

Development of Alert System using Viola Jones and KNN Algorithm for Safe Driving

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Abstract- Everyone's life is valuable, but it is full of danger in perspective of road accidents, so there is a strong demand to take precautions. Road accidents are the most undesirable thing that happens to a driver, even though it takes place frequently. Drivers must keep their eyes open to prevent from unwanted accidents. Main reason for accidents is because of distractions and fatigue of driver. Due to this number of road accidents increases yearly. So, there is a strong need to develop an alert system for safe driving that will detect and inform the driver by giving an alert message and a high volume alarm, that definitely help in reducing the no. of road accidents. So for detecting fatigue and distractions a small high resolution camera is deployed in front of driver's face and it detects the eye movement of driver after detecting face. In first step it detects the face that whether it is a face or not and after it detects the movement of eye (left, right, up, down and closed). It extracts hog feature during the training of dataset and at a tracking time it also takes the hog feature and after evaluating system gives the notification.

Keywords:- Vision Cascade Object Detector, Viola Jones Algorithm, k-Nearest Neighbors (KNN) Classification model, Hog features

I. INTRODUCTION

According to data [1] on road accidents driver fatigue and distraction is main cause of road accidents happen. Report shows that the annual death from road accident is four times more than the terrorism. Across the globe, many countries are wanted to solve this main issue of driver's safety problem. One of the solutions to decrease the number of road accidents is by developing an alert system. In this paper, we want to develop an alert system which uses high resolution camera to detect the driver distraction and fatigue condition.

The distraction and fatigue assessment is mainly based on real-time face (eye movement) recognition [2]. The exciting approach for this project is to design a system for drivers for safe driving is mainly based on visuals (eye movement) information. By only limiting to the methods of visual information, it helps in reducing the time complexity of collecting and integrating the information from many devices (sensors) and also decreases the cost on that device (sensors). This project main motive is to contribute in decreasing the number of road accidents and also reducing the various effects (social economic) like property cost, medical cost, repairing cost of vehicle or losing the household.

II. PRELIMINARY

2.1 Matlab

MATLAB is a numerical computing environment and programming language developed by MathWorks. MATLAB allows manipulations of matrix, Function plotting and data plotting, algorithms implementations, development of user interfaces, and enabling the programs in any other languages, such as C++, Java, Fortran, C, and Python to do interfacing. Although MATLAB focusses mainly for numerical computing, MuPAD is a symbolic engine which is mainly used by an optional toolbox, letting direct access to computing abilities mainly symbolic. Simulink is an additional package which helps to add graphical simulation and model-based design for embedded systems. The application's of Matlab is constructing on basis of scripting language (MATLAB). Primarily uses of the MATLAB are mainly as a tool for computation in the fields of all engineering streams and for also executing the files that contain the code written in MATLAB. MATLAB includes the features of OO programming and provide us the library for large number of functions that are mainly mathematical such as linear algebra, integration and for solving differential equations. MATLAB has two important classes value and reference classes, depending on either the class handled as a super-class (for reference class). In MATLAB, graphical user interfaces can be programmed easily with the help of design environment (GUIDE) tool.

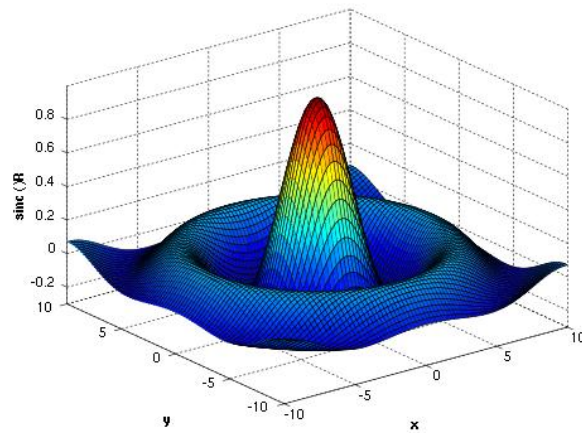


Figure 1: 3D Model

2.2 Image Acquisition Toolbox (IAT)

IAT help us by providing various blocks and functions that enable us to easily connect MATLAB® and Simulink® to cameras. It contains MATLAB applications that enable us to efficiently and effectively configure and detect various properties of hardware. Acquisition modes are enabled by the Toolbox such as processing of loop, triggering of various devices (mainly hardware), synchronizing acquisition across the various devices. IAT supports all important main standards and we can easily connect sensor such as Lidar to the cameras, grabbers, high scientific devices. IAT consists mainly three steps, first one is explore the image data, Second one is configure the image data, and finally the third one is acquire the image data

