The Combined methodology to detect onboard driver fatigue

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Abstract

Fatigue is a feeling of extreme physical or mental tiredness. Almost everyone becomes fatigued at some time, but driver's fatigue is a serious problem that leads to thousands of automobile crashes each year. Fatigue process is often a change from the alertness and vigor state to the tiredness and weakness state. It is not only accompanied by drowsiness but also has a negative impact on mood. There have been studies to detect and quantify fatigue from the measurement of physiology variables such as electroencephalogram (EEG), electrooculogram (EOG), and electromyogram (EMG).This project involves a multi modal sensing of driver's drowsiness. The first method is to count the eye blinking rate. In the second level, we authenticate the results of eye blink module with a grip sensor. The Flexi force sensor is placed over the steering wheel. In the third level, the activities are sensed, the time elapsed from the driver's last activity is counted here. The activities in the sense; changing gear, applying brake, pressing sound horns and turning the steering wheel. Absence of these activities is also an indicator of fatigue.

Keywords: Eye blink sensor, Flexi force sensor, EEG, EOG, EMG

INTRODUCTION

SENSORS

A sensor is a device that detects events or changes in quantities and provides a corresponding output, generally as an electrical or optical signal; for example, a thermocouple converts temperature to an output voltage. But a mercury-in-glass thermometer is also a sensor; it converts the measured temperature into expansion and contraction of a liquid which can be read on a calibrated glass tube.

- EYE BLINK SENSOR

Infrared transmitter is one type of LED which emits infrared rays generally called as IR Transmitter. Similarly IR Receiver is used to receive the IR rays transmitted by the IR transmitter. One important point is both IR transmitter and receiver should be placed straight line to each other as shown in Fig 1.

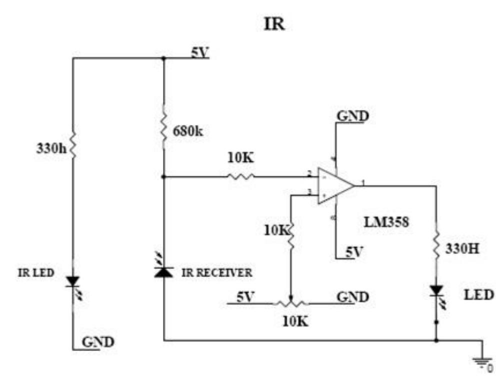


Fig 1 Circuit Diagram for eye blink sensor

The transmitted signal is given to IR transmitter whenever the signal is high, the IR transmitter LED is conducting it passes the IR rays to the receiver. The IR receiver is connected with comparator. The comparator is constructed with LM 358 operational amplifier. In the comparator circuit the reference voltage is given to inverting input terminal. The non-inverting input terminal is connected IR receiver. When interrupt the IR rays between the IR transmitter and receiver, the IR receiver is not conducting. So the comparator non inverting input terminal voltage is higher than inverting input. Now the comparator output is in the range of +5V. This voltage is given to microcontroller or PC and led so led will glow.

When IR transmitter passes the rays to receiver, the IR receiver is conducting due to that non inverting input voltage is lower than inverting input. Now the comparator output is GND so the output is given to microcontroller or PC. By using this sensor the driver's eye blink can be obtained. Whenever the driver's eyes were closed the signal will send to the controller. If the signal sends continuously to the controller the driver is in sleep.

- FLEXI FORCE SENSOR

Flexi force sensor is to convert the force into voltage signal which is used to measure how force is applied to the place where it is connected. Because of piezoresistive property, the resistivity is inversely proportional to the applied force.

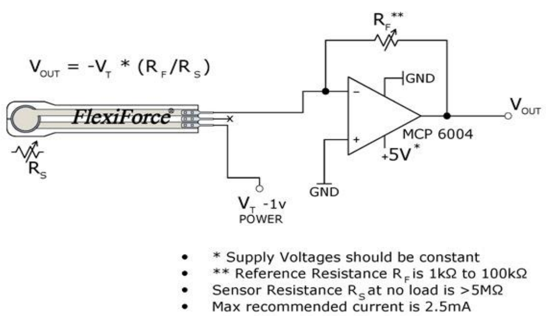


Fig 2: circuit diagram for Flexi force sensor

- Lower Rf -> less resistivity
- Higher Rf -> high resistivity

This sensor act as a force sensing resistor. As per Fig 2, it have an active sensing area in which the pressure is applied. There are two conductor with silver coating is present inside the sensor which transfers the force up to edge link. From the edge link the output signal is taken.

