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Smartphone Based Driver Aided System to Reduce Accidents Using OpenCV

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Abstract*:* Road traffic is increasing rapidly because of availability of various public and private means of transportation. Flow of traffic rarely stops at any hour of the day because of extensive work schedules and travelling needs. This ultimately leads to long driving hours by not only people who are driving continuously to face the adverse effect of fatigue i.e. drowsiness and sleep deprivation. Driver aided system uses android based smartphone which helps to detect driver under fatigue and system alerts driver under sleepy conditions. It is real time driver fatigue detection system which uses OpenCV (Open Source Computer Vision) for tracking driver's facial expression for preventing accident. Proposed algorithm tracks eyes, mouth to detect doziness and yawning respectively. It also detects stress from driver's facial expressions like forehead lines and give warning to passengers. It also provide stress recognition through driver's speech like driver asking for help and takes respective action. Warning system uses different levels of warning includes messages, voice messages, beep, vibrations to alert driver. This system HaarCascade filter libraries for facial tracking and other face region tracking.

Keywords: Drowsiness, OpenCV, HaarCascade, facial tracking, smartphone.

I. INTRODUCTION

Nowadays it is very common for people for drive themselves to various places like for work. It has become one of the basic necessities for a person to learn how to drive but more often than not accidents and casualties occurs .Traffic accident is being critical issue as number of deaths occurred due to traffic accidents are increasing rapidly. Reasons for traffic accidents are driving after alcohol consumption, driving at night, driving without taking rest, aging, sleepiness and fatigue occurred due to continuous driving, long working hours and night shifts. Main reason for traffic accidents is driver's distraction and fatigue while driving. According to traffic accident's statistic 1,500 deaths are caused annually due to driverfatigue and sleep deprivation. Driver drowsiness is occurred due to continuous driving without taking any break. Fatigue is tiredness occurred due to physical exertions and lack of rest. Drowsiness and fatigue reduces driver's concentration on driving and makes driver alert less. Due to drowsiness, if the driver nods off even for a few seconds, it can be very disastrous leading to fatal accidents. Accidents occurred due to driver fatigue and inattention are increasing vigorously. To prevent accidents it is necessary to detect drowsiness and alert driver before being sleepy. This will help to reduce traffic accidents. This can be done by using technology to keep attention on driver in pre drowsy state.

This paper proposes a method for detecting driver in drowsy conditions and it alert driver to prevent accident. Aim of this paper is to provide simple method for detecting driver fatigue which will work efficiently and in fast way. Driver Aided System (DAS) is real time monitoring smartphone based system which detects drowsiness and it also assist driver by providing various help like traffic sign detection and traffic path navigation. This system uses OpenCV (Open Source Computer Vision) libraries for implementation. It utilizes both primary and secondary camera of smartphone where front camera continuously captures driver image. Then it tracks eyes and mouth to detect pre-drowsy states like sleepiness and yawning by tracking closed eyes and open mouth for given fraction of time. It also provides stress detection by facial tracking in various conditions like having headache, stomach ache and crying in pain.

II. BACKGROUND

There are various approaches have been developed for driver fatigue detection. These approaches are divided into three types:

1. Facial feature tracking approach.
2. Non Facial feature tracking approach.
3. Embedded and sensors approach.

In facial feature tracking, they use vision based method to detect closure state of eyes. If closed eyes detected then it gives alarm to driver. Gaze tracking includes detecting pupil's movements, if distraction from driving is detected then it will give alert to driver. Same technique is used foryawn detection. If open mouth is detected then it takes it as yawning and then alerts driver.

Non facial features or non-visual based method includes use of Electrocardiography (ECG), Electroencephalography (EEG) for health monitoring which helps to detect driver fatigue and it also used for eye blinking detection.

