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Driver Fatigue Detection using Deep Learning

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ABSTRACT

Fatigue driving is becoming a dangerous and widespread occurrence for drivers, and it is a key contributor to deadly car accidents. To detect tiredness in drivers, machine learning researchers used a variety of sources of data. The morphological features of both the eye and mouth regions were combined in this work, which looked at the fatigue detection problem in terms of feature quantities, classifiers, and modelling parameters. This particular YOLO model is trained to detect two classes. They are "eyes_open" and "eyes_closed". As soon as the model detects that a person is closing his/her eyes it rings an alarm to alert the driver and passengers.

Keywords—*YOLO, CNN, FCN, Filter, Bounding Box*

1. INTRODUCTION

Automobiles have come a long way in recent years. Having an automobile has become a necessity. This also increases the threat of road accidents. To minimize these accidents, the government has introduced multiple policies. Yet, road accidents are still one among the main threats to life safety. lack of awareness, drunk driving, and fatigue driving are the main factors that cause traffic accidents. Fatigue driving is one of them, accounting for 14 percent to 20 percent of traffic accident causes. NHTSA (National Highway Traffic Safety Administration) conducted a survey, which said 70% of the drivers reported fatigue driving. This paper focuses on developing a deep learning model which could track driver's eyes and alert the driver as well as passengers if the driver's eyes are closed.

2. LITERATURE REVIEW

Create a facial feature triangle (FFT) based on facial area characteristics and coordinates and then a face feature (FFV) vector with the whole area and center. To evaluate whether a driver is fatigued, FFV is used as an indicator [1].

Submitted a CNN-based emotion detection method to identify aggressive driving, using NIR light and thermal camera sensors, with input images of the driver's face. An experiment is carried out in this study using their own database, which provides a high level of classification accuracy for identifying driver emotion, which can lead to aggressive or smooth driving [8].

Introduction to the Eye Feature Vector (EFV) and the Mouth Feature Vector (MFV) which use the Dlibs toolkit to evaluate the eye and mouth of drivers. Check the state of the driver's eyes, how frequent the eyes are blinked, and yawn as well to determine his or her exhaustion level [5].

Data from 72 people driving is used to validate the Dynamic Bayesian Network technique. Under design parameters that favor sleepiness detection, the system performed well at various conditions. The method minimizes false positive rates in highway and rural areas where the light, shadows, etc differ from normal scenarios. These are the ones which cause problem for vehicle-based detection systems, when these parameters are used [10].

Review of deep learning algorithms for detecting driver tiredness based on behavioral measures. Faces provide information that can be utilized to estimate sleepiness levels. Many facial features can be derived from the face to determine the level of tiredness. Eye blinks, head movements, and yawning are examples of these [6].

This research focuses on sleepiness detection system that focuses on the driver's anomalous behavior. Driver drowsiness can be recognized early enough by observing blink patterns and eye movements. A nonintrusive driver sleepiness monitoring system has been built employing computer vision techniques in the proposed system. According to the simulation results, the system was able to detect tiredness despite the driver wearing spectacles and the amount of darkness inside the vehicle. Additionally, the device is capable of detecting drowsiness in less than two seconds. The discovered aberrant behavior is remedied in real time through alarms [11].

3. METHODOLOGY

Python is utilized to assemble the product. The tensor flow library from Google is utilized to build neural networks. The dataset is used to train the model to recognize if the eyes are

closed or not. After the model is trained it will be able to distinguish between closed eyes and opened eyes. If the eyes are closed an alarm rings to alert the driver and passengers in vehicle.

3.1 Data collection

Over thousand images were captured from the webcam. A few images were extracted from the video files.

3.2 Data pre-processing

The images are then annotated using LabelImg tool. This creates a text file for each image which contains co-ordinates of bounding box and the label (class). In this case there are only 2 classes.

3.3 Model training and testing

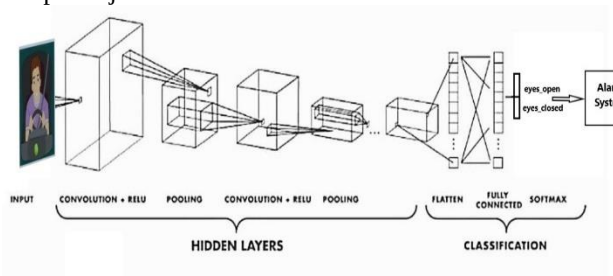
This task is aimed at training the model in order to predict eye status. The images are resized to 416 x 416 x 3 and sent to the CNN model to tune the model for the desired task. Later the testing data is used to test the tuned model for correctness.

