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DRIVER DROWSINESS DETECTION FOR BEHAVIORAL ANALYSIS

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ABSTRACT

Driver drowsiness is the leading cause of traffic accidents; thus, drowsiness detection plays an important role in preventing them. By developing an automatic solution for alerting drivers of drowsiness before an accident occurs, the number of traffic accidents could be reduced. As a result, this study suggests a method for detecting drowsiness in real time. Image processing and machine learning are two aspects of the suggested approach. The purpose of the image processing step is to recognize the driver's face and then extract the image of the driver's eyes. This phase employs the Haar face detection method, which takes video as an input and outputs the discovered face. Next, haar is utilized to extract the detective's eye image, which will be used as an input for the machine learning phase. The role of machine learning, in this case, is to classify whether the driver's eyes are closed or open using a support vector machine. If the classification results show that the driver's eye is closed for a predetermined amount of time, the driver's eyes will be regarded closed, and an alarm will be activated to inform the driver. On available benchmark data, the proposed methodology has been tested. The results show that the hybridized image processing approaches with machine learning techniques are accurate and resilient. As a result, it can be concluded that the presented methodology is a viable solution method for detecting driver tiredness in the real world.

Keywords- Drowsiness detection: Face detection; Eye detection; Yawn detection; Eye aspect ratio; Haar cascade algorithm.

INTRODUCTION

Drowsiness is a transitional state between awake and sleepy. In a drowsy state, the opening and closing of the eyes differs from normal. Human beings require adequate sleep to function properly. Lack of sleep also causes the body to react in effectively, resulting in a loss of attention, which can lead to accidents. The main cause of vehicular accidents is the driver's tiredness, which can be caused by a variety of factors. Because of the driver's drowsiness, serious traffic accidents occur, resulting in financial, mental, and physical losses, the consequences of which are unknown. Drowsiness is defined as a feeling of being drowsy or overtired to the point where it is difficult to keep one's eyes open. Excess sleepiness is another name for drowsiness, which can be accompanied by lethargic weakness to the point where a person may fall asleep in an improper location and at inappropriate times, even throughout the day. One of the primary causes of car accidents is drowsiness. Each year, sleepiness causes lakhs of accidents and thousands of deaths all over the world. However, the exact amount is difficult to determine because it is still higher.

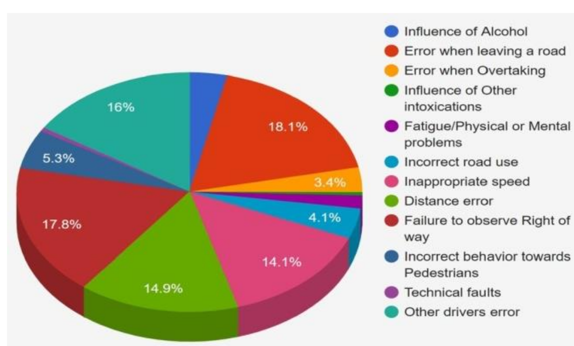


Figure 1. Causes of Accidents on Passenger Car Vehicle type between 2008 and 2017

There are varieties of technologies for detecting drowsiness, which can be split into three categories: Vehicular-based, behavioral-based and physiological procedures.

In vehicular-based technique metrics such as steering wheel and accelerator movement, or pattern of the automobile's break speed, lateral acceleration, etc. are observed persistently. Discovery of some irregular variation in these values are said to be drowsiness of a driver. This is non-invasive in the sense that the devices have no effect on the person who is driving. As a result, determining whether or not a motorist is drowsy is challenging.

In behavioral based the metrics based on driver activities like as flashing of eyes, yawning, closing of eyelids, and so on are investigated for drowsiness detection in a behavioral centric strategy. This is also known as a non-invasive method because a standard camera is used to determine the features.

