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Driver Drowsiness Detection

K.Satish, A.Lalitesh, K. Bhargavi, M.Sishir Prem and Anjali.T

***Abstract*—All over the world Drowsiness has been the significant cause of horrible accidents which is causing deaths and fatalities injuries. Day by Day fatal injuries numbers are increasing globally. From the past many years, researchers have concluded drivers with a lack of sleep and more tiredness which causes drowsiness of the driver. this paper shows a new experimental model is designed for detecting drowsiness of driver is presented to reduce accidents caused by this problem which increases transport safety. In this work, two ways are used to detect the drowsiness of a person effectively. First Driver face is captured and eye retina detection and facial feature extraction are done and blinking values are calculated then threshold values are set. Secondly, the Aurdino module is used which is integrated with elastomeric sensors for real-time calculation of driver hand pressure on the car steering wheel and the threshold value is set. The result from both methods is taken as input for taking the final decision and alerting the driver.**

***Index Terms*—Driving Strategies, Steering wheel, Hand position, Driver fatigue.**

I. Introduction

In our day to day life transportation systems plays an important role in human activities. Anyone can be the victim of road accidents at any time for various reasons but most of the accidents are caused due to drowsiness of the driver. The main reasons for drowsiness are due to lack of rest and sleep which causes tiredness on long journeys. Due to these factors, driver vigilance will reduce which causes serious situations and increases the chances of accidents. Because of this reason yearly, most of the accident is happening all over the world [1]. In this technology advanced era, new technologies can play an important role in providing a solution to this problem.

Considering the data analysis done by the National Sleep Foundation USA 100000 accidents are caused due to driver drowsiness problems. Indeed analysis report shows that if a person awake for 18 hours causes drowsiness [2]. Therefore, the period observation of the motive force standing and of import feedback (e.g. alarms or safety automatic procedures) got to be integrated to improve the security automotive systems.

Luckily, these days various technologies will answer these problems like distributed pressure sensors, eye sensor cameras or wearable devices for important parameter detection [3].

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Even though existing wearable technologies will give data related to the driving force posture, the correct natural process of the person or his pulse[4], the selection of different parameters of vehicle sensors is that the most important and safe particularly in automobile industry wherever the vehicles enforced are additional dangerous than low-security cars. On another hand, 2 other options like driver comfort and redundancy should be considered in-vehicle systems[5].

The sensor equipment is in fact, ought to show a virtually clear view for the driving force so as to permit a traditional behavior throughout drive and neglecting the discomfort or perhaps im-pairing the tasks to be performed just in case of risk to boot, multiple watching system and data sensor merging got to be integrated with the problem of neglecting single failure or false device results [6]. In The vehicle automation system and the various device, platforms show the method within which automobile interacts with the surroundings including driving force to ensure its highly safe and to boost overall comfort throughout the trip of these technologies typically interact with one another through customary automotive bus protocols. here we used a method called controller space network (CAN), a famed customary serial bus communication protocol with a period of time management and high knowledge irresponsibleness unfold all told kinds of vehicles[7].

This paper proposes a unique method for detecting the drowsiness of a person based on two factors. The first one is to capture facial and eye features from the camera and detect the blinking of eyes and threshold value is set for a minimum value of eye closing[8]. Secondly, the Aurdino module is used which is integrated with elastomeric sensors for real-time calculation of driver hand pressure on the car steering wheel and the threshold value is set. A result of both methods is taken as input for taking the final decision and alerting the driver. The paper discusses the design and implementation of an improved algorithm to extract facial and eye features along with hardware integration with Arduino and pressure sensors to detect driver situation [9].

The rest of the paper is organized as follows. Section II and Section III describes about the related work and proposed system of the work respectively. The results are discussed in both Section IV and Section V. At last, Section VI concludes the paper with conclusion of the work.

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II. Related Work

Previous works are reportable within the literature survey to drop the number of road accidents due to drowsiness detection and monitoring drowsiness systems based on real-time data.

P.Davidson et al. [10] designed a simple system that uses the Haar Algorithmic program to detect objects and facial features [11] using OpenCV [12] libraries. The eye region is captured from captured images with measurement factors. Then they find the eyelid to live the extent of the eye closure.

A. Paola [13] designed a method to notice symptoms of driver sleepiness supported by an infrared camera. By exploiting the development of bright features, AN algorithmic program for sleuthing and to pursuit the driver's eyes have been designed[14]. Once sleepiness is detected, the application warns the motive force with an alarm message.

C Kumar [15] used the method called Otsu thresholding to detect the facial features. The attention is created by finding face features and main points like hair and possible face center[16]. Morphological operation and Kmeans is used for correct eye detecting. Then a proper set of form options square measure calculated and the trained exploitation non-linear SVM to urge the standing of the attention.

