HELMET DETECTION USING CONVOLUTIONAL NEURAL NETWORK

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Abstract : Two wheelers are the most preferred means of transport nowadays. Traffic Congestion is one among the severe problems in urban areas. Two wheelers being cheaper, flexible and easier to park gained much popularity in this scenario. According to statistics, around 37 million Indians are using two wheelers. But this high usage has also paved way for higher accident rates. As a safety measure we have helmets and in most cases people refuse to wear helmets. In this paper a method is proposed to detect bike riders without helmet. Convolutional Neural Network is used for automatic helmet detection. If riders are found without helmet then the number plate will be detected and extracted.

IndexTerms **- Convolutional Neural Network, MobileNet SSD Caffe Model, Transfer Learning**

I. INTRODUCTION

According to Global Road Safety Report 2015, more than 200000 deaths occurred in India due to road accidents. About 25% of road accident deaths are associated with two wheelers. Studies also revealed that accident deaths can be reduced to 30-40% by using helmets. Riders without wearing a helmet have a death risk of 2.5 times more than those wearing helmets. So it is evident that it is highly required to ensure the safety of two wheelers by enforcing them to wear helmets .So helmets have been made mandatory by the Govt., but still people refuse to wear it. [1]

Considering the usefulness of helmets some special sensors are included in the ergonomics of two wheelers to ensure the presence of helmets. But it is practically impossible to convince people to install these sensors in already existing bikes. Also image processing techniques to detect helmets using background subtraction and Hough transform are found to be less accurate. So in this paper the aim is to solve the above mentioned problems. A potential solution based on Convolutional Neural Network [2] is proposed here. Traffic videos are continuously processed in real time and the number plate of vehicles of those peoples who are not wearing helmets is extracted. The extracted data can be used for further processing as per requirements. Since the proposed method is planned to implement with the help of free and open source technologies, once it is installed it is free of cost. All the two wheelers on the road will be subjected to detection. Hence every offender is prosecuted and awareness can be created in public.

II. RELATED WORKS

In [3] an approach to detect fall and helmet detection during real time is presented. Background Subtraction and helmet detection is used for fall detection. For detecting helmets Hough Transform Descriptor is used along with background subtraction. Background image is extracted and on a particular segment Hough Transform descriptor is applied. It will detect circles and finds whether the person is wearing helmet or not. If he is not wearing helmet then background subtraction and OCR is used to extract license plate .Fall detection is done with the help of GPS ,background subtraction and OCR.

In [4] adaptive background subtraction was used to detect moving objects. Then CNN was applied to classify these moving objects as motorcyclist or non-motorcyclist. The non-motorcyclist was discarded and another CNN was applied to motorcyclist to classify it as with-helmet or without-helmet.

III. PROPOSED METHEDOLOGY

Proposed Method mainly focused on creating a neural network model that helps to detect the presence or absence of helmet on bike riders and extract number plate information in the absence of helmet. This paper is mainly based on CNN which is considered as one of the most commonly used model in Deep Learning [5].Comparing to other models it requires comparatively less time and also has more efficiency than others. Python 3.6, Keras [6], OpenCV, Numpy [7], Anaconda, Pytesseract API are the different programming languages and packages that are used [8].

Various steps involved in the proposed system are listed below:

Step 1:Initially all persons are detected from real time video frames. There may be pedestrians, bike riders or some other people on road.
Step 2: Now the detected persons are to be classified as biker riders or not, our class of interest is bike riders.
Step 3: After bike rider detection, to the top portion of the image helmet detection model was applied.
Step 4: There can be four possibilities; Motorcyclist with helmet, Motorcyclist with no helmet, None with helmet and None with no helmet. Here, 'None' means not motorcyclist and the concerned class is Motorcyclist with no helmet. and number plate is detected and extracted.

