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Driver Drowsiness Detection System

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Abstract- Drowsy driving poses a significant risk to road safety, leading to accidents with potentially severe consequences. To address this issue, we propose a driver drowsiness detection system utilizing yawning as a prominent indicator of driver fatigue. Yawning is a physiological response closely associated with drowsiness and can serve as a reliable marker for assessing driver alertness levels. Our system employs facial recognition and machine learning algorithms to detect and analyze yawning instances captured by vehicle-mounted cameras. Features such as yawning duration, frequency, and intensity are extracted and fed into a classification model trained to distinguish between normal behavior and signs of drowsiness. The detection of yawning is efficient and works under different situations. This project describes on how to detect the mouth in a video recorded from the. Within the video, the member will drive the driving reenactment framework and a camera will be setup in front of the driver. The video will be recorded using the webcam to record the moves of the driver. The image-processing model will detect the are of mouth and then capture the yawning from the frames generated from the video. The facial analysis is popular research areas these days, which is used for face recognition, tracking human for security, etc. This project is focused on the localization of mouth, which involves looking at the entire image of the face, and determining the position of mouth, by applying the existing methods in image- processing algorithm. Once the position of the mouth is located, the system is designed to determine whether the mouth is opened or closed, and detect fatigue and drowsiness.

Keywords- Driver safety; Drowsiness detection; Image processing; Alert system; facial analysis

I. INTRODUCTION

We believe that drowsiness can negatively impact people in working and classroom environments as well. Our solution to this problem is to build a detection system that identifies key attributes of drowsiness and triggers an alert when someone is drowsy before it is too late.

Figure 1 shows the statistic of road accident. The numbers of vehicles involved in road accident keep increasing each year. From Figure 1, car and taxi type of vehicles shows about nearly 400,000 cases of road accident has been recorded. It keeps increasing every year and by the year 2009, it shows the number of road accident was recorded by nearly 500,000.

The purpose of the drowsiness detection system is to aid in the prevention of accidents passenger and commercial vehicles.

- Driver drowsiness detection is a car safety technology which helps prevent accidents caused by the driver getting drowsy.
- Various studies have suggested that around 20% of all road accidents are fatigue-related, up to 50% on certain roads.

The main idea behind this project is to develop the system which can detect a drowsiness of the driver and issue a timely warning.

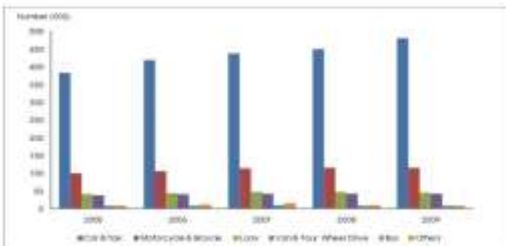


Figure 1: Statistic of Road Accident from 2005 to 2009

1. Contribution of Proposed System

The primary contributions of the proposed system are outlined as follows:

- Our proposed method is able to distinguish the simulated drowsy and sleepy states from the normal state of driving on the low resolution images of faces observed from an oblique viewing angle.
- Hence, our system might be able to effectively monitor bus driver's attention level without extra requirement for cameras. Our approach could extend the capability and applicability of existing vision-based techniques for driver fatigue detection.
- To detect driver drowsiness or not using CNN algorithm.

2. Organization of Paper

The structure of the remaining sections is illustrated in this section. Section 2 conducts a thorough exploration of relevant literature on drowsiness detection, offering essential research context and background. The article outlines the framework of the proposed system, presenting the methodology and design of our research in section 3. Section 4 provides insights into the collected data for the experiments, the experimental setup, and the outcomes, essential for validating our findings and conclusions in Section 5.

II. LITERATURE REVIEW

"Intelligent Driver Drowsiness Detection through Fusion of Yawning and Eye Closure" in this paper, Driver drowsiness is a major factor in most driving accidents. In this paper the author present a robust and intelligent scheme for driver drowsiness detection employing the fusion of eye closure and yawning detection methods. In this approach, 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. The experiments prove the high efficiency of the proposed idea.

"Drowsiness Detection and Alert System" in this paper, today's busy and hectic world, people are unable to get full rest and complete bedtime sleep. Due to this when they drive after a sleepless night, they end up dozing off while driving which can be very fatal. A lot of accidents are caused due to drowsy driving every year and it often goes undetected thereby leading to huge loss of lives and resources. The paper presented a system that detects drowsiness while driving and alerts the driver for the same. Such systems are available in high end cars only. The system uses the front camera of the driver's mobile phone placed in front of the driver. The detection of eyes closed is efficient and works under different situations, it uses camera of any normal android phone. Hence, we provide users with a cheap technology.