2.3 Camera

A camera is a very important instrument mainly in cases of face detection project (detecting for the movement of eye balls) which enable us to take in static image or to record dynamic images, which are captured in the various medium such as in a digital medium. The image camera is one of the basic instruments for capturing images that is produced later as one of the part of the photography's process, digital image processing, and photograph printing. A camera is mainly used in case of image classification or for extracting features by applying the various algorithms (Extract Hog Feature) on captured images

III. PROPOSED APPROACH

The following part describes about the various aspects of project that is considered in implementation part of program. It contains various tools and functional requirements used. Following figure shows flowchart of the project.

3.1 Image Acquisition

It basically involves taking the image of driver that can be taken with the help of high resolution Camera and dividing into different frames. It takes 50 images for each different folder i.e. Left, Up, Right, Down, Stop.

3.2 Face and Eye Detection

By the help of Vision of CascadeObjectDetector, it detects faces and any other objects if it is present. It takes the LEFTEYECART model that is mainly focuses on movement of left eye ball.

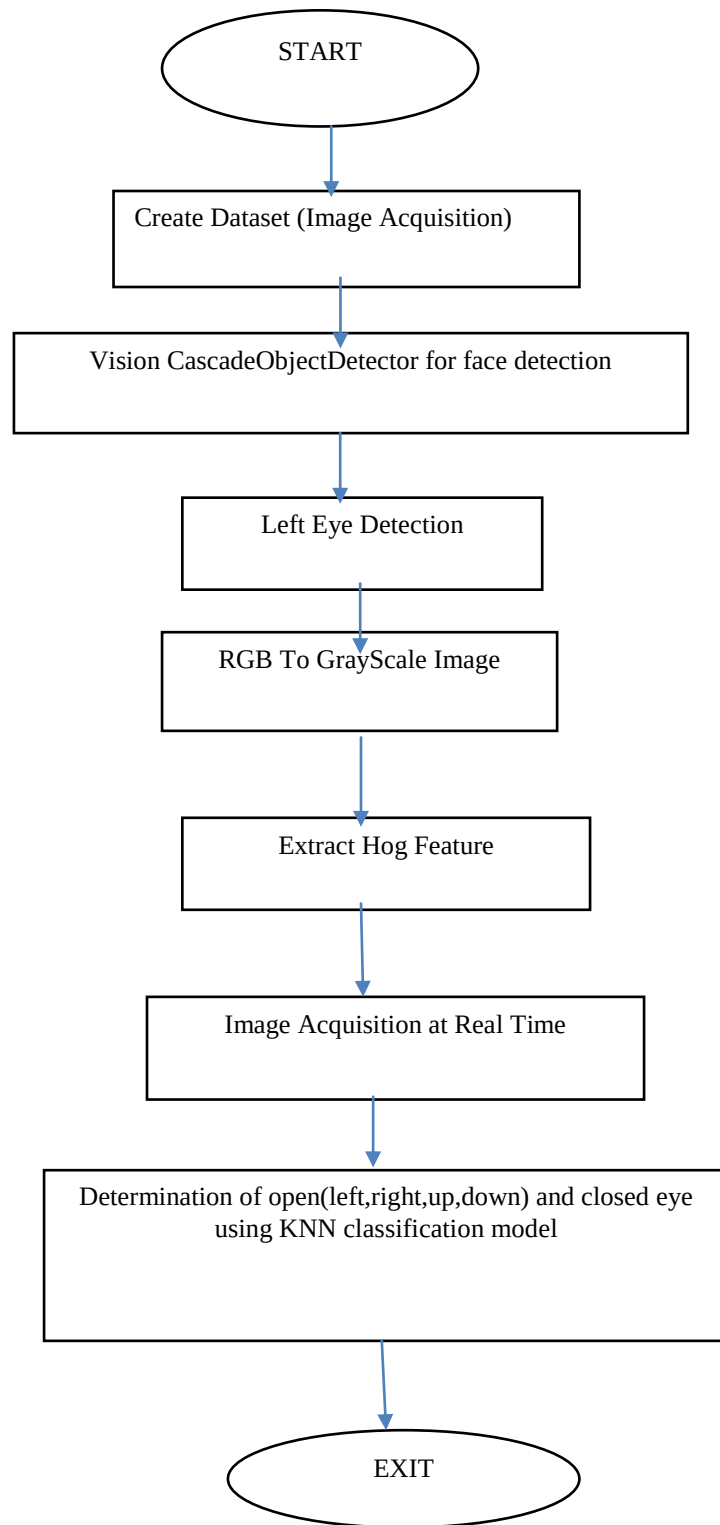


Fig. 1 Flow Chart of the proposed system

3.3 RGB to Grayscale Image

It converts the image which is in RGB form to Grayscale image so that it reduces the effect of background and colour combination.

3.4 Extract Hog Feature

It extracts hog feature which is histogram of oriented gradients which is used by system for evaluation of image. It converts large information of image into the condensed form that contains only important things.

3.5 Determination of Open and Closed Eye

At the time of tracking Image is acquired at the real time and with the help of k-Nearest Neighbors (KNN) classification model and it evaluates the hog feature of present dataset images to the

Hog features of the Images acquired at real time and then give the alert message on screen with the high volume alarm. It reduces the Time complexity because it cannot collecting information from various sensors, it only based on the visual information.

IV. RELATED WORK

