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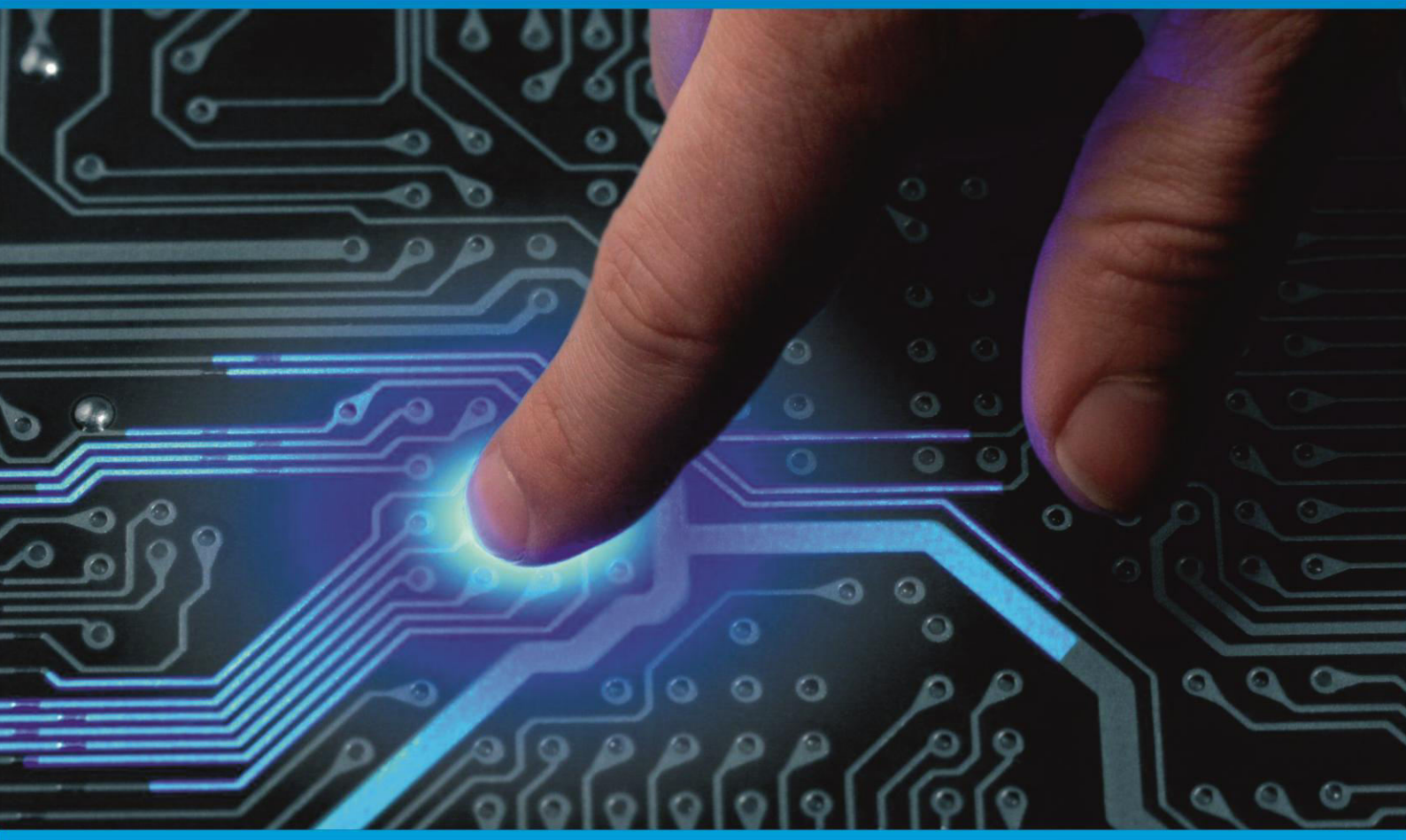

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Drowsiness Detection and Theft Control System in Vehicle Using Computer Vision in AI

