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Eye Blinking Monitoring System for Vehicle Accident Prevention

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Abstract

Most road accidents occur due to careless driving of drivers because of drowsiness. This paper provides Eye Blink Monitoring System (EBM) that will alert the driver in drowsiness. A system for monitoring eye movements would be useful in warning drivers when they fall asleep. The driver's eye is continuously monitored using an IR sensor. The normal eye blink rate will have no effect on the output of the system. If Driver fell asleep, then IR sensor receives abnormal blinking rate & an alarm will ring, to wake him/her up. The sensor part of the EBM system is implemented as a goggle. This goggle is to be worn by the driver while driving the vehicle.

Keywords: Vehicle, Eye Blink, Goggle, Infra-red, Op-amp, Micro-controller.

Introduction

The majority of car accidents are caused by bad driving : driver inattention, failure to merge or yield, speeding, racing, aggressive driving and failure to exercise care in passing. Accidents can be attributed to specific causes aside from poor driving itself include falling asleep, weather (snow, Ice or Rain, Fog); alcohol ,drugs & drunk driving, driver distractions which includes cell phones, playing music; collisions with animals in the road usually deer, horses, cows and dogs etc.

It is found that Driver Fatigue and falling asleep at the wheel is a major cause of car crashes. Fatigue can be very difficult to identify as the source of accidents because estimates are made based almost solely on police reports, and driver statements. It is estimated that 10-20% of fatal accidents and about 5 to 10% of all car accidents may be related to tired drivers.

According to the National Highway Traffic Safety Administration there may be as many as 100,000 crashes from driver fatigue each year, with an estimated 1,550 deaths, 71,000 people injured, causing $12.5 billion economic losses. These figures may be the tip of the iceberg, since currently it is difficult to attribute crashes to sleepiness. In India about 250 people die in road accidents everyday [1].

The drivers tend to sleep while driving due to tiredness caused because of several reasons. Presently no system has been implemented in the vehicle, though developed, to indicate or prevent Drowsiness/asleep of the driver. He has to take care while driving. Some drivers take strong tea before driving so that they would not fell asleep while some drivers avoids driving in such situations. This may create delay in reaching to the destination.

In this paper we are presenting a system entitled 'Eye Blink Monitoring (EBM) System' which will help drivers to alert in drowsiness.

This system is based on principle of monitoring eye movements of driver continuously using an IR sensor. If he/she falls asleep, then an alarm will ring to wake him/her up.

Basic electronics concepts have been used along with micro-controller to implement this system. Infra- red emitter & detector are used for monitoring the driver's eye, which will provide corresponding output according to the eye blink rate of the driver. The output of IR sensor is given to microcontroller where it is decided whether to sound the buzzer or not. The status of operation is displayed on the LCD, which is connected to the microcontroller. As the output of microcontroller is low to drive the buzzer, a driver IC is used to amplify the output of microcontroller.

The sensor part of the EBM system is implemented using a goggle. This goggle is to be worn by the driver while driving the vehicle. It will not act as an obstacle while driving.

Logic diagram of EBM System [2] [3] [4] -

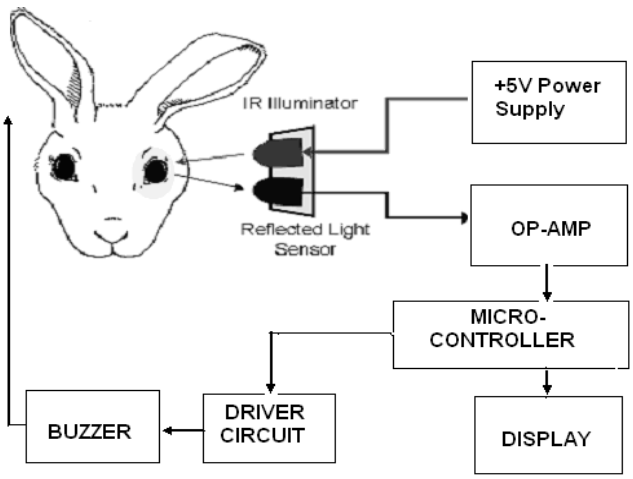

Figure 1: Logic Diagram of Eye Sensor Assembly.

