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Driver Dormant Monitoring System to Avert Fatal Accidents Using Image Processing

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Abstract - *Drowsiness is defined as a state of sleepiness when one needs rest. This state of a person can have a severe impact on the performance of day-to-day tasks: lack of awareness, micro sleeps (blinks with duration over 500ms), fretfulness, lethargy, and lack of mental agility. Therefore, the prototype of driver tiredness identification to ensure the safety of both the driver and the vehicle is developed using Raspberry-pi and with the help of software such as Python, Open CV, and VNC viewer. This prototype system initially checks the alcohol levels of the driver and then works towards detecting drowsiness. After detecting the face successfully, the region of the eye is extracted by eliminating facial hair, clothes, and varied background. Haar face detection algorithm is used for object detection, efficient in identifying and extracting the face and, real-time video. The successive frames are taken as input and the eye's region of interest (ROI) is detected by estimating the threshold value given and different levels of the alerting system are activated such as a buzzer, sprinkler, light indicator, and finally, vehicle ignition is turned off. Later a mail is sent to an immediate family member or the owner to apprise.*

Key Words: **Drowsiness; Raspberry-pi; Open CV; VNC viewer; Haar face; Frames; Region of Interest (ROI); Threshold-value; Alert-system.**

1. INTRODUCTION

The increase in population has led to the emergence of private transportation. This being the main reason is causing a greater number of accidents which in turn is the cause for loss of life and property. The driver's unalertness is mainly due to a prolonged journey without doze and relaxation. There is a fatal car accident for about 25-30 seconds. The public too has become more concerned about this issue regarding the safety and security of the vehicle under the circumstances of thieving or misfortune. The other parameters that contribute to this finding of grief accidents include weather, traffic, road conditions, lack of driver's safety measures and mechanical performance of the vehicle, etc., The psychological cause is mainly due to driver's unawareness. This may be the kind-drunkenness, fatigue, mental condition, and drowsiness. The slackening of these factors can effectively reduce drivers' consciousness.

Over the decades, several drowsiness detection techniques to identify face and eyes in real-time have been formulated for monitoring driver drowsiness. This paper targets to assess the driver's EAR (Eye Aspect Ratio) to identify the drowsiness. The raspberry-pi is programmed with the python code. The algorithm is formulated in such a way that it allows a raspberry-pi camera module to be able to recognize the face and eye region efficiently. The above process is the most significant activity and a prime measuring factor that can serve to measure the drowsiness of the driver. After successful detection of the eye, it is then analysed for drowsiness detection using the PERCLOS algorithm. The driver is further alerted for drowsiness through a different alerting system such as a buzzer, sprinkler, and LED indicator at different levels. Thereby the safety of the vehicle and the driver is ensured preventing loss of life.

2. LITERATURE SURVEY

[1] Neetu Saini et.al. propose a face processing prototype system. This implementation is done through template matching, skin color model using the algorithms of integral images, and cascaded weak classifiers. The applications include biometrics, image database management, and video surveillance.

[2] S Priyadarsini et.al. propose a computer vision technique-based system for driver and road safety. This system is efficient in functioning and working of all its three phases viz. face detection, eye extraction, and detection of drowsiness. The proposed system is effective and efficient as it is of low cost.

[3] K Subhashini Spurjeon et.al. [3] propose a dedicated system for analyzing drivers' tiredness. The cam-shift algorithm is used for the tracking process. The methodologies include eye position detection, eye gaze recovery, and eye blink and, eye closure evaluation. This is an outbreak of the traditional way of drowsiness detection.

[4] Jasmeen Gill et.al. states that traffic accidents are mainly caused due to drivers' sleepiness. The methodologies used include electroencephalogram, ECG and, eye closure capturing. The various detection technique in this system

includes Lab Colour Space [LAB], thresholding fuzzy C: Means Clustering method, and Circular Hough Transform [CHT].

[5] V B Navya Kiran et.al. implement machine learning techniques and, AI technologies to monitor drivers' sleepiness. The areas focused include driver distraction, unalertness and, aggressive driving behavior. The different methodologies include Perclos, Camshaft, Haar training, and Viola-Jones algorithm.

[6] Priya Swaminarayan et.al. propose the technique of face detection in pixels with elaborated features and variabilities provided throughout human faces. Features include pose, expression, smile, role and orientation, pores and complexation and, photo resolutions. This system is also used for computer learning, especially OpenCV. The applications include CCTV video security, human-computer interface, image database search, banking security, e-commerce services, passports, and employee ids.

[7] J Manikandan et.al. propose a face recognition system with the benefaction of computer vision, OpenCV within the scope of cops' investigation. The phases include identification of the face, positioning of the face and, outlining of facial capabilities. The classifiers employed include LBP and Haar.

[8] Ipshita Chatterjee et.al. present a comprehensive and non-obtrusive driver's robustness detection system. It also primarily includes alcohol sensors employed along with motion detection and, landmark detection computer vision techniques.

