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DRIVER DROWSINESS DETECTION SYSTEM

Aishwarya Amangi, Aishwarya Mahajan, Mrudula Huddar, Pranali Kurumkar

Department of Computer Engineering Marathwada Mitra Mandal College Of Engineering

ABSTRACT

Drowsiness and Fatigue of drivers are amongst the significant causes of road accidents. Every year, they increase the amounts of deaths and fatalities injuries globally. In this paper, a module for Drowsiness Detection System is presented to reduce the number of accidents due to drivers fatigue and hence increase the transportation safety. this system deals with automatic driver drowsiness detection based on visual information and Artificial Intelligence. The system is capable of capturing real-time facial landmarks of the drivers. Firstly, face region is detected using the optimized Haar-like feature detection scheme; secondly, we apply horizontal projection of the detected face and geometrical position of the eye on the face to get the eye region; finally, a new complexity function with dynamic threshold to identify the eye state. The method in our paper makes better balance between accuracy and efficiency than lots of other methods.

Index Terms*: Machine Learning, Dlib , Haar Cascade classi- fier, Open CV etc.*

1. INTRODUCTION

Many researchers have been done on measuring the fatigue degree of drivers' physiology. A new approach towards auto- mobile safety and security with autonomous region primarily based automatic automotive system is projected during this conception. According to the National Highway Traffic Safety Administration, every year about 100,000 police-reported crashes involve drowsy driving . These crashes result in more than 1,550 fatalities and 71,000 injuries.

The real number may be much higher, however, as it is difficult to determine whether a driver was drowsy at the time of a crash. So, in order to make the driver aware before any such accident occurs, we have made this system. It predicts the eye and mouth landmarks in order to identify if a person is falling asleep, by checking if his eyes are closed or if he is yawning. Detection of fatigue involves the observation of eye move- ments and blink patterns. Driver drowsiness detection is a car safety technology which prevents accidents when the driver is getting drowsy. Various studies have suggested that around 20percent of all road accidents are fatigue-related, up to 50percent on certain roads. Driver fatigue is a significant factor in a large number of vehicle accidents.

Fortunately, people in drowsiness produce several typical visual cues that can be detected on the human face:

- Yawn frequency,
- Eye-blinking frequency and eye-gaze movement,
- Head movement and,
- Facial expressions.

There are several machine learning algorithms which were proposed by a lot of researchers to autonomously detect the driver dozing off. These algorithms employee the features that are relevant for classifying the driver drowsiness based on the eye aspect ratio, mouth aspect ratio. There a lot of features that can be employed to detect the driver being drowsy or not based on large attributes like lane detection, drivers pulse and driver's heart rate, steering patterns etc. These are some methods in which the driver will not be obstructed and disturbed. As the pervious researches also specify various methods which employee the mental features to detect the driver's fatigue while he is driving the vehicles.

As there is no clear indication to detect the driver being fatigue or drowsy, we can use the basic features as the eyes and mouth which can be easily identified to detect the drowsiness and the fatigue, based on closing the eye for more than the time required to blink the eye and the yawning which are some sort of indication.

2. PROPOSED METHOD

In the proposed method, as the video is captured by a camera which is placed in front of the driver. And from that video frames were extracted to get the 2D images. And the Face is detected in the frames using ”Haar cascade classifier” or ”dlib” library along with the predictor algorithm which is logistic regression for object detection. As from the extracted images the facial landmarks were detected and from that the eye aspect ratio and mouth aspect ratio is computed. Using these calculations and some of the machine learning algorithms the decision is made whether the driver is drowsy or not.

3. METHODOLOGY

This paper focuses on two libraries”OpenCV” and ”dlib” and also on a mathematical concept called eye aspect ratio (EAR):

A) Image Acquisition:

Image acquisition is used to convert input image into an array of numerical data then it is used for processing on a computer. In the first step, acquire the recorded video of a driver face as a input and is convert into image frames stored in dataset. Each of these frames are extracted and processed separately.

B) Image Preprocessing:

Image pre-processing step mainly improves the input im- age which suppresses unwanted distortions in an image or enhances image features that are mainly important for processing.

C) OpenCV:

OpenCV means Open Source Computer Vision Library. It is an open source library used for computer vision and machine learning functions. OpenCV is written in C++ and has cross platform support. Its C++, Python, Java and MAT- LAB interfaces support Windows, Linux, Android, iOS and Mac OS. OpenCV was developed to provide a common tool for developing computer vision applications and to increase the use of machine perception in the commercial products. OpenCV aims towards real-time vision applications.

OpenCV uses machine learning algorithms to search for faces within a picture. the OpenCV cascade breaks the problem of detecting faces into multiple stages. For each block, it does a very rough and quick test. If that passes, it does a slightly more detailed test, and so on. The algorithm may have 30 to 50 of these stages or cascades, and it will only detect a face if all stages pass.

