Driver Drowsiness Detection System

Adithya R[1], Vaishnav K[2], Rohit Vinayakumar[3], Sujisha P[4], Asha Vijayan[5]

[1,2,3,4] UG scholars [5] Asst professor

[1,2,3,4,5] Computer Science and engineering,

College of Engineering Thalassery, Kerala, India

Abstract: Sleep-deprived driving is the operation of a vehicle while being cognitively impaired by a lack of sleep. Drowsiness is the leading cause of motor vehicle accidents and can cause serious injuries and can be fatal too. So we are developing a system to detect sleep as well as abnormal behavior linked to driving. This system will use a webcam to capture a video from which frames would be selected and it would undergo image segmentation to detect aspects of drowsiness like closing of the eyes as well as yawning. Also abnormal head movements would also be detected. We are developing this using python. Facial landmarks on the detected faces are pointed and subsequently the eye aspect ratio, mouth opening ratio are computed and depending on their values, drowsiness is detected. We will be implementing this setup via a simple webpage which will be accessible to both the user and the admin via their respective logins.

Index Terms – Drowsiness detection, accident prevention, facial features, deep learning.

I. INTRODUCTION

Drowsy driving is one of the major causes of road accidents. Drivers who drive for continuous long hours (especially at night), long distance route are more susceptible to this problem. From 2019 to 2022 at least 4500 people have died as a result of drowsy driving. It is so dangerous because it is in most ways similar to the symptoms of drunk driving which includes blurred vision, slowed reaction time and poor decision-making capability. Almost everyone is susceptible to fall asleep while driving. Even the most experienced drivers are prone to fall asleep while driving for long hours without proper sleep. Every year, a large number of injuries and deaths occur due to fatigue related road accidents. Accident due to sleep can result in serious economic losses too. It was reported that one in every six deadly traffic accidents and one out of eight crashes requiring hospitalization of those in the car was due to drowsy driving. Also drowsy driving becomes a regular trait if the same routine is followed by the drivers . So it is also necessary for the drivers to adopt proper sleep breaks before attempting to go on long drives. Hence, detection of driver's fatigue and its indication is an active area of research due to its immense practical applicability. Here, the video of the driver's face is captured and transferred for processing where it is processed to detect drowsiness. If drowsiness is detected, a warning in the form of an alarm is sent to the driver.

II. PROPOSED WORK

In our proposed system, drowsiness detection relies on computer vision technique algorithms that analyze facial features and movements to identify any signs of fatigue or drowsiness. These algorithms can track changes in a driver's eye movements, blink rate, head position, and facial expressions to determine whether they are becoming drowsy or not. The methods based on eye blinking analysis uses blink frequency that is a particular threshold frequency which a measure to detect driver drowsiness. Fatigue and boredom leads to yawning, which is described as uncontrolled wide opening of mouth to increase the oxygen supply in the body. Due to wide opening of mouth during yawning the geometric shape of mouth changes that is analyzed, which than processed and can be used for driver drowsiness detection. The systems based on this feature uses mouth geometrical shape, position of lip corners and degree of mouth open to determine yawning. A mix of more than one facial feature can also be used to detect level of drowsiness in driver. The facial feature set includes eye blink, yawning and head movement. As more than one facial feature is used in detection of drowsiness, artificial neural network and support vector machine (SVM) can be used to optimize the detection. Here in our proposed system YOLO algorithm is mainly used to detect, as it is one of the finest object detection algorithm. Our system identifies the face and captures each frame by frame and gets the image, after face has been detected it then selects the region of interest (ROI). When the feature is extracted it simplifies by putting them in proposed three categories that is eyes, head, mouth. From each states it detects the states of the captured region of interest and classifies them to verify that the driver is drowsy or not, if the driver is drowsy than the system will given a waring alert to the driver by external hardware so called speaker. Fig 1 shown below describes the working mechanism of the driver drowsiness detection.
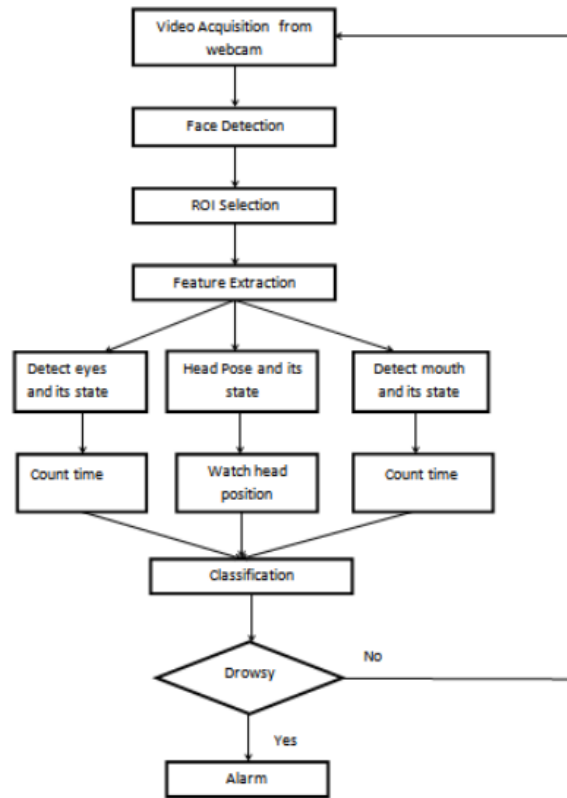
figure 1:

III. YOLO ALGORITHM

YOLO (You Only Look Once) is an algorithm that uses neural networks to provide real-time object detection. This algorithm is popular because of its speed and accuracy. It has been used in various applications to detect traffic signals, people, parking meters, animals and face detection. Object detection is a phenomenon in computer vision that involves the detection of various objects in digital images or videos.

This is an algorithm that detects and recognizes various objects in a picture (in real-time). Object detection in YOLO is done as a regression problem and provides the class probabilities of the detected images.

YOLO algorithm employs convolutional neural networks (CNN) to detect objects in real-time. As the name suggests, the algorithm requires only a single forward propagation through a neural network to detect objects. This means that prediction in the entire image is done in a single algorithm run. The CNN is used to predict various class probabilities and bounding boxes simultaneously. The YOLO algorithm consists of various variants. Some of the common ones include tiny YOLO and YOLOv3.

We chose this algorithm because of its speed, high accuracy, learning capabilities. This algorithm improves the speed of detection because it can predict objects in real-time. YOLO is a predictive technique that provides accurate results with minimal background errors. The algorithm has excellent learning capabilities that enable it to learn the representations of objects and apply them in object detection.

IV. SALIENT FEATURES

- Application of Image processing
- Easy installation
- USB camera based detection
- Real time processing
- Eye closure detection
- Yawn detection
- Head movement detection
- Sounded alert
- User alert history report
- User friendly interface

V. MODULE DIVISION

a) User Module
b) Admin Module

In user module user can able to register on to our driver drowsiness website by creating a profile by their choice of their user name, mail ID and password, so that next time when user try to login, the user can login by providing user name and password. User can able to access features that are provided by the website such as view profile, change password, send feedback and also able to make contact to admin for any service or technical issues.

In user side user can able to access the driver drowsiness detection system before the journey begins all it is monitored through camera that is a real time video is captures and system will process it each frame by frame. After analysis of frame, if system detects any sign of drowsy driving it sends the driver an alert or warning beep sound to weak the driver in which driver able to gets back the consciousness of driving. Here the system gives the alert by checking the conditions of drowsiness like eye closure, yawning and head movement, if system detects any of the mentioned conditions is true then only it gives the driver the warning beep sound and also takes the count of sleepiness.

In admin module admin can able to view users' drowsiness count, that is, admin can able to see how many times does driver have almost gone for sleepy stage, the system detects any sign of drowsiness like eye closure, yawning, head movement, if any one of the earlier mentioned stages is detected by the system, then it takes their count. Admin can able to view user also able to view the feedbacks sends by the user for to take any appropriate actions based on it like any changes or any improvement, etc. Admin also has the option to change admin side password.