4. SYSTEM ARCHITECTURE

To train the model, we must provide it with the labelled data. Suppose we have divided the image into a grid of size N X N and there are a total of 2 classes which we want the objects to be classified into. In this case the classes are eyes_open, and eyes_closed respectively. So, for each grid cell, the label y will be a seven-dimensional vector.

Pc	**Pc** – Probability of a class present in the cell
Bx	**Bx** – X co-ordinate of object's midpoint w.r.t grid cell
By	**By** – Y co-ordinate of object's midpoint w.r.t grid cell
Bw	**Bw** – Bounding box width
Bh	**Bh** – Bounding box height
C1	**C1** – Class 1 (eyes_open)
C2	**C2** – Class 2 (eyes_closed)

If there is no object in the grid cell, Pc value will be zero. Other values in the vector will be ignored. If there is an object, Pc will be equal to 1. Other values will be calculated accordingly. YOLO takes the midpoint of the object and assigns it to the grid-cell in which the midpoint is present. The C1, C2 will be 1 if object belonging to that class is present. Otherwise, zero. The shape of output is N x N x 7. By using IoU it is possible to say that the predicted bounding box is good or bad. To deal with multiple objects anchor boxes are used.



The output N x N x 7 is flattened and fed to a fully connected layer to predict the classes. After predicting the classes. If the eyes are closed, an alarm rings to alert the driver and passengers.

5. PERFORMANCE ANALYSIS

When it comes to evaluating a computer vision model MaP (Mean average precision) is one of the popular metrics. The same has been used here as well.

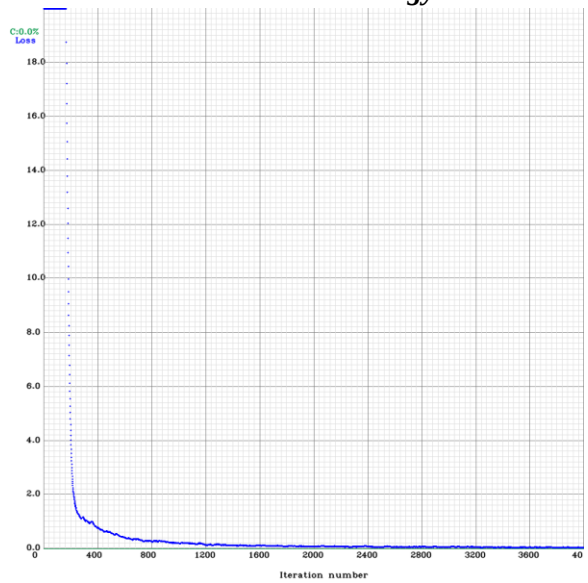


Fig. 1. Loss vs Iterations

5.1 Testing

A training set containing 120 images was prepared and the model was tested on it.

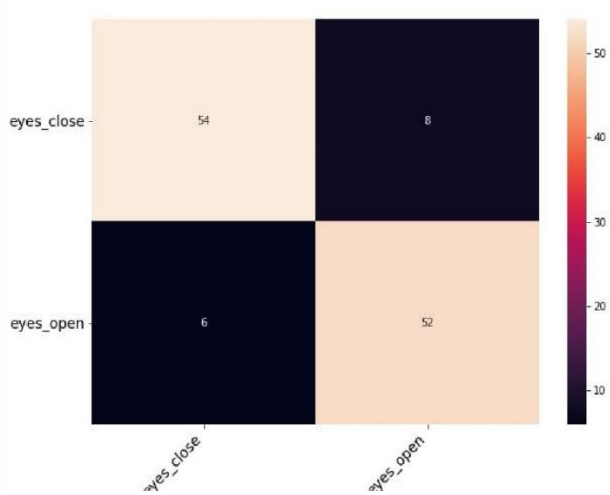


Fig. 2. Confusion Matrix

X-axis - Predicted Values
Y-axis - Actual Values
eyes_closed - 54/62 predicted accurately
eyes_open - 52/58 predicted accurately

Table.1. Classification Report

	Precision	Recall	F1-Score	Support
eyes_closed	0.90	0.87	0.89	62
eyes_open	0.87	0.90	0.88	58
Accuracy			0.88	120

Number of Images used in the dataset:

Eyes Open - 58 Images
Eyes Close - 62 Images
So, all the images totaling to 120 images. Of which the precision of eyes closed is 90% and the precision of eyes open is 87%.

6. CONCLUSION

Sleepy driving may have serious repercussions on driving skills and serious threats to passengers and drivers. Currently, fatigue driving detection has improved study outcomes, but still flaws exist, such as excessive intrusiveness, poor detection performance in complicated surroundings, and simplistic

assessment indicators need to be addressed. Based on the results obtained it can be said that the proposed model can be used to detect sleepy drivers by setting up a camera in vehicles. Thus, alerting the passengers and drivers in well advance.

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