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Driver Drowsiness Detection System using Frontal face predictor.

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***Abstract*—Drowsiness refers to a condition in which a person senses sleepiness mostly during the day time,when they don't want to or in the middle of some daily task which may lead to safety concerns .In considerationof report of the WHO near about 1.3 million people perish each year in the event of road accidents, and in continuation of it, as per the royal society of prevention of accident(ROSPA) near about 20% of the total road accidents are caused due the drowsiness factor of the driver. Driver and his conventional attentiveness are one of the major factors that is to be considered for reducingthe accident caused by the drowsiness. According to theMED (MED INDIA), about 60 percent adult drivers havedriven a vehicle while feeling drowsy over last years, knowing the risk they cause to the life and to the property. However, drowsiness detection system is a research point since a long time, many algorithms, certain factors and different machine learning models are made in many antecedent research works, to give thefinest and accurate outcome. In this paper we will be contemplating few of the major factors like face detection, face landmark predictor which include calculation of eye aspect ratio, to investigate whether thedriver is lethargic or not, and importantly comparing certain algorithms and models concocted and inherited in the antecedent works and transmitting results as, which algorithm can give the better result in certain predicament.**

Keywords—driver; drowsiness; machine learning; frontalface detection; eye aspect ratio; drowsiness detection system .

I. INTRODUCTION

In the crucial juncture of vast population and increasing needof opulent set of circumstances, automobile companies and innovations are widely increasing by degrees, but so are working hours, stress and tiredness according to the NSC (national security council) 13% of workplace injuries can be attributed to fatigue. And in case of a driver, tiredness and drowsiness[1] is the major factor that can involve serious property damage, serious accidents and can even result in deaths. According to the statistics of WHO 1.3 million people lost their lives in road accidents, royal society of prevention of accident (ROSPA) state the fact as near about20% of the total road accidents are a repercussions of driver's drowsy effects. Drivers' attentiveness[2] while drivingleaves a great impact on how safely he/she drives on road keeping in mind the safety of the passenger, other drivers, property concerns, and himself, his active state while drivingis to be considered for reducing the accident caused by the drowsiness. Drowsiness Detection[4] is a research hub from the past few

years, many methods and certain factors and different machine learning models are made in many antecedent research works, to provide better results. In this research paper we will be considering few of the many methods from the previous works like face detection[5,6], face landmark predictor[8,9] which include calculation of eye aspect ratio i.e., EAR[10], to check if the driver is drowsy or not[11], and. In this paper we will be making allowance[12] for few of the major factors like video capturing for framing the subject[13], frontal face detection[14], frontal face predictor, and importantly comparing the computed EAR with the standard active eye EAR comparing certain algorithms and models made and used in the previous works and giving result as, which algorithm can give the better result in certain circumstances. This project involves the detection of the drowsiness with the help of the python, open cv, and Dlib library to give the accurate results. OpenCV[15] is a vast open source for building real time computer vision application[16] it assists better for the video capturing and for the detection for features of the subject in video frame. The major operations utilization of Dlib library in this project are to detect the face of the subjectin the frame provided in the video capturing, and to predict the shape of the subject in the video with the use of one of the extensive applications of Dlib, 68 landmarks of the facial features to detect eyes, nose, mouth, eyebrows etc. The project is divided into three phases, stage 1 includes capturing the video and the frame to get the video of the driver, stage 2 contains the detection of the face and the frontal face features using the Dlib library[16] of the python, stage 3 contains the calculating the EAR (eye aspect ratio) and then comparing[17] it with the standard active eye ratio andeventually the last stage is giving the result. The shape predictor of the Dlib library[18] supports in providing accuracy which was influenced by the regular OpenCV HAAR cascade algorithm[19].

II.RELATED WORK.

In the last ten years from 2012 to 2022 the no of conferences article is 703 and the number of journals is 92 and magazines and other articles are 8. In figure 1 we can see the comparative analysis of total documents available.

