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Driver Fatigue Detection Using Deep Learning Algorithm

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***Abstract*: Recently, machine gaining expertise of strategies have been used to predict a driver's circumstance in order to grant records that will decorate road safety. A driver's circumstance can be estimated through a driver's facial expressions and riding behaviors. Recent developments in video processing the usage of laptop computer analyzing have enabled snap shots acquired from cam-eras to be analyzed with immoderate accuracy. In this proposed system, an approach for extracting certain factors of the eyes and the mouth using Open CV and Dlib library. It offers an alarm when drowsiness and accident occur. An alert will be acquired to the licensed person through the WiFi module linked to the raspberry-pi, the automobile will be stopped.**

***Keywords*: Machine Learning, road safety, Open CV, image processing, Dlib library, Raspberry Pi, WiFi module.**

1. Introduction

Driver drowsiness is the major cause for road accidents, according to a survey in Great Britain around 20% of serious accidents occurs due to fatigue. The Safety strategy for future roads is to identify one of the causes i.e., driver's behavior which is the key for reducing the acci-dents and critical injuries is to be achieved.

The major motive of our system is to increase the accuracy of fatigue detection. The system works by means of examining the eye motion of the driver and alerting the driver by means of activating the buzzer when he/she is drowsy. The gadget so applied is a nonintrusive real-time monitoring gadget for eye detection. During monitoring, the device is capable to figure out the constant blinking of the human eye. If the eyes had been detected closed for a long period time, a sign was once given to warn the driver. Drunken driving is one of the most reason of accidents in nearly all nations all over the world. Alcohol Detector in Car system is additionally designed for the security of the human beings inside the car [1], [15].

2. Literature Survey

Y. Lei had developed an algorithm which is basically developed by using cascade adaboost classifier.

T. Hong, by his view he converted all the gray scale images of an eye to binary images [7], by setting up some basic threshold value.

And by taking up the ratios or the total count of these binary images the detection of the driver's eye is carried out in this process.

By the guidance of Ms. Devi an algorithm was developed which is based on the Hough Transform, this works on the basis of the detection of blinking of human eye, some are also based on the projection of eye. The live images are used to decide the state of the eye. Z. Lui used the vertical approach of detection, these images are used to decide the spacing of the two eyelashes and to determine the state of the driver, even the horizontal projection is also used to figure out the state of the eye [5], [6], [9], [10], [12].

3. Proposed Methodology

The model consists of three phases:

1) *Capturing*
   - The live moment of the driver is captured using web camera, which is known for its efficiency.
   - The Digicam stores the captured video of driver and classifies based on the objects.
   - This obtained facial recordings of driver is divided into different frames for further process.
2) *Detection*
   - In this process, initially detection of driver's face which is obtained using the live video stream.
   - Detection of face is done through facial landmark, which is helpful in finding the face in recorded frame [5], [6], [9], [10], [12].
   - Only face related structures are identified and rest all other obstacles in background are ignored.
   - To discover the state of driver, eye and mouth is the main aspect.
   - The eye or mouth aspect ratio can be determined using the equation (1).
3) *Alerting*
   - The normal state of human eye can be found in open, closed, semi open or semi closed.
   - If the aspect ratio surpasses the given threshold value, then we can conclude that the drowsiness or yawning of the driver will be detected.
   - The process will be carried out until the drowsiness conditions met.

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- If driver does not respond to the alert the vehicle will automatically parked to the left side of the road.

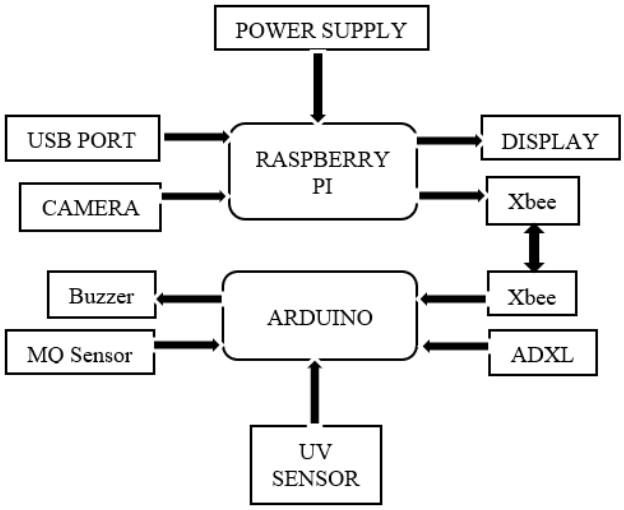

Fig. 1. System architecture

4. Requirements

A. Software Requirements

- Operating system: Raspbian OS
- Library: Open CV Library, Dlib library.
- Languages: C and Python.

B. Hardware Requirements:

- Raspberry Pi Board
- Buzzer
- Zigbee
- Arduino
- DC Motors
- UV Sensor
- Alcohol Sensor
- ADXL Sensor
- 16 GB Memory card
- Web Camera
- LED

5. Implementation

In this project solution are acquired the use of programming languages and embedded system for accomplishing the outcomes of chauffeur's fatigue and boozy detection [1]. Through face visualization one can pick out facial expressions like eye movements and mouth movements analysis [5], [6], [9], [10], [12]. Making an actual time application the usage of computer vision is discovered to be extra environment friendly and creative mission that needs processing accuracy of the system [2]-[4],[13],[15]. Driver drowsiness motion are detected and sends a message and alerts the driver by means of giving alarm. We are using facial landmark algorithm and Haar technique [8], [11], it is a computing device training strategy the place a cascade feature is training for converting a high-quality and binary values [7].