VI. IMPLEMENTATION

Drive drowsiness detection system can be implemented in any simple and compatible smart devices like laptops, smart phones, smart media player in vehicle, etc. Here the system works perfectly well in smart devices and also gives accurate output also. Here any external USB web cam can be used to capture video of the driver's face and each is taken in frame by frame. There the system takes approximately 24 frames per second and each frame is analyzed by creating a region of interest (ROI), in which eye, mouth and head movement is detected from ROI. After which it is feed to classifier to categorize the region of eye, mouth and head. When the system after analyzing, if any sign of drowsy like eye closure, yawning and head movement is detected it will immediately give an alert to the driver by giving a beep sound.

VII. REQUIREMENTS

1) Python

Python is one of the best option for easy built and we use OpenCV for gathering the images from webcam and feed them into a Deep Learning model which will classify whether the person's eyes are open or closed, whether yawning or not and head movement. The approach we will be using for this Python project is as follows :

Step 1 – Take image as input from a camera.

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

Step 3 – Detect the eyes, mouth and head from ROI and feed it to the classifier.

Step 4 – Classifier will categorize whether eyes and mouth are open or closed and change in head movement from its calculated angle of measurement.

Step 5 – Calculate score to check whether the person is drowsy.

2) Flask

Flask is a lightweight Python web framework that provides useful tools and features for creating web applications in the Python Language. It gives developers flexibility and is an accessible framework for new developers because you can build a web application quickly using only a single Python file. Flask is also extensible and doesn't force a particular directory structure. Flask is often referred to as a microframework. It is designed to keep the core of the application simple and scalable. Instead of an abstraction layer for database support, Flask supports extensions to add such capabilities to the application.

We built a small web application that renders HTML text on the browser. We install Flask, write and run a Flask application, and run the application in development mode. We use routing to display various web pages that serve different purposes in your web application. We also use view functions to allow users to interact with the application through dynamic routes.

3) PyCharm

We have written and run our python code on PyCharm which is a dedicated Python Integrated Development Environment (IDE) providing a wide range of essential tools for Python developers, tightly integrated to create a convenient environment for productive Python, web, and data science development.

VIII. CONCLUSION

This model is capable of detecting drowsiness of the driver by monitoring the eyes, mouth and head. Here we have used object detection algorithm YOLO (You Look Only Once) to detect important features of the human face. YOLO detects the symptoms of drowsiness and alerts the driver by sounding a beep alerts. This model performs real time monitoring. The system is capable of detecting whether the eyes is closed or not by measuring the distance between the eye facial landmarks and comparing it to the set threshold value. It also detects yawning using facial landmarks. Also we have included a new feature in our model which is to detect undesirable head movements which is major symptom of drowsy driving. After the symptoms of drowsiness has been detected the system it will alert the driver by sounding an alert which will terminate once the symptoms of drowsiness wears away. The system will sound an alert when it detects at least one of the symptoms of drowsiness which could either be the eye, yawning and head movement. The detection of a single cycle of a symptom of drowsy driving won't trigger the system to raise the alert but rather a series of movements would trigger the alert. Hence preventing the system from sending alerts even for the smallest movement which could eventually irritate the driver. So the system is well configured to work in a realistic environment considering all the factors that comes with the real life application drowsiness detection. This project is designed in such a way that it can be incorporated into any kind of vehicles due to its easy implementation. The goal is to reduce accidents due to drowsy driving in any kind of vehicle.

IX. FUTURE SCOPE

This project is still in its early development stage. Based on the modules completed so far the system is capable of :
*   Detecting closure of the eye.
*   Yawning.
*   Head movement.

We plan to work on a new concept of detection which is to detect the arms of the driver to check if both his arms are on the steering wheel. The regular process it to detect the fingers on the steering wheel. This approach is quite good but consider a situation where the steering wheel is poorly designed which could fool the system into believing that the hands of the driver is still on the steering wheel. Any unusual bumps on the steering wheel could be mistaken for the fingers of the driver. Hence we have come up with the above mentioned idea of detecting the entire arms of the driver to check if it is on the steering wheel.

X. REFERENCES

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