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Detection of Two wheelers Helmet Using Machine Learning

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ABSTRACT

The following paper came up with a method for detecting motorbike riders with &without a helmet with the help of machine learning, and IoT(Internet of things). Two-wheeler accidents are increasing gradually in all countries. A helmet or a protective cap is the predominant safety equipment of two-wheelers, motorcycle riders, and pillion riders, however many drivers neglect wearing helmets. The main outcome of wearing a helmet is to protect the head of a person travelling on two-wheelers just in case of a major or minor accident or fall from a running bike.

We worked on a new approach that priorly collected a dataset of images and videos of road traffic where we collected various kinds of photos like with driver wearing a helmet, a driver without wearing a helmet and also the primary rider is with a hel met and second person without a helmet so and differentiated the 2 wheelers from other heavy and light vehicles like cars and bus on road. This detection of wearing a helmet is done through machine-learning and utilizing a free open-source library cross-platform using which we can develop real-time computer vision applications software called OpenCV

Keywords—Helmet Detection; Machine- Learning; OpenCV

I. INTRODUCTION

In every country around the world, two-wheelers, bikes are most utilized for transport. A middle-class family or small family with few members utilizes a bike as their primary transportation. This is due to the lesser price and very few maintenance charges. But the problem raised by the two-wheelers is less security, unproductive, and high risk is entangled with bikes. It is suggested to always wear a helmet while riding two-wheelers[6]. In the previous decade, it was observed a constant growth in the number of bike accidents and loss of life. With regards to official data provided by the road transport department around 20 to 30 bike riders are facing accidents every day that may lead to death or severe injuries and also leading to permanent bed ridden injuries on Indian streets in 2018 because of the negligence of not taking precautions while riding a bike like wearing head protectors, and guards to arms which will avoid any braking of bones when fell from a bike or met with an accident. In addition to this out of fifteen bike riders, eight bike riders died due to not utilizing a protective helmet. To minimize the involved risk of life, it is highly recommended and encouraged for bicycle riders to wear a protective cap or helmet.

Nowadays there are pre-existing strategies that use sophisticated sensors are fixed to the motorbike to evaluate whether the bike rider is using a helmet and the bike engine starts only if they wear a helmet. But, it is not possible to set the mind of each person to mount sensors on the bikes because of the cost involved in the process of fitting these sensors to bikes.
As in this technologically up to date world, in almost all towns, cities a huge video observation implementing for surveillance on a wide diversity of street dangers and traffic monitoring. In this current situation utilizing such a

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pre -existing method is a cost- efficient system, real-time problem solving is possible like traffic violators and proof for any mishaps, accidents, or can also be employed to the identification of bike riders without a helmet or a security cap [6].

Related work & problems to be addressed

Significance of data
To develop architecture for our problem we require a huge data set required for testing the proposed architecture. As such data must include precise information assortment, highlighting images, characterization of images, and following, in which notable content of images should be collected to accomplish our objective.[1][2]

Different situations:
In some special situations, the other objects unknowingly block each other which results in our required object unable to not ice. Precise recognition and isolation may turn hard for our purpose[3].

Perception of Vehicle:
As vehicles are 3-dimensional objects they generally have various perceptions of vision from different angles. Noticeably the exactness of classifiers depends upon the highlights we implemented. The best-proposed model can provide the best outputs required. We require different appearances of a bike rider from different views and angles like for bike riders head identification purpose front view and a side view to detect many riders identification.

Changes in Climate Conditions and their effects:
In different seasons of a year there
are changes in climate conditions like the intensity of light, shadows forming due to the direction of sunlight, fog generation in winter due to temperature fall, and so on which increases trouble of quality displaying pictures.

Quality of Video:
In general, CCTV cameras capture low recordings and are frequently affected by climatic conditions, for example, low light, cloudy weather, fog and mist, air pollution, due to these restrictions, distinguishing, grouping, may turn out to be much mor e troublesome.

