Automatic Motorcyclist Helmet Rule Violation Detection using Tensorflow & Keras in OpenCV

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***Abstract*— Motorcycle accidents have been hastily growing throughout the years in several countries because road safety is often neglected by riders worldwide leading to accidents and deaths. To address this issue, most countries have laws which mandate the use of helmets for two-wheeler riders so, it is very important for motorcyclists to understand the risks of riding without a helmet. Riders who do not wear helmets are at greatest risk of suffering a traumatic brain injury; if they met with an accident without protection, the head is susceptible to a harrowing impact in an accident. In India, there is a rule that mandate helmet only for riders but not even for passengers. Anyone may suffer from accident or head injuries whom are using motorcycle without helmet. It should be mandatory for everyone to wear helmet; even for children. So, to mandate this we have developed a system which is based on Tensorflow & Keras in the field of Computer Vision. System is able to detect whether motorcyclists wear helmet or not even at real time. If anyone of them is present with no helmet then system will precisely observed the situation and declare the rule violations. The system can be implemented in malls, offices, marts, school and college that only allows people to enter the premises only after detecting helmet with automated barrier. It will definitely affect the use of helmet that will save humans life at all.**

Keywords*— *Motorcycle Accident, Helmet Detection, Tensorflow, Keras, OpenCV, Road Safety, Rule Violation.

I. INTRODUCTION

A helmet aims to reduce the risk of serious head and brain injuries by plummeting the impact of a force or collision to the head, motorcyclists must take extra precautions to protect their body. Riders and passengers wearing helmets increase their possibility of survival appreciably over non-helmet wearers. According to the law, every motorcyclist must wear a helmet while riding the motorcycle. But many bikers ignored and use their vehicle without defence apparatus. The policeman tried to control this problem manually but it is inadequate for the real state of affairs. Recently helmets have been made mandatory, but still, people drive vehicles without helmets. The amount of deaths has been expanding every year, especially in developing countries as helmets are the main safety equipment for motorcycle drivers as well as passengers, but many drivers do not use them. Wearing a helmet is the most effective way to reduce head injuries and fatalities arising from motorcycle and bicycle accidents. Motorcycle drivers who do not wear helmets are at a greatly risk of sustaining head injuries and dying from these injuries. In addition, riders who do not wear helmets impose additional costs on hospitals, while the cost of disability resulting from these head injuries is at an individual, family, or career and social level. Generally helmets are mandatory for riders only as per the Indian Road and Safety Department.

Fig. 1. Helmet Norms Violation [1]

Fig. 1 shows the norms of helmet use in every cities for the safety of motorcyclist. It should be madatory for passanger also which is missing in the figure that could be append in road and safety rules.

Fig. 2. Helmet Norms Indeed [2]

Fig. 2 shows the actual norms that should be followed by everyone for better satefy. There are various premised where proposed system can be implemented that can mandate the use of helmet if arrival is not entertained without helmet. It can be implemented if a barrier is associated with the system that can only open once no violation has been detected. It may force the riders to wear helmet with their passangers at any costs. The proposed system is able to detect head with helmet and without helmet for better prediction and decision making. Even after increasing the penalties over rule violations may not discover the solutions regarding use of helmets in people.

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There should be alternative way that can force public to use helmet with their families and cure about the lives any how.

II. Related Works

A. Related Works

G. Sasikala et al. [3] proposed a system which is based RF transmitter and receiver that enhance the feature of helmet and provide extra protection while accidents. It may increases the cost of helmet and does not provide a solution that could mandate the use of helmet for every riders or non riders. Narong Boonsirisumpun et al. [4] proposed a system which is based on convolutional neural network. System is able to classify the helmet and motorcycle using CNN, but CNN is limited with training samples that restricted if a person is using different kind of helmet or if girls cover her face may detected as helmet that may increases the false recognition rate. Liang-Bi Chen et al. [5] proposed a system which is based on IR sensors that proposes an intelligent helmet with heavy vehicle detection to aware the riders to not to be a part of any casualties. Here system uses camera on helmet's back side for recognizing heavy vehicles that approaches. Mario Andres Varon Forero et al. [6] proposed a system which is based on convolutional neural network and background subtraction approach that may highlight the riders with helmets. Helmet has been classified using support vector machine and samples of training data. The accuracy of the system is bit good but system may not work for various situations specially that encounters in India such as use of clothes over face, passengers with no helmet etc. Rohith C A et al. [7] proposed a system which is based on CNN that is able to detect two wheelers with helmet and no helmet. So as per the earlier discussion CNN is limited with the samples and most of the distinct situation cannot be handled using this technique. Detecting multiple helmet and persons head along with motorcycle is a challenging task.

