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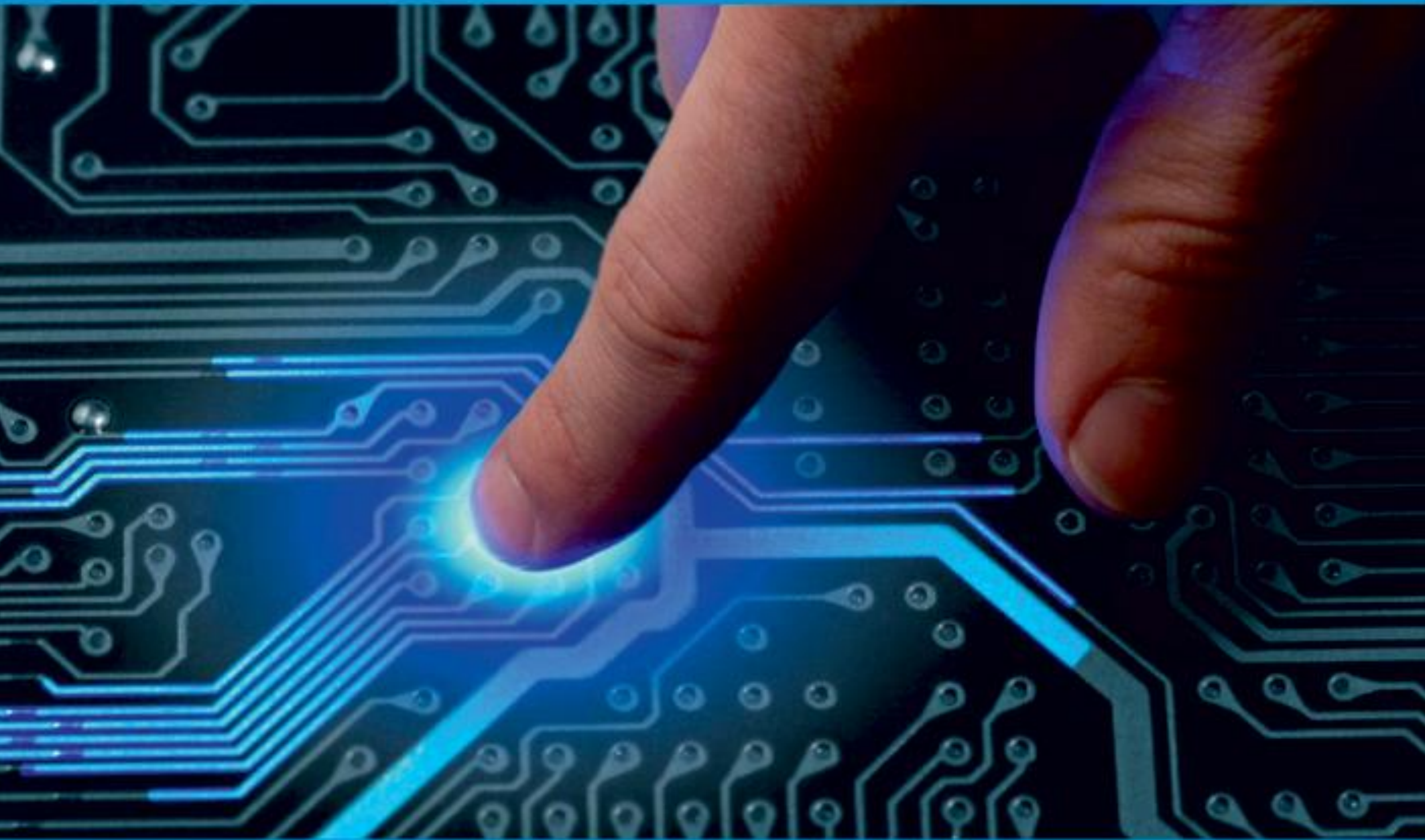

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Driver Drowsiness Detection System Using Deep Learning

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ABSTRACT: These days, an ever-increasing number of professions require long time focus. Drivers should watch out for the street, so they can respond to abrupt occasions right away. Due to driving for a long time or intoxication, drivers might feel sleepy, which is the biggest distraction for them while driving. This distraction might cost the death of the driver and other passengers in the vehicle, and at the same time, it also causes the death of people in the other vehicles and pedestrians too. To prevent such accidents, we propose a system that helps to alert the driver if he/she feels drowsy. To accomplish this, we implement the solution using a computer-vision-based machine learning model. The driver's face is detected by a face recognition algorithm continuously using a camera, and the face of the driver is captured. The face of the driver is given as input to a classification algorithm which is trained with a data set of images of drowsy and non-drowsy faces. The algorithm uses landmark detection to classify the face as drowsy or not drowsy. If the driver's face is drowsy, a voice alert is generated by the system. This alert can make the driver aware that he/she is feeling drowsy, and the necessary actions can then be taken by the driver. This system can be used in any vehicle on the road to ensure the safety of the people who are traveling and prevent accidents that are caused due to the drowsiness of the driver.

