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ABSTRACT

In our country two-wheelers are one of the most used modes of transportation, because it is affordable and available for daily use. It is highly advisable for bike-riders to wear a safety helmet to reduce the risk of head injury caused due to road accidents. Also the government has made compulsory rules for wearing helmets. Due to the violation of these rules, the number of deaths is on the rise. Owing to this the government has made bike riding without helmet a punishable offence and they are being assisted by traffic police to help catch violators. But this increases the manual labor and is also very time consuming. To solve this we propose an automatic detection of bike riders without helmets using surveillance videos and adding of a license plate detector to send immediate penalty to the violators. This system aims to help the law enforcement.

I. INTRODUCTION

The high risk of road accidents is mostly due to non-compliance to protective regulations like wearing a safety helmet. Also the violations of traffic rules are becoming a common trend. Currently the traffic police are tasked with the duty to catch the violators. But this kind of manual work is time consuming and not very accurate. Today most of the busy streets are under the coverage of surveillance cameras. Therefore detecting violators by using existing surveillance footage is cost-effective [2]. We propose an approach for automatic detection of bike-riders' helmets using surveillance videos and adding number plate detectors to send immediate penalties to the violators [1]. Also a database will be available for scrutiny by the police authority. This helps the government to find the violators and thereby we can reduce accidental deaths to an extent.

Our proposed solution will help in improving reliability and also assist the traffic police in detecting violators. This is also a very accurate way of detecting violators. By using this system to an extent we can reduce the non-compliance to safety regulations.

II. METHODOLOGY

In this paper, an automatic helmet detection system is proposed. First we extract frames from the real time videos using background subtraction and then by using classical machine learning algorithms we classify the two-wheelers [2]. The dataset is not the most representative of the real world moving objects; it is still enough to train and test the effectiveness of various machine learning algorithms to check the feasibility of approach. The images were converted to gray scale. Raw pixel values were fed to the classifier. After the detection of two-wheelers the same approach is applied whether the rider is wearing a helmet or not. If the rider is not wearing a helmet the next step is to extract the license plate of the vehicle. We trained the dataset using a YOLOv3 model to detect the license plate from the image. The detected license plate can be cropped and the registration number of the violator’s vehicle can be extracted. Using this

registration number we can report and send immediate penalties to the violators [1].

III. PROPOSED SYSTEM

Helmet Detection System is software that analyses an image given to it as input and detects whether the person is wearing a helmet or not, using machine learning and classifiers. The input image is first checked to see whether it has a motorbike present. If a two-wheeler is present then we crop the head region. The cropped head region is analyzed using a classifier to detect whether the rider is wearing a helmet. In case there is a defaulter, we extract the license plate of that vehicle.

The proposed system consists of four phases:-

- Vehicle Classification
- Helmet Detection
- License Plate Extraction
- Machine Learning Modules

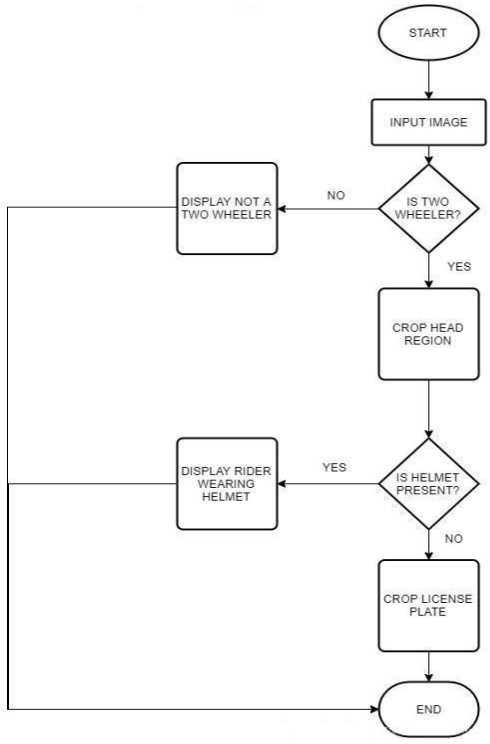

Figure 1: Working of proposed system

1) Vehicle Classification: The first step is to classify the vehicle in the inputted image. We have used a number of machine learning algorithms to classify the vehicles, to see which approach works best in vehicle classification with limited data. We were able to acquire a training set for this through kaggle. Almost the same number of images (750) was gathered for both the classes' two-wheelers and four-wheelers. We eliminated the problem of class imbalance by using equal no of cases for both two-wheelers and four-wheelers which in then leads to better performance of the classifier.

2) Helmet Detection: The same approach as applied to identify the type of vehicle is used to detect whether the rider is wearing a helmet or not. The images that have been used to train a helmet were another set of dataset acquired through kaggle. We were still able to maintain the class balance by using the same number of images where the rider was wearing a helmet and where the rider was not wearing a helmet. We used numerous machine learning classifiers in order to select the best one for this task.

