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Driver Drowsiness Detection Using Deep Learning

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ABSTRACT: Driver drowsiness is one of the reasons for large number of road accidents these days." Drowsiness describes the state of being drowsy or sleepy. A person experiencing drowsiness may feel tired or sluggish and have difficulty staying awake. Individuals are usually less alert when drowsy and may fall asleep but are able to be roused". Truck drivers, company car drivers and shift workers are the most at risk of falling asleep while driving. So, there is need to develop the system which will detect the eyes continuously and alert the driver if drowsy.CNN classifier is used to classify the driver as sleep or non-sleep. This system alerts driver with an alarm when the driver is in sleepy mood. The proposed work is evaluated on a collected dataset and shows better accuracy with 96.42% when compared with traditional CNN. The limitation of traditional CNN such as pose accuracy in regression is overcome with the proposed Staked Deep CNN.
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I. INTRODUCTION

Humans have always invented machines and devised techniques to ease and protect their lives, for mundane activities like traveling to work, or for more interesting purposes like aircraft travel. With the advancement in technology, modes of transportation kept on advancing and our dependency on it started increasing exponentially. It has greatly affected our lives as we know it. Now, we can travel to places at a pace that even our grandparents wouldn't have thought possible. In modern times, almost everyone in this world uses some sort of transportation every day. Some people are rich enough to have their own vehicles while others use public transportation. However, there are some rules and codes of conduct for those who drive irrespective of their social status. One of them is staying alert and active while driving.

Neglecting our duties towards safer travel has enabled hundreds of thousands of tragedies to get associated with this wonderful invention every year. It may seem like a trivial thing to most folks but following rules and regulations on the road is of utmost importance. While on road, an automobile wields the most power and in irresponsible hands, it can be destructive and sometimes, that carelessness can harm lives even of the people on the road. One kind of carelessness is not admitting when we are too tired to drive. In order to monitor and prevent a destructive outcome from such negligence, many researchers have written research papers on driver drowsiness detection systems. But at times, some of the points and observations made by the system are not accurate enough. Hence, to provide data and another perspective on the problem at hand, in order to improve their implementations and to further optimize the solution, this project has been done.

MOTIVATION:

Every year there are many truck or bus accidents that lead to injury and fatality, very expensive insurance claim and lengthy traffic jam as wreckage is cleared. When the truck accidents happen the driver usually comes to spotlight. Because of the severeness of injuries and other damages trucks accidents produce large claim amounts.

Most of the common faults of these drivers is they fail to check the blind spots, not checking before turning or changing lanes and feeling drowsy or falling asleep accidently.

Sometimes the drivers are speeding, not knowing routes, exhaustion and driving under influence of alcohol or drugs.

Sleep deprived driving is the operation of a motor vehicle while being psychologically weakened due to a lack of sleep. Sleep deprived driving is a major cause of vehicular accidents. When a person does not get the required amount of sleep, their ability to properly function is affected. When their ability to function is affected, they have longer reaction time and their memory and judgement is weakened. Many studies have found that sleep deficiency can affect driving as

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much as alcohol inebriation. About 20% of the people have admitted to falling asleep at the wheel with 40% of the people confessing that this has taken place at least once in their driving careers. Research shows, in India, 40% of highway crashes or near crashes occur due to drowsy driving whereas more than 50% of all deadly highway crashes which involve more than two cars are alcohol related. More than 65% of all deadly single car crashes are related to inebriation. Looking at these statistics, it is imperative that we develop a driver safety system.

II. LITERATURE SERVEY

In 2008, Hong Su et. al. [15] described 'A Partial Least Squares Regression-Based Fusion Model for Predicting the Trend in Drowsiness'. They proposed a new technique of modeling driver drowsiness with multiple eyelid movement features based on an information fusion technique—partial least squares regression (PLSR), with which to cope with the problem of strong collinear relations among eyelid movement features and, thus, predicting the tendency of the drowsiness. The predictive precision and robustness of the model thus established are validated, which show that it provides a novel way of fusing multi-features together for enhancing our capability of detecting and predicting the state of drowsiness.

In 2013, G. Kong et. al. [19] described 'Visual Analysis of Eye State and Head Pose for Driver Alertness Monitoring'. They presented visual analysis of eye state and head pose (HP) for continuous monitoring of alertness of a vehicle driver. Most existing approaches to visual detection of non-alert driving patterns rely either on eye closure or head nodding angles to determine the driver drowsiness or distraction level. The proposed scheme uses visual features such as eye index (EI), pupil activity (PA), and HP to extract critical information on non-alertness of a vehicle driver. A support vector machine (SVM) classifies a sequence of video segments into alert or non-alert driving events. Experimental results show that the proposed scheme offers high classification accuracy with acceptably low errors and false alarms for people of various ethnicity and gender in real road driving conditions.