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ABSTRACT: Every year, the drowsiness of drivers while driving increases the number of accidents that result in deaths and injuries worldwide. One problem for car owners is that there is constant fear that their vehicles will be stolen from a parking lot. With these two aspects in mind, we have proposed a system here that detects the drowsiness of drivers while driving and identifies the unknown person who is trying to steal the vehicle. The system handles a drowsiness detection algorithm based on computer vision that generates an alarm sound when drowsiness is detected. It also deals with facial recognition to identify unknown people and send an alert message to the authenticated people. The implementation will reduce the number of accidents and also increase transport safety. A robust and accurate algorithm in the real-time eye tracking system was a fundamental and challenging problem for image processing. This article proposed a new method of estimating eye position and direction based on the initial centroid analysis technique. The proposed method was validated by tracking eye position within a high and low occlusion state. In this article, we will introduce a method for detecting winking in real time.

KEYWORDS: vehicles stolen, drowsiness detection algorithm, initial centroid analysis technique, Eye blinking robustly.

I. INTRODUCTION

Due to the increase in the amount of automobile in recent years, problems created by accidents have become more complex as well. The official investigation reports of traffic accidents point out those dangerous driving behaviors, such as drunk and drowsy driving, have taken a high proportion among all the accidents, it is necessary to develop an appropriate driver drowsiness and alertness system that can directly improve the driving safety. However, several complicated issues are involved with keeping an eye on drivers all the time to wipe out all possible hazards. Driver fatigue is a significant factor in a large number of vehicle accidents. Recent statistics estimate that annually 1,200 deaths and 76,000 injuries can be attributed to fatigue related crashes.

The development of technologies for detecting or preventing drowsiness at the wheel is a major challenge in the field of accident avoidance systems. Because of the hazard that drowsiness presents on the road, methods need to be developed for counteracting its affects. The aim is to develop an algorithm for drowsiness or alertness detection system. The focus will be placed on designing a system that will accurately monitor the open or closed state of the driver's eyes in real-time.

By monitoring the eyes, it is believed that the symptoms of driver fatigue can be detected early enough to avoid a car accident. Detection of fatigue involves a sequence of images of a face, and the observation of eye movements and blink patterns. The analysis of face images is a popular research area with applications such as face recognition, virtual tools, and human identification security systems. This work is focused on the localization of the eyes, which involves looking at the entire image of the face, and determining the position of the eyes, by a proposing well image processing algorithm.

Once the position of the eyes is located, the system is designed to determine whether the eyes are opened or closed, and detect fatigue. It proposes a computer vision based driver drowsiness system, use of OpenCV in image processing, interfacing of web camera to OpenCV, Haar classifiers like feature based face detection methods, eyelid identification, and developing alertness system using eyelid status to warn the driver accordingly by providing an alarm.

The use of vehicle becomes important everywhere in the world and also preventing it from theft is required. Vehicle manufacturers are attaining the security features of their products by introducing advanced automated technologies to avoid the thefts particularly in case of cars. Biometric and non-biometric methods usually provide such security features. Sometimes these systems fail due to hacked password and encryption of decrypted data, but it is almost impossible to make replica of distinctive characteristics. Biometric systems are modern and use techniques like fingerprint recognition, iris recognition and face recognition. Of these face recognition and detection systems are more

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sophisticated, easy to deploy and people can be identified without their knowledge. In vehicle security system, the objective is to prevent the theft of vehicle and ensure safety of vehicle by avoiding the means of theft. One level of ensuring authentication of driving is through face recognition system that authenticates a user being an authorized person to have access to the ignition system.

Face is detected and recognized using algorithm overcoming the pose and illumination constraints. The recognized image is compared with the authorized image of users that are pre-trained. If not matched, it sends an alert message to the authenticated users.

II. RELATED WORKS

2.1 Techniques for Detecting Drowsy Drivers

Possible techniques for detecting drowsiness in drivers can be generally divided into the following categories: sensing of physiological characteristics, sensing of driver operation, sensing of vehicle response, monitoring the response of driver.