3) License Plate Extraction: After the previous

steps, in case of a rider of a two-wheeler not wearing a helmet, one next step is to extract the license plate of the vehicle [1]. We trained the dataset using a YOLOv3 model to detect the license plate from the image given. The detected part of the input image is cropped and the registration number of the violator's vehicle can be extracted from the same [3].

4) Machine Learning Modules:

i. YOLO: Real-Time Object Detection:- We have used in our project YOLOv3 or You Look Only Once a real time object detection system. Compared to other detectors YOLO is extremely fast and accurate. In mAP measured at .5 IOU YOLOv3 is on par with Focal Loss but about four times faster. Our model has several advantages over classifier-based systems. It looks at the whole image at test time so its predictions are informed by global context in the image. It also makes predictions with a single network evaluation unlike systems like R-CNN which require thou-sands for a single image. This makes it extremely fast, more than 1000x faster than R-CNN and 100 times faster than Fast R-CNN.

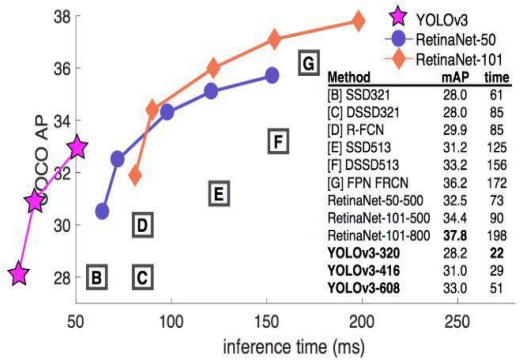

Figure 2: Comparison of YOLO to other detectors

ii. Darknet: Open Source Neural Network in C:- Darknet is an open source neural network framework written in C and CUDA. It is fast, easy to install, and supports CPU and GPU computation. In combination with Google Colab we were able to train our model at a much higher speed. Google Colab is a free cloud service for machine learning education and research. It provides a runtime fully configured for deep learning and free-of-charge access to a robust GPU. One disadvantage of using this platform is that the Colab runtime is volatile. Your Virtual Machine (VM) will cease to exist after 12 hour which results in files being lost after this period. Reconfiguring the runtime is required in order to start training again. This means having to download all the tools, compiling libraries, uploading of the files and so on and so forth. This takes some time each time we need to start every VM.

IV. RELATED WORK

The automatic detection of bike riders using surveillance footage is discussed in a wide category. In [1], a system is implemented using machine learning models and image processing techniques to identify the violators and to crop the region of license plate so that helmet violation tickets can be issued by the authorities effectively. The proposed methodology is to first identify a moving vehicle and then classify these identified vehicles into four-wheelers and two-wheelers. The same can be used to detect whether a rider is wearing a helmet or not.

In [2], the proposed system deals with real-time implementation of identifying bike riders without helmets. First, the bike rider needs to be detected from the video frame. The image is converted to grayscale and background modeling issued to separate the objects in motion. HOG, SIFT and LBP methods are used for feature extraction. Next bike riders are classified using a SVM classifier. Once this is done, the upper 25 percentage part of the person is extracted to determine whether the rider is using a helmet

or not.

A training data set has been developed using TensorFlow to identify bike riders as well as helmets. The COCO model is used for object classification. If no helmet is identified in the area of interest, the license number of the bike is extracted through Optical Character Recognition using tesseract. This creates a dataset of bike riders without helmets [3].

This [4] article discusses the various methodologies that can be used to determine whether a bike rider is wearing a helmet or not. Most systems identify moving objects using background subtraction. The K-nearest neighbor (KNN) classifier can be used for classifying motorbikes as well as helmets [5]. Support Vector Machine (SVM) is another commonly used classifier [6]. Another proposed method involves following the background subtraction method to identify a motorcycle and then Circular Hough Transform is applied on Region of Interest (ROI) and the existence of a circular arc in the top area points to the identification of a helmet [7]. Other classifiers used are CNN, HAAR [8], etc.

Another proposal uses YOLOv2 model, which has the capability to detect all classes of COCO dataset, to detect helmets on the rider [9]. Open Automatic License Plate Recognition is used for the recognition of the license plate [10]. The tracking of the motorbike and ROI extraction is carried out. Identification of bike riders in the frame is carried out using Feature Extraction and Classification. Feature Extraction is done using Histogram of Oriented Gradients (HOG) method. After classification, it is analyzed whether the rider is wearing a headgear or not. Parallel the rider-count is also taken. OpenCV libraries are also used in this approach [11].

V. RESULTS & DISCUSSIONS

In this section we present experimental results and their discussions. Initially we are trying to identify a person who is riding a two-wheeler. This step is crucial for the upcoming step of helmet detection in order to avoid the faulty detection of helmets hanging on a vehicle or placed near one.

After this with the help of YOLOv3 model we detect the helmet. The same approach as applied to identify the type of vehicle is used to detect whether the rider is wearing a helmet or not. Processed image from the initial step two-wheeler detection is given as the input to the helmet detection module.

Figure 4: Detection of Helmet & Two wheeler

License plate detection is also done with the help of YOLOv3 model. After the license plate detection the detected portion is cropped. By using this license plate number we can identify the registration number of the vehicle.

