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A Real-Time Detection of Drowsiness/Sleepiness in Drivers Using Deep Learning

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ABSTRACT

The drowsiness of drivers is one of the significant causes of road accidents. Every year, there is an increase in the number of deaths and fatal injuries globally. By detecting the driver's drowsiness, road accidents can be reduced. The first-rate manner to keep away from accidents because of drivers' drowsiness is to come across drowsiness of the driving force and warn him before fall into sleep For this work, our premise is the following: a camera mounted on a vehicle will record frontal images of the driver, which will be analyzed by using artificial intelligence (AI) techniques, such as deep learning, and convolution neural networks(CNN) to detect whether the driver is drowsy or not. The system uses a small monochrome security camera that points directly towards the driver's face and monitors the driver's eyes in order to detect fatigue. In such a case when fatigue is detected, a warning signal is issued to alert the driver. This report describes how to find the eyes, and also how to determine if the eyes are open or closed. In this system, DeepLearning model will classify whether the person's eyes are 'Open' or 'Closed'. By using that information, the system will be able to alert the driver and prevent accidents.

Keywords: AI, images processing, CNN.

1.INTRODUCTION

Many of the accidents occur due to drowsiness of drivers. It is one of the critical causes of roadways accidents now-a-days. Latest statistics say that many of the accidents were caused because of drowsiness of drivers. Vehicle accidents due to drowsiness in drivers are causing death to thousands of lives. More than 30% accidents occur due to drowsiness.

For the prevention of this, a system is required which detects the drowsiness and alerts the driver which saves the life. In this project, we present a scheme for driver drowsiness detection. In this, the driver is continuously monitored through webcam. This model uses image processing techniques which mainly focuses on face and eyes of the driver.

The development of technologies for detecting or preventing drowsiness while driving is a major challenge in the field of accident avoidance system. Because of the hazard that drowsiness presents on the road, methods need to be developed for counteracting its affects. The aim of this project is to develop a simulation of drowsiness detection system. The focus will be placed on designing a system that will accurately monitor the open or closed state of the driver's eyes and mouth. By monitoring the eyes, it is believed that the symptoms of driver's drowsiness can be detected in sufficiently early stage, to avoid a car accident.

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Many researches have been conducted to implement safe driving systems in order to reduce road accidents. Detecting the driver's alertness and drowsiness is an efficient way to prevent road accidents. With this system, drivers who are drowsy will be alerted by an alarm to regulate consciousness, attention and concentration of the drivers. This will help to reduce the number of road accidents.

FIG 1.1 **THE PERSON IS IN DROWSY**

The analysis of face images is a popular research area with applications such as face recognition, and human identification and tracking for security systems. This project is focused on the localization of the eyes, which involves looking at the entire image of the face, and determining the position of the eyes, by applying the existing methods in imageprocessing algorithm. Once the position of the eyes is located, the system is designed to determine whether the eyes and mouth are opened or closed, and detect fatigue and drowsiness.

2.LITERATURE SURVEY

2.1 ELECTROENCEPHALOGRAPHY (EEG) FOR DROWSINESS DETECTION:

Electroencephalography (EEG) is a method that measures the brain electrical activity.It can be used to measure the heartbeat, eye blink and even major physical movement such as head movement. It can be used on human or animal as subjects to get the brain activity. It uses a special hardware that place sensors around the top of the head area to sense any electrical brain activity.

Among all the frequently used physiological signals, Electroencephalogram (EEG), a record of the electrical activities of the brain, showed the strongest relation with drowsiness.

An electroencephalogram (EEG) is a test used to detect abnormalities related to electrical activity of the brain. This procedure tracks and records brain wave patterns. Small metal discs with thin wires (electrodes) are placed on the scalp, and then send signals to a computer to record the results.

The disadvantages of this method are, it is very sensitive to noise around the sensors. when the person is doing the EEG experiment, the surrounding area must be completely silent. when the driver moves their head, the wire may strip off from their place.

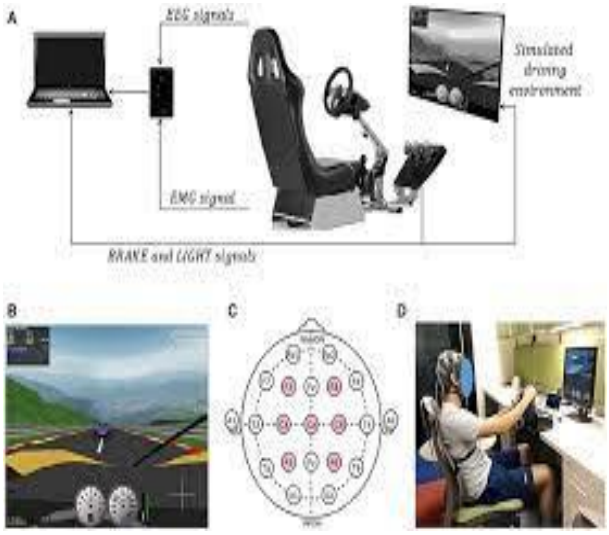

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FIG 2.1
ELECTROENCEPHALOGRAPHY (EEG) FOR DROWSINESS DETECTION

2.2 FUSION OF YAWNING AND EYE CLOSURE:

This part includes combining two factors to correctly decide on the level of drowsiness of the driver. As the above-mentioned techniques only analyze the factors independently, therefore there is lesser accuracy in the detection of drowsiness state of the driver. But by combining multiple factors, it is natural to assume that the certainty of the driver's state.