In August 2014, García et. al. [21] described 'Driver Monitoring Based on Low-Cost 3-D Sensors'. They proposed a solution for driver monitoring and event detection based on 3-D information from a range camera is presented. The system combines 2-D and 3-D techniques to provide head pose estimation and regions-of-interest identification. Based on the captured cloud of 3-D points from the sensor and analyzing the 2-D projection, the points corresponding to the head are determined and extracted for further analysis. Later, head pose estimation with three degrees of freedom (Euler angles) is estimated based on the iterative closest points algorithm. Finally, relevant regions of the face are identified and used for further analysis, e.g., event detection and behavior analysis. The resulting application is a 3-D driver monitoring system based on low-cost sensors. It represents an interesting tool for human factor research studies, allowing automatic study of specific factors and the detection of special event related to the driver, e.g., driver drowsiness, inattention, or head pose.

In January 2017, Gao Zhenhai, Le DinhDat, Hu Hongyu, Yu Ziwen, Wu Xinyu described Driver Drowsiness Detection Based on Time Series Analysis of Steering Wheel. They proposed this solution for detection of the drowsiness of the driver. But there were some limitations to it which are as follows They can function reliably only at particular environments and are too dependent on the geometric characteristics of the road.

In April 2018, Fouzia, Roopalakshmi R, Jayantkumar a Rathod, Ashwitha S, Supriya K, proposed the Driver Drowsiness Detection System Based on Visual Features. They did this driver detection method though it had some limitations like there are still problems with bad light conditions and for persons wearing glasses.

In February 2019, Kyong Hee Lee, Whui Kim, Hyun Kyun Choi, Byung Tae Jan proposed a study on Feature Extraction Methods used to Estimate a Driver's Level of Drowsiness this method was accurate and gave correct results of the driver's drowsiness. Then again there were some limitations.

ANALYSIS MODEL

- SDLC model applied in our system is Waterfall Model.
- Waterfall model is very simple to understand and use. In a waterfall model, each phase must be completed before the next phase can begin and there is no overlapping in the phases.
- The Waterfall model is the earliest SDLC approach that was used for software development.

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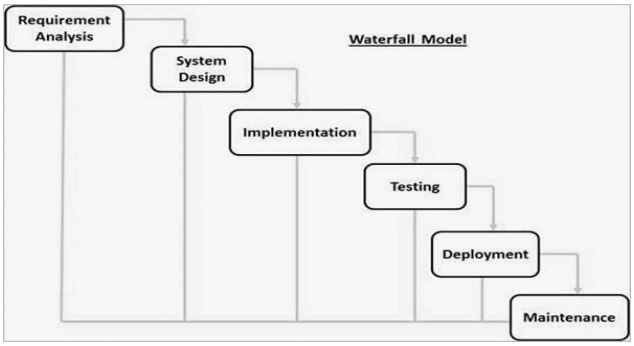
- The waterfall Model illustrates the software development process in a linear sequential flow. This means that any phase in the development process begins only if the previous phase is complete. In this waterfall model, the phases do not overlap.

Waterfall Model – Design

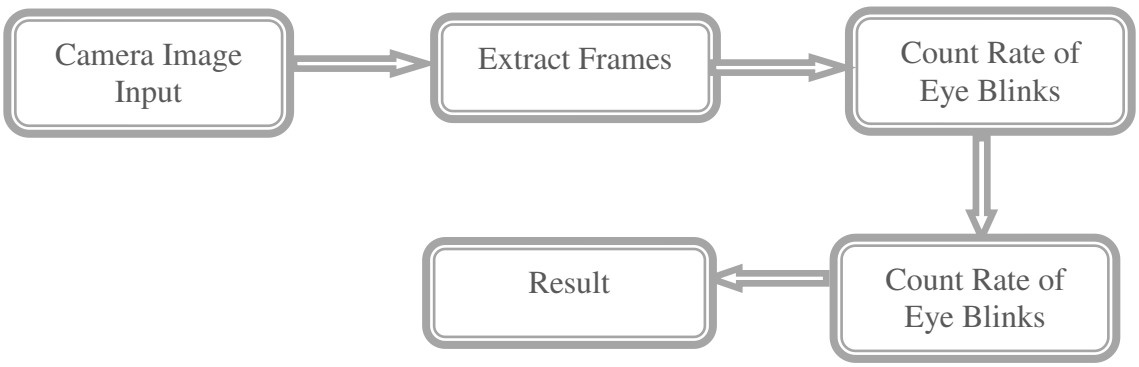
Waterfall approach was first SDLC Model to be used widely in Software Engineering to ensure success of the project. In "The Waterfall" approach, the whole process of software development is divided into separate phases. In this Waterfall model, typically, the outcome of one phase acts as the input for the next phase sequentially.



