety helmets collected from two sources, i.e., manual capture from the video monitoring system at the workplace and open images obtained using web crawler technology, is established and released to the public. The image set is divided into a training set, validation set, and test set, with a sampling ratio of nearly 8 : 1 : 1. The experiment results demonstrate that the presented deep learning-based model using the SSD-MobileNet algorithm is capable of detecting the unsafe operation of failure of wearing a helmet at the construction site, with satisfactory accuracy and efficiency.

KEYWORDS: Helmet Detection, Number plate Detection, Stolen Vehicle Identification.

I. INTRODUCTION

There is a rapid increase in the number of vehicles in this current era and so is the number of attempts at car theft, respectively international and local. Owners are worried about having their vehicles stolen from the common parking area or from outside their home with the invention of strong stealing strategies. The protection of vehicles from theft is indeed important because of the unsafe area. A solution to this issue is offered by a real-time vehicle security system based on computer vision. The proposed vehicle security system performs real-time user authentication based on image processing using face detection and recognition techniques and a microprocessor-based control system fixed with the vehicle on board.

Data assortment is also a compilation assortment data (or dataset). most usually, set refers to the contents of 1 data table or maths knowledge matrix, where each column of the table represents a particular variable and each row corresponds to the knowledge set in question. for each data set member, the knowledge set lists values for each variable, just like the peak and weight of the article. each value shall be said as data. set may includes knowledge matching the quantity of rows of one or further members. a whole of 8858 spammers and 17646 non-spammers square measure labeled . Since the tactic of user labeling is heavily obsessed with human judgment, this can be able to directly lead to potential human error. Therefore, exclusively concerning eighty per cent of spammers and non-spammers unit every which way selected from the classified dataset as our employment data array.

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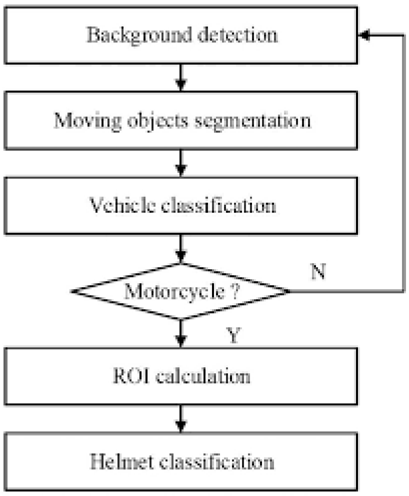

Fig 1: Swin Transformer-based System

In India, wearing helmet for motorcyclists is mandatory by law. Also, considering safety of people using motorcycles, wearing helmet is paramount. Currently, in practice, Traffic Police are entrusted with the task of ensuring that motorcycle riders wear helmet. But, this method of monitoring motorcyclists is inefficient due to insufficient police force and limitations of human senses. Also, all major cities use CCTV surveillance-based methods. But those require human assistance and are not automated. Due to the increasing number of motorcycles and the concern for human safety, there has been a growing amount of research in the domain of road transport. The system proposed in this paper automates the task of monitoring motorcyclists. The system detects motorcyclists not wearing helmets and retrieves their motorcycle number plate in real time from videos captured by CCTV cameras at road junctions by making use of Machine Learning.

The object detection and tracking is the important steps of computer vision algorithm. The robust object detection is the challenge due to variations in the scenes. Another biggest challenge is to track the object in the occlusion conditions. Hence in this approach, the moving objects detection using Tensor Flow object detection API. Traffic rules are there to bring a sense of discipline, so that the risk of deaths and injuries can be minimized significantly. Convolution neural networks(CNN) is excessively being used for object detection applications. CNN is preferable for image classification, character recognition, object recognition and in information retrieval domains due to its effective results. Region based Convolutional Neural Networks is unsuitable for real time applications due to its computational complexity.

II. LITERATURE REVIEW

Construction is a high-risk industry where construction workers tend to be hurt in the work process. Head injuries are very serious and often fatal. According to the accident statistics released by the state administration of work safety from 2015 to 2018, among the recorded 78 construction accidents, 53 events happened owing to the fact that the workers did not wear safety helmets properly, accounting for 67.95% of the total number of accidents.

In safety management at the construction site, it is essential to supervise the safety protective equipment wearing condition of the construction workers. Safety helmets can bear and disperse the hit of falling objects and alleviate the damage of workers falling from heights. Construction workers tend to ignore safety helmets because of weak safety awareness. At the construction site, workers that wear safety helmets improperly are much more likely to be injured. Traditional supervision of the workers wearing safety helmets on construction sites often requires manual work. There are problems such as a wide range of operations and difficult management of site workers. These factors make manual supervision difficult and inefficient and it is difficult to track and manage the whole workers at the construction sites accurately in real time. Hence, it is hard to satisfy the modern requirement of construction safety management only relying on the traditional manual supervision. In this context, it remains a significant issue to study on the automatic detection and recognition of safety helmets wearing conditions.
The automatic monitoring method can contribute to monitoring the construction workers and confirm the safety helmet wearing conditions at the construction site. In particular, considering that the traditional manual supervision of the

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workers is often costly, time-consuming, error-prone, and not sufficient to satisfy the modern requirements of construction safety management, the automatic supervision method can be beneficial to real-time on-site monitoring.
In this paper, based on the previous studies on computer vision-based object detection, we develop a deep learning-based method for the real-time detection of safety helmet at the construction site. The major contributions are as follows: (1) a dataset containing 3261 images of safety helmets collected from two sources, i.e., manual capture from the video monitoring system at the workplace and open images obtained using web crawler technology, is established and released to the public. (2) The SSD-MobileNet algorithm that is based on convolutional neural networks is used to train the model, which is verified in our study as an alternative solution to detect the unsafe operation of failure of wearing a helmet at the construction site. The article is organized as follows. Section 2 gives a brief description of the related work. Section 3 describes the methodology of the research. Introduces the construction of the database. Section 5 reports the experiment results of the study. Discuss the pros and cons of the study and conclude the paper.