The driver's facial appearance is captured via a camera installed in the car. In the first step, the face region is detected and tracked in the captured video sequence utilizing computer vision techniques. Next, the eye and mouth areas are extracted from the face; and they are studied to find signs of driver fatigue. Finally, in a fusion phase the driver state is determined and a warning message is sent to the driver if the drowsiness is detected.

This technique increases the certainty of the drowsy state of the driver by detecting and combining two factors, i.e. eye closure rate and yawning rate, in the repeated successive frames. This leads to an even more accurate conclusion for drowsiness state as yawning along with increased eye closure signifies fatigue.

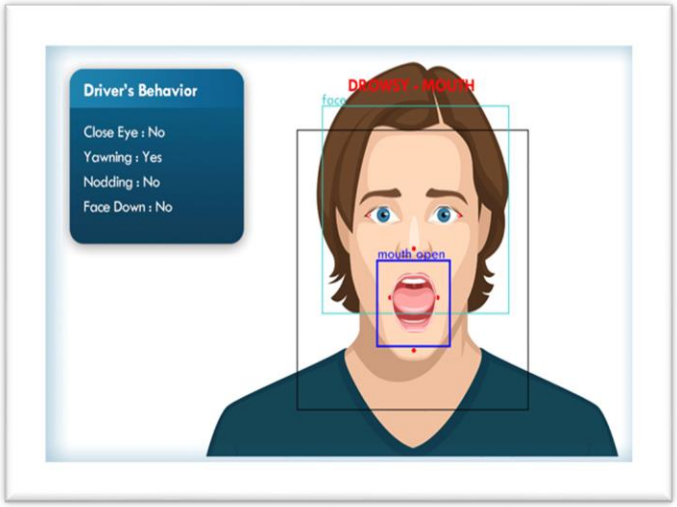

FIG 2.2 **FUSION OF YAWNING AND EYE CLOSURE**

3.METHODOLOGY

The methodology used to design the Drowsiness Detection System is an iterative research and analysis cycle. The research stage generates concepts and the analysis stage selects concepts, analyze requirements and constraints. In this technique eye banking frequency, head pose, etc. Of a person is monitored through a Camera and the person is alerted if any of these drowsiness symptoms are detected.

The various technology that can be used are discussed as:

TENSORFLOW:

It is open source software library for data flow programming across a range of tasks. it is a simple math library and is also used for machine learning applications such as neural networks. It is used for both research and production. Tensorflow computations are expressed a stateful dataflow graphs. The name

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Tensorflow derived from the operations that such neural networks perform on multidimensional data array. These arrays are referred to as "tensors".

TensorFlow is well-documented and includes plenty of machine learning libraries. It offers a few important functionalities and methods for the same.

TensorFlow is also called a "Google" product. It includes a variety of machine learning and deep learning algorithms. TensorFlow can train and run deep neural networks for handwritten digit classification, image recognition, word embedding and creation of various sequence models

COMPUTER VISION:

Computer vision is a process by which we can understand the images and videos how they are stored and how we can manipulate and retrieve data from them. Computer Vision is the base or mostly used for Artificial Intelligence. Computer-Vision is playing a major role in self-driving cars, robotics as well as in photo correction apps.

OpenCV:

OpenCV is an open-source computer source library available in python encoding to encrypt the visual skills of our smart pc. OpenCV was expected for computational capability and having a high focus on ongoing picture location and distinguishing proof. OpenCV is coded with streamlined C and can take work with multicore processors. If we need progressively programmed improvement utilizing Intel models [Intel]. These comprise of low-level schedules in different algorithmic regions which are streamlined. OpenCV therefore uses the IPP library, at runtime if that library is introduced.

CONVOLUTION NEURAL NETWORKS (CNN) :

The suggested system for detecting driver drowsiness is used in the Convolutional Neural Network (CNN). The pre-processing for CNN is much meagerer compared to others classification algorithms. CNN is a mathematical technique that usually consists of three kinds of pooling, convolution, and fully connected layers. The first two pooling layers are convolution handle extraction of features, and the third one is a completely connected layer, maps the characteristics extracted, such as classification, into the final output.

In CNN, which consists of a set of logical operations, such as convolution, A technical method of linear motion, the convolution layer plays a key role. In image data, two-dimensional arrays of pixel values are processed, and at each image location, a small parameter grid called the kernel and function extractor for optimization is added, making CNN"s highly effective for image processing since a feature can appear anywhere in the image. Extracted functionality will get more complex hierarchically and gradually as one layer feeds the output into the next layer. The way parameters such, as kernels are optimized is called planning. This can be achieved by a backpropagation and gradient descent optimization algorithm to minimize the discrepancy between outputs and ground truth marks.

