Drowsy Driver Detection using Representation Learning and Efficient Alarming System

Sarika Jadhav, Rutuja Ghangale, Nisha Mundhe, Prof. Bhosale S. B

Abstract— The advancement of computing technology over the years has provided assistance to drivers mainly in the form of intelligent vehicle systems. Driver fatigue is a significant factor in a large number of vehicle accidents. Thus, driver drowsiness detection has been considered a major potential area so as to prevent a huge number of sleep induced road accidents. The main aim of the project is to develop Drowsy Driver Detection System that allows for warning the driver of drowsiness or in attention to prevent traffic accidents. We propose a vision based intelligent algorithm to detect driver drowsiness. Previous approaches are generally based on blink rate, eye closure, yawning, eye brow shape and other hand engineered facial features. Our system proposes an algorithm for driver drowsiness detection using representation learning. A new perspective towards driver sleep detection is presented as features responsible for decision making are produced by leveraging multi-layer convolutional neural networks. The proposed algorithm makes use of features learnt using convolutional neural network so as to explicitly capture various latent facial features and the complex non-linear feature interactions. A softmax layer is used to classify the driver as drowsy or non-drowsy. This system is hence used for warning the driver of drowsiness or in attention to prevent traffic accidents. We present both qualitative and quantitative results to substantiate the claims made in the system.

Index Terms— Eye Segmentation, Drowsiness Detection, Representation Learning, Facial Features.

I. INTRODUCTION

Nowadays, there are many artificial intelligence development performed to help the safety of human life. One of them is drowsiness detection system. Driver fatigue is a huge traffic safety problem and is widely believed to be one of the largest contributors to fatalities and severe injuries in traffic today, either as a direct cause of falling asleep at the wheel or as a contributing factor in lowering the attention and reaction time of a driver in critical situations .

There has been a very large increase in road accident due to drowsiness of driver while driving which leads to enormous fatal accidents. The driver lose his control when he falls sleep which leads to accident .This is because when the driver is not able to control his vehicle at very high speed on the road. Accidents with commercial heavy vehicles are not only dangerous but also very costly and the counteraction of driver fatigue is highly important for improvement of road safety. Drowsiness is something that happened frequently. We can feel sleepy either when we do an activity or not. However, we must pay attention for that. Feeling sleepy when we are in certain condition can be dangerous and can bring great suffer to many people, for example when we are driving. A lot of factors can cause people to feel sleepy such as lack of rest, driving a car at night, long distance driving, or there is no partner who can accompany the driver which lead him/her to become bored and sleepy. The general solution for this problem is to ask someone to accompany us while driving to prevent drowsiness. However this solution can't be done every day because sometimes the driver must drive alone. Many research about drowsiness detection system have utilized artificial intelligence, but they were not implemented on mobile devices. Therefore, we propose a framework and software to measure fatigue and to detect drowsiness of the driver using low cost Android mobile devices. The software that we made is designed to give a driver the information of fatigue and give him/her a warning so it can prevent incidents like traffic accidents. The software is based on Android application in order to be implemented in real condition, so we can reach the purpose of this research. Finally, a warning strategy in terms of vibrations in the steering wheel has been investigated and evaluated in a driving simulator experiment.

II. OBJECTIVES

1. Attention to prevent traffic accidents.
2. A driver detection system for supporting and warning the driver when becoming drowsy.
3. Provide security for safe driving on road.

III. LITERATURE REVIEW

There are some significant previous studies about drowsiness detection and fatigue monitoring. Many computer vision based schemes have been developed for non-intrusive, real-time detection of driver sleep states with the help of various visual cues and observed facial features. An observed pattern of movement of eyes, head and changes in facial expressions are known to reflect the person's fatigue and vigilance levels[3]. Eye closure, head movement, jaw drop, eyebrow shape and eyelid movement are examples of some features typical of high fatigue and drowsy state of a person. To make use of these visual cues, a remote camera is usually mounted on the dashboard of the vehicle which, with the help of various extracted facial features, analyses driver's physical

conditions and classifies the current state as drowsy/non drowsy[5]. It has been concluded that computer vision techniques are non-intrusive, practically acceptable and hence are most promising for determining the driver's physical conditions and monitoring driver fatigue. Possible techniques for detecting drowsiness in drivers can be generally divided into the following categories: sensing of physiological characteristics, sensing of driver operation, sensing of vehicle response, monitoring the response of driver.

A. Monitoring Physiological Characteristics

Among these methods, the techniques that are best, based on accuracy are the ones based on human physiological phenomena. This technique is implemented in two ways: measuring changes in physiological signals, such as brain waves, heart rate, and eye blinking; and measuring physical changes such as sagging posture, leaning of the driver's head and the open/closed states of the eyes. The first technique, while most accurate, is not realistic, since sensing electrodes would have to be attached directly onto the driver's body, and hence be annoying and distracting to the driver[8]. In addition, long time driving would result in perspiration on the sensors, diminishing their ability to monitor accurately. The second technique is well suited for real world driving conditions since it can be non-intrusive by using optical sensors of video cameras to detect changes[9].

