Automated Driver Drowsiness Detection System Using AI

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Automated Driver Drowsiness Detection System Using AI

Radha R | Naveen M Pujar | Sahiba Ashfaque

Department of Computer Science and Engineering, Alliance University, Anekal

ABSTRACT

According to the survey a total of 21% of all accidents occur due to drowsy driving. Approx. eleven million drivers accepted that they faced accidents because they dozed off while driving or were too tired to drive. To minimize the number of accidents occurring due to driver drowsiness, we have designed and fabricated a device that alerts the driver if he falls asleep. The product's end users can be truck drivers, cab drivers, long-distance travelers or people suffering from narcolepsy. The device that has been designed is a standalone device with precision sensor and analysis technology that can accurately detect the fatigue state of the driver and notify him/her by sending alarms in real time to ensure his/her safety during potentially dangerous driving situations. The device is automated and makes use of the latest technologies like Artificial Intelligence and Machine Learning. This device has wide applications. It can also be used for vigilance and surveillance purposes other than ensuring driver's safety.

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KEYWORDS:Drowsy driving, real time, automated, Machine Learning.

1. INTRODUCTION

In 2016, the government spent 7.5 percent of India's GDP (12.9 lakh crore rupees) on deaths and serious injuries caused by vehicle accidents. According to a study conducted by the Life Save Foundation and Mahindra in 2020, truck drivers in India drive 12 hours a day, covering 417 kilometres , with nearly half of them admitting to feeling sleepy and tired while driving. Many truck and bus drivers who drive vehicles on highway suffer from obstructive sleep apnea (OSA), a disorder that goes undetected leading to a shortage of screening. In 2019, as per the road transport ministry's report India had 151.11 thousand deaths due to road accidents and 40% of these accidents are caused due to drowsy drivers that accounts to 60400 deaths which could have been avoided. Thus, there is a desperate need for a system which could avert these incidents and do much more in safety department.

Identified customer needs:

● The device should be capable of awakening the driver under any circumstance.
● The device should be reliable.
● The device should be easy to use.
● The device user interface should be user friendly.
● The device should be affordable.

Question/ Prompt	Customer Statement	Interpreted need/ Expectation
Typical users • Truck drivers • Occasional long-distance drivers	Drivers tend to fall into "MICROSLEEP" after a stressful day at work	Driver tends to sleep for 7-8 seconds after having a hard day at work.
	Long distance traveling without rest makes driver drowsy	Long distance travelling without rest makes drivers tired
	After a heavy meal, they tend to feel drowsy	The feel of a full stomach makes people feel drowsy
Likes-current methods followed (traditional techniques)	It is comfortable to wear	Few devices use arm band as an actuator few customers feel it's comfortable to wear
	Easy to use	Few customers found the device interface easy to use.
Dislikes-current Methods followed (Traditional techniques)	Couldn't get it to work. It doesn't work with glasses.	Few of the existing devices do not work efficiently when the drivers have their glasses on
	Night vision clarity could have been better	Device camera do not seem to be working properly in low light
	Not sure how reliable it is	Few customers had reliability issues with the existing devices

Requirements List:
- The device should work properly.
- The device should be fail-proof.
- The device should be able to run on the car's battery.
- The device should be easy to use.
- The device should indicate if it's ON or OFF

2. LITERATURE SURVEY

a Alack of motivation, the beginning of tiredness linked with a lack of alertness in drivers is almost always preceded by psycho-physiological and/or overall performance alterations. The basic idea behind vehicle-based detection is to monitor the driver in an inconspicuous manner via on-board technology that can detect when the driver is hampered by drowsiness.

- The goal of a drowsiness detecting device is to alert you if you become sleepy unexpectedly.
- Driving at night is more likely to result in an accident due to weariness than driving during the day.

A. Case study on existing products

- Driving Sleep detection is a car safety tool that allows you to prevent injuries when the driver falls drowsy. According to various studies, almost 20% of road accidents are caused by weariness. A nap alarm is a device that is installed in a car to detect the onset of sleepiness in the driver and to alert the pressure.
- An increase in the prevalence of sleep problems will fuel demand for sleep- improvement technologies. Some of the key factors driving the market expansion include technological advancements in wearable and non-wearable sleep tech gadgets, as well as increased awareness of those products and their benefits.
- Sleep tech gadgets are devices and goods that reveal and manage a character's sleep. Those devices are equipped with advanced sensors.

