International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 8 Issue 12 ǁ 2020 ǁ PP. 49-54

Computer Vision Based Driving Alert System on a Smart Phone

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Abstract
Drowsy driving takes thousands of lives; we could prevent these accidents using computer vision, and small & low-cost hardware system.In this paper we will go through a system which helps us to detect driver drowsiness while driving and alert the driver, speed control for parents and transporters, GPS tracking for locating driver/ children, home direction if child/driver forgot the direction of home, tips help the driver with safe driving tips and control vehicle, this system could prevent road accidents due to drowsy driving, at the end of this paper, discussed drowsiness detection system using computer visionSmart Phone.

Keywords: *Driving alert, Computer Vision, drowsiness, detection, cost-effective, Haar Cascade, OpenCV for Android SDK, Anti drowsy driving system, Android studio, and Smartphone.*

Abbreviations:CRRI, Central Road Research Institute;IDE, integrated development environment; OpenCV, open source computer vision library; CPU, central processing unit; SDK, software development kit; LBP, local binary pattern; API, application program interface; APK, android package.

Date of Submission: 01-12-2020 Date of acceptance: 15-12-2020

I. INTRODUCTION

Computer vision is an interdisciplinary scientific field that deals with how computers can be made to gain high-level understanding from digital images or videos. From the perspective of engineering, it seeks to automate tasks that the human visual system can do [1].

With the help of computer vision techniques, lots of things can happen.Humans use eyes for visualizing things around, capture image and process the image, pick their mean elements (Faces, ways, buildings etc.) and take action.As human vision computer, mobile phones or any electronic device can be more potential than visionless.Machines are more useful than ever and also it could be live saving. Drowsy driving takes thousands of life, we could prevent this accidents using computer vision, and small & low cost hardware system. Driving alert using computer vision, while computer vision most trending technology still have scope of computer vision for human safety where we could save many lives.

Exhausted drivers who doze off at the wheel are responsible for about 40% of road accidents, says a study by the Central Road Research Institute (CRRI) on the 300-km Agra-Lucknow Expressway [2].

In this paper, we will go through a system which helps us to detect driver's drowsiness while driving and alert the driver. This system could prevent road accidents due to drowsy driving, at the end of this paper, discussed drowsiness detection system using computer vision Smart Phone

II. RELATED WORK

Mohamed Fazeen et al [3] presented a safe driving using mobile phone. They used the 3-axis accelerometer of an Android – based smart phones to record and analyse different driver behaviour and external road conditions that can be hazardous to the health of driver, the neighbouring public and the automobiles.

P.Gopi Krishna et al [4] proposed the use of smart phone with embedded hardware to evaluate a vehicle's condition such as gear shifts and overall road conditions such as bumps, potholes, rough road, uneven road and smooth road.

Anu K L et al [5] presented a new technology for detecting driver drowsiness caused mainly due to intoxication, to prevent rear end collisions. their work was done using :a) Raspberry Pi- an ARM11 controller based small size open CPU with 512MB and supports 700MB processing speed. b) Python-IDLE programming software and c) OpenCV Linux version installed to Raspberry Pi.

III. MATERIALS AND METHODS

- Android Studio
- OpenCV Android SDK
- Haar Cascade
- Android SmartPhone

Android Studio

Android Studio is an Integrated Development Environment (IDE) for developing Android app. It is based on IntelliJ IDEA . It enhances productivity when building Android apps by offering features such as:

- Flexible Gradle-based build system
- Fast and feature-rich emulator
- A unified environment where you can develop for all Android devices
- Apply Changes to push code and resource changes to your running app without restarting your app
- Code templates and GitHub integration to help you build common app features and import sample code
- Extensive testing tools and frameworks
- C++ and NDK support

and much more features. Android Studio is a platform, where you can build fully developed advanced applications with current features. Android always get upgraded with the latest technologies with very frequently new versions.

OpenCV Android SDK

Computer Vision, often abbreviated as CV, is defined as a field of study that seeks to develop techniques to help computers "see" and understand the content of digital images such as photographs and videos [6].

OpenCVStands for Open Source Computer Vision Library. It is an open source computer vision and machine learning software library. Basically, it was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products.The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms.

OpenCV4Android SDK package enables development of Android applications with use of OpenCV library.

- **sdk** folder contains OpenCV API and libraries for Android:
- **sdk/java** folder contains an Android library Eclipse project providing OpenCV Java API that can be imported into developer's workspace;
- **sdk/native** folder contains OpenCV C++ headers (for JNI code) and native Android libraries (*.so and *.a) for ARM-v5, ARM-v7a and x86 architectures;
- **sdk/etc** folder contains Haar and LBP cascades distributed with OpenCV.
- **apk** folder contains Android packages that should be installed on the target Android device to enable OpenCV library access via OpenCV Manager API [7].