By monitoring the eye of a human being, we can determine whether he/she is sleeping or not. One common technique of monitoring eye blink rate is by measuring infrared (IR) light reflected from the surface of the eye.

The eye is illuminated by an IR LED, which is powered by the +5V power supply and the reflected light is recorded by an IR photo diode. The IR photo diode converts this reflected light into electrical signal and given to Op-Amp. The output of Op-Amp depends on the intensity of light received by the IR photo diode. The micro-controller drives the buzzer according to output of Op-Amp. The digital display provides various messages to the user.

When the eye is open, maximum amount of light will be reflected from the eye because our eyeball is transparent, while minimum of light will be reflected from the eye, when it is closed as skin part of eye is opaque.

Block Diagram [5] [6] [7] [8] -

EBM system consists of an Eye Sensor Assembly which continuously monitors the driver's eye while he/she drives the vehicles. The eye sensor assembly consists of IR emitter & detector. The output of eye sensor assembly is provided to the micro-controller, which drives the buzzer circuit according to the situation. The status of operation is indicated using LCD.

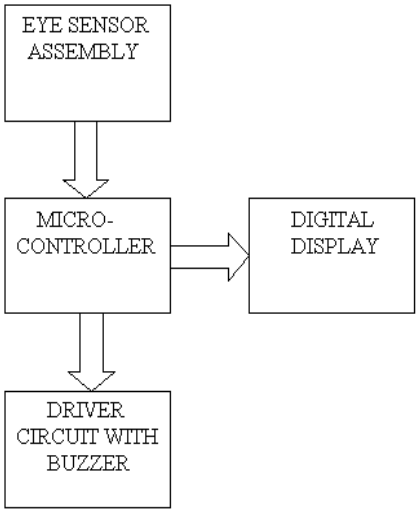

Figure 2: Block Diagram of Eye Blink Monitoring (EBM) System.

Eye Sensor Assembly [3] [7] [8]-

As shown in figure 3, an Infra-red LED emits the light of particular intensity which is received by an Infra-red Photodiode. The Infra-red photo diode is connected at the input of the operational amplifier, whose output is proportional to intensity of light falling on the Infra-red photo diode.

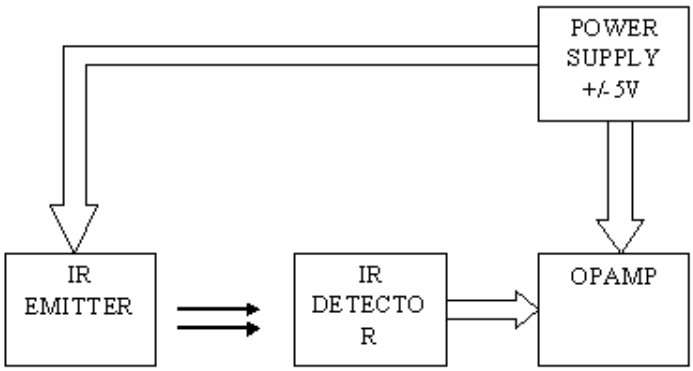

Figure 3: Eye Sensor Assembly.

As the output of IR detector is connected to the inverting terminal of Op-Amp, the input voltage of Op-Amp varies as per the intensity of light falling on IR detector. Hence the output of Op-Amp varies accordingly.

While driving, the IR emitter will continuously emit the light, which falls on the driver's eye. This light will be reflected from the driver's eye and detected by the IR detector. When the eye is open, maximum amount of light will be reflected from the eye, as our eye is transparent. So maximum amount of light will be detected by IR detector and so its output will be of maximum. Hence, voltage at inverting input of Op-Amp will be more compared to non-inverting input of Op-Amp. So the output of Op-Amp will be logic 0. When the eye is closed, minimum amount of light will be reflected from the eye, as the skin part is opaque. In this case minimum amount of light will be detected by IR detector hence its output will be of minimum. This causes less voltage at inverting input of Op-Amp as compared to non-inverting input. So the output of Op-Amp will be logic 1. These two states of output will be provided to the micro-controller to drive the buzzer circuit.