Some of the new project worked in the developing the technological tools for monitoring of the driver [2,3,4]. Researches have been done for avoiding such major causes for the road accidents like driver fatigue and distraction [4]. Some of the organisations using number of ways and technology to solve one of the major concerns. Some of the projects use multiple cameras for recognizing the face of driver's especially eyeball movement [2,4]. Some projects uses rotation of head and various gestures of head, expressions of face for obtaining fatigueness and drowsiness of driver [4,5,6]. One of the research papers describes an eye opening and closing state and also the consequences of drowsiness and fatigue of vehicular driver and also describes the physiological state of drowsiness. Some of the project sing some other solutions like identify the intensity of drowsiness and fatigue, they monitor the rate of closing of eyes to accurately detect the fatigue in driving. Some of the project using various sensor devices and collecting the visual information and after that integrating the information and gives the output, but it has very high amount of time complexity which is one of the major concern.

In Heitmann [4] described that to monitor the movement of head and eye for giving the alert to the driver on the basis of the variation that has been recognized. In ikwon park, provide a way for calculating the rate of blinking of eye under various conditions (Such as night or the day) for detection of system for drowsiness. By calculating the level of fatigue and drowsiness with the help of rate of blinking of eye, it is one of the solutions of detecting positions of eye and measuring the eye lid movements.

In implicit sensing and notification technique [7] paper an Adaptive alert system that used techniques that are mainly (passive) for taking features that are mainly physiological from the user, and a display for head-up actuator that takes pre-processed attaining the data about user drowsiness and distraction. It uses suitable solution of hardware and software for proposed system using various devices like sensors that is depend on vision display that is mainly head up.

V. EXPERIMENTAL ANALYSIS

5.1 Dataset

Human can interacts to the system by creating dataset to identify the person while drive the vehicle for the system. Person can make datasets before driving through camera which is fixed with front mirror of car. System takes 50 images from the camera in different directions of eyes and saves in groups.

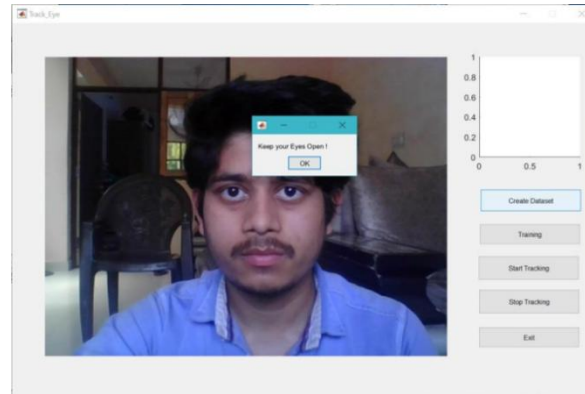


Figure 3: Ready to create dataset with caution to open eyes.