As stated in [1], effective methods for observation applications consist of unique properties like ongoing execution, quality adjusting, dynamic behaviour to changes. Keeping all these difficulties and impacts, we came up with a unique method for the discovery of bike riders without a protective cap utilizing collected data from surveillance cameras mounted in different are as, traffic roads, and crowded areas. C. Chiu et al. defined a way to identify protective caps in surveillance video recordings. This method crops the moving object and afterward distinguishes bikes from the other objects and bike rider's heads. This framework k couldn't distinguish the minute varieties and brightening impacts of moving objects. [4] In [2] two steps were implemented fo r helmet detection. In the main stage, moving vehicles were processed where a cross-line was obtained. In the subsequent procedure, an SVM classifier was utilized to classify and segregate moving objects into two classes. J. Chiverton [5] implemented an edge histogram to distinguish motorcycle drivers and others. This technique showed good outputs regardless of conditions like low light in recordings because of the implementation of advanced technique edge histogram.

II. PROPOSEDFRAMEWORK

The proposed work involves in implementation of two important steps: i) step 1 is an implementation of a neural network which is implemented for determination of mono and couple of riders on a bike by the sophisticated and up to date YOLOv3(you look only once) model ii) We adopted one of the deep neural network in offered framework which is responsible for the spotting of motorcycle riders, the second person sitting on the bike

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whether they are using a helmet. In order implement this framework, traffic video is the must to the YOLO3 model to process through the two steps, and then single video frames are obtained by taking screenshots from processed videos and crop them near the head of the motorcycle rider is visible and these images are throughput of the next stage that is a convolution neural network (CNN) to which identifies and centralizes bike riders and pillion riders wearing or not wearing a helmet or any protective cap.

Bike rider's detection utilizing CNN

The convolution neural network (CNN) is a divergent of a feed-forward network that works based on the back-propagation algorithm. It trains itself with high-level layers utilizing the main data images that are cut and took from the videos. The topmost achievement of convolution neural networks is in their capability to obtain inner-dependent data from the input images that are centralized of the pixels that are precise and sensitive. The convolution neural network training involves in the different inbuilt architecture of convolution layers, relulayer, max-pooling layer, fully connected layer, and a loss function like SVM/Soft-max on the ultimate (fully-connected) layer are the backbone for the detection of objects, classification into various classes, and analyzing of objects in provided images. In the first layers we obtain edge information of the provided input images which look like algorithms but, In the fourth layer, we do get texture information from images and ridge information which can be utilized in evaluating sensitive data considered for the classification of similar objects in input images to different precise classes based on their sizes and categories like moving or not moving.

Helmet detection using CNN

The implemented CNN framework is suitable for identification and classifies bikes and bike rider's images. In the upper part of the classified bike rider, the area closer to the location of the area near head is cropped and processed as input for our proposed convolution neural network(CNN) method of detection of a helmet. This proposed network is processed through five layers. The basic fundamental layer considers the cropped input images of bike riders and processes the image through succeeding convolution layers. Every layer has specific and unique features. By implementing specific functions, algorithms each layer sends to the successive layers. These layers perform similar actions like a filter to filtrate and obtain respective features of each corresponding layer of CNN while passing through the consecutive with implementing required attributes which may differentiate targeted object i.e helmet from other objects. Post successfully processed through five convolution layers of CNN, two completely connected layers are added to the five layers. Relying on the extracted properties from each and every layer, the soft-max classifier comes into the picture which is responsible for the classification of the object to segregate into different classes with different probabilities of distribution Helmet or other objects like caps, turbans, hats. The CNN obtains bounding boxes along with respective class probabilities of each segregated class which helps [4]for accurate prediction of a helmet. In the identification of the helmet, the primary input image of the head area is divided into an $N \times N$ grid. Each bounding box has 4 dimensions for measuring: qx, qy, w, h where (qx, qy) coordinates that indicate the origin of the box with respective to centralize the head in the drawn bounding box. The width (w) and height (h) are utilized to find the helmet to the whole cropped bounding box contain the input image. A single bounding box is allotted per individual object with respect to point of Intersection Over Union (IOU) which is in a range in between 0 and 1. Intersection Over Union (IOU) sigiven by= Area of Intersection/Area of Union (1) Area of convergence is the combined area in between the output bounding box of object and the original box. Area of Union is the compound of the compound area of experimentally founded bound box . The value is already predefined as a basic point for object detection and it is predefined as Intersection Over Union threshold = 0.4 is utilized in this which states that detection with an IOU greater than 0.5 may truly positive but practically, IOU can be closer to 1 to show the accurate matching of the ground truth and bounding box. To add non-linearity to the proposed framework, the Rectified Linear Unit (ReLU) activation function is utilized after successful completion of every convolutional layer, by adding additional max-pooling layers after convolution layers for dimension decrease of the feature maps formed for accurate detection.