III. METHODOLOGY

A convolutional neural network (CNN) is a multilayer neural network. It is a deep learning method designed for image recognition and classification tasks. It can solve the problems of too many parameters and difficult training of the deep neural networks and can get better classification effects. The structure of most CNNs consists of input layer-convolutional layer (Conv layer)-activation function-pooling layer-fully connected layer (FC layer). The main characteristics of CNNs are local connectivity and parameter sharing in order to reduce the number of parameters and increase the efficiency of detection.
The Conv layer and the pooling layer are the core parts, and they can extract the object features. Often, the convolutional layer and the pooling layer may occur alternately. The Conv layers can extract and reinforce the object features. The pooling layers can filter multiple features, remove the unimportant features, and compress the features. The activation layers use nonlinear activation functions to enhance the expression ability of the neural network models and can solve the nonlinear problems effectively. The FC layers combine the data features of objects and output the feature values. By this means the CNNs can transfer the original input images from the original pixel values to the final classification confidence layer by layer.

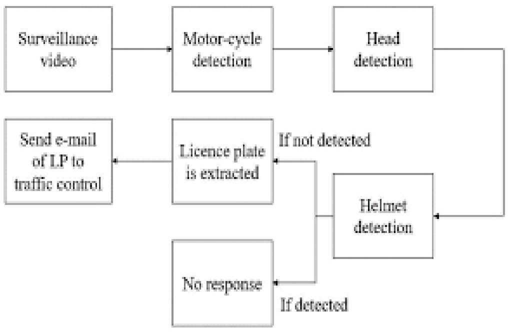

Fig 2: Work Flow

In order to better extract the object features and classify the objects more precisely, proposed the concept of deep learning which is to learn object features from vast amounts of data using deep neural networks and then classify new objects according to the learned features. Deep learning algorithm based on convolutional neural networks has achieved great results in object detection, image recognition, and image segmentation. proposed R-CNN detection framework (region with CNN features) in 2014. Many models based on R-CNN were proposed after that including SPP-net (spatial pyramid pooling network) [21], Fast R-CNN (fast region with CNN features) [22], and Faster R-CNN (faster region with CNN features) [23].
Classification-based CNN object detection algorithms such as Faster R-CNN are widely used methods. However, the detection speed is slow and cannot detect in real time. Regression-based detection algorithms are becoming increasingly important. Redmon et al. [24] proposed YOLO (You Only Look Once) algorithm in 2016. At the end of 2016, Liu et al. [25] combined the anchor box of Faster R-CNN with the bounding box regression of YOLO and proposed a new algorithm SSD (Single Shot MultiBox Detector) with higher detection accuracy and faster speed.
The SSD algorithm is based on a feed-forward convolutional network to produce bounding boxes of fixed sizes and generate scores for the object class examples in the boxes. A nonmaximum suppression method is used to predict the

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final results. The early network layers of the SSD model are called the base network, based on a standard framework to classify the image. The base network is truncated before the classification layers, and the convolutional layers are added at the end of the truncated base network. The sizes of the convolutional feature maps decrease progressively to predict the detections at multiple scales. The SSD algorithm sets a series of fixed and different size default boxes on the cell of each feature map as shown in Figure 1. Each default box predicts two kinds of detections. One is the location of bounding boxes including 4 offsets , which represent, respectively, x and y coordinates of the center of the bounding box and the width and height of the bounding box; the other is the score of each class. If there are C classes of the objects, the SSD algorithm predicts a total of C+1 score including the score of the background.

IV. RESULT ANALYSIS

The data required for the experiment were collected by the author. Since there are few object detection applications of safety helmets using deep learning and there is no off-the-shelf safety helmets dataset available, part of the experimental data was collected using web crawler technology, making full use of network resources. By using several keywords, such as "workers wear safety helmets" and "workers on the construction site," python language is used to crawl relevant pictures on the Internet.

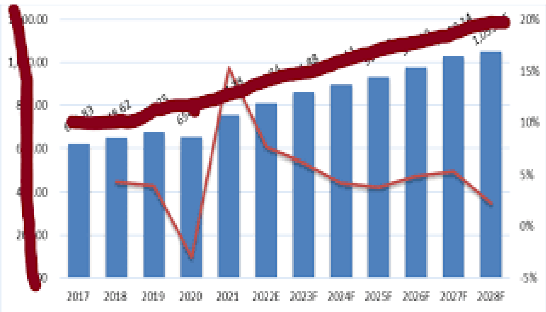

Fig 3: Result Analysis

However, the quality of the crawled images varies greatly. There are problems that there is an only background and no objects in some images, the size of the safety helmet is small, and the shape is blurred. Therefore, images were also collected manually besides web crawling. 3500 images were collected in total. The images that did not contain safety helmets, duplicate images, and the images that are not in the RGB three-channel format were eliminated and 3261 images were left, forming the safety helmet detection dataset. Some images in the dataset are shown in Figure 4. To increase the detection effect of the safety helmet detection model in detecting helmets with different directions and brightness in images, the image dataset was preprocessed such as rotation, cutting, and zooming.

V. CONCLUSIONS

The paper proposed a method for detecting the wearing of safety helmets by the workers based on convolutional neural networks. The model uses the SSD-MobileNet algorithm to detect safety helmets. Then, a dataset of 3261 images containing various helmets is built and divided into three parts to train and test the model. The 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. The presented method offers an alternative solution to detect the safety helmets and improve the safety management of the construction workers at the construction site.

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