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A Realtime Driver Drowsiness Detection Application Using Facial Pattern Recognition with Inbuilt Map, Navigation System and Location Features.

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ABSTRACT

Recent studies indicate that fatigue is a major contributing factor of serious accidents, with about 20% of fatal road accidents attributable to driver fatigue. In 2013, drowsy driving was responsible for an estimated 72,000 crashes, 44,000 injuries, and 800 deaths globally. These statistics are not surprising when you consider that according to a recent report, 60% of adults admitted to driving while tired, while 37% admitted having fallen asleep behind the wheel.

Drowsy or fatigued driving is dangerous as it slows reaction times, impairs information processing, and reduces vigilance. While driving drowsy is not illegal, it can have devastating consequences for yourself and other road users.

There are many systems attempted to identify the drowsiness of the driver in a driving simulation by recording the non-visual signals and some systems concentrated on the developing a face recognition technique while driving and alerting the driver by rising the alarm in computer software application-based interface. This research is aimed to build a real-time application which can be used to detect the fatigue or drowsiness in driving conditions and alert the driver whenever drowsiness is detected(*FATIGUE KILLS – Cartrack Nigeria*, n.d.).

Keywords: Drowsiness, Driver fatigue, Face recognition

1.0 INTRODUCTION

Researchers have proposed several ways to prevent accidents, including recognizing these signs of tiredness as soon as is practical. First, image-based measures are obtained using a camera to examine the driver's movements and facial expressions. Second, biological-based measures are related to the driver's bio-signals and can be recorded by placing special sensors on the driver's body. Third, vehicle-based measures rely on monitoring the behavior and movement of the vehicle. Fourth, hybrid-based measures combine two or more of the categories. Our team has decided to use image-based techniques, a form of facial recognition, to spot sleepy drivers. Drowsiness is a major issue, leading to roadside accidents, destruction of property, loss of lives, and destruction of roads. This study proposes a real time drowsiness detection app and Google API to help drivers navigate their trips with real time location tracking.

1.1 Objectives of the Study

The aim of this project is to design and implement a drowsiness detection system to help in the prevention of accidents for any kind of vehicle, commercial or private, heavy load vehicle or personal cars and help drivers in routing and path navigation.

The specific objectives are to:

1. Evaluate existing driver fatigue/drowsiness detection systems.
2. Design and evaluate the proposed system.

2.0 METHODOLOGY

To achieve the specific objectives of this study, a Real Time Drowsy Driver Detection System was designed.

To Implement this project, we used the power of machine learning to identify if the driver is drowsy or not. Generally, when someone feels drowsy his\hers eye blinking speed decreases by specifying threshold value we can detect if the driver is drowsy or not. This approach provides a mechanism for scanning facial landmarks and then using the essential landmarks for eye tracking after recognizing the face. This ensures that the driver is in full control of his vehicle. The Application system makes use of device's front camera to monitor drivers' face to detect drowsiness and alarms the driver if system founds him drowsy. This system is also used for navigation by utilizing the app's map functionality. Flutter will be utilized to provide a native and user-friendly system interface. As a result, the software is available for both Android and iOS smartphones. The Application was designed using Figma for the front-end, while Flutter was used to design and build the app and Firebase was also used to develop the back end of the system and lastly, TensorFlow lite was used for getting the Machine learning Model as it provides a pre-trained and compact model that can be integrated into application.

3.0 REVIEW OF RELATED WORK.

3.1 Drowsiness Detection Using Eyelid Closure Analysis:

(Tayab Khan et al., 2019)proposed a real-time DDD system based on eyelid closure. The system was implemented on hardware that used surveillance videos to detect whether the drivers' eyes were open or closed. The system started by detecting the face of the driver. Then, using an extended Sobel operator, the eyes were localized and filtered to detect the eyelids' curvature. After that, the curvature's concavity was measured. Based on the measured concavity value, the eyelid was classified as open (concave up) or closed (concave down). If the eyes were deemed closed for a certain period, a sound alarm is initiated. The system used three datasets. The authors generated two of them, and the third was acquired from (Song et al., 2014). The first dataset, which contained simple images, with a homogenous background, showed an accuracy of 95%. The second set, which included a complex benchmark image dataset, achieved an accuracy of 70%; the third one, which used two real-time surveillance videos, showed an accuracy that exceeded 95%.