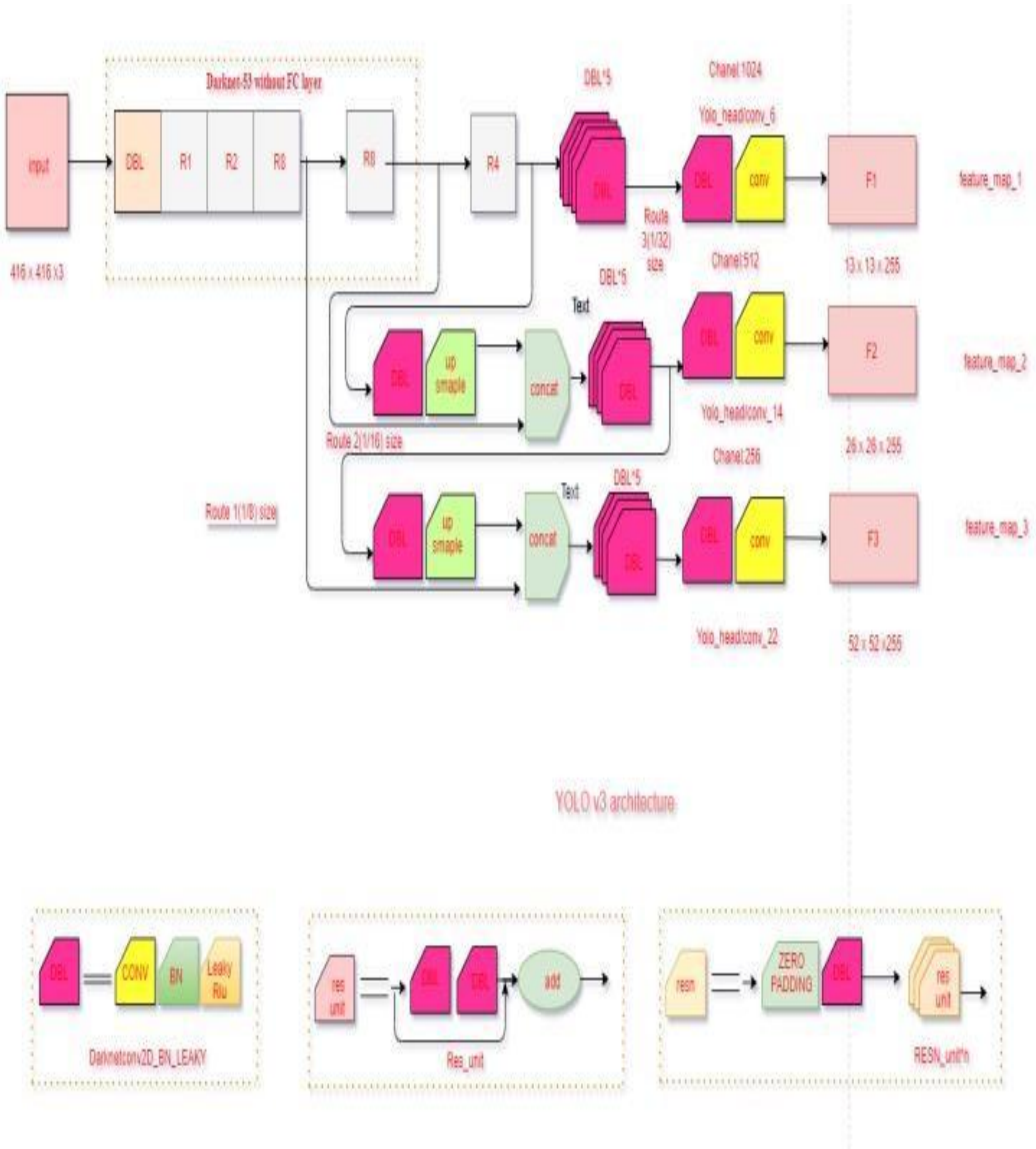

Fig 1 Architecture of YOLO

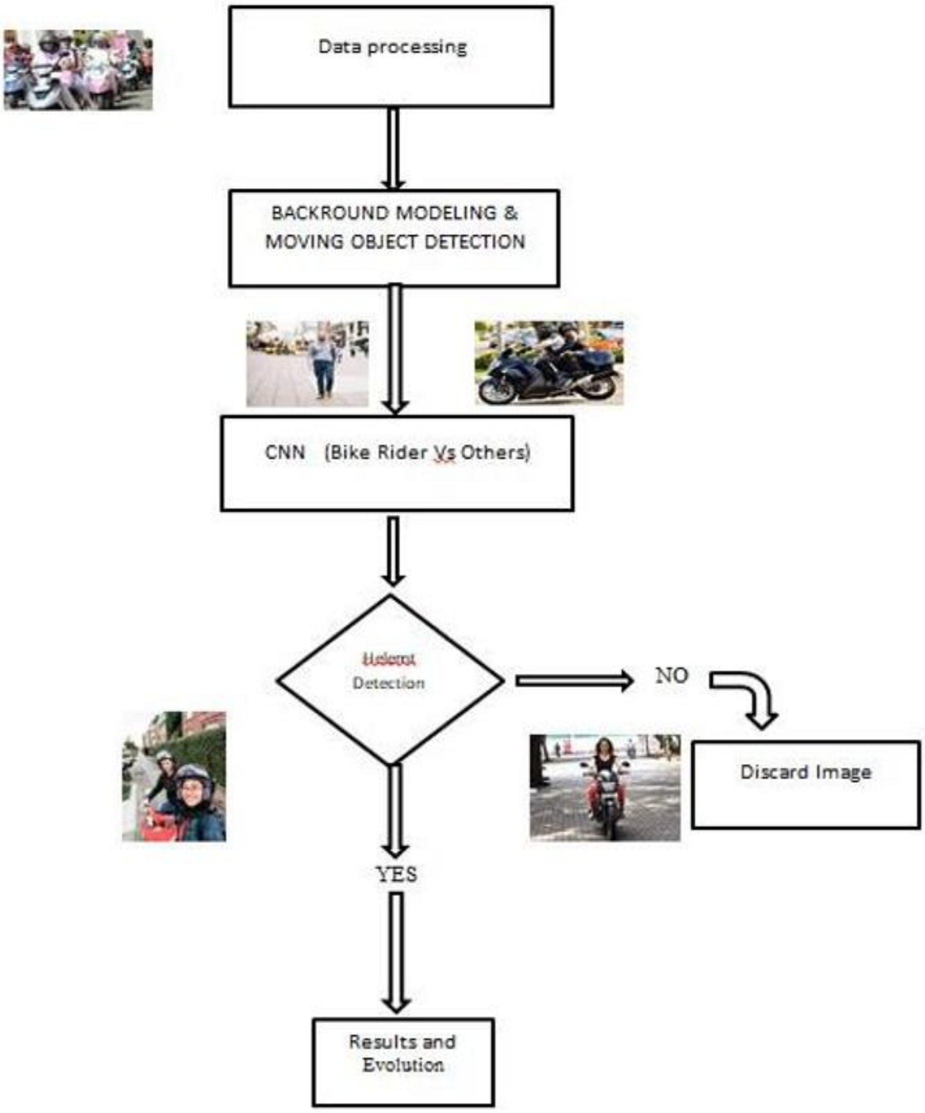

Fig 2 Flow chart of proposed method

Fig.3 Motor cycle riders wearingHelmetFig.4 Motor cycle riders notwearing Helmet

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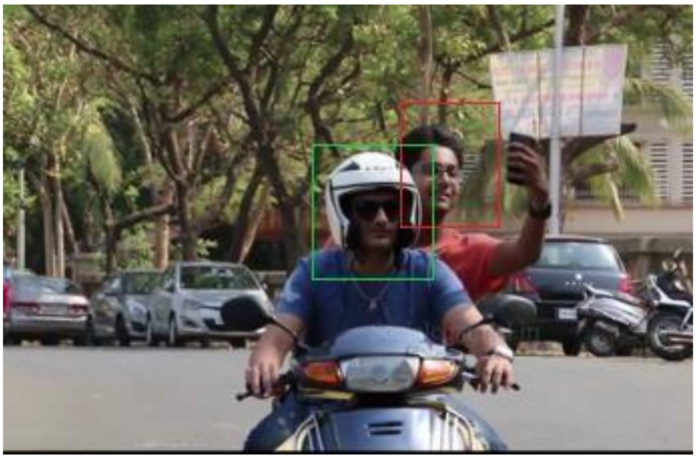

Fig.4 Bike rider wearing Helmet and pillion rider not wearing Helmet

Results and Discussion

Our experiment is performed on the non-GPU type computer. The processer is an Intel Core i5 2.0 GHz CPU and8 GB RAM. To work on our proposed model, we choose Python for code part, OpenCV 3.0 is utilized as a computer vision library, one of the top most popular neural network framework known as Darknet, and multiple libraries required used in evolving and obtaining accurate results. 45 minutes of traffic video is recorded using surveillance cameras and we took it as the primary data set. We utilized some internet images of bike riders are also considered for testing purposes and to train the framework. Almost among 200 motorcyclists, 192 motorcyclists are successfully