There are various factors that reflect driver driving behavior and performance which include environment issues like (climate changes, bad road conditions), physiological and biological factors (tiredness, age) [17] social and economic factors (alcohol, drugs, tobacco, irregular work shift) and issues related to vehicle (bad condition, damaged vehicle) all these factors will affect the driving force at bigger extent each mentally and physically[18].

Various researches are done to calculate driver drowsiness based on objective and subjective measurements[19]. Measurements related to subjective is related to questionnaires given to driver [20]. In this method there are drawbacks like analysis is conducted either before or after driving event and driver drowsiness connected problems are not taken into consideration through driving task [21]

For nearly the last 20 years[22], Methods like muscle fatigue estimation based diagnostic methods have contended significant importance in detecting driver fatigue physically. SEMG has used as a base for various other researchers [23] [24] to find out muscle fatigue in several forms of vehicles which include cars, two-wheelers, heavy vehicles. The modification in the electromyogram method was related to muscle metabolic process which can find driver fatigue physically.

There are chances of using highly sensitive sensors like Load cell primarily based on low-value Nanostructured compound into handwheel which has the technology to track reading in a real-time environment and send details to hardware for monitoring pressure, so as to form a better detection system which can combine both physical and facial features[25]. In particular, we have the option to design an effective integrated system to observe the pressure of driver hand on handwheel and eye blinking features. This system uses both cameras based and sensor-based solution and therefore the signals incoming from both sensor and camera threshold values are calculated [26].

Previous works have through the subsequent physiological signal to detect drowsiness: Graphical record ECG, myogram EMG, Electron-cephalogram EEG, and electrooculogram EoG [27]. Previous works have used EOG signals to spot driver sleepiness through changes in eye movement. The electric difference between the tissue layers generates different electrical field the gives different signals from eye orientation these chances are measured as EOG signals [28]. Previous research has investigated changes in eye movement by inserting a disposable Ag-Cl conductor on either side of the eye and 3rd conductor in the middle of the head for reference.

Based on these signals given by electrodes on different parameters like speed and slow-motion movements of eye drowsiness are detected decision is taken to inform the user.

III. Proposed System

A. Overview Design

The overall design idea of Driver drowsiness detection is to capture an image from the camera and approximately estimate the state of drivers with data processing to realize these requirements; required hardware and software materials have to be collected. For this project Python machine learning and Arduino are used along with camera and load cell sensors. For facial and eye detection OpenCV and HOG algorithms are used and OPENCV libraries are used.

B. Face Detection

Driver Drowsiness Detection requires hardware and software components which include sensors to detect hand pressure and send values to Arduino and camera to detect face and eyes and process eye blinking rate. In this project, several methods are applied which are explained in this paper.

C. Histogram Oriented Gradient

HOG algorithm is used to preprocess the image which includes image resize and color normalization in this project HOG is used to detect efficient features from for eye detection and extract HOG features from the image patterns and gives the exact region of eyes from the captured image of the driver.

D. Eyes Detection

After capturing the driver's image and preprocessing the next process to estimate the drowsiness of a driver based on the blinking eye blinking rate. Values are calculated for every frame and changes in the blink rate are verified with the threshold value. For effectively detecting eye blinking rate HOG is used which is useful for face detection and provides accurate eye detection rate.

E. Hardware

For this project, the Arduino microcontroller shown in Fig. 1 is used which is a user-friendly open-source input and output system. A load cell sensor is used for giving input to the controller whenever

hand pressure is increased on handwheel values are sent to the microcontroller which is s. Another input to Arduino is the eye brink ratio received from camera and software application which is connected to Arduino using system cable, the design is shown in Fig. 2

Technical features of Arduino

- Microcontroller ATmega328
- Operating Voltage 5V
- Input Voltage (recommended) 7-12V
- Input Voltage (limits) 6-20V
- Digital I/O Pins 14 (of which 6 provide PWM output)
- Analog Input Pins 6
- DC Current per I/O Pin 40 mA
- DC Current for 3.3V Pin 50 mA
- Flash Memory 32 KB of which 0.5 KB used by
- Bootloader
- SRAM 2 KB
- EEPROM 512 bytes
- Clock Speed 16 MHz
- 8-bit microcontroller

A.HOG Algorithm for Detecting face and compute the convex hull

Algorithm: Drowsiness Detection

Input: Handwheel Pressure and Face detection from camera
Output: Detect Driver Drowsiness
Begin
1. Initialize the dlib's face detector (HOG-based) and later create the Facial landmark predictor
2. Grab all indexes of the facial marks for the left and right eye, respectively
3. Start the video stream thread
4. Loop over all the frames from the video stream
5. Detect faces in the grayscale frame
6. Convert the facial mark (x, y)-coordinates
7. Extract the left and right eye coordinates
8. Compute the convex hull for the left and right eye
9. Check if the eye aspect ratio is below the blink
10. Threshold, and if so, increment the blink frame counter
11. If the eyes were closed for a sufficient number send data to Arduino
12. Take pressure readings from hand wheel and send to Arduino
13. Check if both values are above the threshold then start alarm.