2.2 Monitoring Physiological Characteristics

Among these methods, the techniques that are best, based on accuracy are the ones based on human physiological phenomena. This technique is implemented in two ways: measuring changes in physiological signals, such as brain waves, heart rate, and eye blinking; and measuring physical changes such as sagging posture, leaning of the driver's head and the open/closed states of the eyes.

The first technique, while most accurate, is not realistic, since sensing electrodes would have to be attached directly onto the driver's body, and hence be annoying and distracting to the driver. In addition, long time driving would result in perspiration on the sensors, diminishing their ability to monitor accurately.

The second technique is well suited for real world driving conditions since it can be non-intrusive by using optical sensors of video cameras to detect changes.

2.3 OTHER METHODS

Driver operation and vehicle behavior can be implemented by monitoring the steering wheel movement, accelerator or brake patterns, vehicle speed, lateral acceleration, and lateral displacement. These too are non-intrusive ways of detecting drowsiness, but are limited to vehicle type and driver conditions. The final technique for detecting drowsiness is by monitoring the response of the driver. This involves periodically requesting the driver to send a response to the system to indicate alertness. The problem with this technique is that it will eventually become tiresome and annoying to the driver.

2.4 Driver Drowsiness Detection System and Techniques

According to the experts it has been observed that when the drivers do not take break they tend to run a high risk of becoming drowsy. Study shows that accidents occur due to sleepy drivers in need of a rest, which means that road accidents occurs more due to drowsiness rather than drink-driving. Attention assist can warn of inattentiveness and drowsiness in an extended speed range and notify drivers of their current state of fatigue and the driving time since the last break, offers adjustable sensitivity and, if a warning is emitted, indicates nearby service areas in the COMAND navigation system.

2.5 Implementation of The Driver Drowsiness Detection System

This paper is about making cars more intelligent and interactive which may notify or resist user under unacceptable conditions, they may provide critical information of real time situations to rescue or police or owner himself. Driver fatigue resulting from sleep disorders is an important factor in the increasing number of accidents on today's roads. In this paper, we describe a real-time safety prototype that controls the vehicle speed under driver fatigue. To advance a system to detect fatigue symptoms in drivers and control the speed of vehicle to avoid accidents is the purpose of such a mode. In this paper, we propose a driver drowsiness detection system in which sensor like eye blink sensor are used for detecting drowsiness of driver. If the driver is found to have sleep, buzzer will start buzzing and then turns the vehicle ignition off.

2.6 Multi-object tracking

This section describes how multiple objects are tracked based on the object box detected. In this study, the ORB algorithm was used to extract the features of the detected vehicles, and good results were obtained. The ORB algorithm shows superior performance in terms of computational performance and matching costs. This algorithm is an excellent alternative to the SIFT and SURF image description algorithms. The ORB algorithm uses the Features From

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Accelerated Segment Test (FAST) to detect feature points and then uses the Harris operator to perform corner detection. After obtaining the feature points, the descriptor is calculated using the BRIEF algorithm. The coordinate system is established by taking the feature point as the centre of the circle and using the centroid of the point region as the x-axis of the coordinate system. Therefore, when the image is rotated, the coordinate system can be rotated according to the rotation of the image, and the feature point descriptor thus has rotation consistency. When the picture angle is changed, a consistent point can also be proposed. After obtaining the binary feature point descriptor, the XOR operation is used to match the feature points, which improves the matching efficiency.

III. PROPOSED SYSTEM

Traffic accidents have increased due to the drowsiness of the driver while driving. Theft of cars is a major threat to the owner of the vehicles. The proposed system alerts the driver if he falls asleep while driving. It also prevents the theft by sending an alert to the authorized person. The system handles a drowsiness detection algorithm based on computer vision that generates an alarm sound when drowsiness is detected. It also deals with facial recognition to identify unknown people and send an alert message to the authenticated people. The implementation of this number of accidents is reduced and also the transport safety is increased. The system was tested using an inexpensive webcam to capture frames. A video recording device, in this case a webcam, is placed in front of the driver to take pictures of the front of the driver and sent to the system for analysis. The method was first created with MATLAB to design the corresponding algorithm, and finally implemented with OpenCV 2, an open source C ++ library for computer vision, since OpenCV uses less time and less processing power than MATLAB in real-time applications. The system first detects the face using the face tag detection algorithm in the video stream. Then the eye region is extracted and the eye aspect ratio (EAR) is calculated to determine whether the eyes are open or closed. If the eyes are found to be closed for a certain period of time, this is recognized as drowsiness and a warning message is immediately sent to the authenticated people.

