Driver Drowsiness Detection using Facial Recognition

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***Abstract* - Every year road accidents are increasing, and people are losing lives. The root cause of many accidents is due to fatigue of drivers. There are some ongoing research happening to identify the fatigueness of driver many methods have been identified and systems are prepared the use of such systems are expensive and hence it is difficult to implement in every vehicle. Therefore, in this paper, a lightweight, real time driver's drowsiness detection system is developed and implemented on Android application and as a python application for remote server functioning. The system captures the video frames and detects the driver's face in every frame by employing image processing techniques. The system is capable of detecting facial landmarks, computes Eye Aspect Ratio (EAR) and Eye Closure Ratio (ECR) to detect driver's drowsiness based on thresholding, thresholding is modified based on driver distance towards the camera. Machine learning algorithms have been employed to test the efficacy of the suggested system. Empirical results demonstrate that the suggested model is able to achieve accuracy of 84% using random forest classifiers.**

I.INTRODUCTION

One of the significant causes behind the losses of individuals in street mishaps is driver's tiredness. After ceaseless driving for quite a while, drivers effectively get worn out coming about into driver weariness and tiredness. Examination contemplates have expressed that most mishaps happen because of driver fatigue. Different nations have various measurements for mishaps that happened because of driver weakness. Creating innovation for distinguishing driver weariness to diminish mishaps is the fundamental test. As per the report by "Service of Road Transport and Highways" there were 4,552 mishaps announced each year in India that ended the existences of thousands of individuals on account of lethargic drivers (Road Accidents in India 2016). For example, numerous vehicles are driven for the most part around evening time like stacked trucks. The drivers of such vehicles who drive for such persistent extensive stretches become more powerless to these sorts of circumstances. Distinguishing sleepiness of drivers is as yet a continuous examination to lessen the quantity of such miss-happenings and mishaps. Run of the mill techniques used to distinguish sluggish drivers are physiological based, vehicle based, and social based(S. Sangle, B. Rathore, R.Rathod, A. Yadav, and A. Yadav,2018)– (A. Kumar and R. Patra,2018). Physiological techniques like heartbeat, beat rate, and Electrocardiogram (T. Hwang, M. Kim, S. Hong, and K. S. Park,2016), (S. Junawane, S. Jagtap, P. Deshpande, and L. Soni,2017) and so forth are utilized to identify exhaustion level. Vehicle based strategies incorporate gas pedal examples, speed increase and controlling developments. Social methods (S. Sangle, B.Rathore, R. Rathod, A. Yadav, and A. Yadav,2018)– (A. Kumar and R. Patra,2018) incorporate yawn, Eye Closure, Eye Blinking, and so forth To experience this overall issue, an answer that catches pictures in a progression, communicates continuous driver's information to the worker, and decides sluggishness utilizing EAR (Eye Aspect Ratio) and ECR (Eye Closure Ratio) has been proposed and executed utilizing an Android application. The registered worth through the framework prompts the driver to take a break or rest for quite a while. The techniques utilized are nosy in nature; consequently, no extra expenses would be brought about throughout the laziness identification strategy. The remainder of the paper is coordinated as follows. In area 2, the writing survey is introduced. Area 3 presents the proposed way to deal with recognizing driver's laziness. It likewise subtleties the segments which are created as.

II. RELATED WORK

To identify tiredness of drivers, various methodologies have been proposed. This part sums up the current ways to deal with identify laziness. Rateb et al. (R.