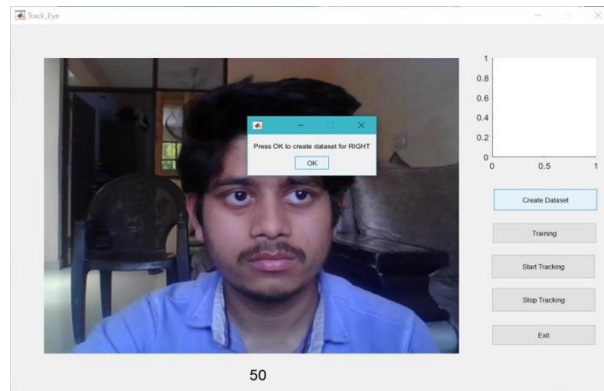


Figure 4: Create dataset of eye movement in different directions.

5.2 Training

After creating dataset on the basis of movement of eyes in different directions system. System extract image RGB to Grayscale format and then detects face and eyes from the images by Viola-Jones Algorithm. This algorithm has four stages for training:

1. Haar Feature Selection
2. Creating an Integral Image
3. Adaboost Training
4. Cascading Classifiers

5.3 Haar Features

- On the Earth, all human faces share some properties that are very similar. Property like
- The nose looks like bridge region is brighter than the eyes on face.
- The eye portion is darker then upper cheeks portion.

Set of these properties make facial feature like:

- On the basis of size and location: nose, mouth, eyes
- On the basis of value: pixel intensities

Rectangle features:

- Value of rectangle feature = Σ (black area pixels) - Σ (white area pixels)
- Rectangle types: 2-rectangle, 3-rectangle, 4-rectangles and in case of Viola & Jones algorithm it uses two-rectangle features.
- For example: the difference between white and black rectangle over a specific region has different colour and brightness
- Each feature is equivalent to a special location in the sub-window.

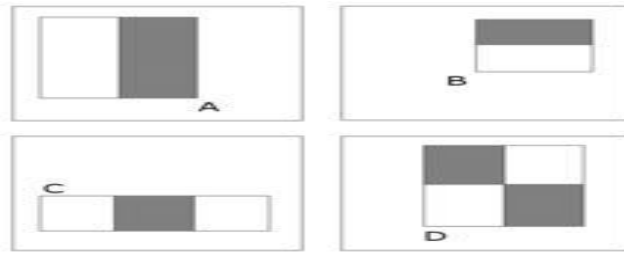


Figure 5. Example rectangle features shown relative to the enclosing detection window

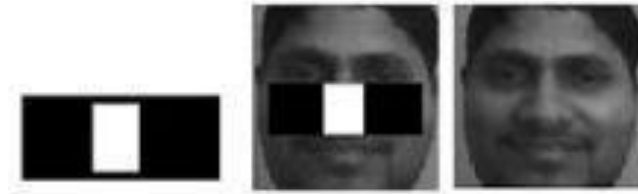


Figure 6. Haar Feature that appears similar to the bridge of the nose is applied onto the face

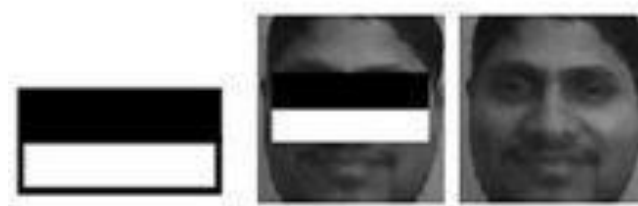


Figure 7. Haar feature similar to eye region

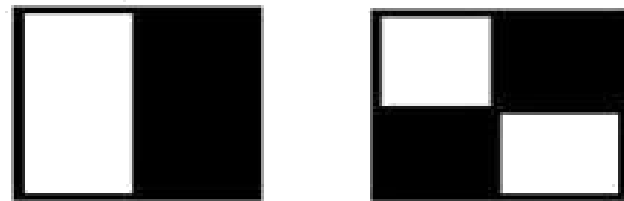


Figure 8 Both are kind of Haar Feature

5.4 Integral Image

Integral image that evaluates rectangular features in constant time i.e. equal time for same area, which gives them a considerable speed and advantages over sophisticated features that may be come because each rectangle shaped area is always alongside to at least one rectangle feature so it is very useful.

5.5 Adaboost Training

AdaBoost algorithm is to both selects the best feature in all to train classifiers form the array that use. Adaboosting consists of Adaptive Boosting in which constructs a “strong” classifier with the help of combination of weight and simple “weak” classifier.