III. Problem Identification

Rohith C A et al. [2] uses traffic cameras in the desired location for shooting or detecting the motorcycle. System creates bounding boxes over the two wheelers around it and crops the frames then CNN has been applied for classifying whether the rider is with helmet or not. If helmet has been detected then system will consider there is no violation at all. System has been trained with various samples of helmets and bikes. Caffe model has been used for detecting objects from video frame. System is lacking when a rider comes with clothes over his face without helmet. System may get confuses because there is no training for classifying head and helmet at all.

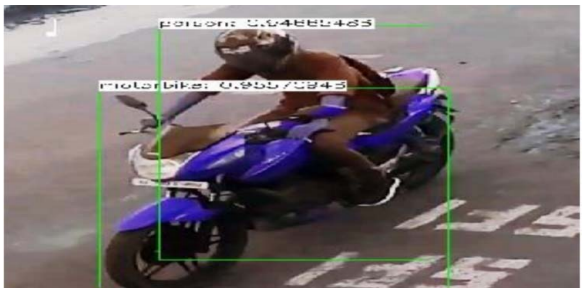

Fig. 3. Output Snapshot [7]

There is no multiple head or helmet detection algorithm that can classifies the rule violators where helmet is mandate for every two wheeler riders and non riders who are along with the bikes. System achieved 86 % of accuracy for correctly detecting two wheeler with helmets and no helmets.

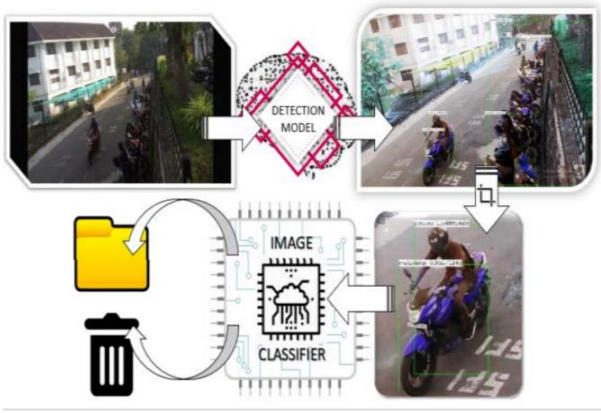

Fig. 4. System Overview [7]

IV. Proposed Work & Implementation

The proposed system is capable of identifying motorcycle with helmet and no helmet. System uses tensorflow for recognizing helmet and motorcycle at real time with high level of accuracy. Tensorflow is precompiled library developed by Google Brain team that is capable enough to classify various objects in a single frame. System also uses Keras API that is running over Tensorflow. Both Tensorflow and Keras work with python effectively. Keras also compiles model with loss and optimizer functions, training process with fit function. System is able to detect head also for classifying motorcyclist with no helmet. Here, system may lead with various situations such as- a motorcyclist may or may not have helmet whether he is not with any passenger, a motorcyclist may have passengers with helmets or may not and a motorcyclist may cover his face with some cloth that should be considered as no helmet. All these situations can be handled by proposed system with effective precision rate.

Fig. 5. State of Helmet Praxis [8]

Fig. 5 shows the state of helmet praxis where both the persons use helmet for their safety concerns that should be followed by everyone and it can be detected as non violation investigation. There is another state where people use a piece of cloth over the face where helmet may exist or not that could be detected accordingly.