Jabbar, K. Al-Khalifa, M. Kharbeche, W. Alhajyaseen, M. Jafari, and S. Jiang, 2018) detected continuous driver languor utilizing profound neural organizations. They built up an Android application. Tereza Soukupova et al. (T. Soukupova and J. Cech, 2016) used EAR (Eye Aspect Ratio) as a standard measure to process laziness of an individual. They additionally point by point the sorts of frameworks utilized for identifying sluggishness of drivers. For instance, Active Systems (considered as solid, however utilize extraordinary equipment that are costly and meddling like infrared cameras and so forth) and Passive Systems (are economical and depend on Standard cameras). Shailesh et al. (S. Sangle, B. Rathore, R. Rathod, A. Yadav, and A. Yadav,2018) utilized a camera fixed on the dashboard to catch and send pictures to Raspberry Pi worker introduced in the vehicle, to recognize faces utilizing Haar classifier and facial focuses utilizing the Dlib Library. Vibin Varghese (V. Varghese, A. Shenoy, S. Ks, and K. P. Remya, 2018) detected milestones for each edge caught to figure the EAR (between stature and width of eye) utilizing the milestone points of face. Subsequent to processing the EAR; (V. Varghese, A. Shenoy, S. Ks, and K. P. Remya,2018) decided the driver as languid if the EAR was not exactly the cutoff for 2 or 3 seconds (in light of the fact that the eye flicker keeps going roughly 100-400ms). Ashish Kumar (A. Kumar and R. Patra,2018) utilized the Mouth Opening Ratio as a boundary to identify yawning during tiredness. There are a few other explorations works that have been directed to decide vision based sleepiness detection (I. García, S. Bronte, L. M. Bergasa, J. Almazán, and J. Yebes,2012)– (K. Sri Jayanthi and M. Vedachary,2013), exhaustion detection (A. Chellappa, M. S. Reddy, R. Ezhilarasie, S. Kanimozhi Suguna, and A. Umamakeswari,2015), eye-following to identify driver fatigue (2011). Accordingly, regarding the writing work we have proposed a framework that identifies driver's languor utilizing EAR and ECR which are nitty gritty in the accompanying area.

III. PROPOSED APPROACH TO DETECT DRIVER'S DROWSINESS

This part subtleties the proposed way to deal with identify driver's languor that chips away at two levels. The application is introduced on the driver's gadget running Android working framework (OS). The android application is fit for working without web access and goes about as a ready framework if there should be an occurrence of no organization in a distant region. Utilizing the Java Dlib library, the facial planning is done inside the cell phone and ready to create a solid alert for the driver to awaken or pull over. Then again, to distantly screen the driver and track the development of the vehicle the customer worker design is utilized, the casings are caught from the camera inside the vehicle and are shipped off the worker. In the worker side the casings are prepared utilizing the Dlib library to plan the facial tourist spots and edge esteem is determined appropriately and an edge esteem is utilized to recognize if a driver is sleepy. In our specific circumstance, the Eye Aspect Ratio (EAR) esteem got at the python application's end would be contrasted and the edge esteem taken really 0.25 changed by driver situating inside the vehicle. Assuming the EAR esteem is not exactly the edge esteem, this would demonstrate a condition of weakness. If there should arise an occurrence of Drowsiness, the driver and the travelers would be cautioned by a caution and the alarm is informed to the individual heads or the chief to hint the crisis or the risk. The ensuing segment contains subtleties of the working of every module.

IV.DATA PROCUREMENT

For utilizing the application, the driver plays out an enrollment if utilizing the application interestingly. Subsequent to playing out a sign-up, the driver adds a ride by entering the source and objective of the ride. Similarly, an interface for the travelers is additionally furnished where the travelers can associate with the ride, added by the driver. The driver at that point begins the ride. The proposed application at that point catches the continuous pictures of the driver. Pictures are caught each time the application gets a reaction from the worker. The cycle goes on until the driver stops the ride. For testing the effectiveness of the proposed approach, an informational index of 50 volunteers was gathered. Each member was approached to flicker their eyes irregularly while taking a gander at the camera for catching EAR esteems. The logs of the outcomes that were caught by the application were gathered and broke down with the assistance of AI classifiers.

