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Driver Drowsiness Detection

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Abstract: *Every year many human beings lose their lives because of fatal road injuries round the arena and drowsy driving is one of the number one causes of avenue accidents and demise. Fatigue and micro sleep at the using controls are often the basis reasons of significant injuries. But preliminary signs of fatigue may be detected earlier than a vital scenario arises and therefore, detection of driving force's fatigue and its indication is an ongoing research subject matter. Most of the conventional strategies to hit upon drowsiness are based on behavioral aspects while some are intrusive and might distract drivers, at the same time as some require costly sensors. Therefore, the development of a lightweight as well as affordable driver's drowsiness detection system has become necessary. The major aim of this project is to develop a drowsiness detection system by monitoring face features. It is believed that the symptoms of driver fatigue can be detected early enough to avoid a car accident. In such a case when drowsiness is detected, a warning signal is issued to alert the driver. This detection system provides a noncontact technique for judging different levels of driver alertness. The implemented system records the video and detects the driver's face in every frame by employing image processing techniques and sends a warning message to the driver about his/her improper driving and raises the alarm (in case of drowsiness). Machine learning algorithms (like SVM and YOLOV5) have been employed to test the efficacy of the carried-out technique. Due to the COVID pandemic, usage of the mask is mandatory. So, the application also includes face mask detection which means this application can keep track of whether the driver is wearing a mask or not. Driver's drowsiness can be detected using different gestures and postures such as yawning. So, the whole system is comprised to detect driver's drowsiness as well as mask usage.*

Keywords: Image Classification, Deep Learning, Machine Learning, Driver drowsiness, Image Processing, YOLOV5, Accident Prevention

I. INTRODUCTION

It is an inarguable fact that the world loses a big chunk of skilled drivers each year due to road accidents especially in bigger vehicles that are used to transmit the load on a longer route. Further, the studies reveal that most of the cases of fatal accidents take place due to driver's fatigue specially during the hours of after meals and due to lack of sleep. Although previously many attempts have been made to build smart systems for driver assistance but could not yield significant results. Most people like travelling at night and there are many occupations that demands travelling overnight. Many a times when travelling overnight or for long duration driver might get tired. One of the root causes of accidents is distracted driving. Combination of fatigue and driving is life threatening for drivers as well as passengers. With this application which alerts the driver when detected drowsiness reduces the chances of accidents.