KEYWORDS: Driver Drowsiness Detection, Deep Learning, Image Processing, Convolutional Neural Networks (CNNs), Facial Recognition, Road Safety

I. INTRODUCTION

Accidents due to driver drowsiness are a significant problem worldwide. When drivers are tired or sleepy, their ability to react and make quick decisions is impaired, and they may even fall asleep at the wheel, resulting in accidents. According to the World Health Organization, driver fatigue is estimated to cause up to 20% of road accidents globally. Statistics from various countries highlight the seriousness of the problem. There are typically three primary techniques used to identify drowsiness.

Humans have always invented machines and devised techniques to ease and protect their lives, for mundane activities like traveling to work, or for more interesting purposes like aircraft travel. With the advancement in technology, modes of transportation kept on advancing and our dependency on it started increasing exponentially. It has greatly affected our lives as we know it. Now, we can travel to places at a pace that even our grandparents wouldn't have thought possible. In modern times, almost everyone in this world uses some sort of transportation every day. Some people are rich enough to have their own vehicles while others use public transportation. However, there are some rules and codes of conduct for those who drive irrespective of their social status.

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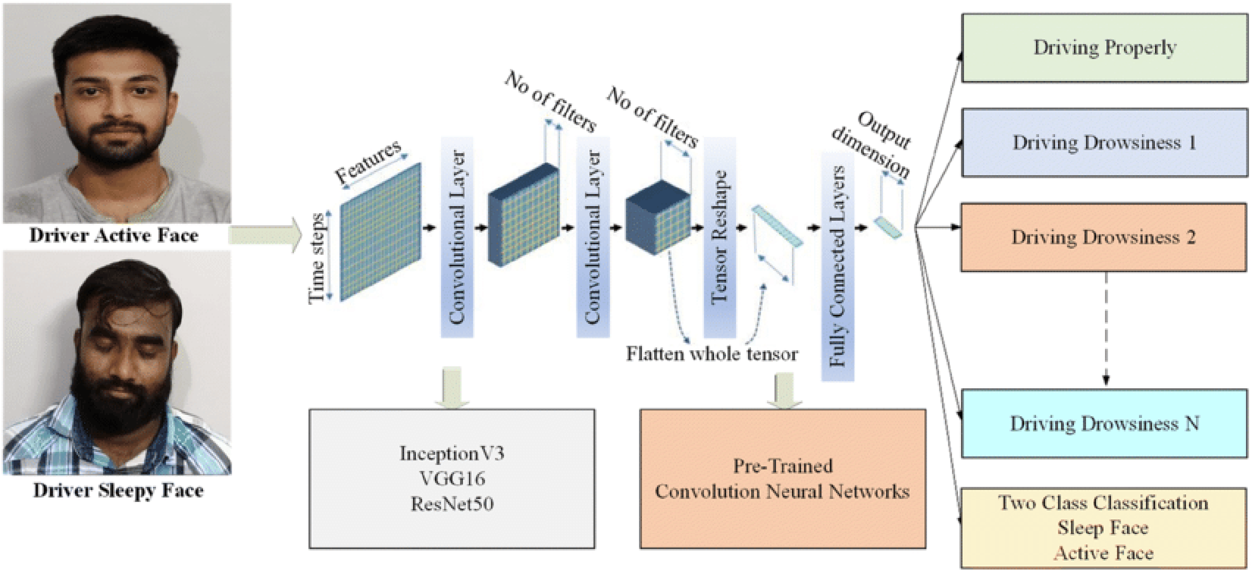

Fig 1: Block diagram of CNN based driver

Driving while being drowsy has become one of the major reasons of causing road accidents. Drivers who drive at night or for a long distance without resting are more prone to get involved in an accident. Large amount of fatal injuries and deaths occur because of this reason. Hence, it has become an active area of research. . Various systems exist for this purpose which makes use of physiological features, behavioural patterns and vehicle-based features. Physiological features considered here are Electroencephalogram (EEG), Electrooculogram (EOG), Electrocardiogram (ECG), heartbeat, pulse rate etc. Behavioural patterns considered here are visual behaviours of drive like eye blinking, eye closing, yawning, head bending etc. Vehicle based features are metrics like wheel movement, acceleration, vehicle speed, brake pattern, deviation from lane pattern etc. Most of these methods are time consuming and expensive. In this system, we propose an alternate system which uses images for detection of drowsiness using machine learning.