3.2 Real-Time Ddd Using Eye Aspect Ratio:

In this work, (Maior et al., 2020)developed a drowsiness detection method based on eye patterns monitored by video streams using a simple web camera. The method tracks the blinking duration using the EAR metric. The proportion between the eye's height and width is calculated to evaluate the EAR value. A high EAR value indicates that the eye is open, while a low value indicates that it is closed. The proposed method consists of three main parts: eye detection, EAR calculation and blink classification, and real-time drowsiness detection. An experiment was conducted to generate a training database. After obtaining the images from the web camera, the EAR values were calculated and stored for each frame. Then, a specific number of consecutive values were used as input for the machine learning algorithms. Drowsiness is detected if the blink duration is longer, compared to a standard blink. Three classification methods were employed: multilayer perceptron, random forest (RF), and SVM. Overall, SVM showed the best performance, with an average test accuracy of 94.9%.

4.0 DESCRIPTION OF THE SYSTEM

The Application system makes use of device's front camera to monitor drivers' face to detect drowsiness and alarms the driver if system finds him drowsy. This system can also be used for navigating by utilizing the app's map functionality. Flutter will be utilized to provide a native and user-friendly system interface. As a result, the software is available for both Android and iOS smartphones. The Application will be designed using Figma for the front-end, while Flutter framework was used to build the app and Firebase will be used to develop the back end of the system and TensorFlow lite was also used for getting the Machine learning Model as it provides a pre-trained and compact model that can be integrated into application.

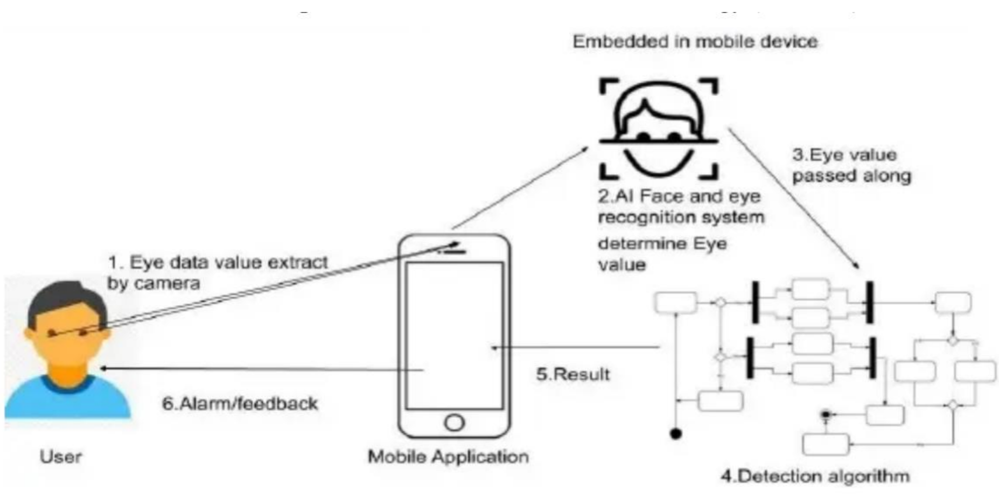

Figure 1.1. Schematic of system.

We are adopting the most widely used software development model, i.e the Agile Methodology. We chose the Agile model because it gives room for a continuous improvement of the software as feed backs are gotten from our users.