The added feature of this system is vehicle theft control. For this purpose, the faces of authenticated users are trained. As a person gets into the car, the person's face is compared with the previously trained faces of the authenticated persons. If it doesn't match, a warning message is immediately sent to the authenticated people.

IV. SYSTEM DESIGN

Drowsiness is a cause for the humans to get distracted in a sensible situation which may even lead to bad conditions. The best way to avoid accidents caused by driver's drowsiness is to detect drowsiness of the driver and warn him before fall into sleep. Hence we have proposed a system that will detect the drowsiness of humans by using computer vision technique and alert them by alarm sound in certain situations. An issue for car owners is that there is constant fear of having their vehicles stolen from a parking. It deals with face recognition to identify unknown person and send an alert message to the authenticated persons. It reduces the number of accidents and hence increases the transportation safety.

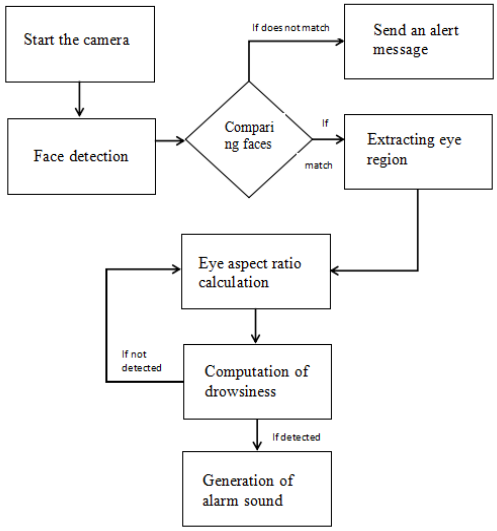

Figure 4.1: System Architecture

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V. METHODOLOGY

5.1 FACIAL LANDMARK DETECTION

This module deals with the face recognition in the video stream. It uses facial landmark detection algorithm. This algorithm is applied to localize each of the important regions of the face such as eyes, nose, mouth, jaw. The dlib's face detector to find and locate the face in the image or video stream. Then facial landmarks are created by using the dlib library.

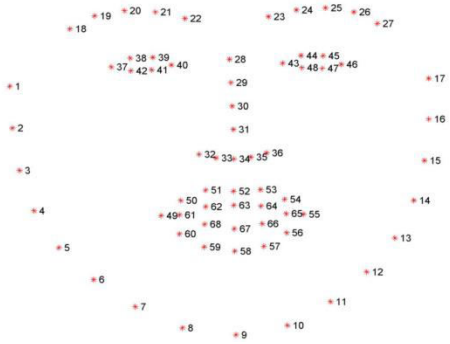

Fig 5.1 Facial landmarks produced by dlib

5.2 EYE ASPECT RATIO DETECTION

- This module extracts the eye region from the face detected using the eye co-ordinates.
- The eye aspect ratio(EAR) is an estimate of the eye opening state.

$$\mathrm{EAR} = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

- The eye aspect ratio is approximately constant while the eye is open, but will rapidly fall to zero when a blink is taking place.
  By using this EAR the eye state can be detected.

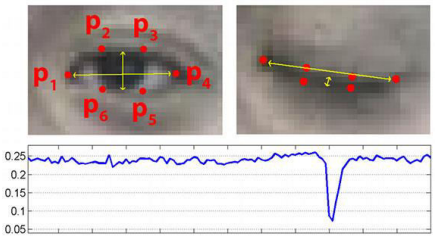

Fig 5.2 Eye Coordinates representation

5.3 DROWSINESS DETECTION

- This module will be monitoring the eye aspect ratio.
- If the value falls and does not increase than the threshold value for a fixed duration, then it will be detected as drowsiness.
- Finally, the alarm sound will be generated to alert the driver to wake him up.

