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Driver Drowsiness Monitoring System Using Visual Signals and Embedded System

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Abstract - *Drowsy driving is a major cause for car accidents. It has caused severe impact on the lives of people.*

Accidents can be avoided by alerting or warning drivers beforehand. Embedded systems and sensors that are equipped on the dashboard of the car will detect drowsy driving by analyzing the physical conditions of the driver. The sensors constantly monitor and detect whether a driver is drowsy by detecting several physical actions such as yawning, sleeping, eye blinking and it also detects health parameters of driver such as heart rate and pulse rate. Whenever the system detects drowsy driving by means of fingerprint and eye detection, the sensors automatically alerts the driver by giving vibrations, blinking of brake lights, and sounding an alert tone using a buzzer. It also calculates health parameters of the driver such as heart rate and pulse rate using embedded sensors and produces results. Thus the proposed system, in all aspects detects all signs of inattention during the course of driving. I have implemented image processing techniques as well as deep learning techniques. Higher accuracy in various luminance conditions can be achieved by implementing this method.

Key Words: Drowsy Driving, facial data, image processing, health parameters, embedded system, sensors

1. INTRODUCTION

Sleepiness and tiredness is a major cause for car accidents. Driver drowsiness occupies one-third of the entire road accidents. The driver has to perform adequate actions in case of drowsy driving in order to prevent such accidents. A high-precision model with unrestricted use has to be developed to capture driver data in continuous locations while driving [1]. The proposed model consists of embedded sensors which can be equipped inside the dashboard of the car and act accordingly when it detects driver tiredness [2]. This innovative idea makes vehicles more brilliant and thereby accidents can be reduced significantly. The proposed system provides an improved and precise model for drowsiness detection [3]. The system uses driver's physiological and behavioural changes to detect drowsiness and takes actions immediately to prevent accidents. Visual data of the driver is primarily taken care [4]. Visual data of the driver is greatly influenced by external parameters like luminance conditions, nature of the device used and other external variables [5]. Physiological data of driver include heart rate/pulse rate. The pulse rate is divided into three namely off, abnormal and normal.

1.1 Objective

Identification of sleepiness symptoms such as closure of eyes, yawning of mouth is captured using image processing techniques. Continuous eye and face monitoring helps to detect weather the driver is drowsy or not. Inclusion of sensors, enhancement of parameters, demonstration and selection are the main objectives of this paper.

1.2 Scope

The main scope of this paper is to reduce car accidents caused due to drowsy driving and thereby provide a safe driving. Identification of face and eyes, extraction of eyes from face and finally algorithm is applied to the extracted data.

2. RELATED WORK

The research in the field of driver drowsiness focuses on four types of drowsiness detection. The first type is with the help of conductors that capture physiological signals, such as electroencephalogram (EEG), electrocardiograph (ECG), and electrooculogram (EOG) of the driver. This method gives good results, but fetching the signals is usually highly complicated. The second type is based on methods of operating behavior of the driver; for example, the driver reduces his force while holding the steering wheel when the he is drowsy or fatigue,. The third type is on based on the vehicle's lane movement, whether it is in the correct lane or not. Finally, the fourth type is based on physiological characteristics of driver like eye blinking and yawning. Most among these methods involves high costs because of the requirement of sensors, cameras inside and outside of the vehicle, and also an external computer for fast processing,making these methods ineffective in a real life scenario.

3. PROPOSED SYSTEM

The proposed model is represented by a camera that initially obtains the driver's real time image. From this image face and eyes are extracted. At the same time the fingerprint of the driver is captured in the MAX30102 detect the fingerprints. After capturing fingerprints, when drowsiness is detected, the sensors alert the driver with the help of vibration sensor, brake lights and buzzer.

3.1 Face Tracking and Eye Tracking

Main objective of face recognition is to decrease the number of features identified mistakenly. The exact location of the eyes and mouth are located. After the face recognition, the picture is transferred to the YCbCr area, where skin division occurs. Switching the picture to YCbCr space has the advantage of eliminating the impact of different luminance conditions. Each component (red, green, and blue) has contrasting appearance in the RGB color space. There is no radiance for the Cb (blue) or Cr (red) segments. Only the Y-segment has radiance data. The RGB picture is divided into Y, Cb, and Cr segments. This method is effective to separate the skin from the rest of the image, discards a higher amount of the non-face images in the process.

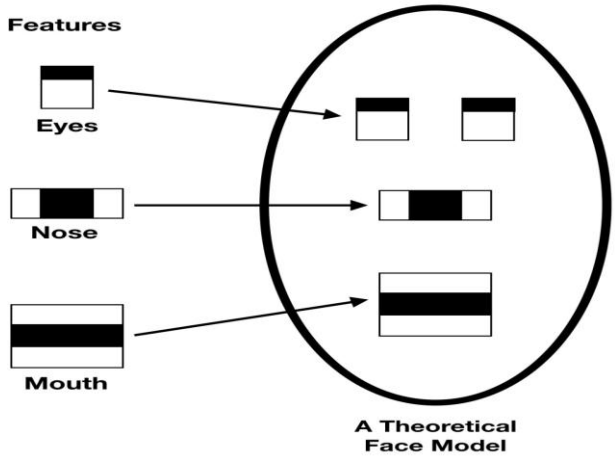

Fig -1: Capturing of facial data

3.2 Sensor Implementation

A. Max30102

The MAX30100 is an integrated pulse and heart rate monitor sensor which combines two LEDs, a photo-detector, optimized optics, and the low-noise analog signal processing unit to detect the pulse as well as the heart-rate signals.