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B. Existing Methodologies to prevent driver drowsiness.
- Ocular dynamics steering
- Wheel moves and guidance wheel variability.
- Lateral role
- Time-to-line crossing (TLC)
- Micro correction in steering

C. Commercially Available fatigue monitors
- DAS 2000 Road Alert System
- SafeTRAC

- SAM
- Trav Alert

*D. Companiesplanningtointroducefatigueor
drowsinessdetectionandwarningsystemsinvehicles.*

E. Literature Survey

Literature details	Gathered Information
Driver Sleep Detection and Alarming System	The aim of this task is to increase the accurate rate of the gadget that can detect sleepiness and hit alarms for that reason, which targets to save you the drivers from drowsy riding and create a safer driving environment. The assignment was executed via a Webcam that constantly takes pictures of people driving the car, a beagle board that implements image processing rules of sleepy detection, and a remarks circuit that would generate alarm and a electricity supply machine.
IJSR Drowsy Driver Sleeping Device and Driver Alert	The primary cause of the Drowsy motive force Detector is to increase a device which can lessen the quantity of injuries from sleep using of automobile. With the two monitoring steps involved, they can offer greater correct detection. For the detecting level, the attention blink sensor constantly video display units the attention blink second. It constantly monitors eye blink. If the monitoring is over, the gathered records may be transmitted to a microcontroller, and the microcontroller digitizes the analogue statistics. If the warning remarks device is brought about, the microcontroller makes a choice which alert needs to be activated
IJCIET_08_09_128	The goal of this paper is to broaden the use of a drowsiness detection gadget. The focal point could be located on designing a system to correctly reveal the open or closed kingdom of the driver's eyes in actual time. Detection of eyes entails a series of pics of a face, and the statement of eye movements. This paper is focused on the localization of the eyes, which includes looking at the entire photograph of the face, and figuring out the placement of eyes, with the aid of a self-developed picture-processing system. Once the location of the eyes is placed, the system is designed to decide whether the eyes are opened or closed.
F11640486S419	To provide security to motive force, the cars are assisted with computerized safety system that signals motive force by way of using alarm. All vehicles need to be ready with eye blink sensor and alcohol sensor sequentially to avoid these types of injuries. The goal of the assignment is to with the aid of the use of IR sensor the eye blink is measured and managed. The infrared rays are transmitted by means of IR transmitter into driving force's eye. If the eye is in closed fame, the output of IR receiver is high. The IR receiver output is low if the attention is in commencing function. This informs that the eye is in the initial or final role. The alarm is indicated if the output is given to good judgment circuit. This task is to lower the accidents because of comatose through eye blink

Ayoob_ellen_m_2005_1	The idea of a drowsy motive force warning device has been studied by some researchers (Wier Wille, Lewin, & Fairbanks, 1996a; Noy, 1998, Mallis et al, 2000 6 Vincent, & Laing, 1998). Although these structures range greatly, they share a common subject matter – the intent to re-alert the driver. However, research has proven that alerting stimuli is ineffective or transitory. It's far clear that imparting alerting stimuli on my own is insufficient to avoid drowsy driver crashes. To obtain a vast safety development drivers must decide to stop riding whilst they're drowsy. supplying comments that can encourage drivers to regulate their regular behavior and are trying to find well scheduled relaxation breaks is an area worth in addition exploration
Camera-based sleepiness detection	The purpose of identifying thresholds for sleepiness signs turned into expanding a sleepiness detector for simulator applications. The power of thoughts of sleepiness thresholds changed into consequently carried out using information from the simulator test best. As a primary step, the maximum promising – from the literature evaluation and through studying the data – sleepiness signs have been determined on and the greatest threshold for each single indicator turns to be decided. The signs and signs and symptoms have been then mixed into a likely detector/classifier. in the final step, the general overall performance of the classifier has become evaluated on unseen records from some other mission. In a truly best global, a sleepiness threshold/detector ought

with the intention to discriminate throughout various sleepiness stages, so that a caution device can be introduced approximately on an arbitrary degree. In truth, this is very hard to gain because of the complicated nature of sleepiness and sleepiness signs.

3. PROBLEM DEFINITION

A. Problem statement with identified objectives

To design and fabricate a device which prevents driver from falling asleep that helps minimize the number of accidents occurring due to driver drowsiness. The device should prompt the driver to pay attention if the device finds that the driver's eyes have been closed for 3 or more seconds or that the driver has been distracted.