In physiological based techniques indications such as ECG, electrooculogram, electro telegram heartbeat, and others are used in physiological centered to identify drowsiness. This is invasive to the extent that the devices are affixed to the driver’s body, which would prevent the person from driving. The size and price of the system will increase due to the various types of sensors used in the system, but the addition of more attributes will observe the one of system precision to a specific range. These factors motivate the development of a low-cost, high-precision real-time driver somnolence detection system.

For drowsiness detection, the majority of researchers employ the behavioral centered technique. Zhang et al. [1] did a driver tiredness detection that was based on eye state identification. The facial attribute is calculated by assessing the transition of facial expressions, such as the duration of eye closure, blinking, and so on.

Process of behavioral- based technique –

It is one of the non-invasive methods for detecting tiredness. The behavioral framework of the drivers, which includes eye closing ratio, head movement position rate of eye blinking, facial expression, and yawning, is used to calculate the driver's weariness metrics for tiredness detection that are most commonly used. On the basis of an inspection of the location of the eye, the percentage of eye closure is assumed. PERCLOS is the fraction of an eye's closure over a period of time, resulting in either an open or closed eye. The yawning detection system analyses the variability in the geometric figure of the driver's mouth, such as the larger opening of the mouth and the position of the lips, among other things.

Few researchers have also suggested a method for vision-based autonomous driver sleepiness detection utilizing a haar cascade classifier and a support vector machine classifier. The suggested method begins by identifying the face, then the eye, using a haar cascade classifier, and then extracting eye parameter features such as eyelid movement and eyebrow, and then classifying whether the eye is open or closed using the SVM function. Because visual signals such as eye state, whether open or closed, can generally give a strong indication of the driver’s level of fatigue, an automatic and robust way to extracting the eye state from input photos is a highly vital and crucial task to our efforts. The emphasis will be on developing a system that can accurately monitor whether the driver's eyes are open or closed through continuous monitoring and analysis.

LITERATURE REVIEW

The research of other authors on behavior-centered sleepiness detection is reviewed in this section. To identify tiredness different researchers, employ different approaches and methods. For driver alertness testing.

Mbouna and Kong et al. [2] calculated the revealed position of eye pose of head visual analysis. In order to retrieve the precarious information on driver vigilance, visual features such as people activity head position (HP) and Eye Index were proposed. A support vector machine (SVM) is a machine that divides data into video clips and classifies them as alert or non-alert driving events. Experiments have revealed that the proposed strategy is effective. The method achieves a high degree of classification accuracy at a low cost. In real-world highway / street driving situations, the suggested approach provides improved classification precision with minimal error technique and incorrect sirens for individuals of various origins and gender.

Singh et al. [3] developed a driver fatigue monitoring system that uses eye tracking to detect drowsiness. They investigated if integrating data such as driving time and contestant information would improve the precision and accuracy of tiredness detection and identification. 21 contestants drove a car for 110 minutes under conditions designed to induce drowsiness. Psychological and behavioral measures such as heart proportion and unevenness rate of respiration, moment of head (blink length, frequency, and PERCLOS) and reported driving activity such as time to lane crossing, speediness, steering angle, and lane direction were accessed. Different combinations of this information, as specified from video recording through trained observer rating, were compared to the real position of the driver.

Doughmi et al. [4] Investigate and prevent driver somnolence using a real-time system based on a recurrent neural network. To discover drivers of somnolence, the author used a monotonous neural network architecture and a multilayer model-based three-dimensional CNN. They reach a 92% accuracy rate, allowing for the use of real-time driver tracking devices to reduce traffic injuries.

Using SVM and Haar classifiers for face identification and eye recognition, Anizy et al. [5] proposed a fully automatic system that proved effective in detecting driver tiredness and attention.

By analyzing the duration of eye closure using a camera and building an algorithm to detect driver tiredness in advance and warn the driver via in-vehicle alarms, an eye tracking-based drowsiness detection system has been developed. Breath and alcohol sensors are used in drunken state analysis systems to detect the presence of alcohol in the driver's breath. The work was carried out with the help of an infrared breath analyzer mounted on the steering wheel, which detects the infrared light absorbed by the alcohol in the driver's breath. Despite the fact that research began years ago, just a few systems have been commercially released. Only high-end vehicles use the sleepiness detecting technologies created by Volvo and Mercedes Benz. The Mercedes-Benz Attention Assist system continuously analyses the vehicle in order to maintain a suitable distance for accident avoidance [6].

