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Driver Aided System Using Open Source Computer Vision

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ABSTRACT: Smartphone based driver aided system helps to detect driver drowsiness conditions while driving. In recent years accidents occurred due to driver's sleepiness and fatigue have been increasing vigorously. By observing driver and notify him in drowsiness condition is one way to reduce accidents. This technology uses smartphone front camera to take driver's image and back end camera is used to provide traffic sign detection. This approach provides real time monitoring. It provides fatigue detection using various methods and also provides different assistance applications for driving. Methods for drowsiness detection are vision based tracking, yawning detection, and stress detection by driver's facial expression tracking and driver assistant application includes traffic sign detection and traffic jam detection. System will process all this facial tracking and will raise the alarm in case of fatigue detection. Different alarms like audio file, message, and beep are used for alerting driver. Open Source computer vision is used for this system. HaarCascade filter library is used for facial tracking purpose.

KEYWORDS: Drowsiness; smartphone; alarm; HaarCascade.

I. INTRODUCTION

After continuous driving for long time, driver easily get tired and which result into driver fatigue and drowsiness conditions. At midnight driver fatigue increases more than day driving. This may lead into accident. Research states that major of accidents are occurred due to driver fatigue [1]. Different countries have different statistic for accidents that occurred due to driver fatigue. Developing technology for detecting driver fatigue to reduce accident is main challenge. There are various approaches available for detecting sleepiness conditions: 1) based on vision based tracking 2) Using physiological signal to measure heartbeat rate to observe driver's behaviour 3) Observing driver's brain activities 4) Vehicle base method. But these approaches are expensive as they require electrodes and high processing back ends to run system and these does not provide accuracy while detecting drowsiness.

Driver Aided System (DAS) is real time monitoring system which provides integration of all driver fatigue constraints into one with driver assistance application. It is smartphone based method which uses both frontend and backend camera. It captures driver's image through camera and process it real time. Driver fatigue state is estimated using eye blinking rate of driver, yawning detection by tracking mouth, head rotation detection & gaze tracking for detecting driver distraction and stress detection from driver's facial expression tracking.

Main module of driver aided system is stress detection through speech recognition which helps to observe for driver's behaviour. This technology also provides driver assistance application like traffic sign detection to make driving easy for driver. After detecting driver fatigue and distraction, system raise an alarm to alert the driver and passengers to prevent accidents. Different types of alarms are used to alert driver. This paper explains about proposed methodology for Driver Aided System to prevent accidents. This approach uses Open Source Computer Vision (OpenCV) library for facial expression tracking [2]. OpenCV provides real time image processing and also satisfies low processing power, high speed and cost effectiveness requirement Figure 1 explains driver aided system functioning.

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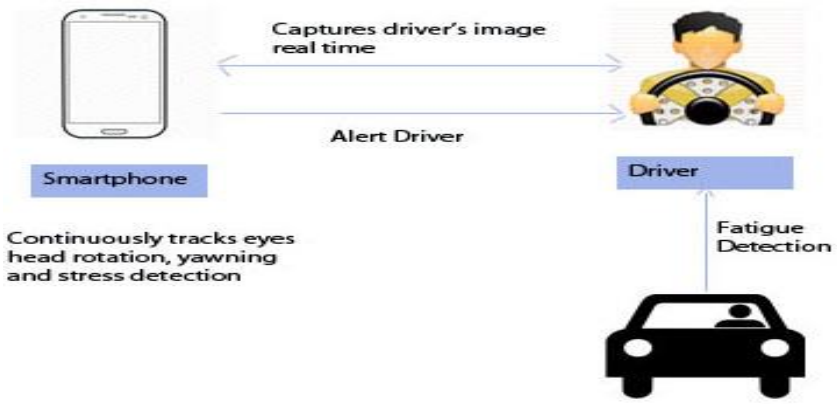

Fig.1. Driver Aided System (DAS)

II. RELATED WORK

There are various researches on this topic [3-13]. Most of the research is based on vision based method. It includes tracking driver's eyes by detecting eyes closure state to detect driver's sleepiness conditions. Eye tracking method is done by using various methods like template matching, eye blinking detection. Some of the approaches include observing driver's behaviour by using physiological approaches like observing brain activities using sensor. It include use of electrodes to detect electric signal from driver's skin. This approach is used for monitoring driver's health and eye blinking detection. Another approach includes use of bio signals and dynamic Bayesian network to detect driver fatigue through different sensors. Many researches have done on eye blinking based driver fatigue detection. Different approaches used different methods to detect driver drowsiness: histogram based method to extract eye contour, skin colour extraction and eyes extraction method using automotive learning and particle filtering algorithm. Another approach is based on the driving behaviour. It includes steering motion based monitoring that is when steering is still for some fractions of time then it help to detect drowsy condition. In this method driver is alerted using steering vibration.

But all of these approaches does not provide accuracy for detecting driver fatigue. Though Electrode ECG, EEG methods provides accuracy for driver health monitoring and eye blinking detection ,they are expensive and annoying as it require electrode to be in contact with driver's skin. Eye blinking based method does not sufficient for detecting fatigue. Therefore there is need of technology which will consider all constraints and will provide integrated solution. Driver aided system provides all solution into one by using smartphone which makes the system cost effective and efficient.