Fig. 6. State of Covering Face without using Helmet [9]

Fig. 7. State of Helmet without Covering Head [10]

YOLO is the fastest to train and detect a wide variety of objects. We need to think about the scenario where we are going to use it. Especially when it comes to the image, there are several factors that affect the accuracy of the object detection model. This can be the intensity of light, the camera angle from where the image / video is being captured, the background of the images, and more. So the first step is to identify the problem and think about its use cases. Once we are done with this we can move the training model forward.

A. Proposed Algorithm

Require: D as dataset, μ as mean, N is total no. of dataset, xi is an individual value, f as mantissa, e as biased exponent, s as sign bit, W & b as output parameters
Input: Datasets
Output: Probability
Step 1. Import or generate data
$D = \{x_n, y_n\}$ is a dataset
Step 2. Transform and normalize data by mean, standard deviation and float to integer

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

$$Where\ \mu\ is\ mean, N\ is\ total\ no.of\ dataset,$$
$$x_i\ is\ an\ individual\ value$$
$$(1-2s) \times (1+f) \times 2^e$$
$$s\ is\ the\ sign\ bit\ (0\ or\ 1), f\ is\ the\ mantissa$$
$$and\ e\ is\ the\ biased\ exponent$$

Step 3. Set Parameters W and b as tensorflow variables for result
Step 4. Built Computation Graph by initializing weights and biases
Step 5. Declare Keras as Loss Function
Step 6. Initialize and Train Model to better predict our data
Step 7. Evaluate the Model //Testing Phase
Step 8. Predict Outcomes & Declare Result
Step 9. End

B. Flow Chart

Flow chart represents the process model for recognizing helmet with optimal prediction level. First of all data has to imported for execution and once the data imported it is required to normalize data as per the system compatibility then parameters are to be declared for Tensorflow variables. Our algorithm usually has a set of parameters that we keep constant during the whole process. For example, it can be number of iterations, learning rate or other specific parameters of our selection. It is considered a good form to start it together so that the reader or user can easily find them. After we have the data, and initialized our variables and placeholders, we have to define the model. This is done by building a computational graph. We tell Tensorflow what operations must be done on the variables and placeholders to arrive at our model predictions. After defining the model, we must be able to evaluate the output. This is where we declare the loss function. The loss function is very important as it tells us how far off our predictions are from the actual values.

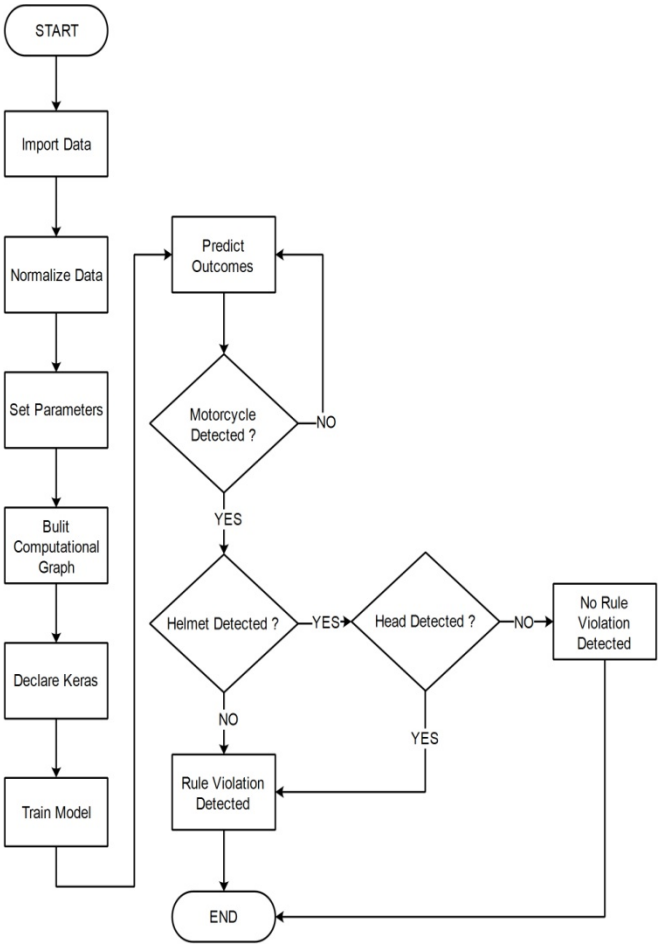

Fig. 8. Flow Chart

V. RESULT ANALYSIS

A. Result Simulation

The system has been tested with various frames that may belong from helmet, no helmet, head, head with weft and multiple head or helmet. The simulation is as follows-