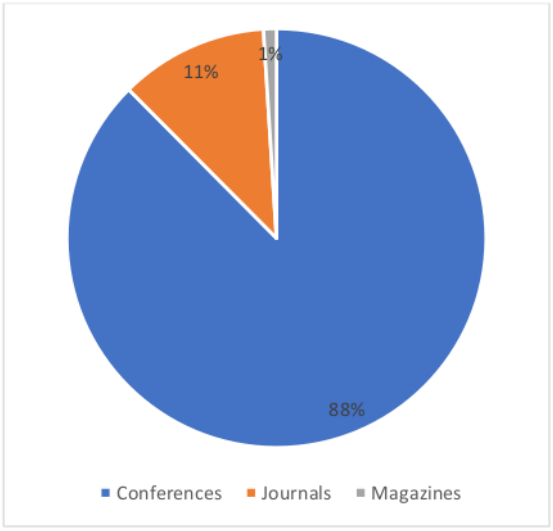

Figure 1: Published Article by type [2012-2022]

The total number of papers published by year is introduced in figure 2. Here we can see a significant rise in documents from last ten years.

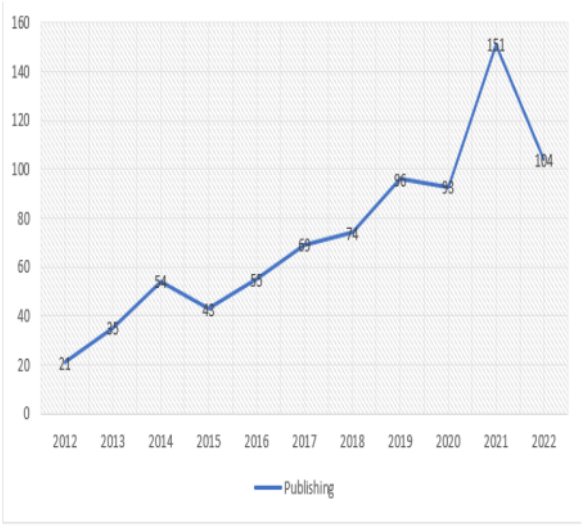

Figure 2: Documents by year [2012-2022]

The above graph as shown in the figure 2 shows how much research work was done particularly in the field of driver fatigue detection system, and publishing of the work in conference, early access, books, journals etc.

Table 1. Major Contributions in Drowsiness

References	Year	Model Used	Data Set used	Major Contribution	Results
[1]	2022	spatial + temporal and spatio-temporal architectures	Sample data sets	detect drowsiness from camera and alert the driver	81% accuracy
[2]	2022	Detects from blink of eye	Sample dats set	detect driver drowsiness	79.86 accuracy
[3]	2022	Random Forest	Sample data set	classify the drowsiness status, three ensemble algorithms have been tested,	overall accuracy of 84.1%
[4]	2022	Convolutional Neural Network (CNN)	Sample data set	Adam optimization algorithm	classification accuracy rate between 80% and 98%
[5]	2022	Federated learning [PFTL-DDD]	NTHU-DDD	CKKS-based privacy-preserving protocol	Accuracy is 83.48%
[6]	2021	humantenna effect and eye aspect ratio (EAR) calculations	Sample data set	driver drowsiness detection system based on the humantenna touch sensor	the steering wheel grip pattern and eye closure.
[7]	2020	Orbit Generation Depth-First algorithm (OGDF) quantum group classifier: QGClassifier (Gq)	Sample sets of Lie group matrices	supervised Lie group ML unsupervised Lie group ML semi-supervised Lie group ML	Accuracy is 87%
[8]	2019	convolutional networks ,Naive halfway fusion	CASIASURF	distinguish between the facial skin and mask materials	HTER 37.3
[9]	2018	convolutional networks	databases, i.e., MegaFace and MS-Celeb-1M datasets	build a new large-scale noise-controlled IMDb-Face dataset	84% accuracy

II. PROPOSED METHODOLOGY

There are many works that are already proposed in this filedwith the support of machine learning and many other features, and sub libraries of machine learning and OpenCV CV [10], are currently in wide use in facial image processingand landmark prediction for facial features extraction and processing [7]. However, in this proposed methodology we are consider the machine learning approach to address the problem and propose a better outcome, without any complications.

The project work is divided into 4 broad stages which are asfollow:

Stage 1: Video capturing of the subject. Stage 2. Frontal face detection of the subject.

Stage 3. Calculating the ear ratio and comparing it with the standard active eye ratio.