One of them is staying alert and active while driving. Neglecting our duties towards safer travel has enabled hundreds of thousands of tragedies to get associated with this wonderful invention every year. It may seem like a trivial thing to most folks but following rules and regulations on the road is of utmost importance. While on road, an automobile wields the most power and in irresponsible hands, it can be destructive and sometimes, that carelessness can harm lives even of the people on the road. One kind of carelessness is not admitting when we are too tired to drive. In order to monitor and prevent a destructive outcome from such negligence, many researchers have written research papers on driver drowsiness detection systems. But at times, some of the points and observations made by the system are not accurate enough. Hence, to provide data and another perspective on the problem at hand, in order to improve their implementations and to further optimize the solution, this project has been done.

II. RELATED WORK

The percentage of road accidents occurred due to distraction of driver tops the list. Among many reasons of distraction of driver, sleepiness, tiredness induced drowsiness is most probable reason. Researches have been done to to detect drowsiness with the help of vehicular, behavioural and biological. For solution, various systems have been proposed using with vehicular components, bio-signalling technologies, machine learning and computer vision. One approach is to decide the condition of driver by its facial expressions is proposed by Kyong Hee Lee et al[1]. it has been shown that the drowsiness level of a driver can be determined by extracting its facial features. Video dataset from NTHU-DDD has been used to test the methods. Head pose, eye blinks and mouth status are the features considered. The angle of driver's head, helps find head yaw and pitch angle. PERCLOS is implemented for eye blinks. Action unit from FACS is used to monitor yawning. The face is detected on the screen and parameters of all other detected features like yawn, blinks, head yaw and pitch angle are shown on the screen. A threshold is set for all the attributes. If parameter value exceeds the threshold value, drowsiness is said to be detected. Second approach includes behavioural measures and machine learning techniques to develop a system.

The system is proposed by Mkhuseli Ngxande et al. [8] Machine learning techniques like support vector machine, convolutional neural network and hidden markov model are used for behavioural measures like eye blinks, yawns and head movements. All three machine learning approaches are applied and results are tabulated. Method with support vector machine approach gives highest accuracy but with high cost, similar to hidden markov model, with accuracy just next to support vector mechanism. Method with convolutional neural network gives good accuracy with lesser cost. They have also listed various

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publicly available datasets for drowsiness detection practices. Another approach by Ashish Kumar et al. in [2] also consider visual behaviours viz. eyes, mouth and nose. Face is detected using histogram of oriented gradients and linear support vector machine. The detection algorithm is applied on frames of 2D images extracted from video. After the detection, facial landmarks are marked with the help of landmark points. Feature extraction is implemented for classification. Nose Length Ratio (NLR), Eye Aspect Ratio (EAR), Mouth Opening Ratio (MOR) are calculated. When values of these parameters go beyond threshold, driver is classified as drowsy.

The system generates accurate results with generated system data. Many researchers have followed visual behaviours with machine learning for implementing the drowsiness detection system. Other researched systems include bio-signalling equipment or vehicular components, without any collaborative use of machine learning algorithms. Machine algorithms like Bayesian classifier, Support Vector Machine (SVM), Hidden Markov Model (HMM), Convolutional Neural Network (CNN) have been used. All of the methods give good accuracy for different facial features; methods support vector machine, hidden markov model, Bayesian classifier cost more than convolutional neural network in training. Bigger the model grows, bigger the cost and computational requirements grow.

III. METHODS

The block diagram of the proposed driver drowsiness detection system has been depicted in Fig 1. At first, the real-time video is recorded using a webcam. The camera will be positioned in front of the driver to capture the frontal face image. The frames are extracted from video to obtain 2-D images. Face is detected in the frames using Haar-Adaboost face detection method. After detecting the face, facial landmarks like positions of eye, nose and mouth are marked on the images. From the facial landmarks, position of eyes and mouth are quantified. Using these extracted features and machine learning methods, a decision is obtained about the drowsiness of the driver.