MAX30100 operates in the voltage range of 1.8 V and 3.3 V power supplies and can be powered down through software with adequate power supply, which allows the power supply to remain connected at all times.

B. DC Motor

DC motor is an electric motor that converts direct current (DC) to mechanical energy. DC motor was the widely used motor initially, as they used direct current. The speed of DC motor can be controlled. Small DC motors are used in tools, embedded systems etc. Large DC motors are used in electric vehicles, elevators and in rolling mills. DC motors have a rotating armature winding, non-rotating armature magnetic field and also a static field winding which is a permanent magnet.

C. Arduino Nano

It is a compact, complete and broadband friendly device. It can be used in IoT sensors. If constant voltage is provided, clock precise frequency is produced. It is composed of pin headers that aids for easy attachment to a board and comes with a mini USB connector. It has no dedicated power jack. It has only a DC power jack. It is commonly used in Arduino projects. It is widely used in embedded systems, robotics and IoT systems.

D. LED Lights

LED stands for Light Emitting Diode. It is a semiconductor device that emits light when an electric current passes through it. LED produces light more efficiently than normal incandescent bulbs. It is used as an indicator to check the validity of results at different stages.

E. Vibration Motor

Vibration motor is a highly powerful and user-friendly motor that can be used with various products. It is used to give vibration to the driver when he is drowsy. It is of small compact size and has a powerful motor. It is used to inform the users by vibration on receiving signal and has no sound.

They are used mainly in mobile, joysticks and so on.

F. Buzzer

It is a tiny speaker and you can connect it directly to Arduino. The tone of the buzzer can be set as per the desired frequency. The sound produced by buzzer is due to the piezoelectric effect created. By making an electric signal at the correct frequency, sound can be made in the buzzer. Buzzer is composed of of piezo crystals between two conductors. When a potential is applied across the piezo crystals, they push on one conductor and pull on the other at the same time. This, push and pull action, results in the production of a sound wave.

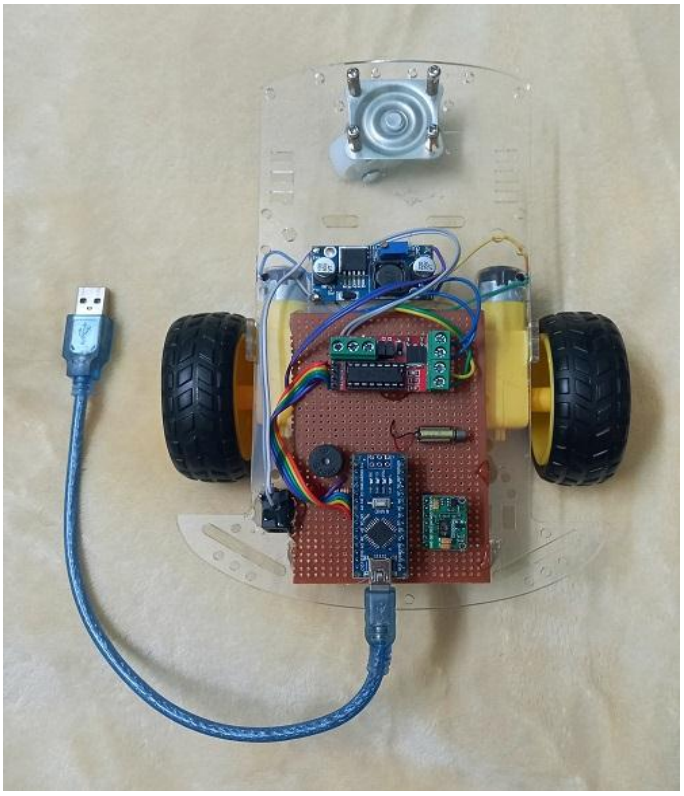

Fig -2: Sensor-set up for drowsiness detection

4. CONCLUSION

The proposed system demonstrates the real time implementation of drowsiness detection system. It detects the tiredness/drowsiness of the driver and alerts the driver by means of buzzer, vibration, brake light blinking thereby reducing the probability of accidents. It performs well under multiple luminance conditions. Image processing techniques are used for real time face and eye recognition using webcam. The proposed algorithm has been implemented and tested using different input parameters. It was observed that the algorithm worked with higher accuracy under multiple luminance conditions with optimum distance from the camera. Also accuracy decreased when the illumination was lower and when the distance from the camera was higher. The proposed algorithm can be tested with deep learning techniques and with different data sets.

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