Once the photo is detected the movements viewed are eye movements, mouth movements. Facial landmark algorithm and Euclidian method for localizing points on face. Consider an instance if eyes width decreases to 2.5 or three seconds, hence driver fatigue is detected correspondingly through the ZigBee module the vehicle is slow downed and automatically parked.

Fig. 2. Proposed model

Formulae for calculating drowsiness and accident detection:

Fig. 3. Eye Aspect Ratio (EAR)

$$EAR=MAR=\frac{||P2-P6||+||P3-P5||}{||P1-P4||} \quad (1)$$

We can calculate the angle of inclination for accident detection,

$$A_{out}=\frac{\frac{ADC\ value\ *Vref}{1024}-Voltage\ level\ at\ 0g}{sensitivity\ factor} \quad (2)$$

6. System Outcomes

The proposed system includes three steps i.e., Face capturing, detection, alerting which is done on real time vision.

1) Face Capturing

- Camera here used to capture the images of a user which is stored in Open CV [2]-[4],[13],[15].
- Haar Cascade Algorithm [8], [11] detects human face and converts the color image to grey level image [7].

Fig. 4. Captured image converted from color to grey images

2) Detection

- Detection of face is done through facial landmark,

which is helpful in finding the face in recorded frame [5], [6], [9], [10], [12].

- Only face related structures are identified and rest all other obstacles in background are ignored.
- To discover the state of driver, eye and mouth is the main aspect.
- The eye or mouth aspect ratio can be determined using the equation (1).

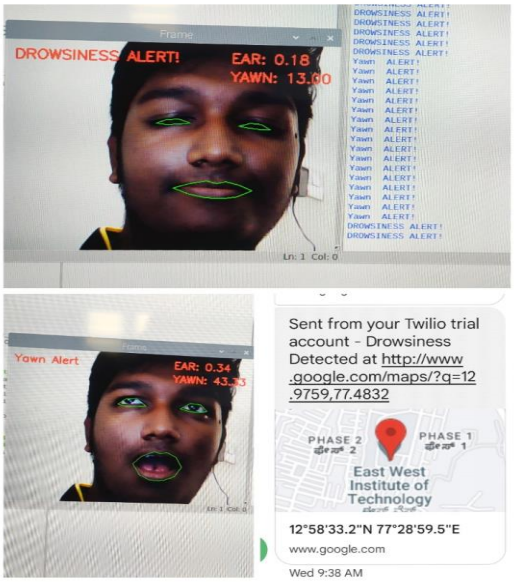

Fig. 5. Results of drowsiness detection and alerting message sent to family member

3) Alerting

If eyes width decreases to 2.5 or three seconds, hence driver fatigue is detected correspondingly through the ZigBee module the vehicle is slow downed and automatically parked.

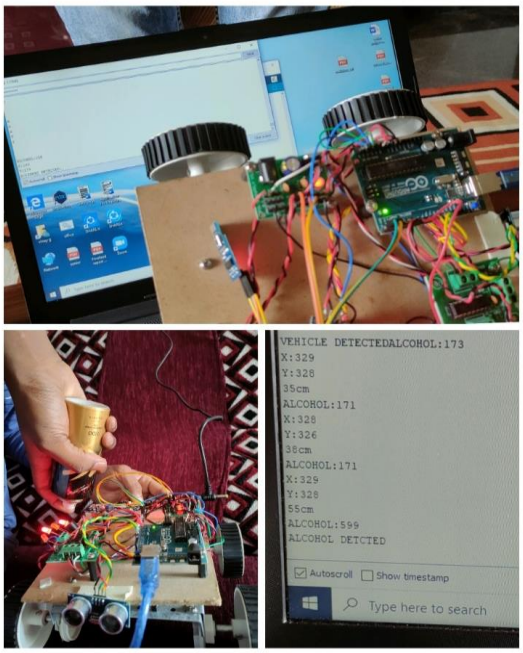

Fig. 6. Results of accident and alcohol detection

Advantages

- It has fully automated operations, without any human intervention.
- No one can manipulate the data sent by the device to the owner.
- It is cost-effective.
- Accidents due to drowsiness can be avoided.
- Drunk and drive can also be prevented using alcohol sensor.
- Fire accidents can also be detected and message will be sent to the owner along with location.

Future enhancement

- Use of DSP processor makes the machine extra suitable for the quicker processing of data.
- Night vision or near infrared digicam can be used instead general digital camera that can work even in low mild circumstance and all through night.
- An enhancement in the algorithm can be made to notice the eyes much faster and results would be extra accurate.

7. Conclusion

- Implementation of drowsiness detection with Raspberry pi and OpenCV makes the overall system a low-cost drowsiness detection system.
- Along with drowsy detection, alcohol detection and obstacle detection help in prevention of accidents.
- Once the above conditions met, the alarm alert given to driver.
- The message along with the location will be sent to the owner of the vehicle.

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