V. FACIAL LANDMARK MARKING

To extricate the facial tourist spots of drivers, Dlib library was imported and sent in our application (T. Soukupova and J. Cech,2016), (J. D. Electronic duplicate accessible at: https://ssrn.com/abstract =3356401 February 26 - 28, 2019 | Amity University Rajasthan, Jaipur, India Page 1335 Fuletra,2013). The library utilizes a pre-prepared face indicator, which depends on an alteration to the histogram of arranged angles and uses direct SVM (uphold vector machine) strategy for object identification. Real facial milestone indicator was then instated, and facial tourist spots caught by the application were utilized to compute distance between focuses. These distances were utilized to register EAR esteem. EAR is characterized as the proportion of stature and width of the eye and was figured utilizing condition 1. The numerator indicates the stature of the eye and the denominator signifies the width of the eye and the subtleties of the multitude of tourist spots of the eye are portrayed by figure 1.

$$EAR = (|p2 - p6| + |p3 - p5|) / 2 * |p1 - p4| \quad -(1)$$

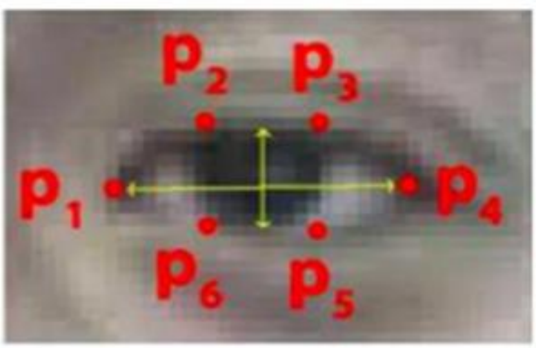


Fig 1. Landmarks of Eye in EAR

Alluding condition 1, the numerator ascertains the distance between the upper eyelid and the lower eyelid. The denominator addresses the level distance of the eye. At the point when the eyes are open, the numerator esteem expands, subsequently expanding the EAR esteem, and when the eyes are shut the numerator esteem diminishes, hence diminishing the EAR esteem. In this specific circumstance, EAR esteems are utilized to identify driver's sluggishness. EAR estimation of left and right eyes is determined and afterward normal is taken. In our sleepiness locator case, the Eye Aspect Ratio is observed to check if the worth falls underneath edge esteem and furthermore it doesn't increment again over the edge an incentive in the following edge. The above condition infers that the individual has shut his/her eyes and is in a lazy state. Despite what might be expected, if the EAR esteem increments once more, it infers that the individual has recently flickered the eye and there is no instance of tiredness. Figure 2 portrays the square chart of our proposed way to deal with identify driver's tiredness. Figure 3 addresses a depiction of facial milestone focuses utilizing Dlib library, which are utilized to process EAR. Table 1 subtleties the facial milestone focuses for left and right eye which were utilized for calculation.

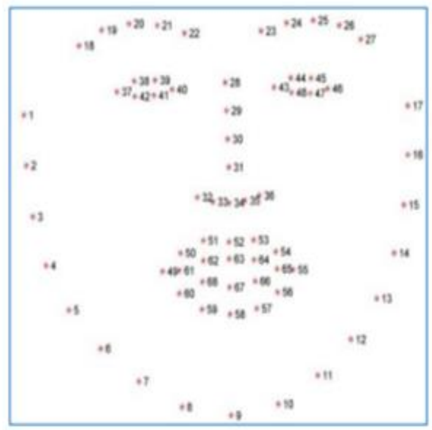


Fig. 3 –Facial Landmark Points according to Dlib library

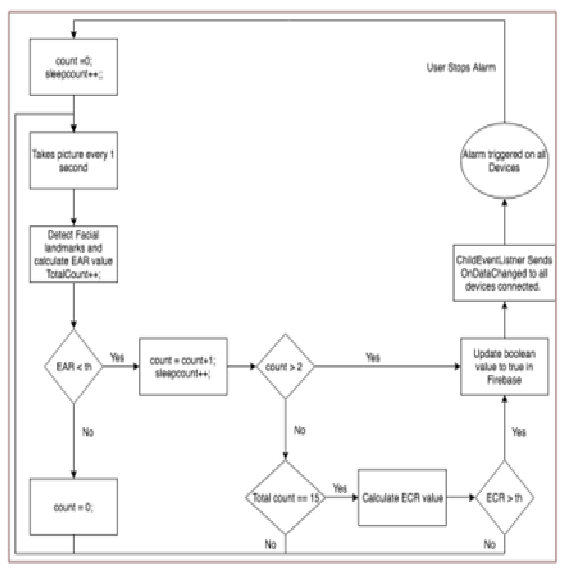


Fig. 2 - Block Diagram of Proposed Drowsiness Detection Algorithm

Part	Landmark Points
Left Eye	[37-42]
Right Eye	[43-48]