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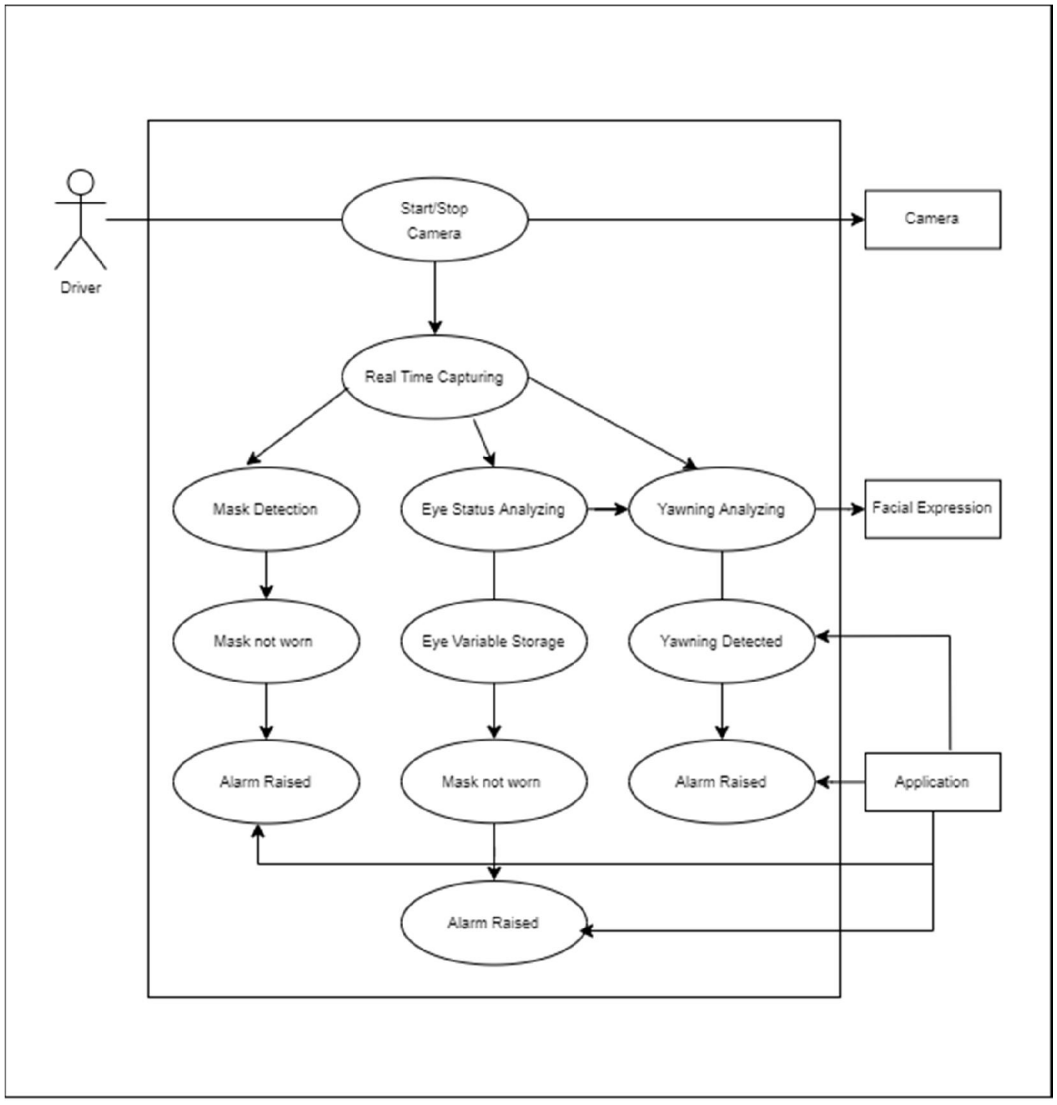
1.1 Project Approach

This project approach design is to solve the various problems that may help to conclude the driver's sleepiness or if driver has worn a mask or not.



1.2 Face Landmark Detection

Accurate face detection is the first and most crucial step. Thus, it required high precision algorithm. Using hog function to detect the facial features.

It determines 68 landmarks to detect facial features. Landmarks ranging from [0,17] depicts facial outlines while [18,22] and [23,37] represents right eyebrow and left eyebrow, respectively. Landmarks scaling from [28,31] and [32,36] altogether forms the nose. Furthermore, points ranging from [37,42] and [43.48] represents eyes and remaining landmark i.e., from [49,68] forms lips.

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1.3 Drowsiness Detection

Drowsiness detection is majorly divided into two sections, first the PERCLOS method is used to calculate if the eyes are closed for a longer duration, then the average blink time and second if yawning is observed.

PERCLOS method: It is defined as Percentage of eyelid closure over the pupil over time.

perclos = (Closed eyes time /(closed eyes time + open eyes time))*100

PERCLOS is obtained Eye aspect ratio (EAR) using the above shown landmarks from the 68-facial landmarks using the below formula

$$EAR = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

where p1-p6 are the points representing individual eye

Figure: Determining if the user has sleepy eyes

1.4 Yawning Detection

In case of yawning the mouth opens more than while talking. Thus, using manual labels ‘awake’ and ‘drowsy’ and capturing two-hundred images for each label, implemented the real time yawning classifier with the use of YOLOv5. `