This approach uses electric signal for health monitoring and blinking detection. But this approach is expensive as it requires large setup to arrange for system execution. Non visual based method also includes bio-signal processing to collect the driver's photoplethysmograph signal. It helps to

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detect driver fatigue. This method provides high performance.

Another method for driver fatigue detection is to use steering motion to analyse drowsiness. If steering is still then it detects driver fatigue. It gives alert to driver by vibrating steering. Other vehicle based detection includes lane deviation detection, pressure of car gas checking methods. This type of methods are affected by external factors like nature of road.

TABLE I
APPROACHES FOR DRIVER FATIGUE DETECTION

	Type	Method
1	Facial features tracking	Eye, yawn detection, gaze tracking,
2	Non facial features	Health monitoring, eye blinking detection
3	Vehicle based tracking	Steering motion, lane deviation

III. SYSTEM DEVELOPMENT

Proposed Driver Aided System (DAS) provides overall integration of all modules to detect driver fatigue and to alert driver.

A. Capture Driver Image

First stepto detect driver drowsiness is capture driver's image. Driver's real time image is continuously acquires using smartphone's front camera. OpenCV provides real time monitoring from which frames can fetched and processed. Then OpenCV library provides classifier for facial tracking. It fulfils low processing power and speed requirements for application. Image is acquired in RGB format which contains large number of colour combinations which it makes time consuming and complicated to track facial regions. Therefore there is need of converting RGB into Grayscale format. Grayscale format provides only two combinations black and white which require less time to track facial features.

B. Face Detection

After capturing image from camera, face is detected from frame. Haar classifier is used to detect face and face regions. Haar classifier is used to detect face and other parts. It provides training dataset which makes easy todetect face and other features. It provides positive and negative samples. Data set of face and eyes are collected. The utility application createsamples () is used to build a vector output file. We can use this file again to get training procedure. Then it extracts the positive samples from images. These learning objects are used to create haarcascade.xml file which can be used to eye, mouth, and nose detection. After detection of face centroid of the face is calculated for accurate tracking of eyes.

C. Select ROI

OpenCV allows us to select region of interest. After selecting ROI, filters get applied to that region. ROI is rectangular region on image which is created by providing x and y coordinates and height and width.

D. Eye Tracking

Eyes are present on the top portion of face i.e. eyes are present at the few pixels below from top of face. After Face detection, we track eyes by using Haar classifier training set. Rectangular frame are used to show both left and right eye. To detect open eyes we track pupils using black coloured pixel which represents open eyes and if closed eyes. 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. Through the decrease in the distance of eyelids, closed eyes are detected. If these pupils are notdetected for given fraction of time then system will ring alarm.