identified that shows an accuracy of up to 96% which is far better and allowed when differentiated with other methods. The required dataset is prepared by combining web based bike rider images and real-time traffic images from cropping the pictures from surveillance video. The first 20 minutes of video and some of the web downloaded pictures are took into consideration for the network. 10 minutes video is used to checking and confirmation of the network.

Table 1 Comparison (%) Accuracies of Different pre implemented techniques of Detection of Helmet

Technique	Accuracy(%)	Performance of detecting Helmet(%)	Performance of detecting NoHelmet(%)
YOLOv3	96.2	99.28	99.23
YOLOv2	94.11	98.78	98.81
R-CNN	94	91.65	91.45
SVM	92.6	81.81	81.83

If we look into the mentioned table it shows the variance between different techniques used for detection of helmets, The perfect accuracy is obtained in the YOLO3 model which was proposed by us for this project. When compared to other method accuracies YOLO3 is gave the wonderful outputs.

TABLE 2 Respective false rates of different techniques

Technique	Low false rate
YOLOv3	0.001 – 0.1
YOLOv2	0.0010
RCNN	0.0011
HOG SVM	<0.5

The table 2 draws a comparison of the false rate of multiple techniques and the YOLO3 has minutiae false rate and most reliable than other techniques.

III. Conclusion and Future work

The implemented architecture of helmet detection has been tested and implemented multiple times and verified the accuracy every time. In our project, we proposed the YOLOv3 based Helmet identification and also studied completely about CNN. We used Jupiter notebook to execute the python program and we successfully compiled the program. We also worked on some applications and the framed future scope of the project.

Our project can be combined with the road traffic cameras and with some modifications of software and if possible, developing an app it can be implemented to recognition helmets automatically in the real-time system. Furthermore, we can further map this to the automatic license plate identification and make a software that generates challans for not wearing helmets.

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