# Avoidance of Accidents through Detection of Drowsiness during Driving using Convolution Neural Network

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***Abstract: One of the most frequent causes of road accidents is due to the driver's drowsiness. Statistics show that drowsiness expose driver to higher crash risks, severe physical injuries, or even death. Tiredness may cause drowsiness which is a state of decreased mental alertness where the driver is no longer safe. Fatigue not only puts the driver himself at risk, but also puts the other participants such as pedestrians and other travelers on road at jeopardy. Due to high variability of surrounding parameters, current techniques developed for this area have several limitations. Poor lighting might affect the ability of the camera to measure the face and the eye of the driver, accurately. This will affect the analysis due to late detection or no detection and thereby decrease the accuracy and efficiency of the technique. In this paper, an intelligent system is developed to detect the drowsiness of the driver and thus prevent accidents, save money and reduce losses and suffering It proposes a real-time system that utilizes computerized camera to automatically track and process driver's eye using Python, and Convolution Neural Network (CNN).***

*Keywords**: Convolution Neural Network, Prevention, Accident, Drowsiness, Driving***

## I. INTRODUCTION

Road accidents are one of the greatest hazards to human life and it has been evidently shown through statistics over the years. The number of injuries and deaths are rising more and more due to the errors of drivers, including drunken driving, drowsiness due to drunkenness, non-observance of traffic rules, rash driving due to the rush of life, poor condition of roads like pot holes due to ill-maintenance by the government, non-regulation of traffic by the traffic police, poor visibility owing to lack of proper lighting of roads, ill-maintenance of vehicles due to which brakes don't function properly, mere carelessness and non-responsible behaviour of drivers and other such factors. Therefore an intelligent system is necessary to avoid accidents due to drowsiness which is one of the major causes of occurrences of accidents. The development of a system, which monitors the driver's level of drowsiness, in real time, will decrease the number of car accidents and will save millions of lives all over the world. The use of such an assisting system that is able to measure the level of vigilance, is critical in car crash prevention. In order to develop the system is important to evaluate the level of drowsiness. Four types of measurements are commonly used to check the level of drowsiness. There are several approaches used in face detection. Some of these encode the knowledge about characteristics of a typical face and find structural elements - such as eyebrows, eyes, nose, mouth and hairline- and use the relationships between them to detect faces. A method based on segmentation has been proposed to identify the face from a cluttered background. The human skin color and texture faces have also proved to be good features for face detection. For this method, the most important feature was the skin color that can be separated from other parts of the background. This method uses maximal varieties variance threshold. Another method used for face detection was the histogram intersection in the HSV color space to highlight the skin region. The template matching methods store several patterns of different faces to describe as a whole or the facial features separately, by computing the correlations between an input image and the stored pattern in order to determine the degree of similarity of the pattern to a face. For detecting the features from the face here we use the CNN algorithm which extracts the features from the image screens. By detecting the features of eyes from the image, whether it is closed or opened we can identify the Drowsiness level of the driver.

## II. APPLICATION OF CONVOLUTION NEURAL NETWORK

Convolution Neural Network (CNN) is a part of deep learning in the class of artificial neural networks. The mathematical principle of convolution is used in CNN in the place of general matrix multiplication at least in one of its layers. It is most often applied in the analysis of visual imagery. CNN is specifically designed to process pixel data in order to be used in image recognition and processing. Figure 1 given below shows one such CNN