The project uses a CNN model to predict whether a person feels drowsy or not based on whether the eyes are closed or open. The project's main objective was to limit the number of trainable parameters of the CNN model so that the system can be deployed on edge or computationally less efficient devices. The proposed model has a wide potential

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application area such as human-computer interface design, facial expression recognition, driver fatigue-sleepiness determination.

This method, which was developed on driver sleepiness data, has been applied on real eye images in the Closed Eyes in The MRL Eye Dataset. Commonly used CNN models are used on the same data to compare performances of the prepared model. According to the classification results obtained, 94.01% of the designed model achieved success and it is seen that this structure can be used in this problem area.

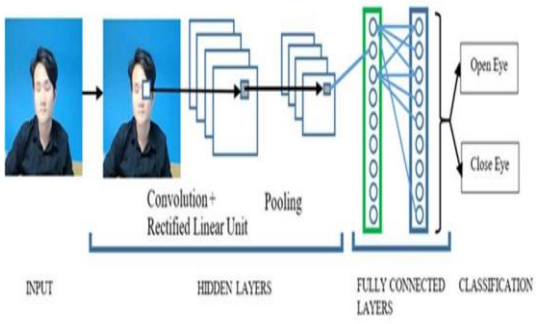

FIG 3.2 EYE-STATE-DETEC

WORKING OF ALGORITHM:

Step 1 – Take Image as Input from a Camera

With a webcam, we will take images as input. So to access the webcam, we made an infinite loop that will capture each frame. We use the method provided by OpenCV, **cv2.VideoCapture(0)** to access the camera and set the capture object (cap). **cap.read()** will read each frame and we store the image in a frame variable.

Step 2 – Detect the face in the image and create a Region of Interest (ROI).

To detect the face in the image, we need to first convert the image into grayscale as the OpenCV algorithm for object detection takes gray images in the input. We don't need color information to detect the objects. We will be using haar cascade classifier to detect faces. This line is used to set our classifier **face_cascade = cv2.CascadeClassifier(' path to our file: haarcascade_frontalface_default.xml')**.

Then we perform the detection using **faces= face_cascade.detectMultiScale(gray, scaleFactor= 1.2, minNeighbors=3)** .

It returns an array of detections with x,y coordinates, and height, the width of the boundary box of the object. Now we can iterate over the faces and draw boundary boxes for each face. **for (x,y,w,h) in faces : cv2.rectangle(frame,pt1=(x,y),pt2=(x+w,y+h), color= (255,0,0), thickness=3).**

Step 3 – Detect the eyes from ROI and feed it to the classifier.

The same procedure to detect faces is used to detect eyes. First, we set the cascade classifier for eyes and then detect the eyes using **eye_cascade = cv2.CascadeClassifier(' path to file: haar cascade_eye.xml file')**

then we perform this line **eyes= eye_cascade.detectMultiScale(gray, scaleFactor= 1.2, minNeighbors=3**).

we need to extract only the eyes data from the full image. This can be achieved by extracting the boundary box of the eye and then we can pull out the eye image from the frame with this code **for (ex,ey,ew,eh) in eyes : cv2.rectangle(frame,pt1=(ex,ey), pt2=(ex+ew,ey+eh), color=(255,0,0), thickness=3)** eye_cascade only contains the image data of the eye. This will be fed into our CNN classifier which will predict if eyes are open or closed.

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Step 4 – Classifier will categorize whether eyes are open or closed.

We are using CNN classifier for predicting the eye status. To feed our image into the model, we need to perform certain operations because the model needs the correct dimensions to start with. First, we convert the color image into grayscale using

gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY).

Then, we resize the image to eye by

eye= frame[ey:ey+eh,ex:ex+w]

eye= cv2.resize(eye,(80,80))

eye= eye/255

eye= eye.reshape(80,80,3)

Expand the dimensions to feed into our classifier by **eye= np.expand_dims(eye,axis=0)** .

We loaded our model using **model = load_model('path to the file : model.h5').**

Now we predict eye with our **prediction = model.predict(eye)** .

If the value of **prediction[0][0]>0.50** ,it states that eyes are closed,

if value of **prediction[0][1]>0.50** then, it states that eyes are closed.

Step 5 – Calculate score to check whether the person is drowsy.

The score is basically a value we will use to determine how long the person has closed his eyes. So if both eyes are closed, we will keep on increasing score and when eyes are open, we decrease the score. We are drawing the result on the screen using **cv2.putText()** function which will display real time status of the person. A threshold is defined for example if score becomes greater than the person's eyes are closed for a long period of time. This is when we beep the alarm using **sound.play().**

4.RESULT

Fig:4.1 shows the eyes were opened and nothing happened.

Fig:4.2 shows the eyes were close and alarm sound is buzzed.

5.CONCLUSION

Due to some reasons drivers refuse to take step back even when they know that they are suffering from fatigue, and will continue driving. Therefore, detecting drowsiness is important as one of the steps to prevent the road accidents. The project has a direct application in the automobile industry, makes drive safer, and reduces the death toll caused by drowsy driving.

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