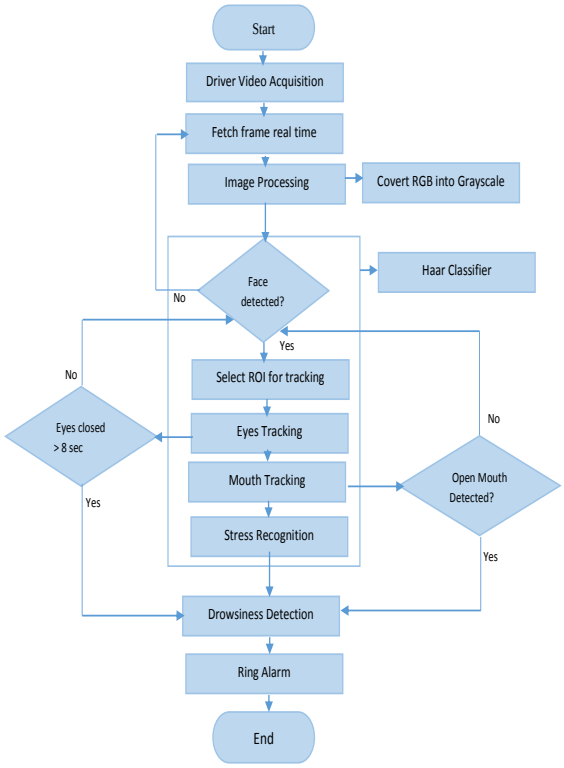

Fig. 1Driver Aided System Development

E. Yawn Detection

Yawning is a pre-drowsy state. Open mouth helps to track yawning. When mouth is open, inside area is darker. Same algorithm which is for eye tracking is used for yawn detection. The only difference is increased distance between lips are calculated in yawn detection. Here we track black region i.e. darker area to detect open mouth. If the distance of mouth increases then yawning is detected and after this system alerts driver by providing voice alert. Driver's mouth contour is used to detect yawning.

F. Stress Detection

Driver Aided System (DAS) detects stress by detecting driver's facial expressions and through driver's speech. Stress is measured by tracking facial expressions like

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forehead lines comes in stress conditions or raised eyebrows. Algorithm used for mouth tracking is used for driver's forehead Detection. After forehead detection system calculates no of lines on the forehead. If eyebrows are in raised condition for fraction of time or if forehead lines appears for the given fraction of time or both then stress gets detected by system. System raise an alarm to alert driver and passengers to stop driving. Other way to detect stress is through driver's voice recognition. Human's voice change when he/she is under stress condition. So DAS acquires driver's voice through smartphone's microphone and check if some stressful words are detected and autodials emergency contact numbers.

IV. REAL TIME ALGORITHM

OpenCV provides HaarCascade classifier which is used to detect faces. It provides easy face detection and face regions and other body parts tracking. Haar classifier detects face regions in form of rectangular frames. Value of a Haar feature is difference between the additions of the black and white rectangular frames pixel values. To find the difference between regions previous calculated sum is used. This differences is used to classify sub regions of that image. Calculated differences are the compared with various threshold values. They are used to decide to determine if object appears in that region or not. Algorithm proposed by Viola & Jones are one of the most efficient algorithm for object detection.

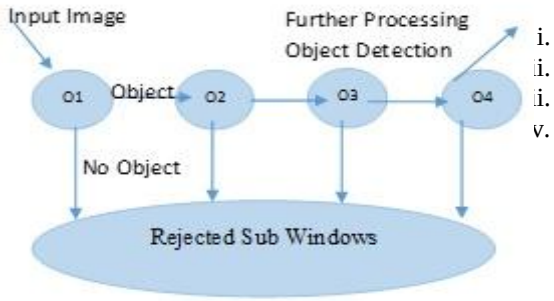

Fig. 2Haar Classifier

Fig 2 shows haar classifier object detection. In this algorithm, detector detects object from input images and every time it discards unwanted region until it find face. When all unwanted regions are rejected it shows the final result in form of object detection. Cascade includes combination of classifier in such a way that current classifier processed only when all classifier coming before current have been already processed.Haar cascade classifier learns strong classifier using set of weak classifier.

V. IMPLEMENTATION

Driver Aided System (DAS) is built using OpenCV libraries with android programming. Open Source Computer vision is an image processing library which provides large training dataset to track facial features. This system uses Haar classifier provided by OpenCV for face detection, eye tracking and mouth tracking. OpenCV is open source library which is easy to use and it provides real time monitoring.

It provides speed and efficiency while tracking facial features. OpenCV satisfies the low processing power requirement for lightweight and fast applications.

OpenCV provides speed in image processing with less resource requirement and it adds cost effectiveness to Driver Aided System as it is open source library.