5.4 THEFT IDENTIFICATION

- In this module, the authenticated persons image will be trained by using deep learning.
- Then the person's face which is detected in the webcam is compared with the pre-trained images.
- If it does not matches with the pre-trained authenticated person's image then it will be considered as unknown person.
- Then immediately an alert message will be sent to the authenticated persons.

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VI. EXPERIMENTAL RESULTS

6.1 OPENCV

OpenCV is the most popular library for computer vision. Originally written in C/C++, it now provides bindings for Python.

OpenCV uses machine learning algorithms to search for faces within a picture. Because faces are so complicated, there isn't one simple test that will tell you if it found a face or not. Instead, there are thousands of small patterns and features that must be matched. The algorithms break the task of identifying the face into thousands of smaller, bite-sized tasks, each of which is easy to solve. These tasks are also called classifiers

For something like a face, you might have 6,000 or more classifiers, all of which must match for a face to be detected (within error limits, of course). But there in lies the problem: for face detection, the algorithm starts at the top left of a picture and moves down across small blocks of data, looking at each block, constantly asking, "Is this a face?Is this a face?" Since there are 6,000 or more tests per block, you might have millions of calculations to do, which will grind your computer to a halt.

Like a series of waterfalls, the OpenCV cascade breaks the problem of detecting faces into multiple stages. For each block, it does a very rough and quick test. If that passes, it does a slightly more detailed test, and so on. The algorithm may have 30 to 50 of these stages or cascades, and it will only detect a face if all stages pass.

The advantage is that the majority of the picture will return a negative during the first few stages, which means the algorithm won't waste time testing all 6,000 features on it. Instead of taking hours, face detection can now be done in real time.

6.2 FACE DETECTION

In recent times, a lot of study work proposed in the field of Face Recognition and Face Detection to make it more advanced and accurate, but it makes a revolution in this field when Viola-Jones comes with its Real-Time Face Detector, which is capable of detecting the faces in real-time with high accuracy.

Face Detection is the first and essential step for face recognition, and it is used to detect faces in the images. It is a part of object detection and can use in many areas such as security, bio-metrics, law enforcement, entertainment, personal safety, etc.

It is used to detect faces in real time for surveillance and tracking of person or objects. It is widely used in cameras to identify multiple appearances in the frame and recognize them.

1. Knowledge-Based:

The knowledge-based method depends on the set of rules, and it is based on human knowledge to detect the faces. Ex- A face must have a nose, eyes, and mouth within certain distances and positions with each other. The big problem with these methods is the difficulty in building an appropriate set of rules. There could be many false positive if the rules were too general or too detailed. This approach alone is insufficient and unable to find many faces in multiple images.

2. Feature-Based:

The feature-based method is to locate faces by extracting structural features of the face. It is first trained as a classifier and then used to differentiate between facial and non-facial regions. The idea is to overcome the limits of our instinctive knowledge of faces. This approach divided into several steps and even photos with many faces they report a success rate of 94%.

3. Template Matching:

Template Matching method uses pre-defined or parameterized face templates to locate or detect the faces by the correlation between the templates and input images. Ex- a human face can be divided into eyes, face contour, nose, and mouth. Also, a face model can be built by edges just by using edge detection method. This approach is simple to implement, but it is inadequate for face detection. However, deformable templates have been proposed to deal with these problems.

4. Appearance-Based:

The appearance-based method depends on a set of delegate training face images to find out face models. The appearance-based approach is better than other ways of performance. In general appearance-based method rely on techniques from statistical analysis and machine learning to find the relevant characteristics of face images. This method also used in feature extraction for face recognition.

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6.3 EYE DETECTION

The camera can detect the face of the driver; we calculate the drowsiness level of the driver based on eye blink rate. For instance, if drivers blink their eyes more frequently, the authors assume that the drivers are drowsy. Thus, it is necessary for this paper to detect eyes accurately in order to calculate for eye blink frequency. The camera recognizes the difference between the normal eye blink and a drowsy eye. This helps in turn in reducing the false alarm regarding the same.