"A Smartphone-Based Drowsiness Detection and Warning System for Automotive Drivers", This paper presents a smartphone-based system for the detection of drowsiness in automotive drivers. The proposed framework uses three-stage drowsiness detection. The first stage uses the percentage of eyelid closure (PERCLOS) obtained through images captured by the front camera with a modified eye state classification method. The system uses near infrared lighting for illuminating the face of the driver during night- driving. The second step uses the voiced to the unvoiced ratio obtained from the speech data from the microphone, in the event

PERCLOS crosses the threshold. A final verification stage is used as a touch response within a stipulated time to declare the driver as drowsy and subsequently sound an alarm. The device maintains a log file of the periodic events of the metrics along with the corresponding GPS coordinates. The system has three advantages over existing drowsiness detection systems. First, the three-stage verification process makes the system more reliable. The second advantage is its implementation on an Android smart phone, which is readily available to most drivers or cab owners as compared to other general purpose embedded platforms. The third advantage is the use of SMS service to inform the control room as well as the passenger regarding the loss of attention of the driver. The framework provides 93.33% drowsiness state classification as compared to a single stage which gives 86.66%.

III. METHODOLOGY

1. ML Model Framework

Convolutional Neural Networks specialized for applications in image & video recognition. CNN is mainly used in image analysis tasks like Image recognition, Object detection & Segmentation.

There are Four types of layers in Convolutional Neural Networks:

Convolutional Layer

In a typical neural network each input neuron is connected to the next hidden layer. In CNN, only a small region of the input layer neurons connect to the neuron hidden layer.

Pooling Layer

The pooling layer is used to reduce the dimensionality of the feature map. There will be multiple activation & pooling layers inside the hidden layer of the CNN.

Flatten

Flattening is converting the data into a 1-dimensional array for inputting it to the next layer. We flatten the output of the convolutional layers to create a single long feature vector.

Fully-Connected Layer

Fully Connected Layers form the last few layers in the network. The input to the fully connected layer is the output from the final Pooling or Convolutional Layer, which is flattened and then fed into the fully connected layer.

System Architecture

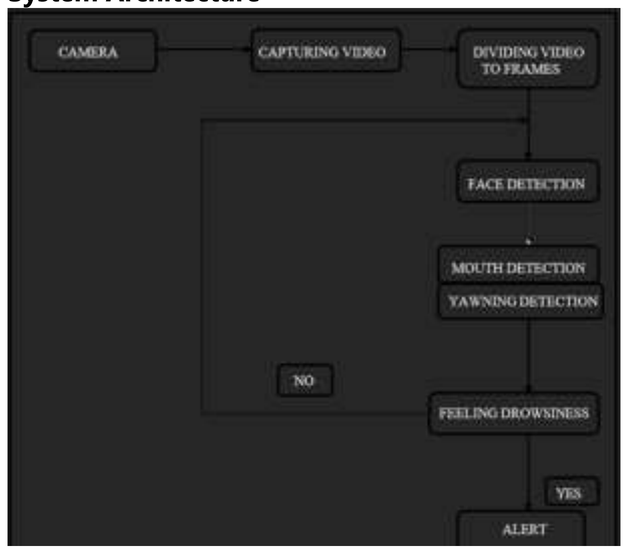


Figure 2: System Architecture

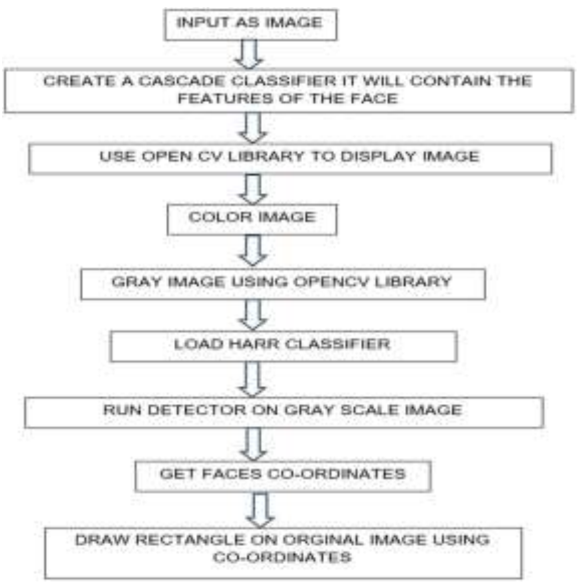
Data Selection

Kaggle was founded by Anthony Goldbloom and Ben Hamner in April 2010. Kaggle has implemented a progression system to recognize and reward users based on their contributions and achievements within the platform. This system consists of five tiers: Novice, Contributor, Expert, Master, and Grandmaster. Each tier is achieved by meeting specific criteria in competitions, datasets, kernels (code-sharing), and discussions.