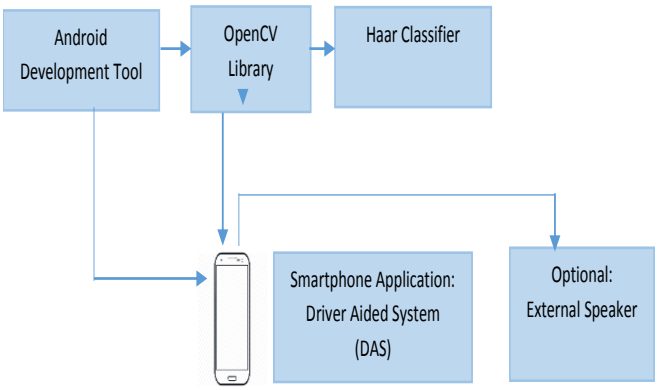

Fig. 3 DAS Implementation Requirements

Following are requirement for implementation of Driver Aided System (DAS):

i. Smartphone with both primary and secondary camera
i. OpenCV library
i. Android development tools
v. Optional: external speaker for better quality voice alert

Different types and levels of alerts are used to give warning to the driver. It includes various audio messages, beep, rings, vibrations which will keep driver alert.

VI. EXPERIMENTAL ANALYSIS

This system is developed in Open Source Computer vision (OpenCV) with android.

Final result is a smartphone application DAS (Driver Aided System) with all driver fatigue detection functions and driver assistance modules.

Time	Area1	Area 2	Area 3
Morning	61	79	87
Afternoon	85	88	91
Evening	92	90	95
Night	68	74	79

TABLE 2

Driver Fatigue Detection at different time

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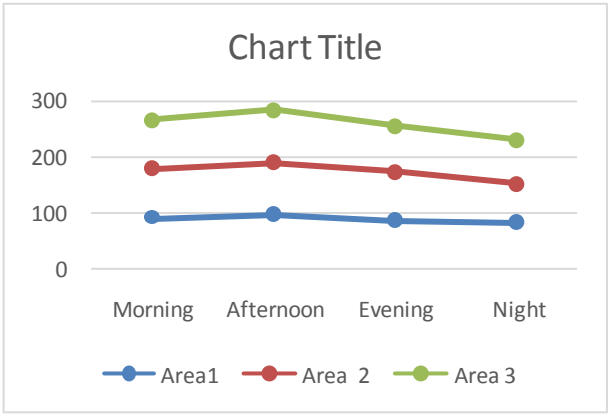

Fig. 4 Driver Fatigue Detection Graph

A. *Eye Tracking*

After detecting face using Haar classifier, eye tracking module detects whether eyes are closed or open and if eyes are closed it provides voice alert "You are sleepy please take a rest" to driver.

Fig. 5 Closed Eye Detection

B. *Yawn Detection*

Yawn Detection includes mouth tracking. When Open mouth is detected system detects yawning and provides voice alert "Stop yawning and continue driving" to driver.

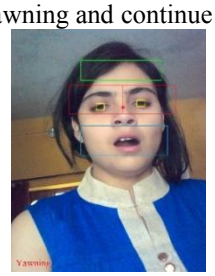

Fig. 6Yawn Detection

C. *Stress Recognition*

Stress recognition is detected using forehead lines and eyebrows movement and it provides alert "Driver is under stress, please stop driving".

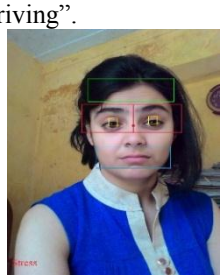

Fig. 7 Stress Detection

VII. CONCLUSION

Driver Aided System is a real time fatigue monitoring system using OpenCV. It uses Haar libraries for tracking facial regions which provides fast eyes and mouth tracking. This system captures driver's image and tracks closure state of eyes and mouth. If closed eyes are detected it alerts driver for taking a break and if open mouth is tracked then it detects yawning and ring alarm to alert to driver. It also provides stress detection using facial expression tracking and speech recognition. This paper considers all conditions for detecting driver's drowsiness while driving. It also provides different features like traffic sign detection, traffic jam detection which assist driver in driving. We measured this system under different light conditions and using different constraint like eye tracking with eye glasses. This system would effectively and efficiently work to prevent any accidents by detection of driver fatigue.

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BIOGRAPHY

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