Convolution neural network is applied for classification of eyes, which detects drowsiness of driver by considering blinking of eyes. As an additional attribute to the system, feature extraction method is used for calculating mouth opening ratio, which also helps to decide if the driver is easy. If drowsiness is detected, an alarm will be sent to the driver to alert him/her. The details of each block are discussed in further sections. For the purpose of training the model to detect the open or closed eyes , a dataset of eyes from Media Research Lab is used.[6] The dataset contains images of eyes of males and females, eyes closed and open, with and without glasses, with low reflection, high reflection and no reflection.

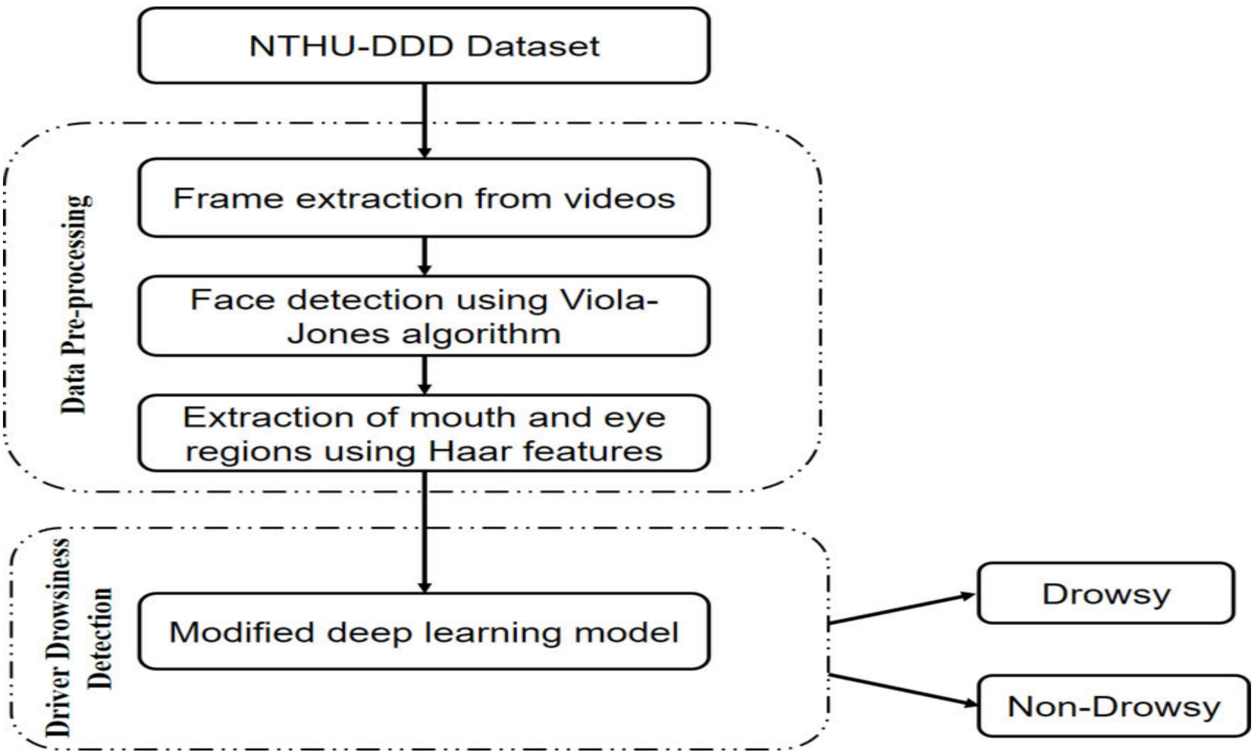

Fig 2 : Proposed Driver Drowsiness Detection

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In this paper a novel approach to critical parts of face detection problems is given, based on analogic cellular neural network (OpenCV) algorithms. The proposed Open CV algorithms find and help to normalize human faces is, effectively while cause for most accident related to the vehicles crashes. Driver fatigue their time requirement is a fraction of the previously used methods.The algorithm starts with the detection of heads on colour pictures using deviations in colour and structure of the human face and that of the background.By normalizing the distance and position of the reference points, all faces should be transformed into the same size and position.For normalization, eyes serve as point reference. Other OpenCV algorithm finds the eyes on any grayscale image by searching characteristic is features of the eyes and eye sockets. Tests made on a standard database show that the algorithm works very fast and it is reliable.In proposed method, first the image is acquired by the webcam for processing. The images of the driver are captured from the camera which is installed in front of the driver on the car dashboard. It will be passed to preprocessing which prepares the image for further processing by the system. Its main operations are to eliminate noises caused by the image acquisition subsystem and image enhancement using Histogram Equalization. Then we search and detect the faces in each individual frame. If no face is detected then another frame is acquired. If a face is detected, then a region of interest in marked within the face. This region of interest contains the eyes. Defining a region of interest significantly reduces the computational requirements of the system. After that the eyes are detected from the region of interest.