When sensor,

- Unloaded -> resistance is very high
- Loaded -> resistance decreases

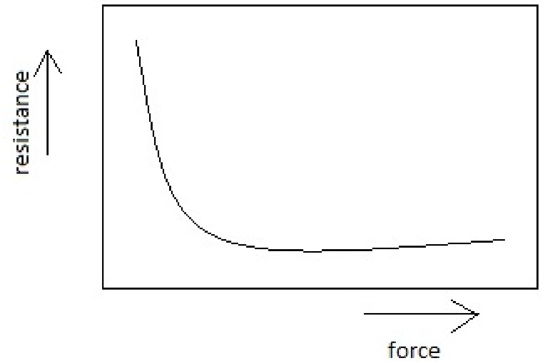


Fig 3: Force VS Resistance

The pressure can be measured by observing these changes in resistance. The resistivity will decrease while the force increased, shown in Fig 3.

By placing number of flexi force sensors around the steer, the drivers grip pressure can be measured.

Related works:

Nanxiang Li, Jinesh J. Jain, and Carlos Busso (2013), created a database containing 20 drivers were asked to perform common secondary tasks such as operating the radio, phone and a navigation system. These tasks are sensed by various noninvasive sensors including controller area network-bus (CAN-Bus), video cameras and microphone arrays. By using these studies they build statistical models in the form of Gaussian Mixture Models (GMMs) to compute the driver's deviation from the expected normal driver's behavior. They use an UTDrive car platform to extract and record various CAN-Bus signals, such as steering wheel angle, vehicle speed, RPM acceleration, and brake value,

Luis M. Bergasa, Miguel A. Sotelo (2006), calculated six parameters they are, Percent eye closure (PERCLOS), eye closure duration, blink frequency, nodding frequency, face position, and fixed gaze. And they used a fuzzy classifier to combine these parameters in order to deduce the level of inattentiveness of the drive. They developed a FSM to distinguish between a blink and an error in the tracking of the pupil. By using an uncalibrated camera the face pose is depicted and a model-based approach is used to recover the face pose by establishing the relationship between 3-D face model and its 2-D projections.

Ji Hyun Yang, Zhi-Hong Mao, Louis Tijerina, Tom Pilutti, Joseph F. Coughlin, and Eric Feron (2009), created two major contributions. First, the disguise nature of drowsiness is revealed and second, a probabilistic framework based on Bayesian networks (BNs) for inferring drivers' state of drowsiness is introduced. Five different tracking tasks were given to the driver they are, 1) a curved road; 2) a straight road with changes in steering dynamics; 3) a straight road with a lead vehicle; 4) a straight road without any disturbance; and 5) a straight road with disturbances.

Afizan Azman, Qinggang Meng, Eran A. Edirisinghe, & Hartini Azman (2011), categorized Driver distractions into 3 major parts: visual, cognitive and manual. Visual and manual distraction on a driver can be physically detected. Driver cognitive can be detected by using several methods: Physiological measurements, 999performance measurements (primary and secondary tasks) and rating scales. They concluded with two important points are: (1) mouth and eye movements are highly correlated to each other; and (2) right eye is more correlated to mouth movement either from eye's height or width compared to the left eye.

Gustavo A. Peláez C., Fernando García, Arturo de la Escalera, and José María Armingol (2014), used three set of sensors: The first set of sensors is biomedical sensor which is based on the measurements of biomedical signals, the second set of sensors used for monitoring the driver are onboard sensors, and finally computer-vision-based sensors are used. They created a database containing various drivers' behavior in which they recorded the three sets of movements: The first set was recorded in a controlled scenario under artificial light; the second set was recorded inside the vehicle, with natural light. A final set involved 30 s of driving movements (free movements).

DESCRIPTION

PROPOSED SYSTEM

BLOCK DIAGRAM

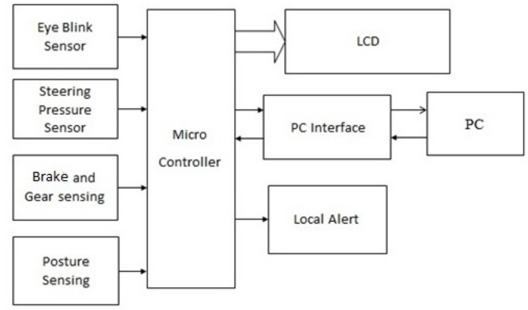


Fig 4: Block Diagram Of the system

A new method is developed to estimate the fatigue state of human drivers in real time. The driver's eye blink rate, the grip of his hand on the steering and his sitting posture is observed using sensors. If there is any distraction in the eye blink rate or grip of his hand on the steering or his sitting posture an alert is given to the driver using a buzzer.

When the driver feels drowsy his eye blink rate will stop at that time an alert is given to the driver using a buzzer. If the grip of his hands on the steering gets loosen then there will be an alert to the driver using a buzzer, so as if any change in his posture.

System Description:

Drowsiness is a very common problem with people. Whenever the people do uninteresting jobs they usually feel drowsy. The drowsiness is the effectof heavy oily food, improper sleeping habits or continuous work load. If the driver is drowsy, he not only puts his own life but also the lives of other road users in danger. Here in this project, a method is proposed to identify the driver's drowsiness and wake him up if he is drowsy.