D) Artificial Neural Network (ANN):

ANNs are loosely based on biological neural networks in a sense that they are implemented as a system of interconnected processing elements, sometimes called nodes, each node in thenetwork takes many inputs from other nodes and calculates a single output based on the inputs and the connection weights. This output is generally fed into another neuron, repeating the process. The input layer receives the inputs and the output layerproduces an output. The layers that lie in between these two are called hidden layers. For example, if the network is givena task to recognize a face, the first hidden layer might act as a lie detector, the second hidden takes these lines as input and puts them together to form a nose, the third hidden layer takes the nose and matches it with an eye and so on, until finallythe whole face is constructed.

Fig. 1. Facial Landmark Detection

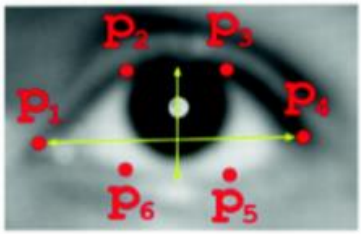

Fig. 2. Eye Aspect Ratio Points

E) Eye Aspect Ratio (EAR):

Eye aspect ratio is the ratio of height to width of the eye. If you notice, each eye is represented using 6 landmarks points. The EAR for a single eye is calculated using this formula:

$$EAR = \frac{||p2 - p6|| + ||p3 - p5||}{2||p1 - p4||}$$

Where, p2-p6 means distance between the points p2 and p6.

The more the EAR, the more widely eye is open. We would decide a minimum EAR value and used this to decideif the eye is closed or not. The value of EAR changes very quickly. Even if you blink your eye the EAR will drop quickly. But blinking does not mean drowsiness. Drowsiness would be a situation where a person has closed his eye(his EAR is very less) for let's say 10 consecutive video frames.So this variable tells the maximum number of consecutive frames in which EAR can remain less than MINIMUMEAR, otherwise alert drowsiness.

F) Haar Cascade Classifier:

Haarcascade file contains a number of features of the face, such as height, width and thresholds of face colors., it is constructed by using a number of positive and negative samples. For face detection, we first load the cascade file. Then pass the acquired frame to an edge detection function, which detects all the possible objects of different sizes in the frame. To reduce the amount of processing, instead of detecting objects of all possible sizes, since the face of the automobile driver occupies a large part of the image, we can specify the edge detector to detect only objects of a particular size, this size is decided based on the Haarcascade file, wherein each Haarcascade file will be designed for a particular size. Now, the output the edge detector is stored in an array. Now, the output of the edge detector is then compared with the cascade file to identify the face in the frame. Since the cascade consists of both positive and negative samples, it is required to specify the number of failures on which an object detected should be classified as a negative sample.

G) Play Alarm Beep sound:

Based on the parameters we found taking input image dataset, we could able to detect driver state weather he is sleeping state or active state. When the driver eyes (blink) i.e.,eye open and eye close is found based on the parameters we identify, our system gives us immediate warn beep alarm.. Firstof all, two constants are defined: threshold value and frame number limit. Threshold is fixed as 0.3 and the frame number limit is fixed to be 50. First, we'll setup a camera and checkfor faces. If a face is found, facial landmark detection will be applied and the eye regions will be extracted. Now we havethe extracted eye regions and this can be used to compute the eye aspect ratio to determine if the eyes are closed. Whenever the EAR is less then threshold, Count will be incremented by

1. Otherwise Count value will remain 0. If the Count value exceeds the frame number limit given, then an alarm will be sounded to wake up the driver. Else next frame will be captured by the camera. Inshort, whenever EAR remains lower than the given threshold for a sufficiently long period of time, the proposed algorithm assumes the driver to be drowsy and an alarm will be played

H) Convolutional Neural Network (CNN):

A Convolutional Neural Network (ConvNet/CNN) is a Deep learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects or objects in image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. A ConvNet is able to successfully capture the Spatial and Temporal dependencies in an image through the application of relevant filters. The architecture performs a better fitting to the image dataset due to the reduction in the number of parameters involved and reusability of weights. The CNN follows a hierarchical model which works on building a network, like a funnel, and finally gives out a fully-connected layer where all the neurons are connected to each other and the output is processed. Once we have an input image (28×28), a filter is run along all the pixels (rows, columns) of the image which captures

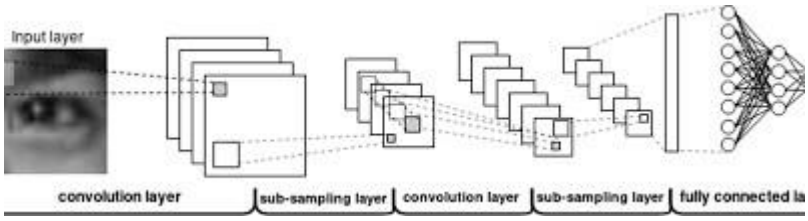

Fig. 3. Convolutional Neural Network

the data . This is passed on to the pooling layer where it performs a mathematical computation and gives out a specific result.There are four layered concepts we should understand in Convolutional Neural Networks:

1) Convolution,
2) ReLu,
3) Pooling and
4) Full Connectedness (Fully Connected Layer).

I) Comparative Analysis

TABLE I: Comparative analysis on various methodology

Sr.No.	Method	Classifier and Al-gorithm	Accuracy
1	Eye features,train the model usingdataset	Convolutional Neural Network(CNN)	97%
2	Eye features, train the model usingdataset	Artificial Neural Network(ANN)	67%

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