IV. RESULT ANALYSIS

A functional prerequisite is described as one portion or an element of a product, in the entire methodology of programming building. A capacity or part is also depicted as the lead of a section and its yields, given a great deal of data source. A useful perquisite may be the figuring identified with specialized and subtitles or data controland getting ready or whatever other express usefulness that describes the target of a particular structure uses the useful necessities are found being utilized cases.

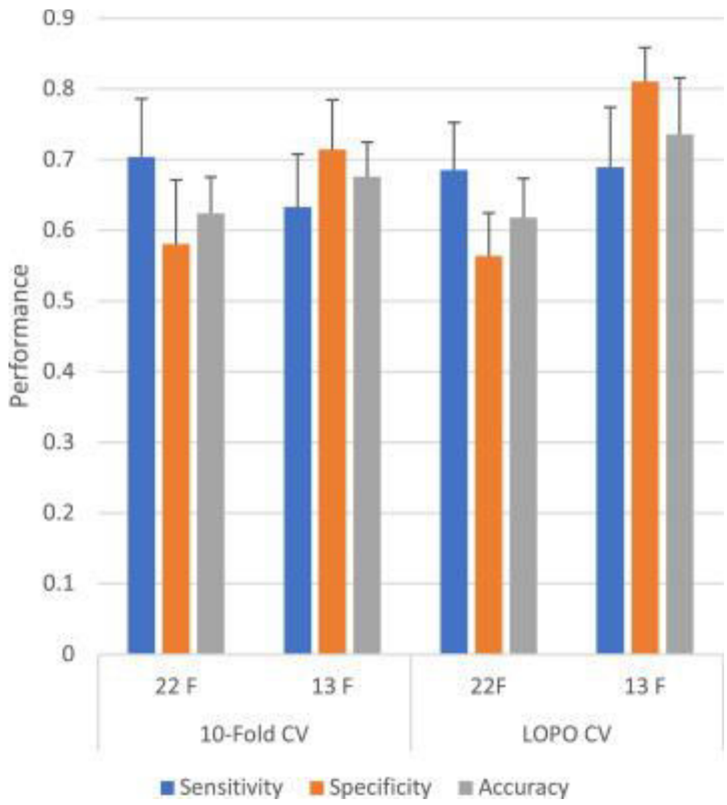

Fig 3: Result of Validation and interpretation

With 80% accuracy, it is obvious that there are limitations to the system. The most significant limitation is that it will not work with people who have very dark skin. This is apparent, since the core of the algorithm behind the system is based on binarization. For dark skinned people, binarization doesn't work. Another limitation is that there cannot be

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any reflective objects behind the driver. The more uniform the background is, the more robust the system becomes. For testing purposing, a black sheet was put up behind the subject to eliminate this problem. For testing, rapid head movement was not allowed. This may be acceptable, since it can be equivalent to simulating a tired driver. For small head movements, the system rarely loses track of the eyes. When the head is turned too much sideways there were some falsealarms. The system has problems when the person is wearing eyeglasses. Localizing the eyes is not a problem, but determining whether the eyes are opened or closed.

V. CONCLUSION

It completely meets the objectives and requirements of the system. The framework has achieved an unfaltering state where all the bugs have been disposed of. The framework cognizant clients who are familiar with the framework and comprehend it\'s focal points and the fact that it takes care of the issue of stressing out for individuals having fatigue-related issues to inform them about the drowsiness level while driving. Currently there is not adjustment in zoom or direction of the camera during operation. Future work may be to automatically zoom in on the eyes once they are localized. This would avoid the trade-off between having a wide field of view in order to locate the eyes,and a narrow view in order to detect fatigue. This system only looks at the number of consecutive frames where the eyes are closed. At that point it may be too late to issue thewarning. By studying eye movement patterns, it is possible to find a method to generate the warning sooner. Using 3D images is another possibility in finding the eyes. The eyes are the deepest part of a 3D image, and this maybe a more robust way of localizing the eyes. Adaptive binarization is an addition that can help make the system more robust. This may also eliminate the need for the noise removal function, cutting down the computations

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