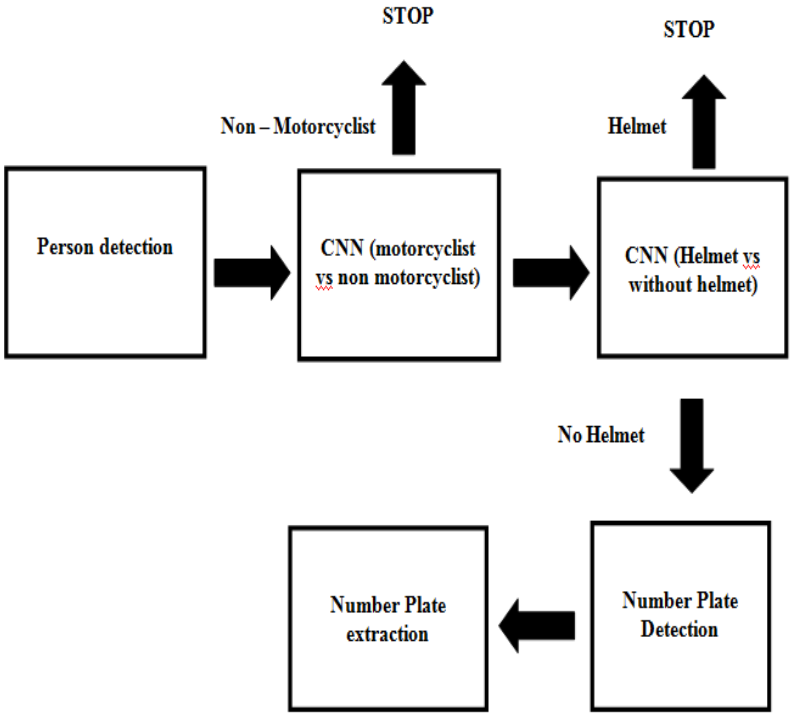

Fig 1 Block Diagram Of proposed System

1.BIKE RIDERS AND NON-BIKE RIDERS DETECTION

First of all persons are detected from real time video frames [9]. For this purpose a pretrained model named "MobileNet SSD.Caffe model" was used. MobilNet is a neural network that is used for classification and recognition whereas the SSD is a framework that is used to realize the multibox detector.The combination of both can do object detection .The model consist of several classes and it should be retrained for custom object detection. MobileNetSSD.caffe Model [10] consists of a large number of classes including bird, bottle, bus, car, person, motorbike etc. All these classes except person and motorbikes were ignored and model was retrained with more images of motorbikes. Figure 2 shows the additional images that were added to the existing dataset. Figure 3 represents ignored classes.

Firstly persons were detected- it may consist of pedestrians or bike riders. Our requirement is to filter out bike riders from it. After detecting persons the same model is applied for bike detection in the region of interest this gives the bike rider class. Now there will be four possible combinations 'bike riders with Helmet' , 'bike riders without Helmet' , 'None with Helmet' and 'None without Helmet'. Here "None" represents that it is not bike rider. The requirement is bike riders without helmets. So when bike riders without helmet are detected then their images are saved into a different folder.

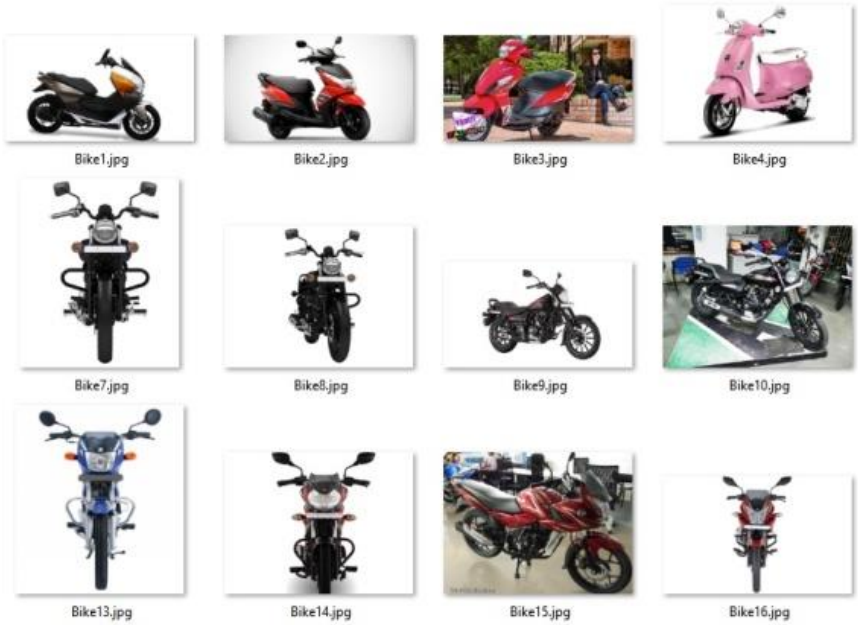

Fig 2 Dataset of motorcyclist

Fig 3 Dataset of ignored classes

2.HELMET DETECTION

After detecting motorcyclist, the next step is to check whether the motorcyclist is wearing helmet or not. For this first a helmet detection model was created. The objective of the model is to classify the input into either of the two classes – helmet or face. Figure 4 and figure 5 represents the dataset of helmet and face. The dataset consist of 205 images of helmet and 205 images of people's face (which means he/she is not wearing helmet). Here Transfer Learning technique was used. Transfer learning [12] uses a trained model MobileNet in which the dataset can be changed and the model can be retrained to detect helmet or face. Transfer learning improves the accuracy and requires less training time even if the dataset is less. There is no need to apply the model over the entire image and the need is to extract head region from the input image. For this a Haar cascade [13] which selects the head region was created. In haar cascade two classes were made: negative class which contains the images which is not of our interest and positive class which contains images of people wearing helmet. Before training the cascade a region of interest was selected using mouse and this saves the coordinates of the region of interest as XML (eXtensible Markup Language). Negative class contains 265 images and positive class contains 411 images. If an input image is given the cascade identifies the head region and in that region the helmet detection model was applied.[14].