EMB Goggle [4] -

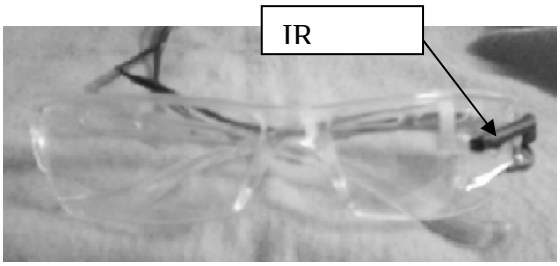

Figure 4: EBM Goggle.

The sensor part of the EBM system is implemented in the form of a goggle. The goggle used is an ordinary one, in which IR LED & IR photo diode are placed in such

a way that light emitted by the IR LED falls on the eyeball and the reflected light is collected by the IR photo diode. The goggle receives the power from +5V power supply and it sends the signal to the input of Op-Amp.

The goggle is to be worn by the driver while driving. The sensors are implemented in such a way that it won't obstruct the sight of the driver.

Working [5] [6] [7] [8] [9] -

The normal blinking rate of eye is 20 closures per minutes. It will not have any effect on the performance of the system [10].

When the driver falls asleep, his/her eyes will be closed; hence less light will be reflected from the skin part of the eye (as it is opaque). This produces maximum output of op-Amp. The op-amp output is given to micro-controller, which treats it as logic 1. The micro-controller will wait for 3 seconds. Then if it finds that the eyes are still closed, micro-controller sounds the buzzer. The status of operation will be shown using liquid crystal display (LCD).

Result

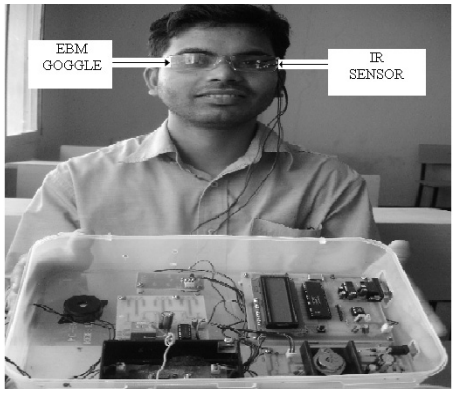

Figure 5: Hardware of Eye Blink Monitoring (EBM) System.

1. When the circuit is switched on, following message appears on the LCD screen – *"EYE BLINK MONITORING SYSTEM"*
2. When the user wears the goggle provided with the system, the same message will be displayed. The normal eye blink rate will have no effect on the output of the system.
3. When the user falls asleep, then after a delay of 3 seconds, following message will be displayed – *"DONT SLEEP"* and the buzzer sound an alarm.
4. Hearing this buzzer, the user wake up and the buzzer stops sounding. Again the previous message will be displayed – *"EYE BLINK MONITORING SYSTEM"*
5. Advantages and disadvantages

Advantages

- Simple setup.
- Remote detection - no mechanical contact with eye.
- Stray visible and IR light not affected.
- Our system does not require the restraint of the external eyelids.
- Head movement not affected.
- Excellent frequency characteristics (DC to more than 500 Hz).
- Excellent working distance (15-25 mm).

Disadvantages

- Difficult to calibrate using common units of eye blink measurement. (e.g. mm of eyelid displacement)
- The signal is proportional to the exposed area of the eyeball. Independent measurements of the individual eyelids are not possible [4].

Conclusion

By observing the working of EBM system, it is found that while driving when the driver wears the goggle with IR sensor –

1. The normal blinking rate of eye is not affected.
2. When the driver is awake, the system will be in standby mode.
3. When the driver tends to sleep, the system sounds an alarm, causing the driver to wake up & concentrate on driving.

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