International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 07 | July- 2018 www.irjet.net p-ISSN: 2395-0072

Visual Analysis of Eye State for Driver Alertness Monitoring

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Abstract - *Various investigations show that drivers drowsiness is one of the main causes of traffic accidents. Thus, countermeasure device is currently required in many fields for sleepiness related accident prevention. Real-time driver drowsiness system alerts users when they are falling asleep. The project is designed to combat narcolepsy and micro sleep. Micro sleep strikes quickly. Users probably don't even realize that they are in the process of falling asleep, and almost certainly don't notice that eye blinking for longer than usual. The implemented project is mainly based on three components 1) Face and Eye detection: Performs scale invariant detection using Haar Cascade Classifier perform through a webcam. 2) Eye feature extraction: Eye features are extracted using Hough Circle and 3) Extract single eye and perform drowsiness detection on it. Whereas the complete system is implemented on Raspberry Pi which uses a webcam to monitor user's eye blink rate and average blink duration to detect drowsiness. The project is designed for a car safety which helps prevent accidents caused by the driver getting drowsy.*

Key Words: *drowsy driver, Raspberry Pi, Python, Face Detection, Eye Detection.*

1. INTRODUCTION

One of the important goals of the intelligent transportation systems (ITS) is improvement of public safety and the reduction of accidents. The most important factors in accidents, especially on rural roads, is the driver fatigue and monotony. The U.S. National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System Encyclopedia[1] shows that there were approximately 55,926 vehicles involved in collisions in 2007, 9,797 of which were due to driver fatigue and inattention. Driving with drowsiness is one of the main causes of traffic accidents. Drivers are not typically conscious of how their capabilities could be diminished due to drowsiness. One possible solution is to enable the vehicle to detect drowsiness or discrepancies in the driver's behavior and alert the user when it occurs. The best strategy for such systems is to indicate the current drowsiness condition. Drowsiness is simply defined as "a state of near sleep due to fatigue". Fatigue affects mental alertness, decreasing an individual's ability to operate a vehicle safely and increasing the risk of human error that could lead to fatalities and injuries. Sleepiness slows reaction time, decreases awareness, and impairs judgment. Fatigue and sleep deprivation impact all transportation operators (for example: airline pilots, truck drivers, and rail-road engineers). It is necessary to develop driver alertness system for accident prevention due to driver Drowsiness.

There are the three approaches for driver's state detection approaches based on

1) Biological signals
2) Vehicle behavior
3) Drivers face Monitoring

The approaches based on biological signals have a very good accuracy and speed at detecting fatigue, but they are usually intrusive. The approaches based on driver face monitoring have lower accuracy than the approaches based on steering motion, but they can detect driver fatigue earlier. Three main approaches for driver fatigue/drowsiness.

As one of the salient features of the human face, human eyes play an important role in face recognition and facial expression analysis. In fact, the eyes can be considered salient and relatively stable feature on the face in comparison with other facial features. Therefore, when we detect facial features, it is advantageous to detect eyes before the detection of other facial features. The position of other facial features can be estimated using the eye position

Block Diagram of proposed system

The proposed system comprises of three components in addition to these there are three external typically hardware components namely, Camera for video acquisition, Raspberry pi and an audio alarm.

1. Capturing: Camera mounted on automotive dashboard capture the images of drivers face including eyes

2. Processing and detecting: Captured facial image is used to determine drivers eyes i.e. open or closed. The drivers current eye state can be determined using HAAR classifiers

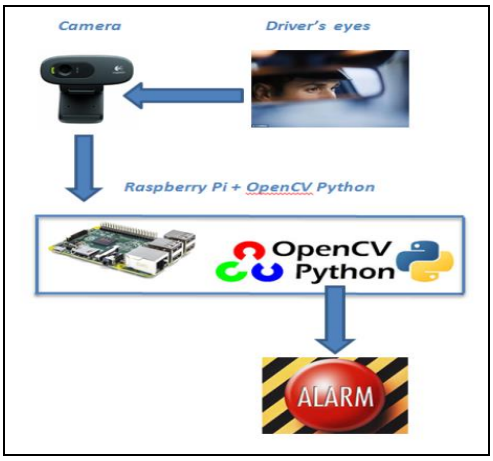

Fig -1: Proposed system architecture

Stepwise execution of project:

- Detect face using Haar-Cascade Classifier
- Detect Eyes using Haar-Cascade Classifier
- Extract face coordinate to calculate center and diameter
- Extract Eyes Region Of Interest (ROI), Cropping mouth and hair
- Search for eyes in ROI (Hough Transformation to find shape of eye and Harries Corner Detection to get corners of eye and draw circle on pupils)
- Ensure at most two eyes found
- Loop over each eye split left and right eye
- Compare eyes and face midpoint to get left and right eye
- Based on state of eye we can specify user is in sleep or not

3. CONCLUSIONS

The primary goal of this project is to develop a system for visual analysis of eye state of driver for driver alertness monitoring in automobiles. We developed a simple system consisting of modules namely video acquisition, dividing video into frames/images, face detection, eye detection and drowsiness detection. Each of these components can be implemented independently thus providing a way to structure them based on the requirements. Four features that make our system different from existing ones are:

1. Focus on the driver, which is a direct way of detecting the drowsiness
2. A real-time system that detects face and iris and driver drowsiness
3. A completely non-intrusive system, and
4. Cost effective.

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