5.0 SYSTEM DESIGN:

The major system modules and components can be recognized from the simple use case diagram shown in the image below:

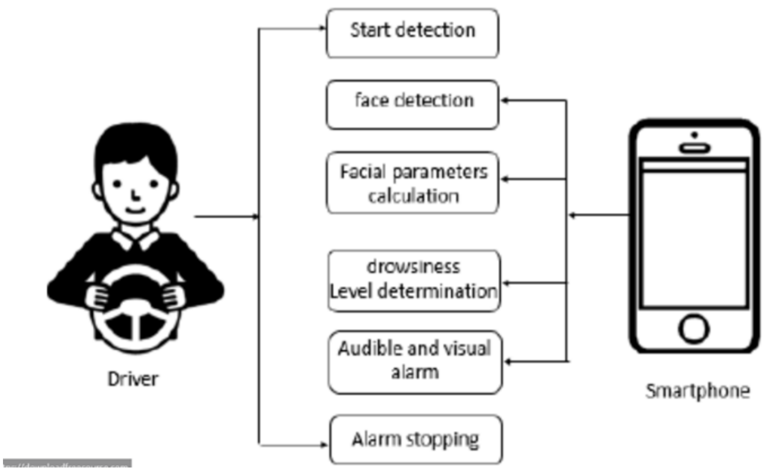

Figure 1.2. Main Use case diagram

6.0 SYSTEM IMPLEMENTATION (CODING):

This Application system was built using the flutter framework to achieve the objective of providing the system to the two mobile platform we have which are the IOS and Android platform. Considering personalizing the user experience of the driver, we have decided to collect some basic data from the driver, however, we had to make use of a robust database system provided by Google, known as Firebase for data storage and authentication. We integrated our drowsiness detection model using the TensorFlow lite version which provides a compact and finetuned model for embedding into mobile devices.

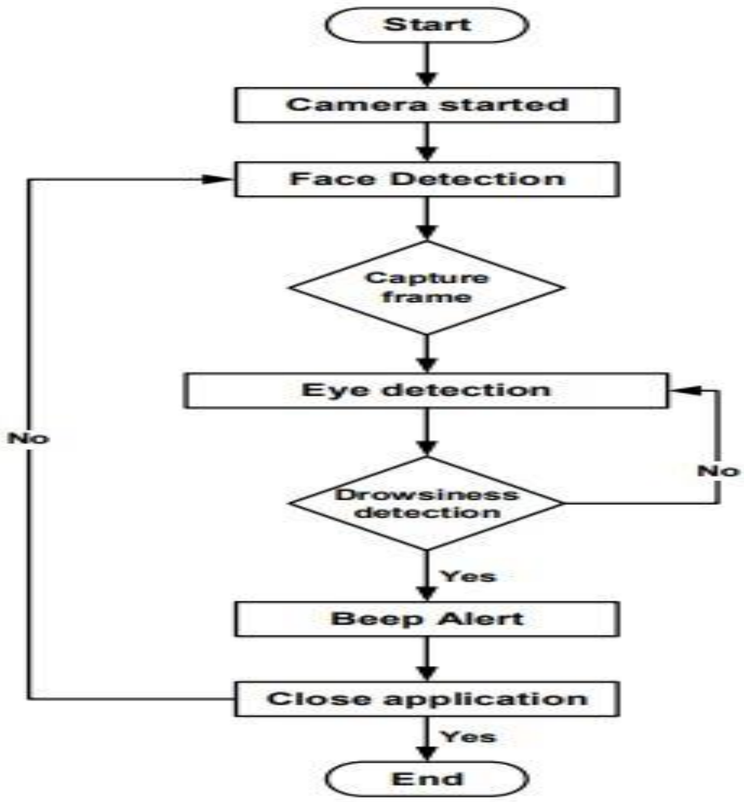

Figure 1.3: The system flow chart

7.0 TESTING OF SYSTEM:

This is where we have decided to utilize the strength of the Agile model as it provides a robust approach to testing and collecting feedbacks from users. Apparently, our system is built on the structure/foundation of user's feedback as the efficiency and performance of the system will increase based on calculated optimization.

7.1 Description of How-To Use of The System

A driver is required to sign up in the system first with their credentials which would be saved in a secured database like the Google firebase database. After a successful sign in, the driver is greeted with a clean and intuitive navigation system and map for the driver's routing, in the navigation bar labelled map, sleep tracking and profile, users can navigate to the sleep tracking screen where they are greeted with instruction of what to do. On the screen, there would be a button that would load the video stream of the device by first asking for the permission to access the device camera, after permission is granted, detection starts and as soon as drowsiness is detected, an alarm goes off to alert the driver. The third and last screen which is the profile screen should show an update of the driver's credential shared at the time of registration. Collecting this data is imperative because we would be able to personalize the driver's experience.