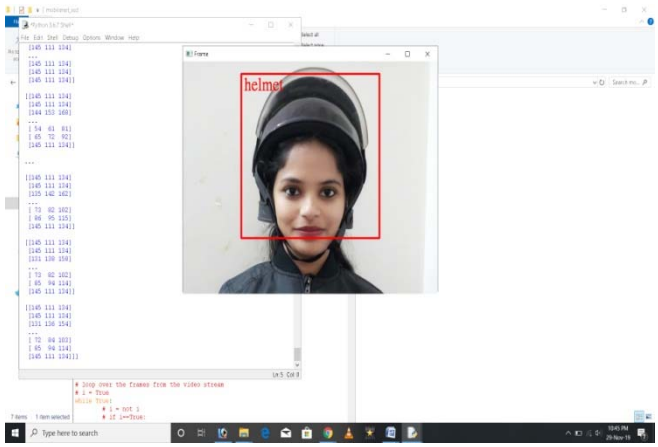

Fig. 9. Helmet Detection

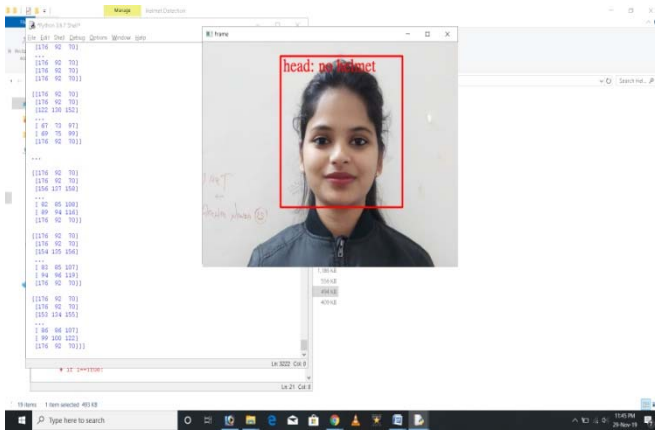

Fig. 10. Head Detection without Helmet

Fig. 9 & 10 represent helmet detection and head detection with no helmet respectively.

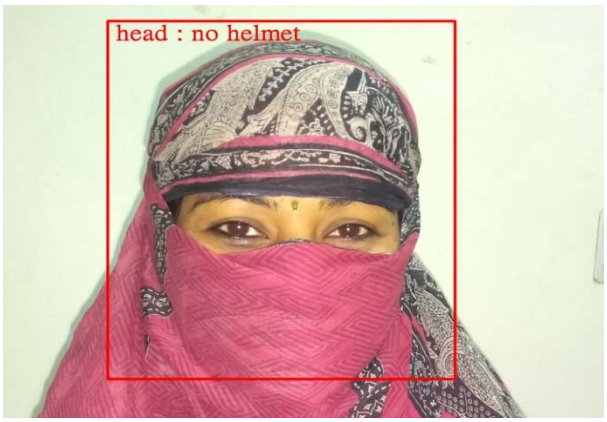

Fig. 11. Head Detection without Helmet

Fig. 11 shows there is womam with no helmet and her face has been covered by weft that is detected by the system precisely. Here the violation is recognized by the system.