The Driver Drowsiness Dataset (DDD) is an extracted and cropped faces of drivers from the videos of the Real-Life Drowsiness Dataset. The frames were extracted from videos as images using VLC software.

Data Preprocessing

This section focuses on the dataset description and preprocessing, etc., followed by the model development phase and finally the evaluation and comparison. The flow chart below depicts all the steps included in this study, starting from the literature review, then dataset selection criteria, data pre-processing, proposed model development, and finally, the analysis and evaluation of the results obtained via a variety of experiments. The dataset was obtained from public data sources like Kaggle, and after due preprocessing, the model was built. Though the dataset contains some demographic features like gender, age group, etc., they were not explicitly used in the analyses, like gender-based or age-group-based analyses.



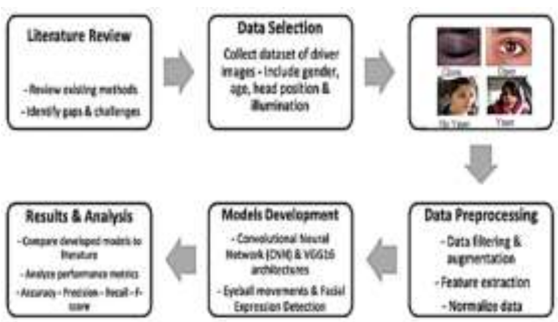


Figure 3: Methodological Steps

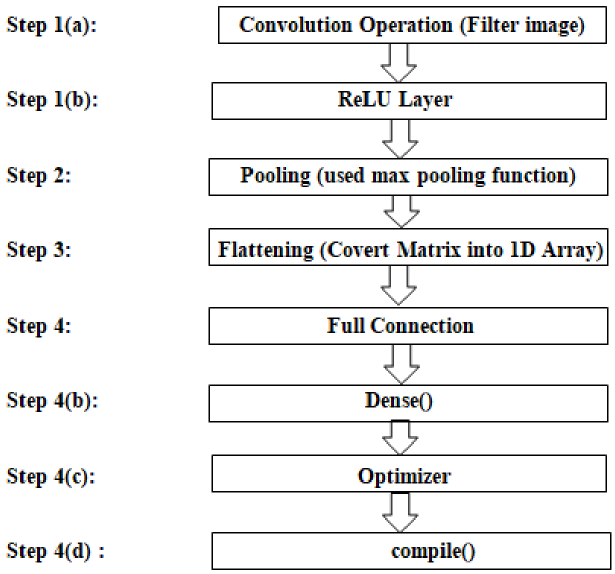
Parameter Selection

Haar Cascade Detection is one of the oldest yet powerful face detection algorithms invented. It has been there since long, long before Deep Learning became famous. Face detection using Haar cascades is a machine learning based approach where a cascade function is trained with a set of input data. OpenCV already contains many pre-trained classifiers for face, smiles, etc.

Table 1: Evaluation Parameters

Parameters	Description
Accuracy	Accuracy is a straightforward metric that gauges the frequency with which the classifier makes correct predictions. $$\mathrm{Accuracy} = \frac{\mathrm{TP} + \mathrm{TN}}{\mathrm{TP} + \mathrm{TN} + \mathrm{FP} + \mathrm{FN}}$$
Precision	Precision elucidates the proportion of correctly predicted positive cases among the cases predicted as positive. It becomes particularly relevant in situations where a higher emphasis is placed on minimizing False Positives compared to False Negatives. $$\mathrm{Precision} = \frac{\mathrm{TP}}{\mathrm{TP} + \mathrm{FP}}$$
Recall	It denotes the number of actual positive cases accurately predicted by our model. Recall becomes a pertinent metric in scenarios where minimizing False Negatives takes precedence over minimizing False Positives. $$\mathrm{Recall} = \frac{\mathrm{TP}}{\mathrm{TP} + \mathrm{FN}}$$
F-score	It provides a comprehensive understanding of both Precision and Recall metrics. Its highest value occurs when Precision equals Recall. $$\mathrm{F1-Score} = \frac{\mathrm{Precision} \times \mathrm{Recall}}{\mathrm{Precision} + \mathrm{Recall}}$$

The process of designing The Driver Drowsiness Alert Detection System is outlined in a concise step-by-step procedure as follows:



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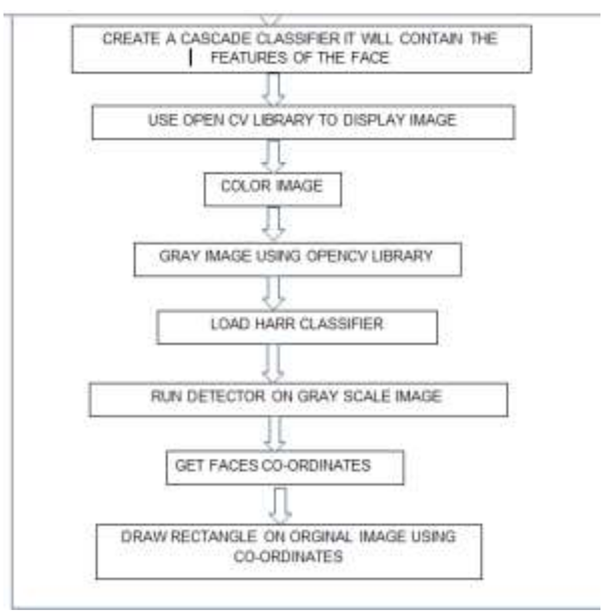

Figure 4: Process of Driver Drowsiness Detection

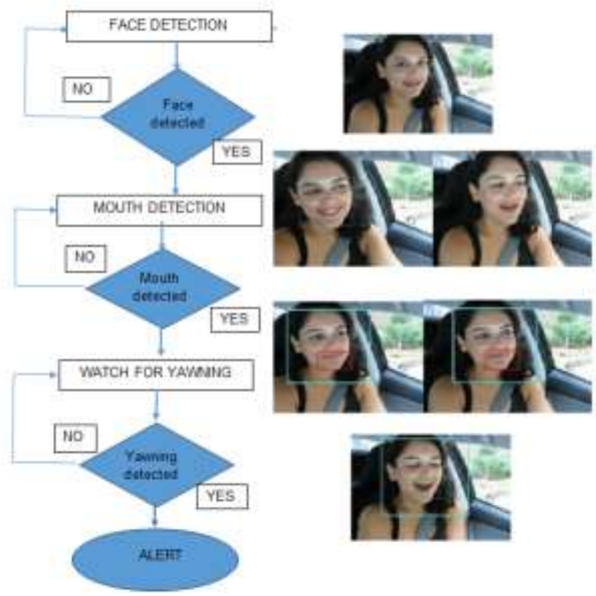

Figure 5: Yawning Detection

IV. RESULT & DISCUSSION

Every individual who volunteered for the test will be approached to squint multiple times and act languid multiple times amid the test procedure. The yawning exactness was determined by beneath referenced recipe.

[Drowsiness Detection Accuracy = Total no. of times alarm sounds / (Total no. of times alarm sounds + Total no. of times alarm didn't sound)]

Table 2: Accuracy Table

I/P	DROWSINESS ACCURACY
SAMPLE 1	84.25%
SAMPLE 2	79.57%
SAMPLE 3	89.78%
TOTAL	84.53%

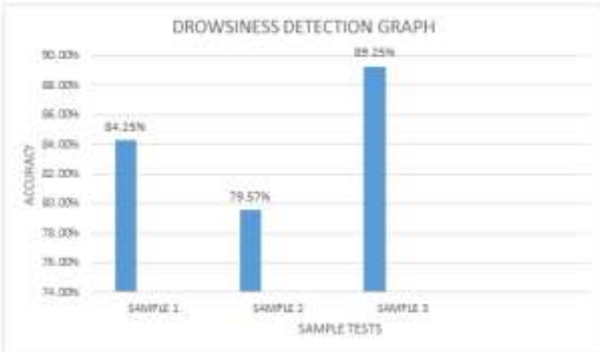

Figure 6: Drowsiness Detection Accuracy Graph

V. FUTURE WORK

1. Enhanced Drowsiness Detection Algorithms

Explore and develop more advanced machine learning or computer vision algorithms to improve the accuracy and robustness of drowsiness detection. This can include incorporating deep learning techniques, such as convolutional neural networks (CNNs) or recurrent neural networks (RNNs), to capture more intricate patterns in eye movement and physiological data.

2. Multi-Modal Sensor Integration

Integrate additional sensors or data sources to enhance the drowsiness detection system. For example, include sensors to measure heart rate, skin conductance, or steering wheel movement to provide a more comprehensive assessment of the driver's state. Combining multiple modalities of data can improve the accuracy and reliability of the system.

3. Driver-Specific Profiles

Develop personalized models or profiles for individual drivers. Collect data specific to each driver's characteristics and behavior to create personalized drowsiness detection models. This approach can lead to more accurate and tailored alerts, considering individual differences in eye movement patterns and drowsiness indicators.

VI. CONCLUSION

The face will detect using computer vision and forms contours around the face. The person is checked with drowsiness detection then Face detection through the camera. The set of camera checks for drowsiness parameters taken by the person. The face detection and driver drowsiness detection through the camera using Haar Cascade algorithm and CNN algorithm. The driver inconsistency watching system made is fit for distinguishing drowsiness and silly conduct of drivers in a brief time allotment. The proposed system can hinder disasters that can happen due to distraction of driver while driving.

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