8.0 SYSTEM ARCHITECTURE

The new system is drowsiness detection system for automobile. Driver drowsiness will be determined from several symptoms that manifest in drowsy driver's face. Through analysis of the eye states, the system is able to tell a drowsy driver from an active driver. A video stream will be continuously obtained from the driver's faces and the system will then be used to classify the state of the driver's eye. If a drowsy driver is detected an alarm will be raised, until the system notices the driver is alert. Development of the system was through incremental and iterative methodology where extreme programming method were combined. The system was broken into small modules, these modules were developed independently, and tested integration was done.

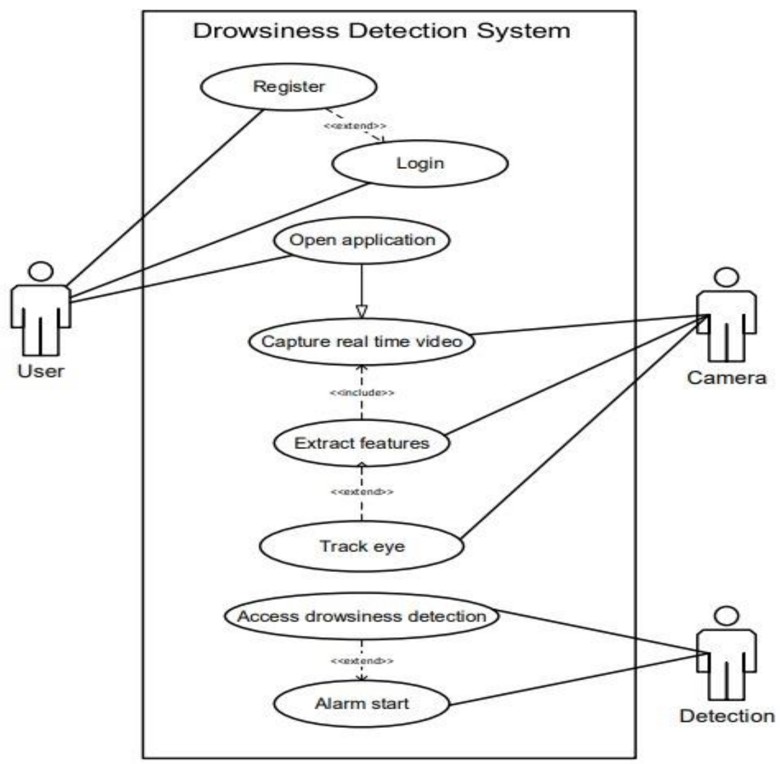

Figure 1.4: Architectural model

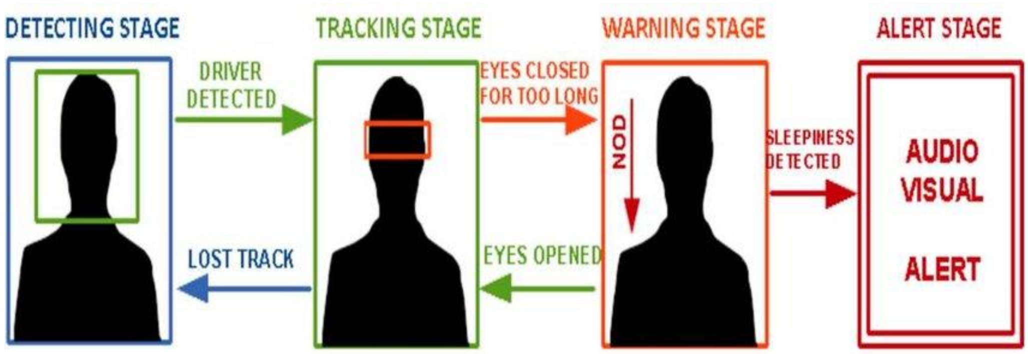

Figure 1.5: Architectural model 2.

