International Journal of Scientific Research in Science and Technology
Available online at : www.ijsrst.com
OPEN ACCESS
Print ISSN: 2395-6011 | Online ISSN: 2395-602X
doi : https://doi.org/10.32628/IJSRST

Drowsiness Detection Using Deep Learning and Camera-Based System

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ARTICLEINFO

Article History:

Accepted: 02 Feb 2024

Published: 22 Feb 2024

Publication Issue :

Volume 11, Issue 1

January-February-2024

Page Number :

505-511

ABSTRACT

To address this issue, we propose a drowsiness detection system that leverages deep learning techniques, specifically a Convolutional Neural Network (CNN), to monitor and alert drivers in real-time. Our system utilizes readily available hardware components, including a camera, USB cable, laptop as the processing unit, and a speaker as a warning system. The camera captures live video feed of the driver's face, which is then processed by the CNN model in real-time. The CNN model is trained to analyse facial features and detect signs of drowsiness such as drooping eyelids, yawning, and head nodding. When the CNN model identifies drowsiness indicators in the driver's facial expressions, it triggers an alert system. The alert system, through the speaker, emits warning sounds or voice prompts to grab the driver's attention and prompt them to stay alert. The USB cable connects the camera to the laptop, ensuring a seamless data transfer and processing flow. This drowsiness detection system not only enhances road safety but also offers the advantage of easy integration into existing vehicles, as it relies on commonly available components. Our research demonstrates the feasibility of implementing a cost-effective and efficient solution to mitigate the dangers of drowsy driving, ultimately saving lives on the road

Keywords : Convolutional Neural Network, USB Cable, Alert System

I. INTRODUCTION

In today's world, a growing number of jobs need long-term attention. Drivers must keep a careful eye on the road in order to react quickly to unexpected incidents. Many road accidents are caused directly by driver sleepiness. There is a need to develop technologies that can detect and alert a driver when they are in a

negative psychophysical state, which could help to reduce the frequency of fatigue-related car accidents. However, the development of such systems has numerous challenges, including the rapid and accurate assessment of a driver's fatigue symptoms. The employment of a vision-based technique is one of the technical options for implementing driver drowsiness detection systems. We present a vision-based fatigue detection system for bus driver monitoring that is simple and adaptable to install in buses and large vehicles in this paper. Head detection, face detection, eye detection, eye openness estimation, fusion, sleepiness measure estimation, and classification are among the system's modules. The current technique is less accurate in predicting tiredness and takes more time. It can't be used on all datasets or with a complicated model. The proposed approach has the advantages of requiring less time and eliminating manual labor. It may be used on any dataset and has a higher accuracy rate for predicting drowsiness. It's a model that's easy to use. The most common type accident in today's world is the accident occurring due to the sleepiness of the driver irrespective of day and night. The death rate of accidents due to this has spiked to 21% over the world. This shows how serious this problem is. The Drowsiness Detection is a safe technology that can prevent accidents that are caused by drivers who fall asleep while driving. The objective of this python project is to build a Drowsiness Detection Model which will detect that a driver's eyes are closed for a few seconds. The implementation of this project uses a pre-built model of face landmark for easy deployment on edge of computationally less efficient devices. The project has a direct application in the automotive sector. This paper is aimed at designing a Drowsiness Detection Model, which takes the driver's eyes as ROI (Region of Interest) and continuously senses (in real-time) the eye lid to detect whether the driver is feeling sleepy or not. If the driver feels sleepy, the model will generate Sound Alarm to bring the driver back to his/her conscious state. This model is also effective even when the driver is wearing a spectacle. The number of accidents show just how much grave this matter is and that's why we chose to develop this project that is intended to reduce these accidents.

The organizational framework of this study divides the research work in the different sections. The Literature survey is presented in section 2. In section 3 and 4 discussed about Existing and proposed system methodologies. Further, in section 5 shown Simulation Results is discussed and Conclusion and future work are presented by last sections 6.

II. LITERATURE SURVEY

The survey has been done which consists of present research and technologies on this Drowsiness Detection. The idea of this survey is to understand the field of study, and also to understand where we should be putting our efforts while designing this project.