Figure 5: Detection of License Plate

The intended user for our system is the law enforcement. They are given the admin privileges such as login, logout and keeping track of violators. Our system allows the user to upload the surveillance images to the web server which in turn stores it to a database. PostgreSQL is being used for tracking the database. The user side application is built using Flask. The machine learning module then sends the output back giving an indication to the admin whether the given image has a violator or not.

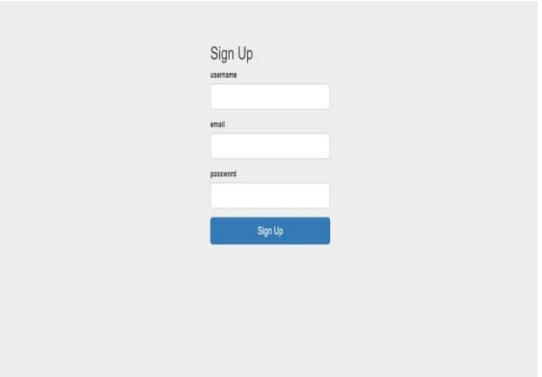

Figure 6: Login for Admin

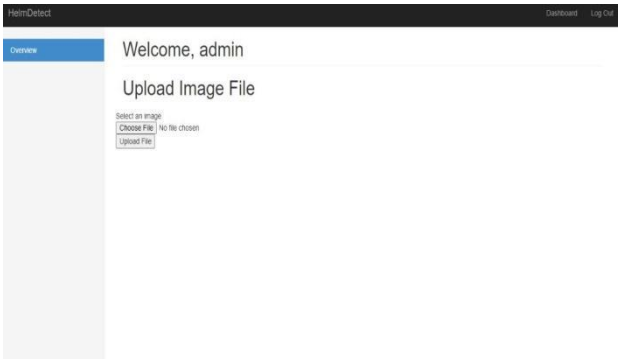

Figure 7: Upload Images by Admin

VI. CONCLUSION

In this paper, we propose an automatic helmet detection system to identify who fails to wear a helmet and also we added a license plate detector to send immediate penalties to the violators by identifying the registration number of the violator's vehicle. This system will reduce the manual work of the traffic police for detecting such violators. This system will help the government to find the traffic rule violators and we can reduce accident deaths to an extent. However, we see that the co-passengers or the pillion rider safety condition is lacking in our system. This is due to lack of training dataset. Moreover further improvements can be brought about through video processing. With better training data we can implement a much better system than the current one.

VII. REFERENCES

[1] Ramesh Babu D R, Amandeep Rathee,

KrishnanginiKalita, Mahima Singh Deo.”Helmet Detection on Two-Wheeler Riders using Machine Learning”.

[2] Shubham Kumar, Nisha Neware, Atul Jain, Debabrata Swain, Debabrata Swain, Puran Singh “Automatic Helmet Detection in Real-Time and Surveillance Video”.

[3] Kavyashree Devadiga, Pratik Khanapurkar, Shreya Joshi, Shubhankar Deshpande, Yash Gujarathi “Real Time Automatic Helmet Detection of Bike Riders ”.

[4] Prajwal M.J., Mahesh Madivalappa Murgod, “A Review on Helmet Detection by using Image Processing and Convolutional Neural Networks”.

[5] Rattapoom, Waranusast ;Nannaphat, Bundon ; Vasan, Timtong ; Chainarong, Tangnoi ; and Pattanawadee, Pattanathaburt 2013. Machine Vision Techniques for Motorcycle SafetyHelmetDetection.28thInternationalConferenceonImageandVisionComputing New Zealand.

[6] Romuere, Silva ;Kelson, Aires ; Thiago, Santos ; Kalyf, Abdala ; Rodrigo, Veras ; and Andr´e, Soares 2013. Automatic detection of motorcyclists without helmet. 2013 XXXIX Latin America Computing Conference (CLEI).

[7] Thepnimit, Marayatr ; and Pinit, Kumhom 2014. Motorcyclist’s Helmet Wearing DetectionUsingImageProcessing.AdvancedMaterialsResearchVols931-932(2014)pp 588-592.

[8] Abhijeet, S.Talaulikar; Sanjay, Sanathanan ; and Chirag,N.Modi 2019. An Enhanced Approach for Detecting Helmet on Motorcyclists Using Image Processing and Machine Learning Techniques.

[9] J. Li et al., ”Safety helmet wearing detection based on image processing and machine learning,” 2017 Ninth International Conference on Advanced Computational Intelligence (ICACI), Doha, 2017, pp. 201-205, doi: 10.1109/ICACI.2017.7974509.

[10] Kang, Li ; and Xiaoguang, Zhao 2017. Safety Helmet Wearing Detection Based on ImageProcessingandMachineLearning.2017NinthInternationalConferenceonAdvanced Computational Intelligence (ICACI)

[11] Pradeep Maiya, Sharath Kumar R , Shreyas P V , Vishwa Prakash H V , Poornima M . ”Helmet and Triple Riding Detection on Motorcyclists using Image Processing”.