Framing the objectives:

• **The device should be capable of awakening the driver under any circumstance:** The device should be able to detect any set of eyes in any kind of lighting conditions and alert the driver without fail.

• **The device should be reliable:** The device should work properly, and it should be fail-proof.

• **The device should be affordable and easy to use:** The device should not cost more, and its interface should be user friendly.

• **The device should be compact:** The size of the device should not be large as it might cause discomfort to the driver while driving.

• **The device should be able to run on car's battery:** External power input should be avoided to make the device as compact as possible.

• **The device should be aesthetically pleasing:** The insertion of device should not disrupt the overall look of the interior of the car. The device should be compact with no wires hanging out the device.

Objectives in terms of working of the device:

• The device should be able to track head position and blink rate.

• The device should be able to track the direction of the gaze of the driver.

- Using its tracking abilities, it should be able to judge whether the driver is focused, distracted or drowsy.
- The device should prompt the driver to pay attention by alerting him.
- The device is to be designed in such a way that the alerting will not stop till the driver opens his/her eyes or becomes attentive.

B. Deciding the solution process.

To come up with a solution, we are required to fabricate a device integrated with a camera for image processing to know the state of the driver in real time.

Dependingonthedriver'scondition(ifsleepy),severals ystemscanbeusedtogetattentionofthedriversuchas: Loudbuzzer

Among these, sound has been proven to be a better way to get a person's attention whilefeeling drowsy. So, the discussion with our mentor concluded by choosing loud buzzeras the systemtoseekdriver'sattentioninour solutionprocess.

C. Constraints of the product as proposed by the expert.

- **To lower the size of the overall product to get to it as compact as possible:**
The product shouldn't be too large as it can cause discomfort to the driver
- **To make it flexible to various types of eyes:**
The device must be trained in such a way that it does on all sets of eyes without fail. The shape and size of eyes differ from person to person.
- **To make the device vulnerable to different kinds of lighting conditions:**
The device has to be successful at any time of the day. It has to be designed to work even in minimal lighting conditions.

IV. DESIGN AND IMPLEMENTATION

A. Steps Involved

In this Python project, we will be using OpenCV for gathering the images from webcam and feeding them into a Deep Modeling model which will classify whether the person's eyes are 'Open' or 'Closed'. The methodology we will be applying for this Python project is as follows:

Step 1 – Take image as input from a camera.

Step 2 – Identify the face in the image and generate a Region of Interest (ROI).

Step 3 – Identify the eyes from ROI and input it to the classifier.

Step 4 – Classifier will classify whether eyes are open or closed. Step 5 – Estimate score to verify whether the person is drowsy.

B. Algorithm

The model we employed is developed with Keras using Convolutional Neural Networks (CNN). A convolutional neural network is a unique type of deep neural network which performs exceptionally well for image classification purposes. A CNN basically comprises of an input layer, an output layer and a hidden layer which can have several layers. A convolution operation is achieved on these layers using a filter that performs 2D matrix multiplication on the layer and filter.

C. Project Prerequisites

The requirement for this Python project is a webcam through which we will captureimages.Youneed tohavePython installed on yoursystem,thenusingpip,youcan installthenecessarypackages.

- OpenCV – pip install opencv-python (face and eye detection).

- TensorFlow – pip install tensorflow (keras uses TensorFlow as backend).

- Keras – pip install keras (to build our classification model).

- Pygame – pip install pygame (to play alarm sound)

1) *Step 1 – Take Image as Input from a Camera*

With a webcam, we will take images as input. We use the method provided by OpenCV, cv2.VideoCapture(0) to access the camera and set the capture object (cap). cap.read() will read each frame.

2) Step 2 – Detect face in the image and create a region of interest (ROI)

To identify the face in the image, we need to initially convert the image into grayscale as the OpenCV algorithm for object recognition takes gray images in the input. We don't need color data to detect the objects.

3) Step 3 – Detect the eyes from ROI and feed it to the classifier.

The same procedure to detect faces is used to detect eyes. First, we set the cascade classifier for eyes in leye and reye respectively then detect the eyes using left_eye = leye.detectMultiScale(gray). Now we need to extract only the eyes data from the full image. This can be achieved by extracting the boundary box of the eye and then we can pull out the eye image from the frame with this code. l_eye only contains the image data of the eye. This will be fed into our CNN classifier which will predict if eyes are open or closed. Similarly, we will be extracting the right eye into r_eye.