VI. CLASSIFICATION

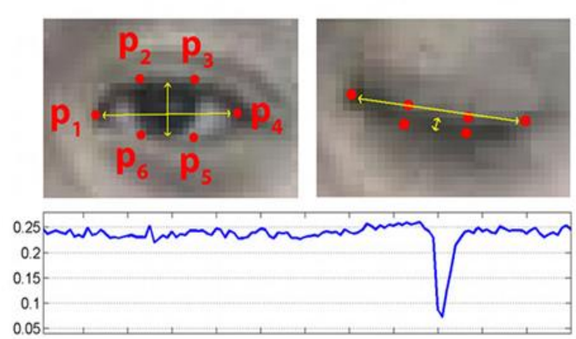
In the wake of catching the facial milestone focuses, EAR esteem registered by the worker is presently gotten at the android gadget of the driver and contrasted and the limit esteem which was before set to be 0.25 or versatile dependent on the distance of driver to camera inside the vehicle. In the event that the worth is not exactly the limit, the counter worth is augmented, else the counter worth is slowed down to nothing. On the off chance that the counter worth arrives at three, a caution is set off in the android gadget. Furthermore, another variable (Sleep Counter) is kept up which tallies the occasions the EAR esteem is not as much as edge esteem. Variable (Total Counter) stores the absolute tally of reactions from the worker side and is utilized to compute the ECR (Eye Closure Ratio). It is characterized as the proportion of Sleep Counter and Total Counter worth and was figured utilizing condition 2. ECR = $\mathit{Sleep\ Counter}$ $\mathit{Total\ Counter}$ - (2) In our specific circumstance, the estimation of ECR was determined for each 15 continuous edges (caught from camera). When the edge number arrives at 16, the estimation of the all-out counter becomes one and the rest counter gets zero. At whatever point the ECR esteem surpasses the edge esteem, which is set to 0.5, at that point a notice is created in the android application to show sleepy condition of the driver

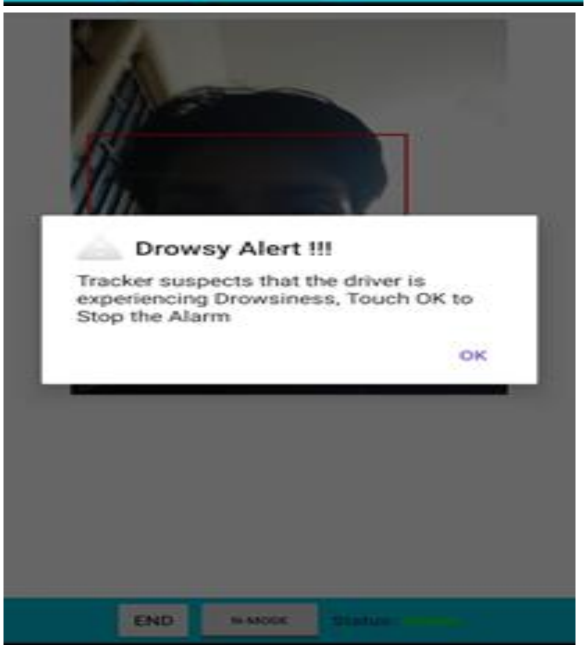
VII. COMPARISON OF STATE OF ART APPROACH