B. Other Methods

Driver operation and vehicle behavior can be implemented by monitoring the steering wheel movement, accelerator or brake patterns, vehicle speed, lateral acceleration, and lateral displacement. These too are non-intrusive ways of detecting drowsiness, but are limited to vehicle type and driver conditions. The final technique for detecting drowsiness is by monitoring the response of the driver[7]. This involves periodically requesting the driver to send a response to the system to indicate alertness. The problem with this technique is that it will eventually become tiresome and annoying to the driver.

IV. Problem Statement

The main aim of the project is to develop Drowsy Driver Detection System that allows for warning the driver of drowsiness or in attention to prevent traffic accidents. We define driver eye segmentation technique for detecting drowsiness of driver. We propose a face detection algorithm to detect driver drowsiness using representation learning. If the detection of drowsiness is positive alarm is generated that is warning feedback system is triggered for driver.

V. Proposed Work

The primary purpose of the Drowsy Driver Detector is to develop a system that can reduce the number of accidents from sleep driving of vehicle. With our two monitoring steps, we can provide a more accurate detection. For the detecting stage, the eye blink sensor always monitor the eye blink moment. It continuously monitor eye blink. If the monitoring is over, the collected data will be transmitted to a database and face detection algorithm is used to make a proper result and if the detection of drowsy is positive alarm is generated that is warning feedback system is triggered for driver

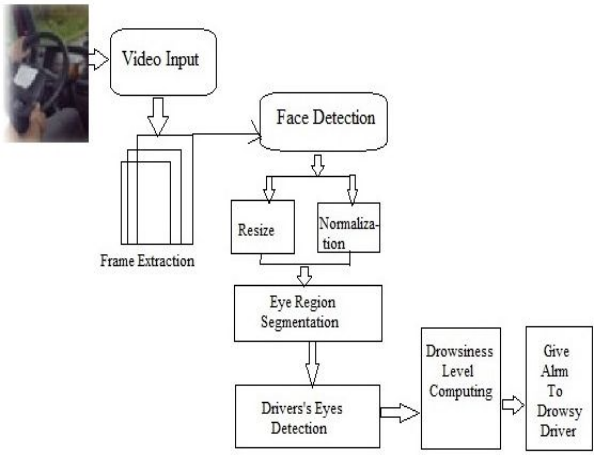

Fig 1. System Architecture

The proposed method aims to classify frames in videos based on special facial features learnt via convolutional neural network. Firstly, frames are extracted from the video. These frames are fed to a features based face detectors. The detected faces are cropped and resized to 48* 48 square images. These cropped images are normalized by subtracting each pixel by the mean followed by division with its standard deviation. Normalized images of 80 percent subjects are further fed to a multi-layer convolutional neural network. The outputs of the hidden layer are considered as extracted features. On the basis of these features, the softmax layer classifier was trained, the rest twenty percent of the images extracted earlier are tested on the trained classifier.

VI. Algorithm Implementation

A. Real Time System:

The real-time system includes a few more functions when monitoring the driver, in order to make the system more robust. There is an initialization stage, in which the for the first 4 frames, the driver's eyes are assumed to be open, and the distance between the y coordinates of where the intensity changes occur, is set as a reference[8]. After the initialization stage, the distances calculated are compared with the one found in the initialization stage. If the lower distance is found (difference between 5-80 pixels), then the eye is determined as being closed.

Dividing into frames: This module is used to take live video as its inputand convert it into a series of frames/ images, which are then processed.

Face detection: The face detection function takes one frame at a time from the frames provided by the frame grabber, and in each and every frame it tries to detect the face of the automobile driver. This is achieved by making use of a set of pre-defined Haarcascade samples.

Eyes detection: Once the face detection function has detected the face of the automobile driver, the eyes detection function tries to detect the automobile driver's eyes. This is achieved by making use of a set of pre-defined Haarcascade samples.

Drowsiness detection: After detecting the eyes of the automobile driver , the drowsiness detection function detects if the automobile driveris drowsy or not , by taking into consideration the state of the eyes , that is , open or closed and the blink rate.

Algorithm Implementation Steps:

Step1. Start
Step2. Image Capture
Step3. Face Detection
Step4. Feature Extraction
Step5. Eye Detection
Step6. Eye state
Step7. Drowsiness detect
then warning msg. (sound)
Step8. Else
Step9. Go to step

VII. DEVELOPMENT ENVIRONMENT

The proposed system requires Eclipse that is an open source software development environment. Eclipse consists of an Extensible plugin system and an IDE. The Android project has been developed in the Helios version of Eclipse, as it has plugins that are mainly used for Android.