[9] Wen-B-Horng et.al. propose a driving safety system by employing the methodologies based on color models such as RGB, YCM and HSS color model that is well suited for differentiating skinny and, non-skinny colors irrespective of shadows and reflections.

[10] Khushbu Pandey et.al. propose a contemporary image presentation technique based on contractive images. The hardware requirements include an 89C52 microcontroller, L293D motor driving, and LCD MAX232IC power supply under the bridge rectifier. The advantage is the addition of more databases and cheaper components. It can be used in electronic gadgets for security.

[11] Feng You et.al. is a non-invasive and, cheap method of identifying drivers' unalertness based on their behavior. The fatigue detection algorithm is based on CNN. It is used in combination with AdaBoost and kernel correlation filter. This algorithm outperformance in both accuracy and speed, the services include an intelligent transport system and traffic safety.

[12] Paul Viola et.al. describe a distinguished work with three contributions viz. representation of a new image, AdaBoost learning algorithm and, complex cascade classifier for computation on regions where promising objects are detected. This system achieves high computational efficiency with less time. It also throws generic insights that have wide applications in computer vision and processing of the image.

[13] Souvik Das et.al. propose experimental results formulated by using computer vision and, libraries under the framework of OpenCV. A python programming technique is used for tracking and, detection of the face and in turn for correct classification.

[14] Muhammad Ramzan et.al. state that driver drowsiness is the main factor leading to severe injuries and, financial losses. The implemented system consists of an alarm to alert the drivers if out of concentration. The research methodology comprises data acquisition, data selection, drowsiness detection techniques, dynamic template matching, analysis of mouth and, yawn, eye closure and, head posture techniques.

3. OBJECTIVES

1. To detect the alcohol consumption and if the alcohol is consumed by the driver, then the ignition will not turn on.

2. To design a system to detect driver's drowsiness based on measurement of the face and eye detection.

3. To imple0ment a buzzer and sprinkler system to further increase the vigilance of the driver.

4. Further to increase the protection of the driver, the indicator is turned on followed by switching off the ignition.

5. To mail the image of the driver to the owner/ immediate family member to appraise.

4. METHODOLOGY

Although Viola-Jones is an outdated framework, it is quite exceptional and influential in real-time face detection. This algorithm has a slow training speed but, once trained can detect faces with enormous speed in real-time. The characteristics of this algorithm include an eye positive detection rate, robustness, and practical application of detection of faces from non-faces. The working of this algorithm is in such a way that image pixels are summed up within rectangular areas. The four stages of this algorithm include the selection of Haar features, integral image creation, training of AdaBoost and training of cascading classifiers.

A methodology where a classifier is framed comprising of a set of positive and negative photos and drilled into a classifier with the aid of machine learning is what is Haar

cascading algorithm. Both the Haar cascade and Viola-Jones algorithm were put forth by Paul Viola and Michael Jones. The classifiers implemented for Haar feature extraction are exclusively trained for object detection. The successful detection of the face and facial expression in an image is also achieved. Both the positive and negative of the image are fed to the classifier and the characteristics are extracted, where each character is an individual attribute obtained by the difference in the summation of pixels in a white rectangle and from the summation of pixels in a black rectangle. The Haar-like feature is an integral image and can be calculated in constant time irrespective of its size.

AdaBoost short for adaptive boosting is a meta-algorithm used for statistical classification. It is flexible as it can be used with other learning algorithms to improve performance. The principle behind this boosting algorithm is to first build a model based on the training dataset, a second model is built to rectify the errors present in the former model. This is a continuous procedure and it terminates once all the errors are minimized and a correct prediction of the dataset is achieved. Boosting algorithm combines multiple weak learners to reach the final output consisting of strong learners.