We have utilized the EAR (eye viewpoint proportion) and proposed an approach to process ECR (Eye Closure Ratio). Contrasted with different techniques from the writing, our proposed calculation gives better exactness and lessens reaction season of figuring the EAR at worker as the worker is locally arrangement and furthermore the returned EAR esteem is privately checked in the android gadget of the driver along these lines improving the consequences of readiness when the driver feels tired. Also, in other nosy techniques (T. Hwang, M. Kim, S. Hong, and K. S. Park,2016), (S. Jun disappear, S. Jagtap, P. Deshpande, and L. Soni,2017), various machines and gadgets should be appended to the driver's body were required, consequently making it awkward for the driver to focus on his driving. Also, in past approaches an arrangement should be played out without fail, at whatever point the driver begins the ride. In any case, these meddlesome techniques include a decent measure of cost to quantify beat rate, pulses, and so on in our recommended measure, we have quite recently utilized an android gadget and a nearby worker to identify sluggishness that eliminates the components of cost of machines and break in driver's fixation. In contrast with the use of outer cameras in the meddlesome strategies, we have utilized the android gadget, which is regularly utilized by individuals for route and different purposes. The proposed calculation has functioned admirably in conditions having great lightning. It likewise works for individuals wearing exhibitions. Following area portrays the exhibition assessment of the proposed approach.

VIII. PERFORMANCE EVALUATION WITH EXPERIMENTAL RESULTS AND DISCUSSION

The segment presents the presentation assessment of the proposed approach by playing out an observational examination of acquired outcomes. In the first place, the framework gathers the ongoing information of the drivers portrayed by Figures 4-a, 4-b and 4-c. It at that point decides sleepiness of the drivers dependent on the EAR esteems that are figured dependent on the pictures caught of the client and its reaction from the worker. It additionally identifies the sleepiness utilizing ECR esteems.





Two-way examination has been acted in our work. Our first stage incorporates the outcomes got by the android application when the driver faces the camera. Information gathered from this stage is additionally utilized in the second stage where nitty gritty examination of the outcomes has been performed utilizing AI classifiers to test the viability of the proposed approach. Classifiers that were utilized for observational investigation were Naive Bayes, Support Vector Machine and Random Forest. To assess the presentation of the classifiers, we looked at the outcomes acquired dependent on standard execution measurements. Gullible Bayes Classifier is utilized to recognize protests by applying Bayes Algorithm. Irregular Forest Classifier is a gathering calculation which creates a bunch of uncorrelated choice trees by haphazardly choosing the subset of preparing set and afterward totals them to come to an end result. SVM (Support Vector Machine) is a discriminative classifier that finds a line that divides the classes. Table 2 lists the outcomes acquired by utilizing various classifiers.

A.Table 2 – Results (in percentage) obtained after applying different classifiers

TPR: True Positive Rate, FPR: False Positive Rate, SVM: Support Vector Machine

S.No.	Classifier	TPR	FPR	Accuracy	Precision	Recall	F-Measure
1.	Naive Bayes	80	20.7	80	80.7	80	79.8
2.	SVM	80	20.4	80	80.1	80	79.9
3.	Random Forest	84	16.1	84	84	84	84

From table 2 we enumerate that Random Forest classifier give the best classification results with the accuracy of 84%.

IX. CONCLUSION AND FUTURE WORK

Two-way investigation has been acted in our work. Our first stage incorporates the outcomes got by the android application when the driver faces the camera. Information gathered from this stage is additionally utilized in the second stage where nitty gritty examination of the outcomes has been performed utilizing AI classifiers to test the viability of the proposed approach. Classifiers that were utilized for observational investigation were Naive Bayes, Support Vector Machine and Random Forest. To assess the exhibition of the classifiers, we analyzed the outcomes got dependent on standard execution measurements. Innocent Bayes Classifier is utilized to recognize protests by applying Bayes Algorithm. Arbitrary Forest Classifier is an outfit calculation which produces a bunch of uncorrelated choice trees by haphazardly choosing the subset of preparing set and afterward totals them to come to an end result. SVM (Support Vector Machine) is a discriminative classifier that finds a line that divides the classes. Table 2 lists the outcomes acquired by utilizing various classifiers.

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