4) Step 4 – Classifier will Categorize whether Eyes are Open or Closed

We are using CNN classifier for predicting the eye status. To feed our image into the model, we need to perform certain operations because the model needs the correct dimensions to start with. First, we convert the color image into grayscale using r_eye = cv2.cvtColor(r_eye, cv2.COLOR_BGR2GRAY). Then, we resize the image to 24*24 pixels as our model was trained on 24*24 pixel images cv2.resize(r_eye, (24,24)).

5)   Step5   – CalculateScoretoCheckwhetherPersonisDrowsy

The score is basically a value we will use to determine how long the person has closed his eyes. So if both eyes are closed, we will keep on increasing our score and when eyes are open, we decrease the score. We are drawing the result on the screen using.

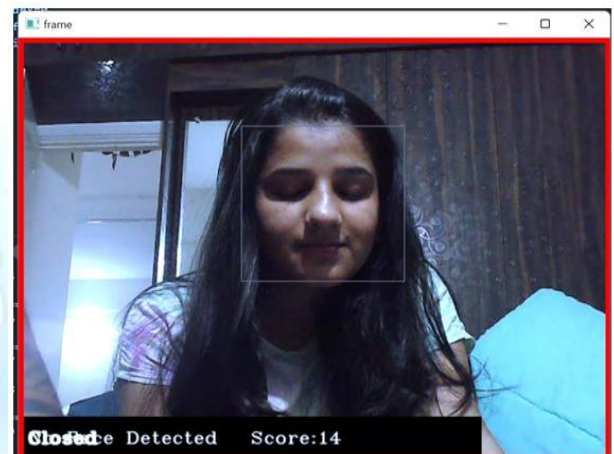cv2.putText() function which will display real time status of the person.

4. RESULT

Testing was done in a safe confined area in a day-to-day environment.

EYESOPEN
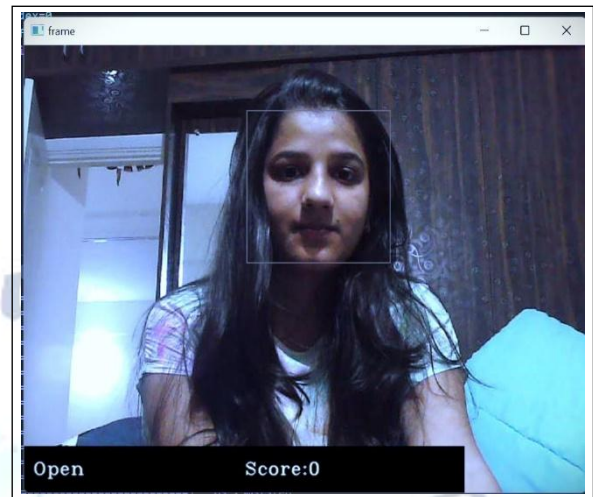
EYES CLOSED

5. COCLUSION AND FUTURE SCOPE

In a country where traffic decency is a huge problem and driving conditions are not suitable for standards, a driver must bear a lot of stress during his driving hours. Thus, making him/her tired and exhausted mentally and physically. Sleep seems inevitable to them but the pressure of completing the delivery is monumental. Hence, we have come up with a device to help them stay awake and be safe and keep others safe in this process.

This device can track head position, blink rate, direction of gaze, and other visual attributes to establish if the driver is focused on the road, distracted or drowsy. If the device finds that the driver's eyes have been closed for 3 seconds or that the driver has been distracted, the device prompts the driver to pay attention by making a loud buzzer sound. The device has been designed in

such a way that the sound will not stop till the driver opens his/her eyes or becomes attentive. This device can benefit society by reducing the number of accidents. Using this device can highly enhance the driver's safety by helping him/her to maintain focus on the road while driving.

Market opportunity

1. DDDS is a big growing market according to Asia Pacific. Advanced technology has been adopted by Developing Countries like India, China, and Japan. Also, the increasing inclination of people towards the enhanced safety features in vehicles is fueling the growth of the DDDS market in this region.

2. North America holds the largest share of the global driver drowsiness detection system market owing to the high volume of commercial vehicles in this region

Future Scope

With one the largest population of vehicles in the world, India has huge potential for a product that prevents them falling asleep. Thus, creating a huge opportunity for capital gain soon. And as this product is still in the prototype phase the room for development and innovation is enormous. And the user interface and safety can be improved using technologies like IOT and app/cloud-based programming. With the electronic market growing at a rapid pace the quality of the required electronic devices is ever increasing and the durability is also promising.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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