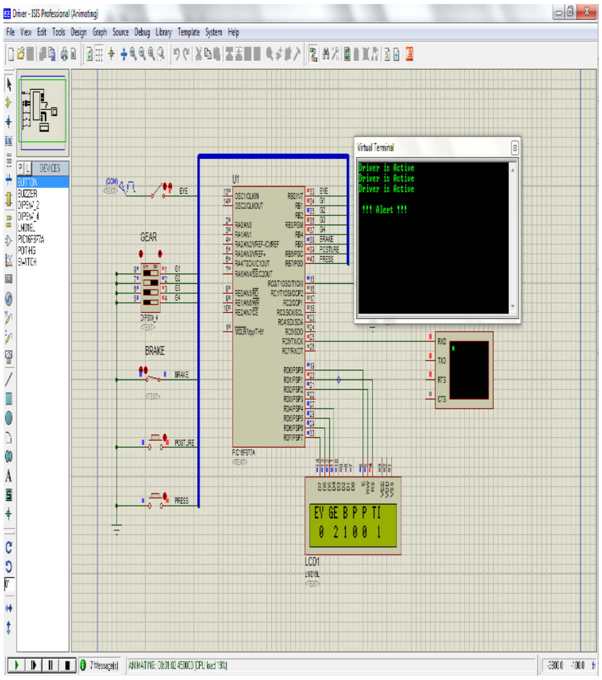
This project involves a multi modal sensing of driver's drowsiness. The first method is to count the eye blinking rate. The driver is provided with a special eye gear, where in the edges an IR sensor pair. In the second level, we authenticate the results of eye blink module with a grip sensor. The grip sensor is placed over the steering wheel. If the driver is drowsy, his grip pressure over the steering wheel will also be reduced. This is another indication.

In the third level, the activities are sensed, the time elapsed from the driver's last activity is counted here. The activities in the sense, changing gear, applying brake, pressing sound horns and turning the steering wheel. Absence of these activities is also an indicator of drowsiness.

SOFTWARE USED

1) CCS COMPILER
2) PROTEUS

RESULTS



Simulation Result

Fig 5: shows the simulation result of Collective Approach towards On-board Driver Fatigue Detection System.

While simulating the system, at beginning the timer is on and it starts to count down the value from what we have set already. When it reaches zero it checks whether the driver has done any changes or not, if any changes has happened it sends the signal to controller and the LCD will display “Driver is Active”, that denotes driver is in normal. If not it shows “Alert” message that denotes driver is not in normal he feels drowsy.The changes mention above are, Eye blink, Position change, Steer grip, applying brake or not and change the gear or not. These changes are made by driver, in simulation these are designed as buttons and switches. The Eye blink can detect and measured by using Eye Blink Sensor. By measuring the drivers grip presser of the steer can identify any changes in driver activities or not, this can be done by steer grip presser sensor.

Hardware Result

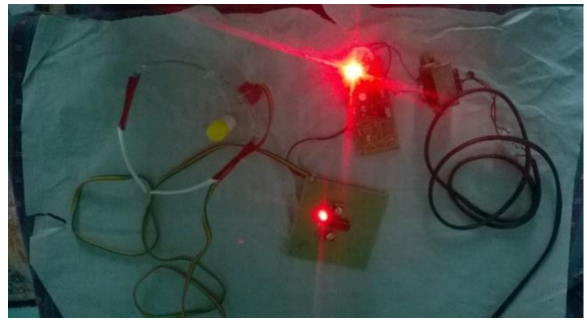


Fig 6: Eye Blink Sensor with Interrupt

Fig 6 shows the Eye Blink Sensor hardware kit with any interrupt. The IR transmitter sends the IR signals that will reflect from the eye and the reflected signal will be collected by the IR receiver. While eyes of the driver are in open the signal will send to the circuit that shown by glowing LED.

Fig 7: Eye Blink Sensor without Interrupt

Fig 7 shows the Eye Blink Sensor hardware kit without any interrupt. While no interrupt is present the sensor does not send any signal to the circuit, so the LED does not glow.

Tabulation 1: Result for eye blinks and grip sensors

CONCLUSION AND FUTURE WORK

There are many studies to detect and quantify driver’s fatigue from the measurement of physiology variables such as ElectroEncephaloGram (EEG), ElectrooCuloGram (EOG), and ElectroMyoGram (EMG).This system has revealed the drowsy driver characteristics by using various sensors such as Eye blink sensor, Steer grip sensor, Position Sensor and by

	EYE BLINK SENSOR		GRIP SENSOR
Eyelid close	Signal sends to controller	Low force	No signal sends to controller
Eyelid open	No signal sends to controller	High force	Signal sends to controller

observing the changes in brake and gear. By considering these observed parameters the driver's condition is decided, whether the driver is in normal or feels drowsy.

This system is developed and simulated to get the desired result. The observed result is obtained from the simulation tool. It is accurate and more desired to implement in hardware kit. The implementation to hardware should be explored further for the effective design of drowsy-driver detection systems

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