5.6 Cascade architecture

- 0.01% of all in sub windows are +ve faces.
- Equal computation time is spent on all Sub windows
- 100% detection rate can take by only 2-feature classifier.
- Mostly first layer filter most negative window from the array from that classifier.
- Eight features contains in second layer try solve negative window in first layer and so on to all

In cascading, each stage consists of a strong classifier. So all the features are grouped into several stages where each stage has certain number of feature so it makes it better..

For cascade training simple framework is:

- A = min. adaptable detection rate / layer.
- B = max. adaptable false +ve rate/ layer.
- M = set of negative examples.
- S = set of +ve example.
- R_{target} = target overall false +ve rate.
- $A(0) = 1.0$;
- $F(0) = 1.0$;
- $i = 0$
- while $H(i) > R_{target}$
- increase M_i
- $T(i) = 0$; $H(i) = H(i-1)$
- while $H(i) > B \times H(i-1)$
- increase $M(i)$
- use S and M to train a classifier with $M(I)$ features using AdaBoost
- decrease threshold for the i^{th} classifier until the current cascaded classifier has a detection rate of at least $S \times A(i-1)$ (this also affects $H(i)$)
- Evaluate current cascaded classifier on validation set to determine $H(i)$ and $A(i)$ both concurrent
- $N = \emptyset$.
- if $H(i) > R_{target}$ then evaluate the current cascaded detector in the set of non-face images and put any false detection into the set M .

5.7 Cascade Object Detector

Vision.CascadeObjectDetector is use by some pre-trained classifiers for recognised faces, noses, mouth and the upper body that are not sufficient for a specific application. This is overcome by CascadeObjectDetector in Computer Vision Toolbox. This is a function use to train a custom classifier.

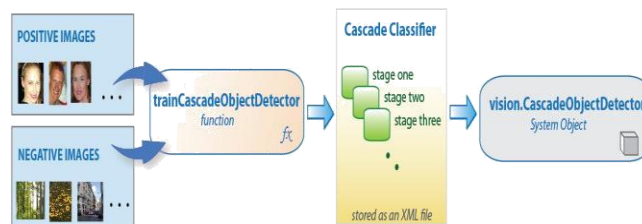


Figure 9. Cascade Classifier

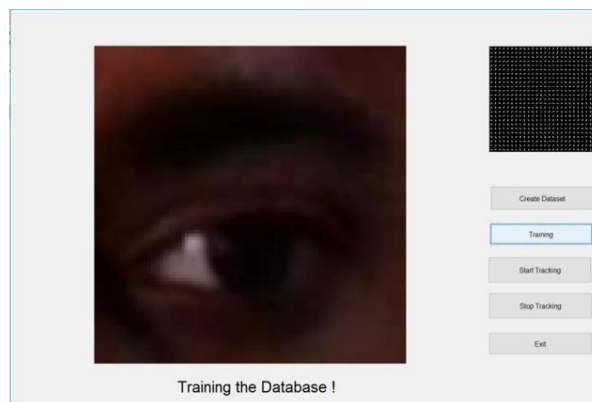


Figure 10: System training the Database automatically.

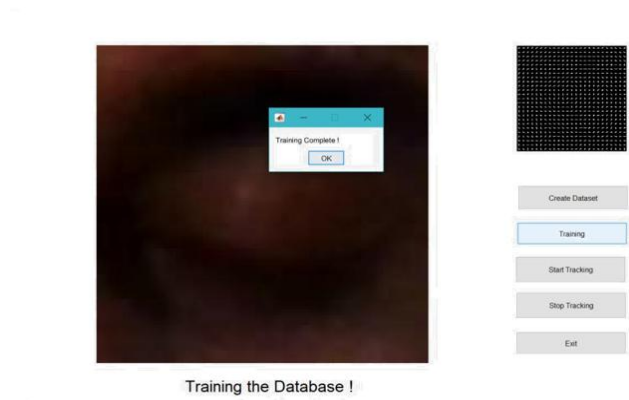


Figure 11: Alert after training database successful.

5.8 Experimental Results

After successful training dataset System track eyes movement continue while driving through camera. System alerts to the driver according the direction of eyes. If driver see in same direction for many times it alert that you are seeing in this direction. If driver's eye closes it gives alert to stop the vehicle.