III. PROPOSED SYSTEM

System architecture of proposed system is given in figure 2. Proposed Method make use of android and OpenCV library. OpenCV provides training dataset which makes it easy to detect face and track facial expressions and various region on face. Alarm system include use of message, beep or audio/voice recorded message to alert driver.

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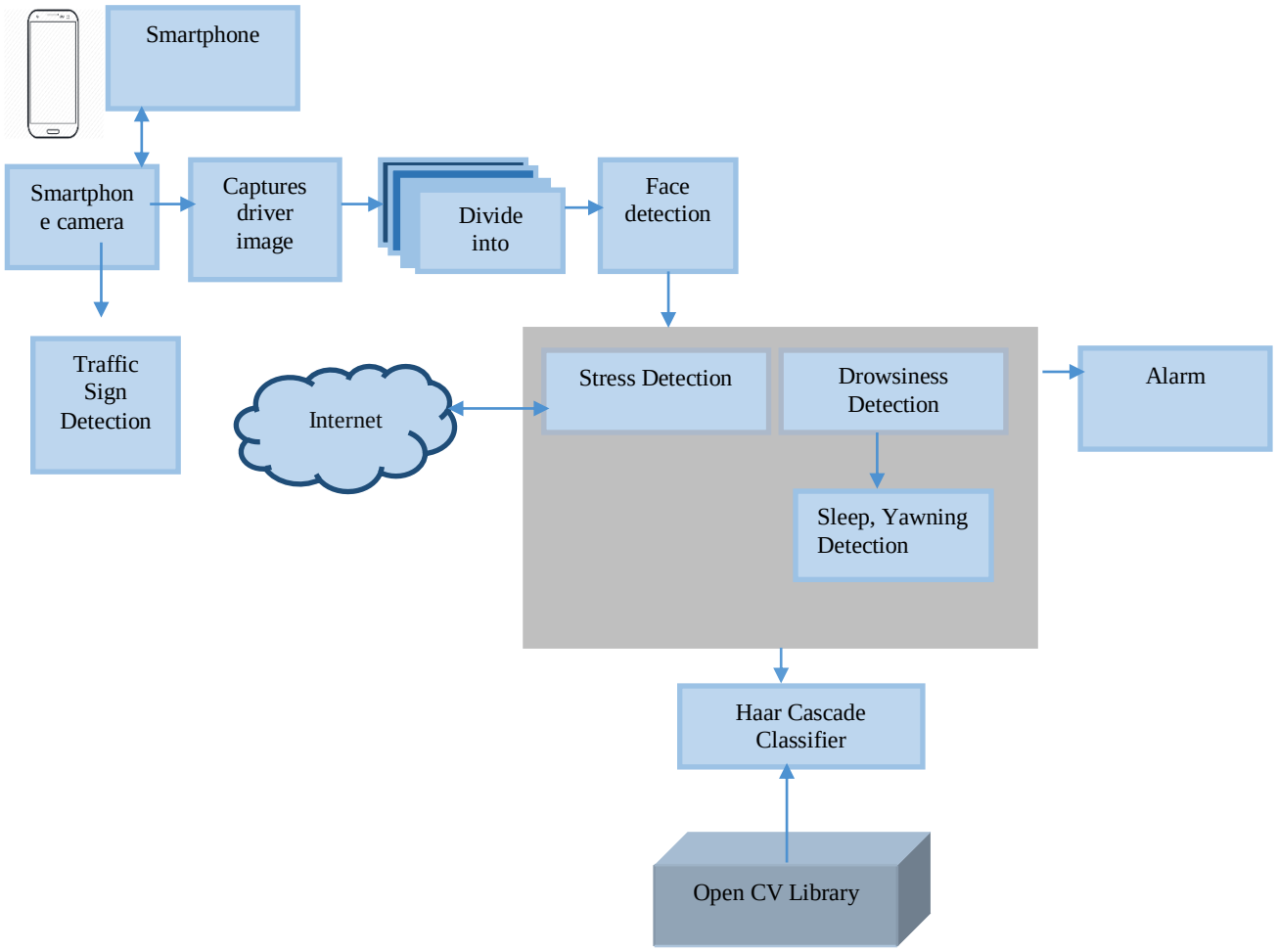

Fig 2: Driver Aided System Architecture

IV. METHODOLOGY

In proposed Method, driver live image is acquires through the smartphone front camera. OpenCV provides a way through which live video can be acquired and processed. OpenCV is used to track face from images acquired. It helps to provide quick processing by consuming less power. Open Source computer vision provides accuracy in tracing face. Acquired image is present in RGB format which has too many color combinations to track face and face regions. So there is need to convert RGB into Grayscale format. Grayscale format gives only black and white combination which makes face regions detection easy. HaarCascade classifier is used to detect faces. It provides training dataset for face and regions tracking. Haar classifier provides rapid face regions detection in rectangular frames. After detection of face centroid of the face is calculate. Centroid of the face is necessary for accurate eyes and mouth tracking.