Driver Drowsiness Detection System Using Computer Vision (2021), this paper includes to detect a driver's drowsiness based on eyelid movement and yawning and is reliable to give appropriate voice alerts in real-time.[1]

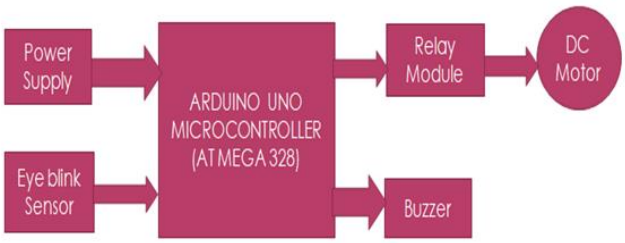
The Detection of Drowsiness using a Driver Monitoring System (2019), research has established the ability to detect drowsiness with various kind of sensors. The author studied drowsy driving in a high-fidelity driving simulator and evaluated the ability of an automotive production ready Driver Monitoring System to detect drowsy driving. Additionally, this feature was compared to and combined with signals from vehicles-based sensors.[2]

Real-time Driver Drowsiness Detection based on Driver's Face Image Behavior using a System of Computer Interaction Implemented in a Smartphone (2018), this study has shown promising result in applying the vehicular driver surveillance based on Artificial Vision Techniques and implemented in a

smart-phone. The implemented system allows an efficient detection of the indicators that appear in drowsiness, as long as the measurements are carried out under the established conditions. The correct functioning of the system depends on these conditions. [3].

III.EXISTING METHOD

The IR receiver is used to receive the reflected infrared rays of the eyes. If the eyes are open then the output of IR receiver is high otherwise the output is low. This way the system can understand that the eyes are closed or not. This output is channelized to the logic circuit to indicate the alarm. Using this device we can even identify whether the driver is unconscious or not. The eye blink sensor activates the alarm if anybody closes his/her eyes for more than 3 seconds.



IV. PROPOSED METHOD

The primary goal is to develop an effective drowsiness detection system to prevent accidents caused by driver fatigue. A standard camera (e.g., webcam) is used to capture the driver's facial expressions and eye movements. USB Cable Connects the camera to the processing unit for real-time data transfer. The laptop serves as the computational hub for running the deep learning model and processing video feed. Speaker (Warning System) is An audio output system is integrated to alert the driver when signs of drowsiness are detected. Continuous video feed from the camera is captured through the USB cable, providing input data for the deep learning model. Deep A Convolutional Neural Network is employed to analyze facial features and eye movements in real-time video frames for signs of drowsiness.

ALGORITHM

Algorithm: Driver drowsiness detection system

1. Initialization:
- Set up the necessary libraries and frameworks (e.g., TensorFlow, OpenCV).
- Initialize the face and eye detection models.
- Load the pre-trained CNN model for drowsiness classification.
2. Start Camera Stream:
- Open the camera stream to capture real-time video input.
3. Loop:
- Repeat the following steps for each frame of the video stream:
- Read the next frame from the camera stream.
- Detect faces in the frame using the face detection model.
- For each detected face:
- Extract eye regions using the eye detection model.
- Preprocess the eye regions (resize, normalize).
- Extract features from the eye regions (blink rate, eye aspect ratio, etc.).
- Input the extracted features into the CNN model for drowsiness classification.
- Determine the drowsiness state based on the output of the CNN model.
- If the drowsiness level exceeds a predefined threshold:
- Trigger an alert mechanism (e.g., sound alarm, visual notification).
4. End Loop:
- Stop the camera stream and release resources.
5. System Deployment:
- Integrate the drowsiness detection system into vehicles or other relevant environments.

- Ensure the system's robustness, efficiency, and reliability in real-world usage.

6. Continuous Improvement:

- Gather feedback from users and monitor the system's performance.
- Continuously update and refine the model and system components to enhance detection accuracy, speed, and reliability over time.