A. Android SDK

Integrated Development Environment (IDE) is used in Android development in order to make it more straight forward and quick. It has been recommended for the developers because of its simplicity in working. Android is basically a multitasking platform. To give an example, the application has one application for navigation, another application for games, and another messaging. These applications can work simultaneously because of this multitasking ability of the Android platform.

B. ADT Plugin

ADT (Android Development Tools) is a plugin developed by Google. Its main purpose is for developing Android mobile applications in Eclipse. It makes it easy and convenient for all the Android developers working in Eclipse environment to quickly create Android projects and debug the programs whenever needed. Text editor should not be used in the development of large applications having a large amount of code as the text editor cannot highlight wrong spellings.

C. Android Emulator

Android emulator is a virtual mobile device which is included in every Android SDK which runs on the users computer. Android emulators are used to test Android applications, so there is no need of any physical device.

Android emulator supports Android Virtual Device (AVD) configuration, which in itself is an emulator containing specific Smartphone Operating System. Using AVD, one can easily test his applications. Any application running on an emulator can use the services provided by the Android platform like play audio, store or retrieve data etc. But with these features comes a few limitations. Neither does it support Bluetooth, nor does it support SMS/MMS communication

VIII. SOME PHASES

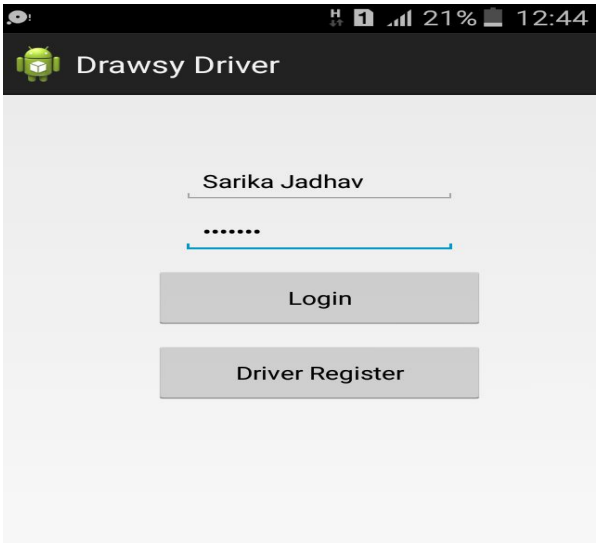

Fig 2. Login Page

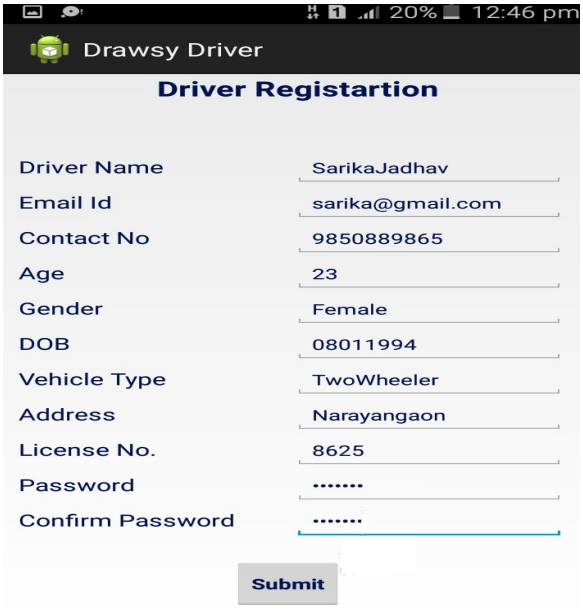

Fig 3. Registration Page

IX. CONCLUSION

The analysis and design of driver drowsiness detection and alert system is presented. The proposed system is used to avoid various road accidents caused by drowsy driving. And also this system used for security purpose of a driver to

caution the driver if any fire accident. This system involves avoiding accident to unconsciousness through camera by checking eye blink. Here one eye blink sensor is fixed in vehicle where if driver lose his consciousness, then it alerts the driver through buzzer to prevent vehicle from accident. A complete study on road safety is going to be the next boom for the automobile industry for it to flourish and survive every human from the risk.

X. FUTURE SCOPE

Currently there is not adjustment in zoom or direction of the camera during operation. Future work may be to automatically zoom in on the eyes once they are localized. This would avoid the trade-off between having a wide field of view in order to locate the eyes, and a narrow view in order to detect fatigue. This system only looks at the number of consecutive frames where the eyes are closed. At that point it may be too late to issue the warning. By studying eye movement patterns, it is possible to find a method to generate the warning sooner. Using 3D images is another possibility in finding the eyes. The eyes are the deepest part of a 3D image, and this maybe a more robust way of localizing the eyes. Adaptive banalization is an addition that can help make the system more robust. This may also eliminate the need for the noise removal function, cutting down the computations needed to find the eyes. This will also allow adaptability to changes in ambient light.

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