End

IV. Experiment and Results

This part details the investigations performed to validate our proposed framework shown in Fig. 3.

A. Dataset

The data set is collected from the live video file of persons who are driving the car. Features of users are captured using the live camera and live tracking of eye movements is captured and used as input data for taking a decision. The shape predictor landmark is used for verifying user data.

Fig. 1. Microcontroller circuit.

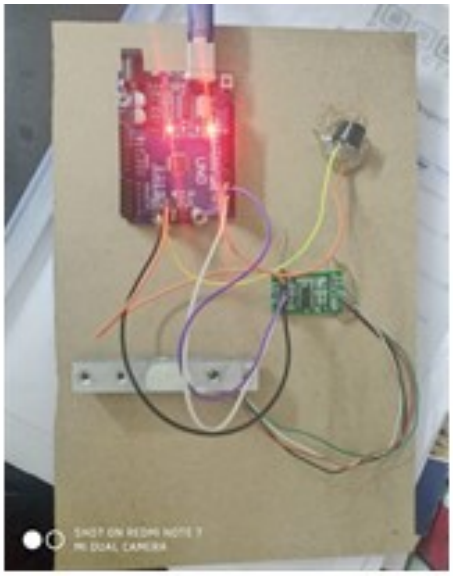

Fig. 2. Aurdino Design.

B. Evaluation metric

Number citations consecutively in square brackets [1]. The Performance of this application is tested under different scenarios like when the user is not driving but eyes are closed and opened along with pressure sensor values are calculated and if the user is driving on the go values are tested with both eye blinking and pressure sensor. If pressure sensor values and eye blink values are above threshold value then only the alarm is set to on state else alarm is off state. False rate and positive rates are detected and values are calculated. False rates are chances when the alarm is not set to on state. Positive rates are chances when the alarm is set to on state when both sensor and eye blink threshold are matched.

V. Results

Table I, shows different tested values with various input videos and sensors and eye blinking values. Here we have tested with various persons with live video tracking. We have also tested without any person on video but getting pressure sensor values. From these results false and positive test results are generated.

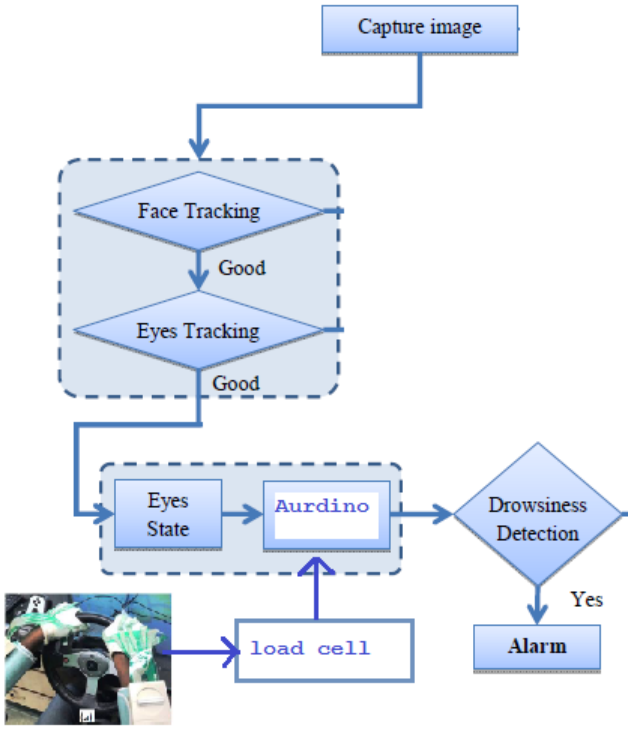

Fig. 3. Framework of Driver Drowsiness Detection.

TABLE I
DATASET DETAILS

Dataset	Eyeblink values	Sensor value	Correctly Detection	False detection
Live video with eye blink	**48**	**-10**	**30%**	**70%**
Live video while driving without an eye blink	**<48**	**-10**	**0%**	**100%**
Live video without the person	**0**	**0**	**0%**	**100%**
Live video without pressure sensor data	**<48**	**0**	**50%**	**50%**
Live video with pressure sensor and eyeblink data	**>48**	**>20**	**96%**	**4%**

VI. Conclusion

This paper proposes a unique method for detecting the drowsiness of a person based on two factors. First one, capture and detect. Second one, is used to integrate. The results are verified using arduino. The simulation prototype is shown. From there results false and positive test results are generated

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