FLOW DIAGRAM

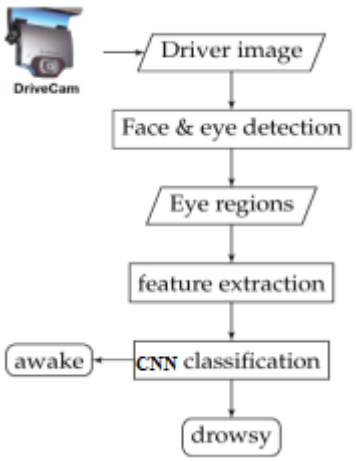


Figure 2. Flow Diagram

1. *Data Collection*: Gather a dataset of driver images or videos with labeled drowsiness states.
2. *Pre-processing:* Normalize images and resize them for consistency.
3. *Face Detection:* Use a face detection algorithm to locate the driver's face within the image or video frame.
4. *Eye Detection:* Apply an eye detection algorithm to identify the driver's eyes within the face region.
5. *Eye Region Extraction:* Extract the regions of interest corresponding to the driver's eyes.
6. *Feature Extraction*: Utilize feature extraction techniques (e.g., HOG, LBP) to capture relevant information from the eye regions, such as blink rate or eye closure duration.
7. *CNN Classification:* Design and train a Convolutional Neural Network (CNN) to classify the extracted features into drowsy and alert states.
8. *Model Training:* Split the dataset into training and testing sets. Train the CNN model on the training data and validate it on the testing set.

IMPLEMENTATION STEPS

1. **Environment Setup**:

Set up your development environment with necessary libraries and frameworks such as TensorFlow, Keras, OpenCV, etc. Ensure you have access to a camera or webcam for capturing real-time video input.

2. **Data Collection**:

Collect a dataset of driver images or videos depicting various levels of drowsiness. Annotate the dataset with labels indicating the drowsiness state of each sample (e.g., alert, drowsy).

3. **Data Pre-processing**:

Normalize the image data to ensure consistent pixel values across samples. Resize images to a standard size suitable for input to the neural network model.

4. **Face Detection**:

Use a pre-trained face detection model (e.g., Haar cascades, MTCNN) to detect and localize faces within each image or video frame. Extract the bounding boxes or facial landmarks representing the detected faces.

5. **Eye Detection**:

Apply an eye detection algorithm (e.g., Haar cascades, Dlib) to locate the driver's eyes within the detected face regions. Extract the bounding boxes or coordinates of the detected eyes.

6. **Eye Region Extraction**:

Crop and extract the regions of interest corresponding to the detected eyes from the facial images. Pre-process the eye regions (e.g., resize, normalize) for further analysis.

7. **Feature Extraction**:

Extract relevant features from the preprocessed eye regions to characterize drowsiness-related patterns. Features may include eye aspect ratio, blink rate, eye closure duration, etc.

8. **CNN Model Design**:

Design a Convolutional Neural Network (CNN) architecture for classifying drowsiness based on the extracted features. Experiment with different CNN architectures (e.g., VGG, ResNet, custom architectures) to find the most suitable model for the task.

9. **Model Training**:

Split the dataset into training, validation, and testing sets. Train the CNN model using the training set, optimizing the model parameters to minimize classification loss. Validate the model's performance on the validation set and fine-tune hyperparameters to prevent overfitting.

10. **Model Evaluation**:

Evaluate the trained model's performance on the testing set using metrics such as accuracy, precision, recall, and F1-score. Analyze the model's performance to identify areas for improvement.

11. **Integration with Camera**:

Set up a real-time video stream from the camera or webcam. Apply the face and eye detection algorithms to each frame of the video stream to locate the driver's face and eyes.

12. **Real-time Drowsiness Detection**:

Process each frame of the video stream to extract eye regions and compute the relevant features. Input the extracted features into the trained CNN model to classify the driver's drowsiness state (alert or drowsy). Trigger an alert mechanism (e.g., sound alarm, visual notification) when the model detects drowsiness beyond a certain threshold.

13. **System Deployment**:

Integrate the drowsiness detection system into vehicles or other relevant environments where driver monitoring is necessary. Ensure the system's robustness, efficiency, and reliability in real-world scenarios.

14. **Continuous Improvement**:

Gather feedback from users and monitor the system's performance in real-world usage. Continuously update and refine the model and system components to enhance detection accuracy, speed, and reliability over time.

V. RESULTS AND DISCUSSIONS

Here the input will be the continuous stream of video, In the below output drowsiness is detected because the person had closed the eyes for too long, and the below the eye threshold value. Because of which the system has classified that the person is feeling drowsy.