Eyes are present on the top portion of face i.e. eyes are present at the few pixels below from top of face. Haar classifier training application is used to track eyes. Eyes are detected in the form of rectangular frame. In eyes tracking, eyeballs are detected using black colored pixels which represents pupils. Haar classifier is used to detect both left and right eye. In this if white pixels are detected then eyes are in open state and if white pixels are not detected then eyes are in closed state. Closed eyes are detected through the decrease in the distance of eyelids. If these pupils are not detected for given fraction of time then alert will be raised. After detection of close eyes it provides “you are sleepy, please take a rest” voice alert.

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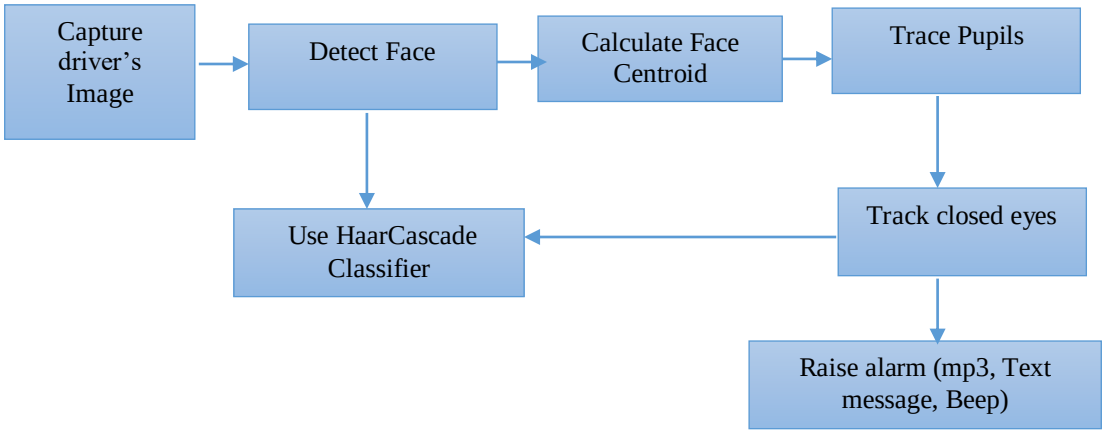

Fig 3: Closed Eyes Detection

Yawning is one of the main symptoms for sleepiness. Yawning is detected by tracking open mouth. Driver aided system detect the mouth based on the region of lips tracking. Algorithm used for eye tracking can be used for yawning detection. Only increased distance between lips are calculated which is possible through black region tracking of open mouth. If the distance increases then yawning is detected and system will raise alarm to alert driver. Yawning state is detected by measuring both the rate and amount of changes in the driver's mouth contour. After detection of yawning it provides "stop yawning and continue driving" voice alert.

Stress is detected from the driver's expressions. Driver's forehead is tracked using the same algorithm used above. No of lines in the forehead and raised eyebrows are extracted and if lines appears for the given fraction of time and eyebrows are raised for specific time, then stress is detected and system will raise an alarm. Another condition for detecting stress is baring of teeth. If this increases then high stress condition will detected and system will alert driver and passengers. Stress detection through driver's voice is also one of the way to detect critical conditions. In this driver's voice is acquired with the help of smartphone's microphone and if stressful words are detected then system will raise alarm or take particular action like call emergency numbers.

Rapid head movement also helps to detect the stress condition. In this head rotation and gaze tracking is used to detect rapid head movement. Head rotation is also useful in detecting driver's distraction while driving. If driver lean or rotate his head for more than given number of times then system will raise alarm to tell user to focus on driving. It can be useful when driver talks with passengers at back seats or looks at another side rather than looking straight while driving.

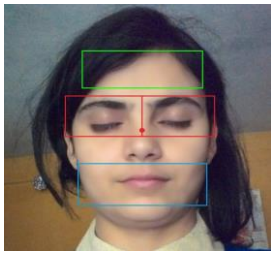

Fig 4: Closed Eyes Detection

V. APPLICATIONS

- Eye tracking module can use in many applications. For driver to assist in driving and reduce accidents occurred due to sleepiness.

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- Stress Conditions module using speech and stress recognition can be used by parents for their children who are alone at home.
- Eye tracking and yawn detector can use by companies to keep attention on their employees and fatigue detection of employees.
- In colleges, where students are drowsy during lectures.
- To check whether security guards are doing their job honestly.
- Stress condition detection module can be used at hospital for keeping watch on patient's health.
- Head rotation or gaze tracking can be used in exams to observe students behavior for detecting cheating during exam.

VI. CONCLUSION AND FUTURE WORK

This paper describes methodology for driver aided system. Proposed Real time Driver Aided System helps to reduce accident occurred due to driver fatigue. This technology takes all aspects for preventing accidents into consideration like vision based fatigue detection, yawning detection and various stress conditions. Driver stress detection via speech and facial expression helps to detect driver's behaviour which can be used to alert driver and passengers in critical conditions. This approach also provides traffic sign detection and traffic jam detection to assist driver on road. It provides efficiency and fast facial tracking using OpenCV library. As this method uses smartphone for processing, it makes the system cost effective.

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