Stage 4: To give status of the subject to be active, drowsy or sleeping

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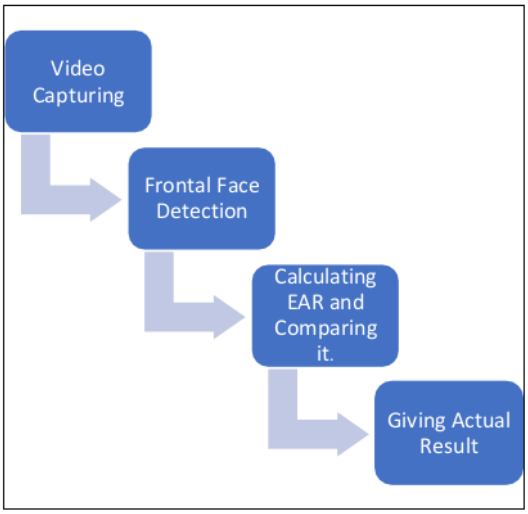

Figure 3.1 Working of the project

I. Video capturing of the subject

The very first phase of the driver drowsiness detection system is video capturing of the subject for this we are using the OpenCV [10] which provide a real-time sanguine computer vision library. It also reinforces model accomplishment for machine leaning we are using the cv2 module of the OpenCV for capturing video and taking instance of the webcam it helps in getting the actual video frame and provide the framework of the entire process.

II. Frontal face detection

The second and most important phase of the project work isthe frontal face detection of the subject to be evaluated further, for detecting the status. For this we are using the Dlib library of python, it is originally a modern c++ toolkit whichcontains the machine learning algorithms. But we are using the wrapping and the binding python version of Dlib in our project. The use of the Dlib library and inbuilt function of get_frontal_face_detector() is better than that of the regular HAAR cascade of OpenCV which was used in this referenced paper[4] because HAAR cover the greater area ascompared to the Dlib library get_frontal_face_detector()function as more area will result in multiple face capture that may affect the accuracy and , it also don't require any file input to proceed further as compared to the HAAR cascade.Fig 3.2 shows the actual flow of the system.

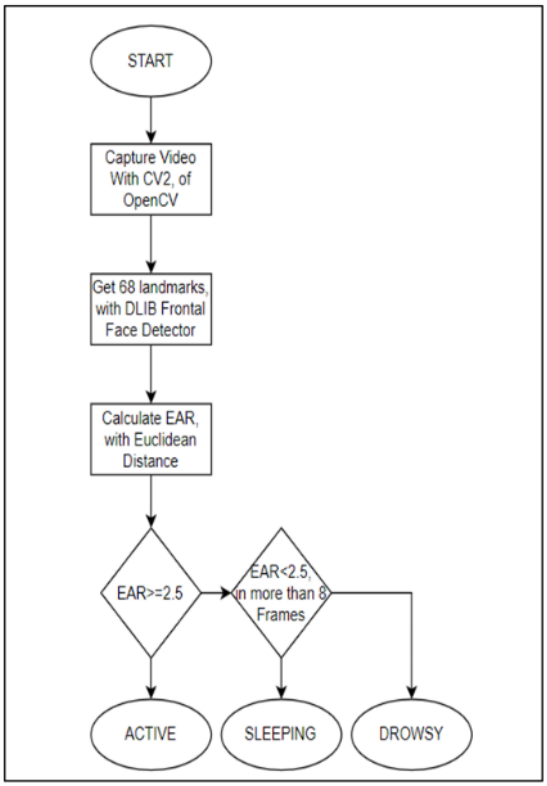

Figure 3.2 Flow chart of the procedure of the project

III. Frontal face predictor.

The frontal face predictor is another most

important phase ofthe project that will give us 68 landmarks of the subject face detected to proceed further, that will detect the features of the face using the landmarks pointers the Fig 3.3 is the visual representation of the 68 landmarks of the predictor .

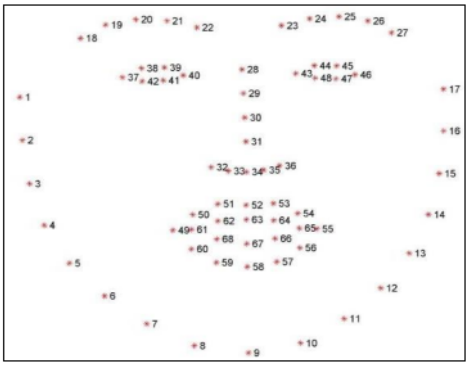

Figure 3.3 68 landmarks predicting shape of the Facial Features

III.A. Calculating the EAR ratio.

