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Driver Drowsiness Detection

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Abstract: *Car crashes are the leading cause of death, killing around 1.3 million people every year. Most of these accidents were caused by distracted or drowsy drivers. The construction of highways reduces the margin of error for drivers. Countless people drive long distances on the highway every day. Lack of sleep or distractions, such as phone calls, conversations with passengers, etc. May cause an accident. This system uses convolutional neural networks to effectively assess levels of driver drowsiness and fatigue. The system can be divided into three parts: the model architecture, the mobile components and the website. It was created for logistics and ridesharing companies to track and analyze the performance of their drivers. The system is designed to create a safer environment for drivers and has become a major asset for these companies.*

Key Word: *Drowsiness Detection, Machine Learning.*

I.INTRODUCTION

Real-time drowsy behaviors associated with fatigue manifest as eye closing, head shaking, or brain activity. Thus, we can measure changes in physiological signals such as brain waves, heart rate, and eye blinks to monitor drowsiness, or consider physical changes such as leaning posture, driver head tilt, and sleepiness. Opening/closing of the eyes. The first technique, although more precise, is impractical because the highly sensitive electrodes must be attached directly to the driver's body, which can be inconvenient and distracting while driving.

Additionally, long hours of work can cause the sensor to sweat, reducing its ability to monitor accurately. The second technique is to measure body changes (i.e. eye opening/closing to detect fatigue) well suited to real-world conditions as it is non-invasive and uses a video camera to detect fatigue. changes. In addition, short sleep durations of 2 to 3 minutes, the micro sleep, are good indicators of fatigue.

Therefore, by constantly monitoring the driver's eyes, it is possible to detect driver drowsiness and issue a warning in time.

The main idea behind this project is to develop a non-intrusive system capable of detecting fatigue in any person and issuing a timely warning. Drivers who don't take frequent breaks on long journeys are likely to experience drowsiness, which they often go undetected at first. According to expert research, about a quarter of serious road accidents are caused by drivers who are drowsy and in need of rest, meaning that drowsiness causes more traffic accidents than drunk driving. drunk. The system will monitor the driver's eyes using a camera, and by developing an algorithm, we can detect driver fatigue symptoms early to prevent them from falling asleep. Therefore, this project will help detect driver fatigue in advance and give warning output in the form of alerts and pop-ups.

Drowsiness detection systems are considered an effective tool to reduce the number of road accidents. The parameters used to detect drowsiness are face and eyes. The warning system is used to warn the driver. Our goal is to implement effective solutions for road accidents and system development costs in real time. Driver drowsiness is one of the main causes of road accidents.

The number of deaths and injuries around the world is increasing every year. Provides Automatic Driver Drowsiness Detection System (ADDDS) to reduce the number of accidents due to driver fatigue, thereby improving transportation safety.

II.LITERATURE REVIEW

In this project, authors Anushka Vijay Sant, Atharva Shrikant Naik, Anirban Sarker Vandana Dixit mention[1] that one of the main causes of fatal road accidents is drowsiness and fatigue. Drowsiness threatens the safety of drivers, especially when they have to travel long distances. With that in mind, this article describes a system that can improve, analyze, and improve driver safety. This article describes a research approach based on systems design. In the proposed system, drivers would be alerted when they are drowsy, and if the warning alert exceeds a threshold, the driver's current location would be sent to their emergency contacts.

The system uses a convolutional neural network to efficiently assess driver drowsiness and fatigue levels. The system can be divided into three parts: the model architecture, the mobile components and the website. It was created for logistics and ridesharing companies to track and analyze the performance of their drivers.

According to the authors of this article, Mahamad Salah mahmoud, Hossam Almahasneh, Anwar Jarndal, Ahmad

Alzghoul[2], drowsy driving is one of the main causes of road accidents in the UAE and worldwide. Many people die every day from drowsy driving, making automatic driver fatigue detection systems an urgent need in our modern society. Many such systems have been studied in academic and industrial research in recent years, but none have yet been widely used in our daily lives due to their high cost or limited effectiveness. In this article, we present the first steps of an intelligent, non-intrusive, real-time drowsiness detection system that works in different scenarios and real-world lighting conditions. Our system uses computer vision technology to detect the driver's face in infrared video, then a deep neural network predicts if the driver is sleepy based on their face alone.

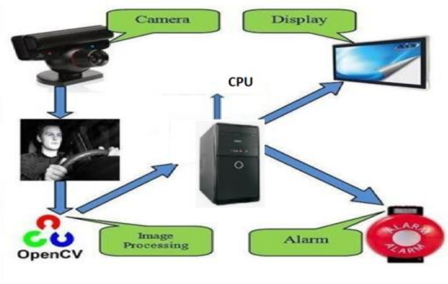
Our preliminary experiments report a prediction accuracy of 94.39%, surpassing many previously published works, especially under nighttime conditions or when the driver is wearing sunglasses.