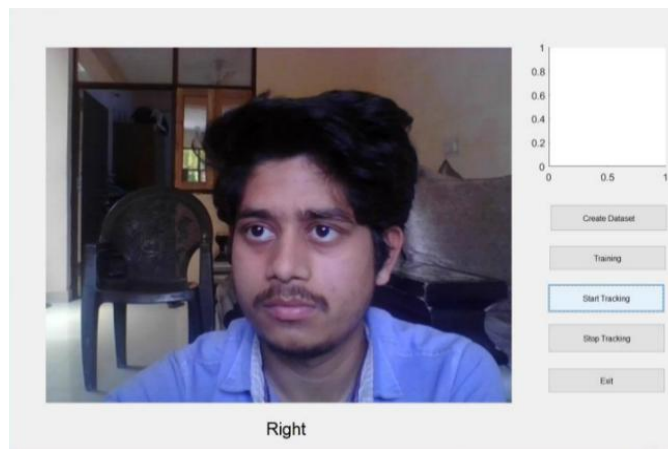


Figure 12: Right



Figure 13: Left

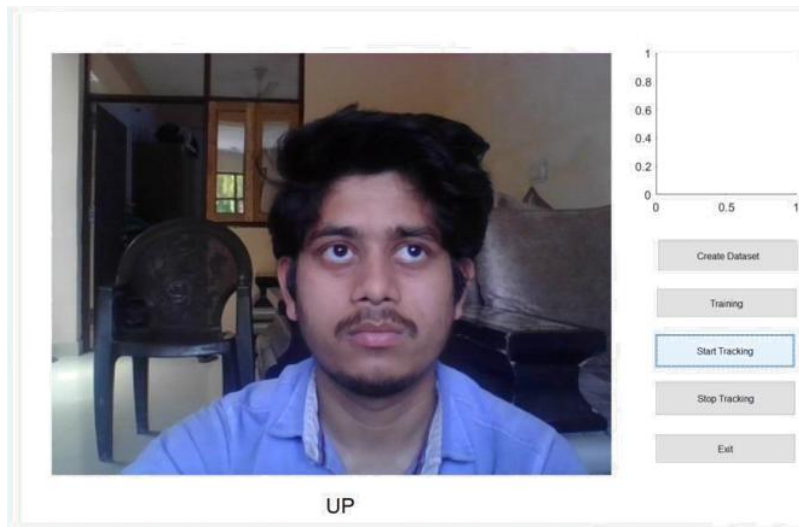


Figure 14: Up

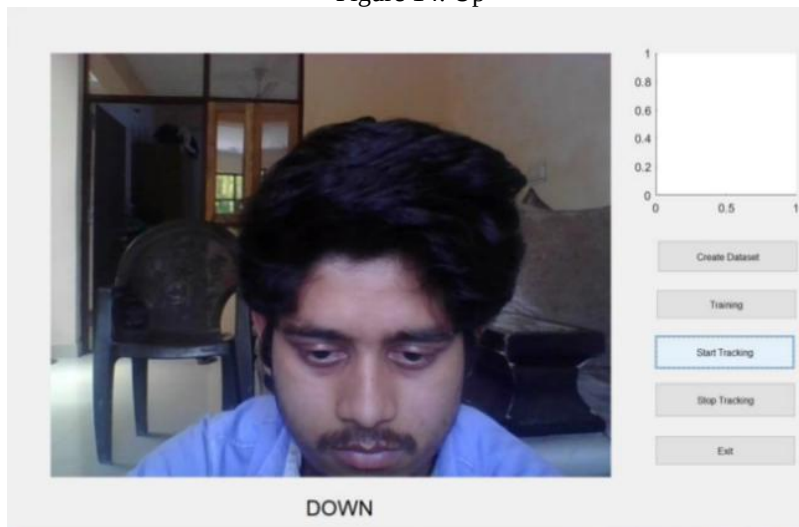


Figure 15: Down



Figure 16: Stop

VI. CONCLUSION

The study has given the reliable and accurate results in applying the Alert system for driver based on VIOLA JONES [8, 9] and KNN algorithm. This alert system is based on camera vision that has been presented in this paper. This system uses visual features (Haar Features) to analyze and to detect driver's eye at real time driving situations. We have performed these experiments in the four wheel vehicle with different drivers. The implemented project enable us an efficient detection of the indicators mainly movement of eyeballs and head movement that appears in case of fatigue and drowsiness condition, as long as the measurements are carried out under the predefined conditions.

VII. REFERENCES

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