The Gabor wavelet is a widely used descriptor for representing visual textual data. Tian et al. [7] used a neural network to categorized the state of the eye by mining Gabor wavelets at various sites as a multimedia tools application, a series of multi scale and multi orientation Gabor constants, and a series of multi scale and multi orientation Gabor constants.

Tadesse et al. [8] proposed a dynamic model to detect somnolence that uses a hidden Markov model to analyze the driver's facial expression. An algorithm was created with the help of a stimulated driving setup. The proposed strategy has been demonstrated to be quite effective.

Bin yang et al. [9] They suggested that in a simulator or under experimental settings, measurements of a driver's eyes may be utilized to identify fatigue. The performance of the most recent eye tracking technologies and the accuracy of in-vehicle fatigue prediction algorithms is studied. These factors are analyzed both analytically and by an outside party. Based on a 90-hour dataset of actual road travels, a categorization system was developed. Eye-tracking appears to be successful, according to the data. Sleepiness detection works effectively for some drivers as long as the blink detection is working. Despite the stated improvements, however, there are still concerns for persons who wear glasses and in low-light settings. Thus, the sleepiness tests using a camera are reliable. They are, however, insufficiently trustworthy to be used as a sole source of information.

Based on an infrared camera, Vitabile et al. [10] build a system to identify symptoms of driver fatigue. An algorithm for identifying and tracking the driver's eyes has been devised using the phenomenon of bright pupils. When the system detects drowsiness, an alarm message is sent to the driver.

The application of head movement-based detection for driver drowsiness was reviewed by the authors of [11]. They discussed general measures that can be used to identify tiredness in a driver, as well as a comparison of several drowsiness detection devices.

Mkhuseli Ngxande et al. [12] To detect weariness levels, behavioral techniques employ mounted cameras in the automobile to analyze facial features such as eye state, head movement, blinking rate, and yawning. Most studies use a consistent technique to extract face data, highlights from the live camera stream additional processing are done once these characteristics are acquired to determine the extent of contamination. Machine learning techniques such as Support Vector Machines (SVM) and Convolutional Neural Networks (CNN), Hidden Markov Models (HMM), or Neural Networks (CNN) are commonly used to detect sleepiness (HMM). These approaches are trained using features, which are subsequently labelled outputs for developing drowsiness prediction models.

Shabnam Abtahi et al. [13] Based on yawning measurements, the author of this study developed a novel approach for identifying driver fatigue. This approach includes real-time face detection and tracking, mouth contour detection and tracking, and yawning identification based on detecting both the rate and quantity of changes in the mouth contour region. This study employs a number of tactics to ensure that yawning expression can be accurately identified in a variety of lighting situations and with facial occlusions. According to test findings, the suggested system is capable of assessing the aforementioned elements and detecting yawning as a sign of driver fatigue.

A. Picot et al. [14] determined how high an elevated speed camera should be positioned. The EOG is used to mine the blink property in order to detect tiredness in draughts. They demonstrate a technique for detecting and categorizing blinks. This method employs an energy single obtained from the video assessment. They discover a strong link between EOG and video indicators and length, occurrence, PERCLOS, and bright qualities. The influence of the rate of frame on the position of the various mined attributes is also looked at.