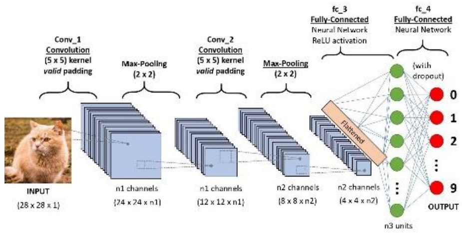


Fig. 1 Convolution Neural Network

## III. RELATED WORKS

Rahman et al. (2015) have proposed [1] realtime drowsiness detection using eye blink monitoring. Danisman et al. (2016) [2] have proposed a system using eye blink patterns in order to detect a drowsy driver. Redmon et al.[4] (2016) have utilised unified real-time object detection. Ren (2016) [5] have used Faster R-CNN for real-time object detection with region-proposed networks. McDonald, (2012) [23] C. Schwarz, J. D. Lee, and T. L. Brown have studied Real-Time Detection of Drowsiness Related Lane Departures Using Steering Wheel Angles brought forth an accuracy of 93.88%. Kublbeck and Ernst (2006) [6] have studied face detection and tracking in video sequence using the modified census transformation. Blome et al. (2010) [7] have studied visual object tracking using adaptive correlation filters. Ren et al. (2014) have worked on face alignment at 3000fps via regressing local binary features [9]. Soukupova T. and J. Cech, [10] (2016) studied real-time eye blink detection using facial landmarks. Al-Zubi et al. (2013) [12] studied electro encephalogram-based driver fatigue detection and yielded an accuracy of 86.35%. Rahim et al. (2015) [14] detected a drowsy diver with the help of a pulse sensor and produced an accuracy of 94.23%. Wireless wearables were used by Warwick et al. (2015) [15] for detecting drowsiness of drivers and successfully produced an accuracy of 95.61%. Awais et al. (2017) [16] did a hybrid approach to detecting drowsiness in drivers with the suggestions of physiological signals with an accuracy of 97.95%. Bhatt et al. (2017) [17] studied the various methods for detecting drowsiness in drivers. Katyal et al. (2014) [18] observed safe driving by detecting lane discipline and drowsiness in drivers. Zhenlai et al. (2017) [19] used time series analysis of steering wheel angular velocity to detect drowsiness of drivers. Li et al. (2017) [20] used steering wheel angles for real driving conditions to detect fatigue of drivers online. Donald et al. (2012) [21] did their studies based on related lane departures using steering wheel angle to detect drowsiness in real-time. Ghosh et al. (2015) [22] proposed a tracking method for driver assistance system with real-time eye detection. Mittal et al. (2015) [23] studied the state-of-the-art techniques to detect the movement of head of the drivers and their drowsiness and produced an accuracy of 95.18%. Horng et al. (2004) [24] used dynamic template matching and eye-tracking to detect fatigue in drivers. Saradevi and Bajaj (2008) [25] did an analysis on mouth and yawning to detect the fatigue of drivers and it yielded 84.4% accuracy. Asari et al. (2011) [26] did an extensive study on the recognition of face expressions to detect drowsiness of drivers. Teyeb et al. (2014) [27] used wavelet network to estimate head posture and eyes movement to thereby detect drowsiness of a driver and achieved 94.08% accuracy. Ahmad et al. (2015) [28] used eye-blink detection to identify a drowsy driver. Amditis et al. (2004) [29] studied information and data flow in awake multi-sensor driver monitoring system. Lakshmi et al. (2015) [30] studied car-safety systems which spots the errors of drivers. Zhenhai(2017), [4] L. DinhDat, H. Hongyu and Y. Ziwen, W. Xinyu, performed an amazing work on driver drowsiness detection based on time series analysis of steering wheel angular velocity which yielded a whopping 96.82% accuracy.

## IV. METHODOLOGY OF THE PROPOSED SCHEME

The research methodology adopted in this paper is described in this section. The acquisition of data is the first step. This step is followed by Pre-processing of data. This is a very important step since here is where the data is made suitable for further processing.

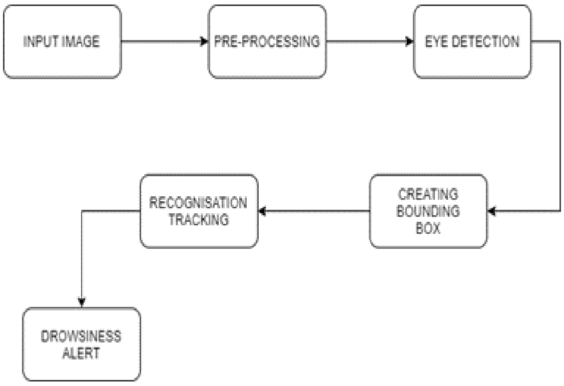


Fig. 2 System Design Diagram

A. UML USE CASE DIAGRAM

UML stands for Unified Modeling Language. UML is a standardized general-purpose modeling language in the field of object- oriented software engineering. A Use case diagram in the Unified Modeling Language (UML) is a type of behavioral diagram defined by and created from a Use- case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. The main purpose of a use case diagram is to show what system functions are performed for which actor. Roles of the actors in the system can be depicted.

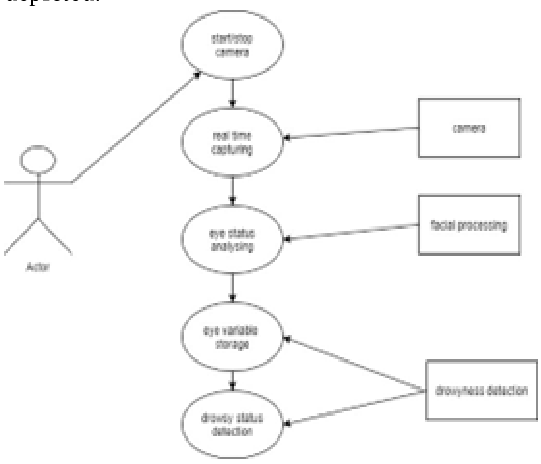


Fig. 3 UML Use Case Diagram

B. ACTIVITY DIAGRAM

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control.