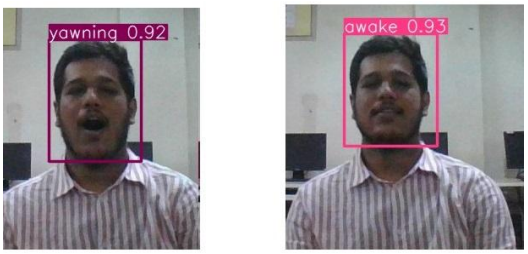

Figure: Classification of awake and drowsy using YOLOv5

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1.5 Mask Detection

During the times of COVID, it became integral part of living to wear a mask to prevent spread the virus as well as taking care of oneself to not get infected with the same. Thus, implementation of a system to check if the driver has worn the mask is essential. With the use of Support vector machine, a higher accuracy was achieved i.e 99%.

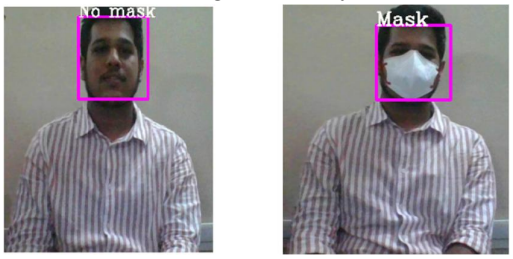

Figure: Output mask detection

II. Experimental Research

The project has three modules which are getting implemented as threads using the python language's capability of multithreading. Three modules are: calculating the EAR ratio using PERCLOS method, yawn detection using YOLOv5 method and mask detection using SVM classification method. The project had the below accuracy:

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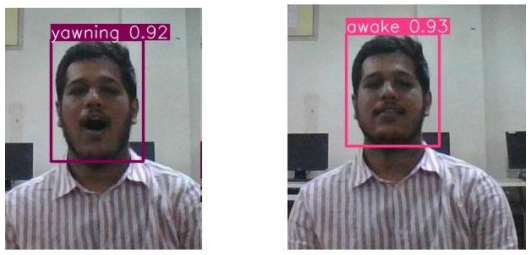

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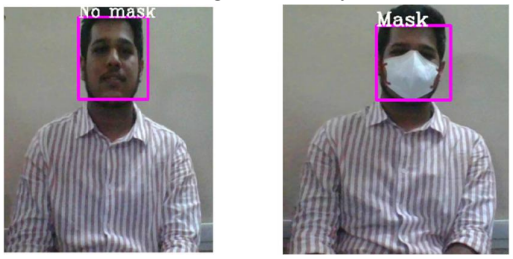

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Mask detection was implemented using multiple Classification algorithms that yielded out different accuracies

Classification Model	Accuracy %age
SVM	98.80%
Decision Tree	98.20%
Random Forest	99.40%

Since maximum accuracy was achieved using Random Forest Classification, we have used the Random Forest for the final implementation. After integrating all the three modules using KivyMD, drop in FPS is noticed, though the parameter for FPS is initialized to 60 FPS. Subsequently research was conducted to test the modules separately no loss in FPS was observed. Likewise, the application was tested on two other system with "8 GB RAM, 1 TB HDD, i5 5th generation" and "8GB RAM, 512GB SSD, i5 10th generation" specifications however, no changes in computing speed was noticed. One of the reasons for slow computing is processor since all the modules are executed parallelly using multithreading, the processor's performance is degraded and hence delay in capturing frames. This can be overcome by using high performance processors like i7 and i9.

III. Conclusion

This system will work by analyzing the eye movement of the driver and alerting the driver by activating the buzzer when he/she will be drowsy. The system would be nonintrusive real-time monitoring system for eye detection and other face features' detection. During monitoring, different face features would be considered to find out driver's fatigue. Also, system will comprise of one more feature that is mask detection. Wearing mask is one of the important rules which is imposed by government. So, we will add this feature. Also, we will add one module so that system will be able to perform face detection at night. Thus, initial signs of fatigue and drowsiness can be detected before a critical situation arises with this system. Thus, the objectives for implementing this system are mask detection and prevention of car accidents due to driver's drowsiness. We have decided to use python and its Kivy framework will be used to build an application. Thus, system would be low cost.

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