Haar Cascade

Haar Cascade is a machine learning object detection algorithm used to identify objects in an image or video and based on the concept of features proposed by Paul Viola and Michael Jones in their paper "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images. The algorithm works in four stages: 1. Haar Feature Selection, 2. Creating Integral Images, 3. Adaboost Training, 4. Cascading Classifiers. It is well known for being able to detect faces and body parts in an image, but can be trained to identify almost any object.

Android Smart phone

Now a day, there are a variety of android smart phones available in the market at low prices and almost all of them are equipped with in built front camera with resolution of 16 megapixel and speakers, GPS. We are less bothered about the rear camera resolution here right now. GPS must be enabled in the smart phone.

IV. RESULTS AND DISCUSSION

System Description

The proposed system requires an Android smart phone equipped with front camera. This Smart phone must run on Android SDK version. It must be equipped with at least 16 megapixelsin built front camera, GPS enabled, good sound quality speakers.The system starts once the user tap on the app icon from the smart phone menu screen. The system screen looks like the one shown in figure below:

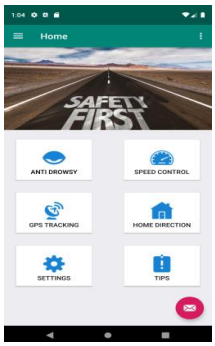


Fig.1 Start up Screen

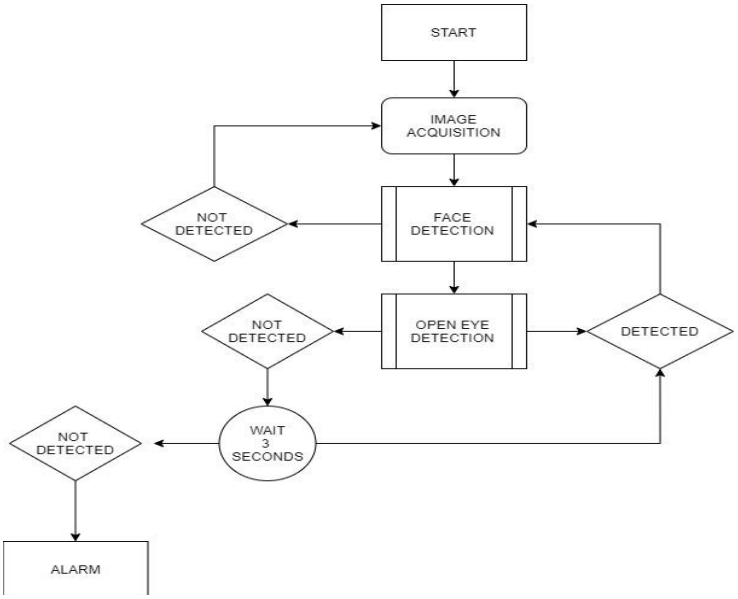
Speed Control: Speed Control is a useful feature for parents and transporters, they can set the vehicle speed using a setting option, if the driver crosses the set limit it will send the alert to the parent or transporter.
GPS Tracking: Parents and transporters can track the driver/children where he/she locating
Home Direction: If child/driver forgot the direction of home or aim location it will help to the driver to by showing Google map direction by just one click
Tips: Tips helps the driver with safe driving tips and control vehicle
Settings: In setting, the parent or transporter can set password, speed limit, home / office location etc, and mobile number where they receive messages
Anti-Drowsy: This is the main unit of functionality of the proposed system. Once it is tapped, the system starts detecting the user face by capturing a video using smart phone front camera. If it detects the face, then it calls up for a routine for detecting the eyes of the user. If the system fails to find face in the captured video, it again captures another video and continues to do so. If eyes not detected, the system gets back to the face detection routine and continues from there. Upon detection of the user eyes, the system continuously monitors the state of eyes, if eyes found to be opened. If eyes detected as closed for 3 seconds, the system triggers an alarm indicated by beep sound and a message on notification bar. This will make the driver alert and come out of its drowsiness.
To get a clear understanding of the proposed work, we need to have a look at the following:

- Algorithm
- Flow chart
- Sequence of events

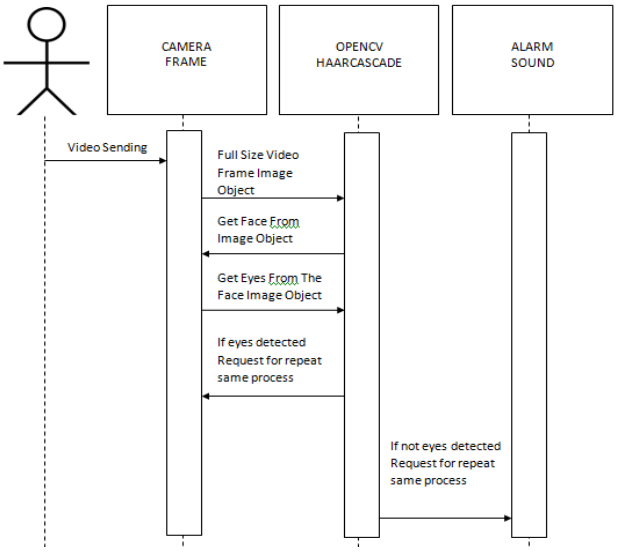
Algorithm

1. START
2. Capture Video
3. While Loop frame by frame
4. Search for Face Detection if face detected then go for step 5 else repeat step 4 until face detected
5. Search for Eyes Detection if eyes detected then repeat step 4,5 until eyes not detected, if eyes not detected go to step 6
6. Wait for 4seconds, while waiting if eyes detected abort step 6 and go for step 5, if after a wait eyes not detected go to step 7
7. Start Alarm sound until eyes detected, if eyes detected repeat steps 4,5
8. STOP (If not required)

Flow Chart



Sequence of Events



Experimental Result

Fig.1 Home Screen of the System

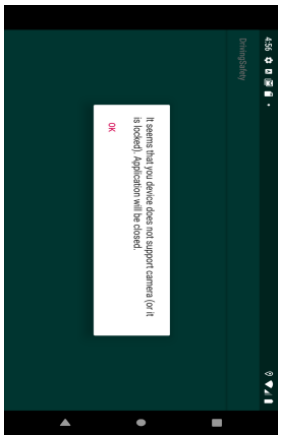


Fig. 2 Screen If Camera Not Detected

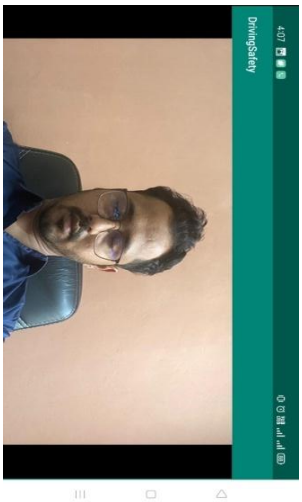


Fig.3 Closed Eyes Detected

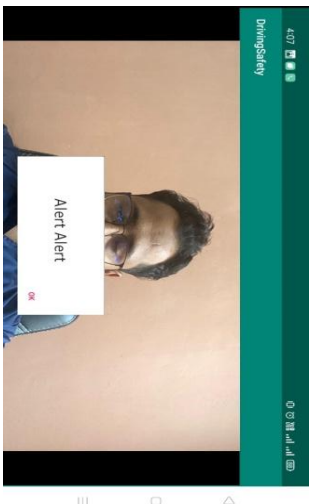


Fig. 4 Triggers Alarm & Popup Message after 30 sec.

V. CONCLUSION

There are several intrusive and non-intrusive methods to implement driver drowsiness detection system. From the study and design of proposed work, it is clear that use of Android smart phone and OpenCV for Android SDK is even more suitable for this particular application in terms of size, cost and power requirement, as no additional hardware is needed. The results are accurate and reliable for detection of face, eyes & mouth. A real-time eye blink detection algorithm was presented. We quantitatively demonstrated that

Haar feature-based cascade classifiers and regression-based facial landmark detectors are precise enough to reliably estimate the positive images of face and a level of eye openness. While they are robust to low image quality (low image resolution in a large extent) and in-the-wild. Operations are performed on static image as well on feed of live webcam. It is observed that, the result varies due to un-even lighting conditions; however, it is accurate even in low light conditions. Proposed system can be used in real working environment. In future, yawning detection and head nodding can be possible.

*Limitations***:**

- In case the user uses spectacle then it is difficult to detect the state of the eye. As it hugely depends on light hence reflection of spectacles may give the output for a closed eye as opened eye. Hence for this purpose the closeness of eye to the camera is required to avoid light.
- If multiple face arises in the window, then the camera may detect more number of faces undesired output may appear. Because of different condition of different faces. So, we need to make sure that only the driver face comes within the range of the camera. Also, the speed of detection reduces because of operation on multiple faces.

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