METHODOLOGY

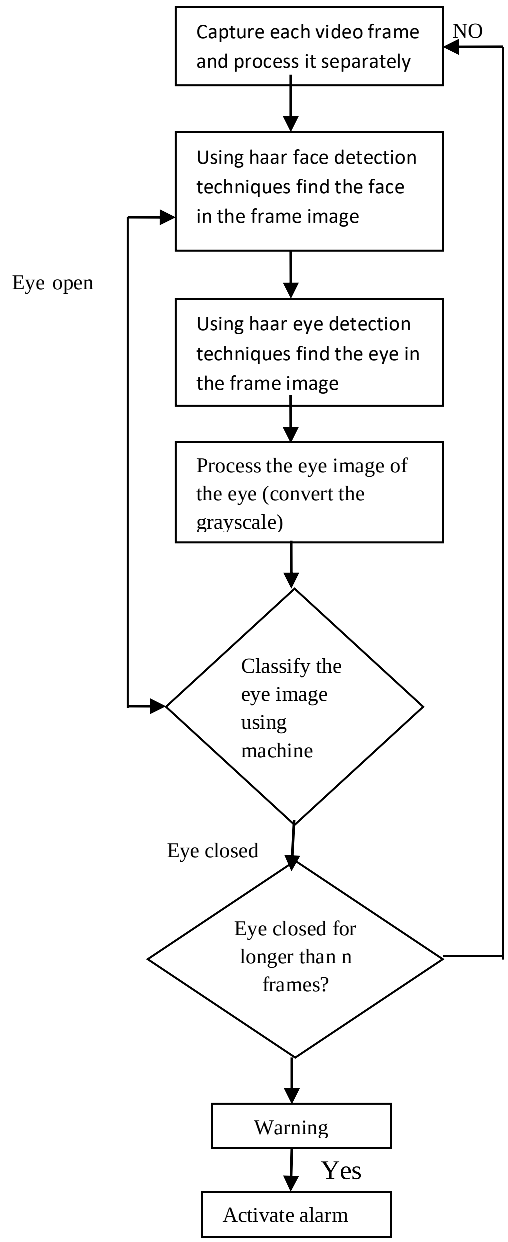
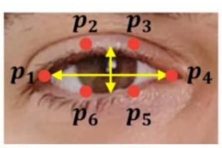


Figure 2. Flow chart

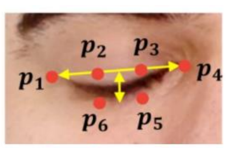
The approach used in this study is separated into two sections:

The first portion is in charge of analyzing the video frame and detecting the facial picture, followed by detecting the eye image. The second section is in charge of creating and implementing the classification model.

The overall process employed is shown in the flowchart in fig.2. The proposed method will begin by recording individual video frames. The system will detect the face in the frame picture and then the eye image in the face image for each frame. The eye image will be pre-processed (by converting it to grayscale) before being identified using a machine learning classifier to determine whether it was open or closed. If the driver's eye is closed for a period of time, the system will sound an alarm to alert him. The haar algorithm will be used to detect the face and eye picture in the first stage. The haar method is a well-known robust feature-based technique that can recognize the face image efficiently (Viola and Jones 2001) cording individual video frames. The system will detect the face in the frame picture and then the eye image in the face image for each frame. Second part: Classifying the eye image using the same approach, a machine learning classifier was created to categorize the pre-processed eye image. SVM is capable of solving both linear and non-linear classification problems. It can find an ideal classifier by maximizing the margin around the separating hyper plane.



Open eye will have more EAR



Closed eye will have less EAR

$$EAR = \frac{||P2 - P6|| + ||P3 - P5||}{2||P1 - P4||}$$

EXPERIMENTAL RESULT

The experiment was carried out in a real world setting to get the desired outcome.

Sample 1

Sample 2

Sample 3

CONCLUSION AND FUTURE SCOPE

Driver fatigue is one of the primary elements that might be fatal at times. To raise his or her awareness, countermeasures must be taken. There are three types of drowsiness techniques: behavioral, vehicular, and physiological.

Drivers are critical to attaining the primary goal of arriving at the destination. Many taxi drivers, truck drivers and other professionals are needed to travel to remote regions, which can lead to an excursion. Excursion can cause weariness, laziness and sleepiness, among other things, and driving when tired might be dangerous. As a result, there is a strong surge to reconsider the parameter and find new solutions to avoid such disastrous events.