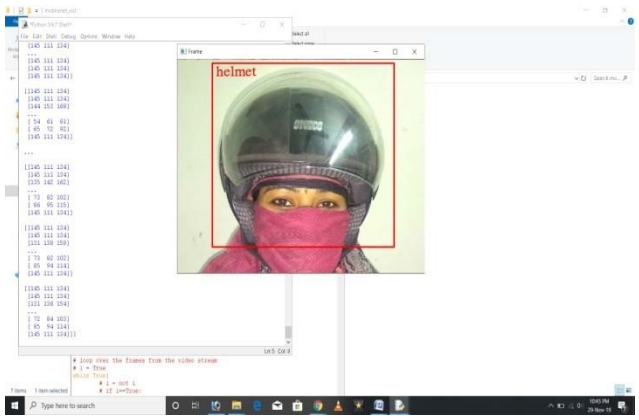

Fig. 12. Helmet Detection even Face Covered

Fig. 12 shows how a helmet has been detected by the system even face is covered. It means that if there is a single person in a frame and helmet is detected instead of head, it means that there is no violation detected by the system. But if there are more than one person in a frame along with motorcycle and head is detected with helmet; it means that rider may have helmet but passenger is without helmet that violate the rules as per the norms.

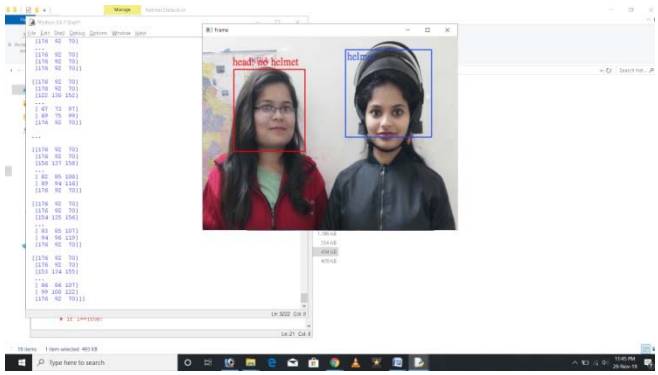

Fig. 13. Head & Helmet Detection with Multiple Person

System has been also tested with multiple persons in a single frame with helmet and without helmet. System is capable enough to recognize the results precisely.

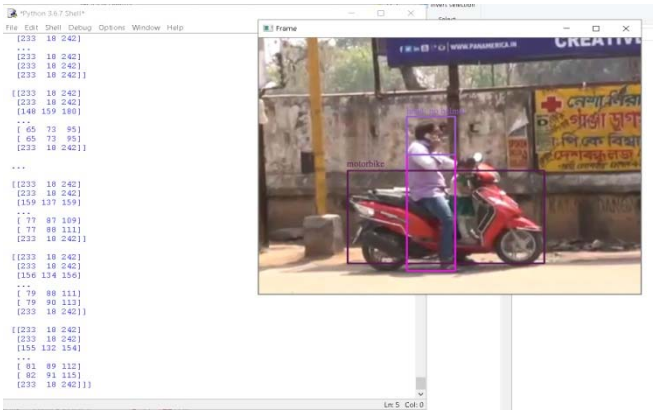

Fig. 14. Motorcycle and Head Detection with no Helmet

The result is obtained and computed over correct recognition and incorrect recognition. There are 50 as total testing classes that have been tested where 10 head images without weft for head detection without helmet, 10 head

images with weft for head detection with weft along with helmet or not, 10 images with helmet for helmet detection, 10 motorbike images for motorbike detection and 10 images with two person with helmet and no helmet respectively. The result is as follows- 49 as correct recognition and 1 as incorrect recognition. Error has been encountered in a frame where a woman wear weft without helmet and system detected helmet instead of head. So, overall accuracy has been calculated as 98 %.

Table No. I Result Analysis & Comparison

Terms	Correct Recognition	Incorrect Recognition
Proposed	49	1
Total = 50	Accuracy = 98 %	
Rohith C A [7]	Proposed	
86 %	98 %	

VI. Conclusion & Future Scope

The proposed system is very much capable for detecting helmet in all certain situations with high level of accuracy. Here the system has been tested with various frames and result is effectively obtained with minimal error rate. Tensorflow and Keras are two main packages that allow to train a system with certain circumstances that affect the accuracy at very good extents. The proposed system can be practically implemented in various places such as school, colleges, offices, shopping mall, marts and various public places that mandate the person to use the helmet with their family and friends at better safety concerns. System can be enhanced in future by testing various samples and can be trained for other situations where traditional systems may become failed.

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