The eye parameter is essential that helps in detecting the state of the driver whether the driver is active, sleepy or drowsy. The eye detection is done by analyzing the rate at which the driver blinks his eye. There is a particular threshold value set that decides the drowsiness. It is a time taking process and once the detection is done the result is matched with the particular threshold value set. After the successful eye detection , if the system detects the driver drowsy or sleepy, an alert alarm is sent to the driver to prevent accidents or any other mishap. The further demonstration for the same is given in the paper for the same. We use a library called 'dlib' that helps in easy detection of face as well as the eye. We use a method called 'Euclidean Distance' to identify the distance between the eye lids that helps in detecting the drowsiness. A driver with small eyes, with a spectacles or any other feature can be easily detected with the help of this library.

Next, we need to define our sound_alarm function which accepts a path to an audio file residing on disk and then plays the file:

Drowsiness detection with OpenCV

```
def sound_alarm(path):
# play an alarm sound
playsound.playsound(path)
```

We also need to define the eye_aspect_ratio function which is used to compute the ratio of distances between the vertical eye landmarks and the distances between the horizontal eye landmarks:

Drowsiness detection with OpenCV

```
def eye_aspect_ratio(eye):
# compute the euclidean distances between the two sets of
# vertical eye landmarks (x, y)-coordinates
A = dist.euclidean(eye[1], eye[5])
B = dist.euclidean(eye[2], eye[4])
# compute the euclidean distance between the horizontal
# eye landmark (x, y)-coordinates
C = dist.euclidean(eye[0], eye[3])
# compute the eye aspect ratio
ear = (A + B) / (2.0 * C)
# return the eye aspect ratio
return ear
```

The return value of the eye aspect ratio will be approximately constant when the eye is open. The value will then rapid decrease towards zero during a blink.

If the eye is closed, the eye aspect ratio will again remain approximately constant, but will be much smaller than the ratio when the eye is open.

6.4 DROWSINESS DETECTION

A countless number of people drive on the highway day and night. Taxi drivers, bus drivers, truck drivers and people traveling long-distance suffer from lack of sleep. Due to which it becomes very dangerous to drive when feeling sleepy.

The majority of accidents happen due to the drowsiness of the driver. So, to prevent these accidents we will build a system using Python, OpenCV, and dlib which will alert the driver when he feels sleepy.

After the detection of eye blink, if the closure of eye lids extends to certain duration, It will be detected as drowsiness and an alarm sound will be generated to warn the driver and wake up from sleepiness.

6.5 THEFT CONTROL

The another issue for the vehicle owners is the theft of the vehicle in the parking areas. To control this theft control system has been implemented. The authenticated user's face has been trained and labeled. When the camera starts capturing the video stream, the face will be located.

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The face which is detected in the video stream will be compared with the pre-trained images. If it does not match immediately an alert message will be sent to the authenticated person's mail.

VII. CONCLUSION

Here we have proposed a system that provides solution to the road accidents due to drivers drowsiness and also to safeguard the vehicle from theft. The system first identify the face which is captured in the video frame. Then it extracts the eye region from the face using EAR to identify the state of eyes whether it is open or close. If it detects the drowsiness an alert sound will be generated to alert the driver. And it also prevents the vehicle theft by recognizing the unknown faces by comparing it with the pre-trained authenticated drivers face. If it has been detected as unknown face, immediately an alert message will be sent to the authenticated persons. Hence the proposed system will reduce the road accidents because of drivers drowsy and also control the vehicle theft.

VIII. FUTURE WORKS

When it is about a life of a human being, a decision should not be taken which is not 100% reliable. The system is still in development and experimentation. In this stage, it can only be used as a driving companion. Also, the method itself is still time consuming to reach its decision and sometimes can give a false decision (concerning the experiments which can happen in rare case) as it depends only one physical symptom. Further developments of the system with other physical signs of drowsiness (i.e. skin tone analyze, grip pressure measurement etc. It has already begun and a hopeful outcome can be expected.

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