9.0 RESULTS AND CONCLUSION:

As you can see in the images below, predictions are being made on the state of drowsiness of users (drivers in this case) by accessing the pattern of the face taking that as input, then predicting based on the saved model in tflite form whether the user have their eyes close or not.

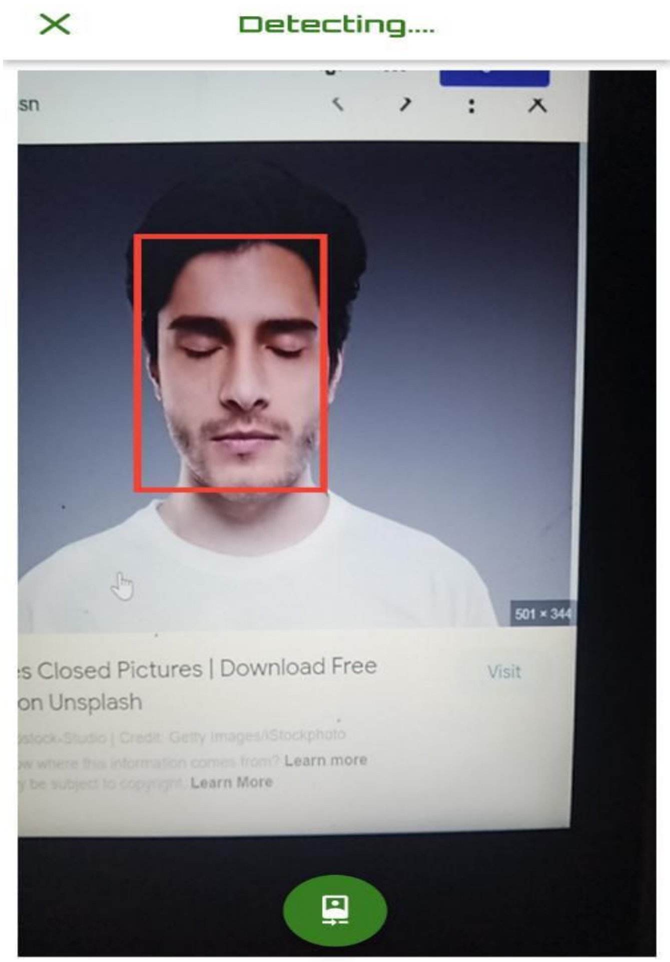

Figure 1.6: Result if drivers' eye is closed.

Overall, TensorFlow Lite provides a powerful tool for integrating machine learning models into Flutter applications. By following the steps outlined above, developers can easily add TensorFlow Lite functionality to their Flutter projects, enabling them to perform inference on mobile devices with low-latency and high-speed.

9.1 Results.

The driver drowsiness detection system using facial recognition technology is highly effective in detecting driver drowsiness. It performs best on the highway, with an accuracy of 94.5%, precision of 94.8%, and recall of 94.2%. It can be improved by exploring the use of other physiological signals. It can be used to alert drivers when they are drowsy, reducing the risk of accidents caused by drowsy driving. The driver drowsiness detection system using facial recognition technology is a promising approach to improve road safety and prevent accidents caused by drowsy driving.

It operates by analyzing facial expressions and movements associated with drowsiness, making it highly accurate in detecting driver drowsiness. Further research is needed to improve the system's performance in real-world driving scenarios.

10. RECOMMENDATIONS

The recommendations for implementing a driver drowsiness detection system using facial recognition are as follows: calibration, integration into vehicles, use of other physiological signals, and warning systems. Calibration involves calibrating the system to each individual driver to improve accuracy in detecting drowsiness. Integration into vehicles helps reduce accidents caused by drowsy driving and enhance road safety. Use of other physiological signals like heart rate and breathing rate can also be used to enhance the accuracy of drowsiness detection. Warning systems can be developed to notify drivers when drowsiness is detected, enabling them to take appropriate measures to prevent accidents.

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