In this article, authors Belal Alshaqaqi, Abdullah Salem Baquhaizel, Mohamed El Amine Ouis [3] mentioned that driver drowsiness and fatigue are one of the important causes of traffic accidents. Every year they add to the death toll and death toll worldwide. According to the authors, an Advanced Driver Assistance System (ADAS) module is provided to reduce the number of accidents due to driver fatigue and thus improve transport safety; the system processes the automatic detection of driver drowsiness based on visual information and artificial intelligence. We propose an algorithm to detect, track and normally no warning is issued,If the eyes are close for more analyze the driver's face and eyes to measure PERCLOS, a scientifically backed measure drowsiness associated with slow eye closure.

In this article, authors Esra Vural, Mujdut Cetin, Aytul Ercil, Gwen Little wort consider [4] driver fatigue detection as one of the potential applications of intelligent vehicle systems. Previous approaches to drowsiness detection mostly make a priori assumptions about relevant behaviors, focusing on blink frequency, eye closure, and yawning. Here we use machine learning to extract real human behavioral data during sleepiness. An automatic 30 facial action classifier for facial action coding system was developed using machine learning on an independent database of spontaneous expressions. These facial movements include blinking and yawning, among many other facial movements. These metrics have been transferred to learning-based classifiers such as Adaboost and peak multinomial regression. Head movement information is collected through automated eye tracking and accelerometers. The system was able to predict subjects' sleep and crash events with 98% accuracy on a simulator. This is the highest predictive rate reported to date for detecting drowsiness. Additionally, the analysis revealed new insights into the human facial behavior of drowsy drivers. Driver fatigue - sleepiness - machine learning - facial expression - facial action unit - head movement - multinomial logistic regression - support vector machine (SVM) - coupled driver behavior.

In this paper author Aneesa Al Redhaei, Yaman Albadawi, Safia Mohamed, Ali Alnoman mentioned that[5], Driver drowsiness is one of the leading causes of traffic accidents and has a substantial impact on road safety. Many traffic accidents can be avoided if sleepy drivers were given early warnings. Drowsiness detection systems monitor the driver condition and generate an alarm if drowsiness signs are detected. In this paper, a real-time visual-based driver drowsiness detection system is presented aiming to detect drowsiness by extracting an eye feature called the eye aspect ratio. In the proposed system, which is applied on videos obtained from a public drowsiness detection dataset, the face region is first localized in each frame. Then, the eye region is detected and extracted as the region of interest using facial landmarks detector. Following that, the eye aspect ratio value of each frame is calculated, analyzed, and recorded. Finally, three different classifiers, namely, linear support vector machine, random forest, and sequential neural network, are employed to improve the detection accuracy. Subsequently, the extracted data are classified to determine if the driver's eyes are closed or open. An alarm will then be triggered to alert the drowsy driver if an eye closure is recognized for a specified duration of time.

III.METHODOLOGY



After reviewing many different articles, the following methods were identified:

A .Face Detection

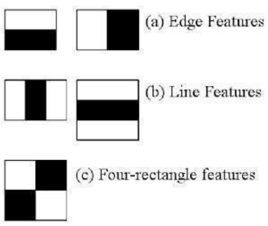


Fig. 1(A) *Fig. 2(B)*

It is a machine learning based approach where a waterfall function is formed from many positive and negative images. This is then used to detect objects in other images. Here we will use face detection. Initially, the algorithm requires many positive (images of faces) and negative (images without faces) images to train the classifier. Then we need to extract functionality from it. Fothis, used the hair feature shown in the image below. They are like our convolution kernels. Each feature is a single value obtained by subtracting the sum of the pixels under the white rectangle from the sum of the pixels under the black rectangle. As shown in the image.

5.1.2(B) depicts five hair-like features, examples of which are shown in Figure 1. shown in 5.1.

Use Adaboost classifiers cascaded with Haar features to find facial regions. First, the compensated image is segmented into many rectangular regions at any position and scale in the original image. Haar-like features are effective for real-time face detection due to differences in facial features. It can be calculated from the difference of the sum of pixel values in the rectangular area. These characteristics can be represented by different compositions of black and white regions.

A cascading Adaboost classifier is a strong classifier that is a combination of several weak classifiers. Each weak classifier is trained by the Adaboost algorithm. Facial regions can be found if candidate samples pass through the Adaboost classifier cascade. Almost all face samples can be accepted and non-face samples can be rejected.

B. Eye detection

In the system we have used facial landmark prediction for eye detection Facial landmarks are used to localize and represent salient regions of the face, such as:

- Eyes
- Eyebrows
- Nose
- Mouth

Facial landmarks have been successfully applied to face alignment, head pose estimation, face swapping, blink detection and much more. In the context of facial landmarks, our goal is detecting important facial structures on the face using shape prediction methods. Detecting facial landmarks is therefore a two step process:

- Localize the face in the image.
- Detect the key facial structures on the face ROI.