Important behavioral factors such as the driver's eye curvature, blinking, yawning and head tilting can properly determine the driver's condition. The current first method includes two phases: the first is to detect and pre-process the eye image using image processing techniques, and the second is to construct a classification model that can decide whether the eyes are open or closed, and then start and alarm appropriately.

However, in a complex situation where the driver is wearing sunglasses and yawning during the day. While the mouth is covered with the hand, determining the condition is difficult. A large data set can be useful as well. The same is being discussed.

REFERENCES

[1]. Zhang, Z and J.Zhang 2010. A new real time eye – tracking based nonlinear unscented Kalman filter for monitoring driver fatigue.J. control theory Applic, 8: 181-188.

[2]. Ralph Oyini Mbouna, Seong G. Kong, Senior Member, IEEE, and Myung-Geun Chun," Visual Analysis of Eye State and Head Pose for Driver Alertness Monitoring." IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 14, NO. 3, SEPTEMBER 2013.

[3]. Singh H, Bhatia JS, Kaur J.: Eye tracking based driver fatigue monitoring and warning system. InPower Electronics (IICPE), 2010 India International Conference. pp. 1-6. IEEE (2011).

[4]. Ed-Doughmi, Y.; Idrissi, N.; Hbali, Y. Real-Time System for Driver Fatigue Detection Based on a Recurrent Neuronal Network. J. Imaging 2020, 6, 8.

[5]. G. J. AL-Anizy, M. J. Nordin, and M. M. Razooq, "Automatic Driver Drowsiness Detection Using Haar Algorithm and Support Vector Machine Techniques," Asian Journal Appl. Sci., 2015.

[6]. Eriksson, M and Papanikolopoulos, N.P, "Eye-tracking for Detection of Driver Fatigue", IEEE Intelligent Transport System Proceedings, pp 314-319, September 2014.

[7]. Tian Y-l, Kanade T, Cohn JF (2000) Eye-state action unit detection by gabor wavelets. In: Proceedings of the Advances in Multimodal Interfaces. Springer, pp143-150.

[8]. Eyosiyas Tadesse, Weihua Sheng, Meiqin Liu," Driver Drowsiness Detection through HMM based Dynamic Modeling." 2014 IEEE International Conference on Robotics & Automation (ICRA) Hong Kong Convention and Exhibition Center May 31 - June 7, 2014. Hong Kong, China.

[9]. Fabian Friedrichs and Bin Yang, "Camera-based Drowsiness Reference for Driver State Classification under Real Driving Conditions" 2010 IEEE Intelligent Vehicles Symposium University of California, San Diego, CA, USA June 21-24, 2010.

[10]. S. Vitabile, A. Paola and F. Sorbello, "Bright Pupil Detection in an Embedded, Real-time Drowsiness Monitoring System", in 24th IEEE International Conference on Advanced Information Networking and Applications, 2010.

[11]. A. Mittal, K. Kumar, S. Dhamija, and M. Kaur, "Head movement-based driver drowsiness detection: A review of state-of-art techniques," Proc. 2nd IEEE Int. Conf. Eng. Technol. ICETECH 2016, pp. 903–908, 2016.

[12]. Mkhuseli Ngxande, Jules-Raymond Tapamo, Michael Burke, "Driver drowsiness detection using behavioral measures and machine learning techniques: A review of state-of-art techniques," 2017 Pattern Recognition Association of South Africa and Robotics and Mechatronics (PRASA-RobMech), 2018, doi: 10.1109/RoboMech.2017.8261140

[13]. Shabnam Abtahi, Shervin Shirmohammadi, Behnoosh Hariri, Daniel Laroche, Luc Martel, "A yawning

measurement method using embedded smart cameras, July 2013, doi: 10.1109/I2MTC.2013.6555685

[14]. A. Picot, A. Caplier and S. Charbonnier, "Comparison between EOG and high frame rate camera for drowsiness detection," 2009 Workshop on Applications of Computer Vision (WACV), Snowbird, UT, 2009, pp. 1-6, doi: 10.1109/WACV.2009.5403120.