5. BLOCK DIAGRAM

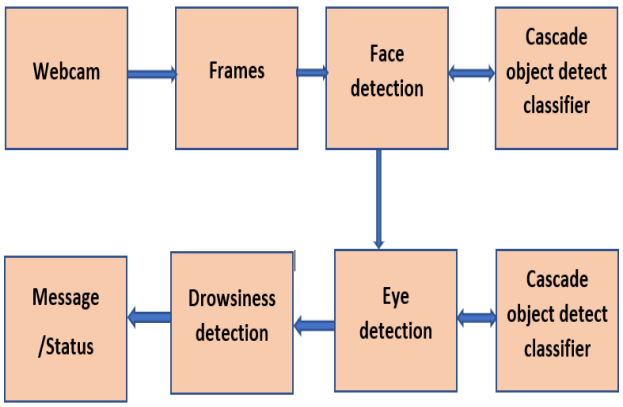

Fig -1: Methodology for drowsiness detection

This can be categorized and worked upon in two ways: by evaluating and analyzing variations in physiological behavior such as changes in brain waves, heart rate and flickering of the eye. The second path is by the analysis of physical changes, for example, posture verification whether straight or sagging, driver's head inclination, and percentage of the eyes open/shut under varied light conditions. But, all of these methods pose threat and it is not reasonable as the electrodes that detect all of the above-mentioned variations need to be directly injected into the driver's body thereby causing irritations and diversions to the driver. The precise screening capability of electrodes may reduce when exposed for a long duration and also due to the profuse sweating of the driver. But, the proposed system for drowsiness detection mainly targets PERCLOS also called the percentage of closure which provides error-free and precise information on eye closure. This approach is non-obtrusive and non-invasive and a completely driver-friendly system works well irrespective of road conditions even a micro nap can be detected as per the eye threshold value given in the code. The stages of development of this system are a series of important operations such as face tracking, identification, eye extraction, detection of the state of the eye and testing of driver fatigue. The PERCLOS estimation efficiently computes the portion of the eyes being shut/open with the average number of frames for a particular period. And adding to it will be the Alcohol Sensor to detect the level of consumption of alcohol if the driver has consumed alcohol more than the threshold value the vehicle ignition is not enabled.

6. MODULE DISCRIPTION

1. Face Detection: By using a webcam the face is captured and continuous video images or face is considered, and this face is further divided into different frames. Different features by using the Viola-Jones algorithm are applied to frames.

2. Eye detection: Once the face is detected, the next region in the face is the eyes. Here, the per-closure value or threshold value is considered and this value depends on the user code. For example, if the user fixes a value of 0.33 as the threshold in the code, if the driver closes the eye below the defined threshold value, then the driver is said to be drowsy.

3. Drowsiness detection: As mentioned in the eye detection, if the driver closes his eyes below the threshold, then the driver is considered to be drowsy. This drowsiness is mainly due to continuous driving without taking short breaks or any mental disorders. This problem can be solved by using an alert system.

4. Alert system: To alert the driver, this system is implemented. In this project, the alert systems are buzzer and sprinkler. Whenever the driver is drowsy i.e., when the driver closes his eyes below the threshold value the alert system gets alerted. The buzzer turns on for a few seconds and if the driver does not respond, the sprinkler sprinkles the water on the driver's face which is acting as the next level of an alert system. Then further to increase the vigilance of the driver the indicator is turned on followed by switching off the ignition.

Here, the indicator is a signal for the vehicle behind and around, thereby indicating the drowsiness detected vehicle is about to stop. As soon as the vehicle stops, the image of the drowsy driver is sent to the immediate family member or the owner to appraise.

7. SOFTWARE DESCRIPTION

1. OpenCV (Open-Source Computer Vision Library): It is an open-source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code. The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras and stitch images together to produce a high-resolution image of an entire scene, find similar images from an image database, remove red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc. OpenCV has more than 47 thousand people in the user community and an estimated number of downloads exceeding 18 million. The library is used extensively by companies, research groups, and governmental bodies.

2. Dlib: Dlib is a landmark facial detector with pre-trained models, the Dlib is used to estimate the location of 68 coordinates (x, y) that map the facial points on a person's face like the image below. These points are identified from the pre-trained model where the iBUG300-W dataset was used.

3. Imutils: Imutils consist of a series of convenient functions of basic image processing such as translation skeletonization resizing, sorting contour colors, and edge detection and work easier with OpenCV. The shifting of an image is done along its axes. The image translation process involves shifting upwards, downward ds, or sideways directions or with the combinations of these directions.

4. NumPy: NumPy stands for Numerical Python, is a standard library consisting of objects in an array and ac collection of particular routines for the previously array processing. Mathematical and logical operations can be performed on this array. NumPy is a python package created in the year 2005 by Travis Oliphant.

5. SMTP: Simple Mail Transfer Protocol is used to send and receive email. It is usually paired with IMAP or a user-level application such as POP3, to handle the reclamation of messages. SMTP is an asymmetrical protocol in which one server interacts with many clients and it runs on TCP/IP listening to port 25.

8. FUTURE SCOPE

The drowsiness detection system can be further enhanced and extended by extracting the mouth region of the driver to indicate drowsiness through yawning. This work can be achieved by implementing an IR webcam that uses IR radiations to detect drowsiness. To reduce the cost of hardware, this project can be turned into a mobile application. The Raspberry Pi and Pi camera can be mounted on the sun vision of the vehicle. A fully wireless system or loop can be achieved.

9. CONCLUSION

Drowsy driving is as destructive and life-threatening as drunk driving. An automatic prototype system is developed for drowsy condition detection while driving. The alcoholic levels of the driver are checked, and different not the alcohol sensors have varied ranges to verify the same. The continuous video stream is extracted, read and detected by using the Haar Cascade algorithm. Haar features include digital image features that are useful in object detection. This prototype system is efficient in detecting drowsiness under varied light conditions and in the case when the driver wears spectacles. An inbuilt system for driver safety and car security is present in luxurious cars. Hence this prototype system can be interfaced with normal cars also.

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