III. SYSTEM DESIGN

SYSTEM ARCHITECTURE

Model framewor



In above block diagram we are going to get the input from the user through the images taken by the camera and using some machine learning algorithm it is checked whether the driver is sleepy of drowsy and then we will get actual result that is alert is sent.

UML DIAGRAM

DATA FLOW DIAGRAM
Functional model and description:
Functional Modeling gives the process perspective of the object-oriented analysis model and an overview of what the system is supposed to do. It defines the function oftheinternalprocessesinthesystemwiththeaidofDataFlowDiagrams(DFDs).

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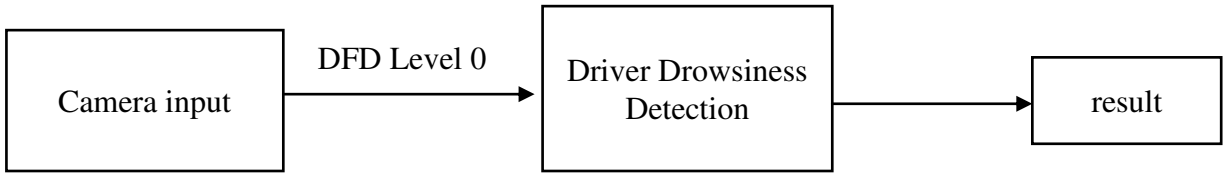

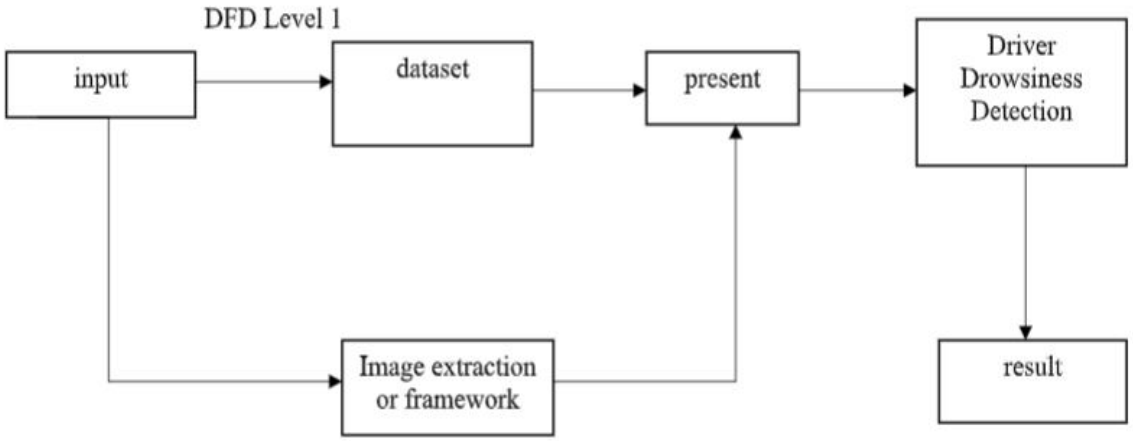

IV. PROJECT IMPLEMENTATIONS

TOOLS AND TECHNOLOGIES USED

Tools: -

- Trained model
- Display device

Technologies: -

- CNN
- OpenCV
- Keras
- Python
- HTML
- PyCharm

ALGORITHM DETAILS

ALGORITHM USED:
1)CNN
2)HAAR Cascade

1)CNN
Convolutional Neural Network, also known as convnets or CNN, is a well-known method in computer vision applications. It is a class of deep neural networks that are used to analyze visual imagery. This type of architecture is dominant to recognize objects from a picture or video. It is used in applications like image or video recognition, neural language processing, etc.
A convolutional neural network for image classification is not very difficult to understand. An input image is processed during the convolution phase and later attributed a label.