Localize the face in the image: The face image is localized by Haar feature-based cascade classifiers which was discussed in the first step of our algorithm i.e. face detection. Detect the key facial structures on the face ROI: There are a variety of facial landmark detectors, but all methods essentially try to localize and label the following facial regions:

- Mouth
- Right eyebrow
- Left eyebrow
- Right eye
- Left eye
- Nose

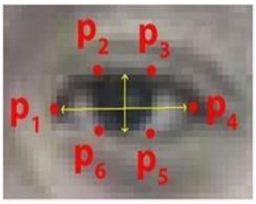
The facial landmark detector included in the dlib library is an implementation of the One Millisecond Face Alignment with an Ensemble of Regression Trees paper by Kazemi and Sullivan (2014).

C. Recognition of Eye's State

Ocular regions can be estimated by optical flow, sparse tracking or frame-by-frame intensity difference, and adaptive thresholding. Finally decide if the eyes are covered by the eyelids. Another approach is to infer eye open state from a single image, e.g. by correlation fitting to eye open and close patterns, heuristic horizontal or vertical image in intensity projections on eye regions, parametric models to find Fit eyelids or live shape models.

A major shortcoming of the previous methods is that they often implicitly place high demands on parameters, such as the relative position of the face camera (head orientation), image resolution, lighting, dynamics of the movement, etc. In particular, heuristics using raw image intensities can be very sensitive, despite their real-time performance. Therefore, we propose a simple but efficient algorithm to detect eye blinks using recent facial cue detectors. A single scalar reflecting the plane of the eye opening is derived from the landmarks. Finally, with the image-estimated sequence of eye openings, blinks are detected by an SVM classifier trained on examples of blinking and non-blinking patterns.

D. Eye Aspect Ratio Calculation



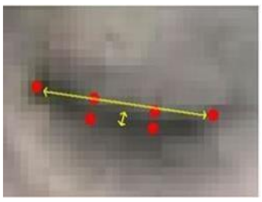


Fig.1(c) *Fig.1(D)*

For every video frame, the eye landmarks are detected. The eye aspect ratio (EAR) between height and width of the eye is computed.

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

Where p1, . . ., p6 are the 2D landmark locations, depicted in Fig. 1. The EAR is mostly constant when an eye is open and is getting close to zero while closing an eye. It is partially person and head pose insensitive. Aspect ratio of the open eye has a small variance among individuals, and it is fully invariant to a uniform scaling of the image and in-plane rotation of the face. Since eye blinking is performed by both eyes synchronously, the EAR of both eyes is averaged.

E. Drowsiness Detection

The last step of the algorithm is to determine the person's condition based on a pre-set condition for drowsiness. The average blink duration of a person is 100-400 milliseconds (i.e. 0.1-0.4 of a second). Hence if a person is drowsy his eye closure must be beyond this interval. We set a time frame of 5 seconds. If the eyes remain closed for five or more seconds, drowsiness is detected and alert pop regarding this is triggered.

Algorithm

Algorithm uses the following techniques in its algorithm :

- HAAR features
- Facial landmark
- AdaBoost Technology
- A cascade
- Tensor Flow

Features are selected based on the pixel intensities in HAAR based feature representation. It does not take into consideration, the values of the pixel. HAAR based features are scalar product between the image and some HAAR templates.

Facial landmark use to detect the positive and negative images.

Adaptive boosting (Ada Boost) is used to select the required features. Due to the use of Adaptive Boosting there is a reduction in the computational time of the algorithm.

TheOpenCVlibraryprovidesacommandprompttrainingutilitycalledHAAR-trainingwhich generates a classifier in XML format when given positive and negative examples of the object to be detected

IV.CONCLUSION

Implement drowsiness detection using Python and Open CV, if consecutive frames detect eye closure, classify it as a drowsy state, otherwise treat it as a normal blink, and repeatedly loop driver condition image capture and analysis. state, the eyes are not circled or detected.

This project describes how to build a sleepiness detector using the open source libraries OpenCV, Python and Dlib. The first step in building an eye blink detector is to perform facial cue detection to locate eyes in a given frame of a video stream. The eye aspect ratio for each eye can be calculated using OPEN CV's Euclidean distance function, which is a single value that relates the distance between vertical eye landmarks to the distance between the horizontal landmarks.

Once the eye aspect ratio is calculated, an algorithm can threshold it to determine if a person is blinking. When blinking, the aspect ratio of the eye will remain approximately constant. Eyes open, then quickly approach zero when blinking, then increase again when eyes open. The blink duration additionally provides estimates of micro sleep. For realistic results, the camera position is centered on the driver's face. Additionally, the algorithm was tested during day and night driving with infrared cameras. The results are discussed in the Results section and are satisfactory.

The proposed algorithm focuses on using eye aspect ratio as a quantitative measure to determine whether a person is blinking in a video stream. However, due to noise in the video stream, detection of tiny facial landmarks, or rapid changes in viewing angle, simply thresholding the eye's aspect ratio can lead to false positive detections, signaling that a blink occurred when the person did not blink. To make our scintillation detector more robust against these challenges, the following improvements can be implemented. Calculate the eye aspect ratio for image N and the eye aspect ratios for images N − 6 and N + 6, then concatenate these eye aspect ratios to form a 13-dimensional feature vector.

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