Now in the next step we will be calculating the EAR ratio i.e., eye aspect ratio, we will be using the Euclidean distance formulae for calculating the distance between two points figure 3.4 shows the Euclidean distance formulae. With the help oflinear algebra module of the NumPy library of python we can directly calculate it and with help of it we calculate small distance with landmarks (38,39,41,42) and long distance of eyes with landmarks (37 and 40) of right eye similarly we calculate it for the left eye and then we compute the EAR = small distance/ (2*(long distance)).

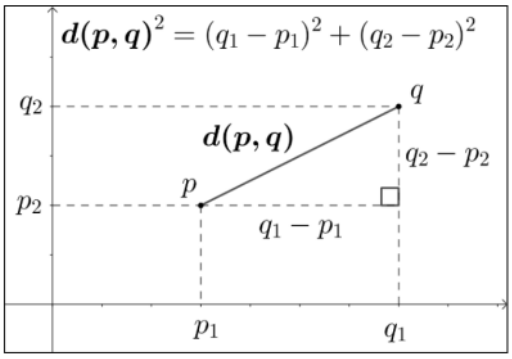

Figure 3.4 Euclidean Distance Graph

III.B. Comparing it with the standard active eye ratio.

We are using the 2.5 as the standard active eye ratio that wewill compare with our computed EAR that we have calculated in the last step with the help of small and long distance of the eyes.

*IV.*RESULTS

The outcomes of the project will turn out to be a real time video capturing screen, detecting the facial features of thedriver calculating EAR as attested by the movement of theeyes and eyelids and then giving the results if the driver is drowsy at times, he is sleeping while driving or else if he is Actively Driving. The screen will exhibit the "Driver isActive" state if the driver's computed EAR>=2.5 as shownin the below Figure 4.1.

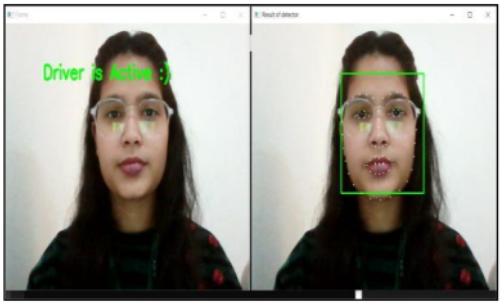

Figure 4.1 Driver is Actively Driving

Further on evaluation of the driver's facial features mainly the ROI that is EAR, if the computed EAR <2.5 then the result will display "Driver is Drowsy", as shown in Figure 4.2

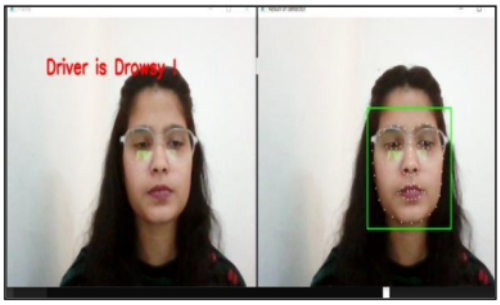

Figure 4.2 Driver is Drowsy

Similarly on further investigation of driver's eye movements and state, if the driver 's computed EAR<2.5 for more than 8 frames of the evaluation the driver screen will show the result as "Driver is Sleeping", shown in Figure 4.3

Figure 4.3 Driver is Sleeping

III. CONCLUSION.

In this research paper we are using the machine learning approach to investigate whether the driver driving, is in the conscious Active state, in a drowsy slumberous state, or sleeping, we have used the Dlib library functions to enhance the accuracy, this project is in the 4 phases, first is the video capturing phase and then the frontal face detection using the68 landmark of the predictor, and then computing the EAR ratio and comparing it with the standard active eye ratio, andthen finally giving result as active, drowsy or sleeping.

IV.FUTURE SCOPE

The Future Scope of the project work will be integrating themachine learning part of the project into full stack, so that itwill emanate into a full-fledged working application. We canalso integrate it into already prominent cab and taxi applications and adding the feature of alert message to the passenger and driver, so that both can follow safety measures.