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A typical convnet architecture can be summarized in the picture below. First of all, an image is pushed to the network; this is called the input image. Then, the input image goes through an infinite number of steps; this is the convolutional part of the network. Finally, the neural network can predict the digit on the image.

An image is composed of an array of pixels with height and width. A grayscale image has only one channel while the color image has three channels (each one for Red, Green, and Blue). A channel is stacked over each other. In this tutorial, you will use a grayscale image with only one channel. Each pixel has a value from 0 to 255 to reflect the intensity of the color. For instance, a pixel equals to 0 will show a white color while pixel with a value close to 255 will be darker.

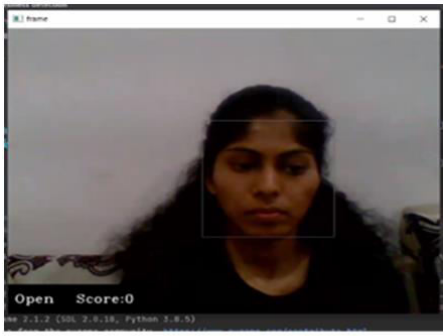
The picture below shows how to represent the picture of the left in a matrix format. Note that, the original matrix has been standardized to be between 0 and 1. For darker color, the value in the matrix is about 0.9 while white pixels have a value of 0.

TESTING:

Test case ID	Test case objective	Test Case description	Expected output
1	Create dataset of images of driver.	Make the dataset of the images of driver.	Created dataset of the images of driver.
2	Maintain data of the eyes closed.	Maintain data of the seconds of the eyes closed.	Checked data of the seconds of the eyes closed.
3	Apply machine learning for predictions.	To perform operation, apply machine learning.	Analyzing of the eyes of driver is done.
4	Design web app for user interface	Develop web App.	Web app for easy user access.

V. RESULTS

Considering statistics from Maharashtra Highway Police reports 2,754 fatal accidents between 2019 to June 2021 on four national highways in which 3,012 people lost their lives. Drivers who face sleep deprivation are at a higher risk of causing accidents. So, technology for driver drowsiness detection system is required to reduce road accidents. Machine learning is among the best-known techniques for such forecasting. Machine learning is a data analytics technique that provides machine the potential to learn without being comprehensively programmed. Unlike the traditional methods of driver's drowsiness detection that were not suitable for historical unstructured and semi structured data, machine learning takes into account or has the capabilities for analyzing such data.



Driver's eyes detection when eyes open

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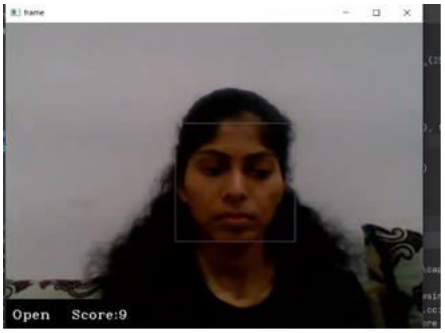
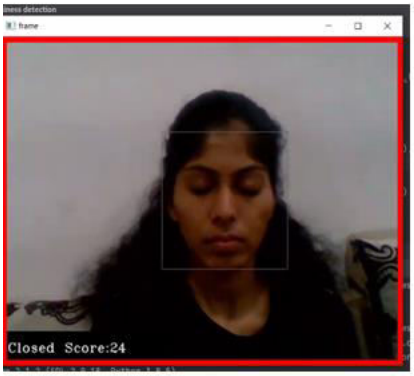


Driver's eye detection when eyes closed for about 9 seconds of time



Driver's eye Detection when eyes closed for more than 15 seconds

VI. CONCLUSIONS

The drowsiness detection system is capable of detecting drowsiness in quickly. The system which can differentiate normal eye blink and drowsiness can prevent the driver from entering the state of sleepiness while driving. The system works well irrespective of driver wearing spectacles and under low light conditions also. During the monitoring, the system is able to decide if the eyes are closed or opened. When the eyes have been closed for too long a warning signal is issued. The ultimate goal of the system is to check the drowsiness condition of the driver. Based on the eye movements of the driver, the drowsiness is detected and according to eye blink, the alarm will be generated to alert the driver and to reduce the speed of the vehicle along with the indication of parking light. By doing this, many accidents will be reduced and provides safety to the driver and vehicle. A system that is driver safety and car security is presented only in luxurious costly cars. Using eye detection, driver security and safety can be implemented din normal car also.

VII. FUTURE WORK

The System can be implemented in embedded processors such as raspberry PI. The System can be further extended to control the breaks or lower the speed of the vehicle as the alarm beeps.

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