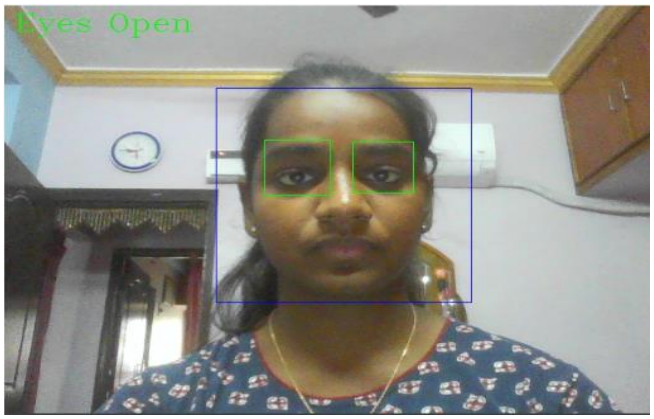


Figure 3 : no alerts when eyes open

A text message will be prompted on the screen and an audio alert is activated when eye closed continuously, then a certain threshold, indicating that the driver is feeling drowsy. Once this threshold is crossed, the system triggers an audio alert, which can be in the form of a loud beep, a voice command or a sound signal

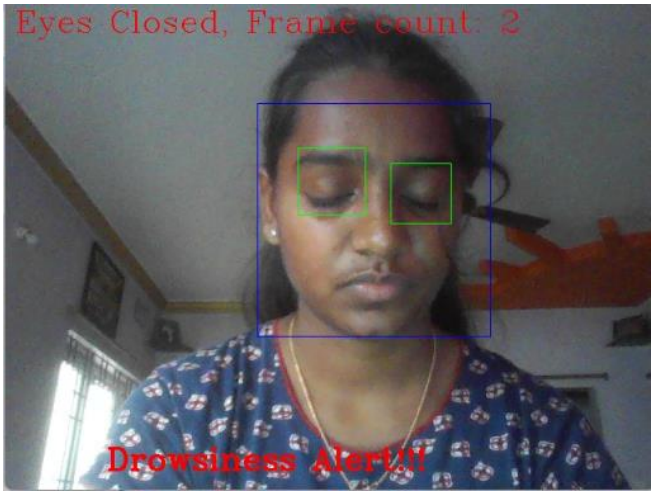


Figure .4: drowsiness alerts when eyes closed

VI. CONCLUSION AND FUTURE SCOPE

The Drowsiness Detection Model is competent of detecting the sleepiness by keeping track of the eye's movement of the driver. The inputs are obtained from the facial detection algorithm which is pre trained by the Dlib model of facial recognition. The model deals with the eye's aspect ratio to detect the region of interest. The eye's aspect ratio is calculated using the EAR function. The alert is generated if the value of the detection counter exceeds the threshold value defines inside the driver code. The main focus for developing this project is to reduce the number of accidents which occur due to the sleepiness of the drivers.

VII. FUTURE SCOPE

The correctness of this model is hugely dependent on the quality of camera. The quality of detection degrades if the driver's eyes are not clearly visible for the detection. It can happen because of the Sunglasses or spectacles having light reflection or any other kind of obstacles between the eyes and the camera. Also, if the driver is not facing the camera properly, the accuracy is compromised.

VIII. ACKNOWLEDGEMENT

It gives us great pleasure in presenting the preliminary project report on. I would like to take this opportunity to thank my guide Mr. E. ANANT SHANKAR M.Tech (Ph.D), Assistant Professor and Dr. D. Srinivasulu Reddy, Ph.D., Professor, & Head of the Department (HOD) of Electronics and Communication Engineering, SV College of Engineering (SVCE) (Autonomous), Tirupati, Andhra Pradesh India, for giving me all the help and guidance I needed. I am really grateful for their kind support and valuable suggestions were very helpful. Thank you all!

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Cite this article as :

E. Anant Shankar, P. Poojitha, N. Rishitha, P. Vishnu Vardhan, M. Guru Yaswanth, P. Lukesh, "Drowsiness Detection Using Deep Learning and Camera-Based System ", International Journal of Scientific Research in Science and Technology (IJSRST), Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 11 Issue 1, pp. 505-511, January-February 2024.

Journal URL : https://ijsrst.com/IJSRST52411156