Fig 4 Dataset of Helmet

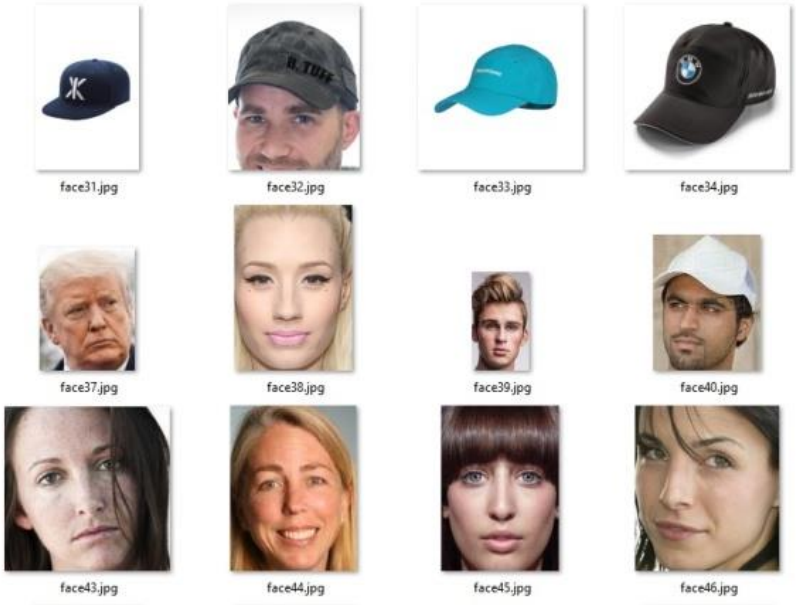

Fig 5 Dataset of Non-Helmet

3.NUMBER PLATE DETECTION AND EXTRACTION

Each vehicle may have a unique identification number called vehicle registration number or license plate which can provide all details about the vehicle.. Using the trained network model bike rider without helmet was detected then location of number plate of corresponding vehicle was marked using bounding box Number plate is detected using image processing techniques. Various image processing operations like top hat/black hat operations, Gaussian blur for noise removal, thresholding, contour detection were applied. Every number plate consist of a black and white contrast, that is white background and black characters. Using contours possible characters were detected. If there are multiple characters together on a white background then it is considered as number plate. Then a bounding box is drawn over the region of interest. The detected plate is then cropped and it is saved as an image to another folder. These images can be used for further processing.

IV. RESULTS

Figure 6 shows the images of persons detected from the real time video .

Fig 6 Person Detection

MobileNet model was again applied to the images of persons saved in the folder (shown above) and images of bike riders without helmet was saved to another folder as shown below in figure 7

Fig 7 Helmet Detection

Result of number plate detection is as follows:

Figure 8 shows number plate detection by drawing bounding box.

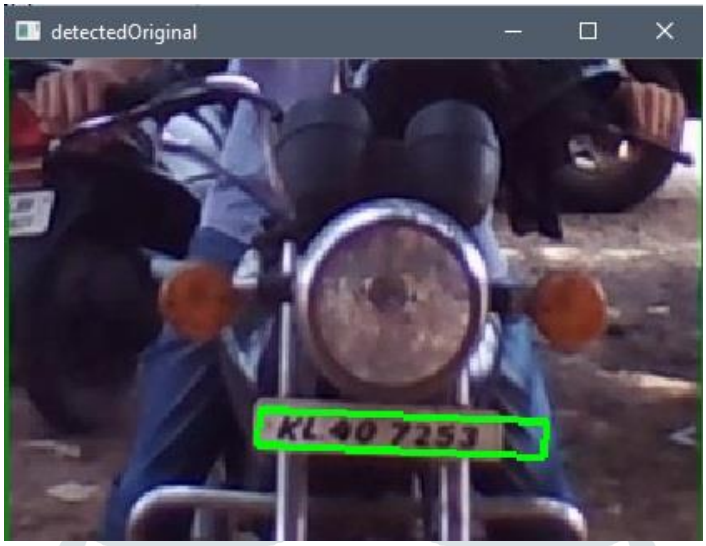

Fig 8 Number Plate Detection

After localizing number plate, its image will be cropped out and will be saved to another folder.Figure 9 shows the cropped image of Number plate.

Plate.png

Fig 9 Cropped image of Number Plate

V. CONCLUSION

This paper discusses a smart and efficient method to automatically detect the presence of helmets in bike riders. Initially bike is detected and then it is determined whether the person is wearing helmet. If he is not wearing helmet then number plate of the corresponding vehicle is detected and extracted. The extracted number plate can be used for further processing. In future number of add-ons can be made like, the system can be modified by adding a fine system. If a motorcyclist without helmet was detected and its number plate was extracted next stage will include sending alert or fine paying message to the respective owner. Proposed methodology can be modified to detect vehicles parked in No Parking areas. There by parking tendency of the public in No Parking areas can be reduced. The proposed system thus decrease the violation of motor vehicle act by ensuring the presence of helmets and will reduce the accident rates.

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