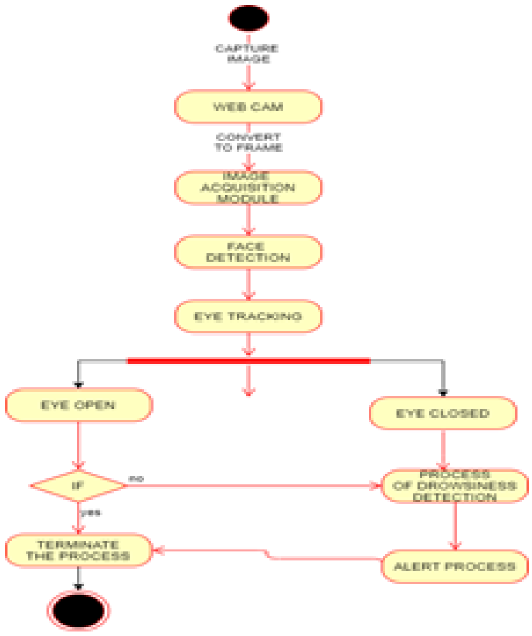


Fig. 4 Activity Diagram

C. STATE CHART DIAGRAM

A State chart diagram is a kind of UML diagrams used to model the dynamic nature of a system. It defines different states of an object during its lifetime and these states are changed by events. State chart diagrams are useful to model the reactive systems. Reactive systems can be defined as a system that responds to external or internal events.

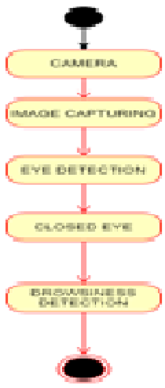


Fig. 5 State Chart Diagram

V. DATA SETS

Training Dataset:

The training data set consists of a huge set of images captured on camera- images with the person's eyes open, in a variety of angles and also images with the person's eyes closed in a variety of different angles. The training data set is exclusively used for training the convolution neural network. When the training is completed successfully, the algorithm will yield an optimum result.

Open_Eyes

Fig :6 Open_Eyes

The Figure 6 shows a very big data set containing images with the person's eye open, for training the CNN. The training procedure consumes a lot of time. But the training is the most important step that helps in improving the efficiency of the algorithm.

Closed_Eyes

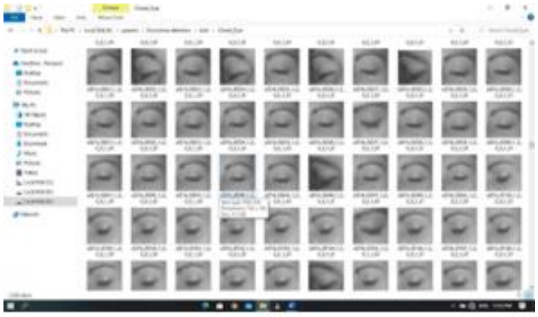

Fig :7 Closed_Eyes

The Figure 7 shows a very big data set containing images with the person's eye closed, for training the CNN.

VI. RESULTS AND DISCUSSION

The proposed method yielded very good results and produced a really high accuracy which is actually unprecedented. A comparison was made with the existing techniques which were studied as part of the literature survey.

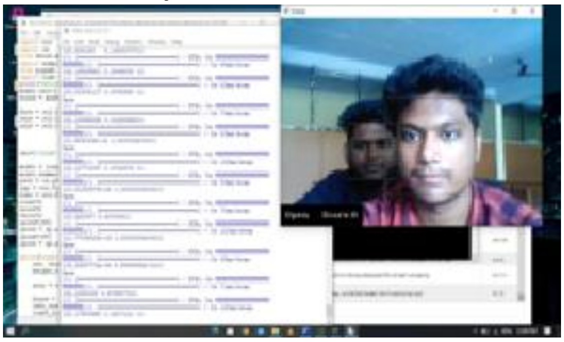

Fig : 7 Output for without drowsiness

This diagram Figure 7 shows the output of the proposed method with eyes open, which means the driver is detected as not being drowsy.

Fig : 8 Output for with drowsiness

This diagram Figure 8 shows the output of the proposed method with eyes closed or semi-closed, which means the driver is detected as being drowsy and that there is high risk of getting into an accident. Alarm should be sounded and the driver should be woke up to avoid any accident and lives can be saved.

The following table Table 1 shows the comparison of the accuracies yielded by the existing techniques and the accuracy of the proposed method.

| Existing Methods | Overall Accuracy |
|---|---|
| Saradevi [2] et al. (2008) | 84.44 |
| Al Zubi [13] et al. (2013) | 86.35 |
| McDonald [8] et al.(2012) | 93.88 |
| Teyeb [4] et al. (2014) | 94.08 |
| Rahim [14] et al. (2015) | 94.23 |
| Mittal [12] et al.(2016) | 95.18 |
| Warwick [15] et al. (2015) | 95.61 |
| Zhenhai [11] et al.(2017) | 96.82 |
| Awais [16] et al. (2017) | 97.95 |
| PROPOSED SCHEME | 98.34 |

Table 1 : Comparison of Existing Methods and the Prodposed Method

From the Table 1 it is very clearly seen that the proposed scheme far surpasses the previous acchievements in terms of the accuracy of the results. The proposed scheme is shown to have yielded an amazin accuracy of 98.34% which is unprecedented up to this time in this area.

VI CONCLUSION

This paper presents a prototype implemented in small scale in reality. It shows implementation under various scenarios like low light, dark and the system seems to give efficient results under these conditions. In future we plan to improve the User Interface which was not of much importance currently. Moreover, we plan to extend the research by analyzing road conditions too with the help of rear camera. With some more improvements the system can be placed in use for general public.

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