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Driver's Sleep Detection

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Abstract - God has granted each and every individual a beautiful gift called life, so it is our responsibility to live our life to fullest and try to stay safe from the dangers of the world. With the rapid growth of automobiles and technologies, we can't ignore the risks associated with its "Accidents". There's never a fixed cause of accidents, they can be caused due to human errors, human distraction, human carelessness, or sometimes mechanical problems. Nowadays much of the attention is paid towards drivers driving their cars after consuming alcohol, in this project we're going to focus on the other factor that is sleepiness or drowsiness of drivers while driving. This Sleep Detection system is created with the help of machine vision-based concepts. In order to detect fatigue or drowsiness of drivers, a small camera has been placed directly pointing towards the driver's face that detects the condition of the driver. Firstly, the system detects the face and then detects the eyes and crops the eye portion to calculate the form factor, this form factor is later used as a reference to compare it with other form factors of the samples. Based on this comparison we'll decide the condition of eyes (open/close). We've incorporated certain safety and recovery mechanisms in our project, so once the system detects the driver is asleep it will produce a warning tone, vibrations and eventually work on stopping the automobile. To get precise results of whether the driver is falling asleep or not, we'll take a collection of samples in a loop for the corresponding classification. Within a time limit, the system gives information that the driver is getting unconscious and there is a need to alert him/her.

Key Words: *Viola-Jones algorithm, Arduino UNO, Form Factor, Vision Cascade Object Detector, Image Acquisition.*

1. INTRODUCTION

According to a recent survey, driver's drowsiness accounts for 25% road accidents and around 60% of road accidents result in death or serious injuries. Based on these statistics we need to create a system that monitors the physical attributes of the drivers while driving. Various experiments have been conducted earlier with regard to the sleep detection of the driver. In the past few years, many countries became curious to pay high attention towards driver's safety problems. Researchers have been making various efforts to invent techniques for the detection of the drowsy driver such as monitoring of road and physiological techniques which require the contact of the electrode with our body parts like chest, face making it an implantable method. In this thesis, we described the direct method which can detect drowsiness without any help of electrode using various detection functions.

2. LITERATURE SURVEY

Department of Electrical and Computer- Hakim Sabzevari University of sabzevar, published a paper on the Real-Time Intelligent Alarm System of Driver Fatigue Based on Video Sequences. The objective was to conduct the detection process by recording the video sequence of the driver's and image processing techniques. The technique involved was Skin segmentation using HSV /YCbCr color spaces + Voila Jones algorithm. Its advantages were high accuracy in segmentation, low error rate and quick processing of input data and future work included improving the algorithm further.

Foundation of Computer Science FCS, New York, USA, published a paper on Drowsiness Detection based on Eye Movement. The objective was to reduce the number of accidents and therefore improve the worsening road conditions. The technique involved was Haar classifier. Its advantages were can predict position by observing a change, in contrast, so cost-effective and the future work included improving the algorithm further.

Technical University of Szczecin Poland Department GE&II, IUT de Troyes, France2009, published a paper on Robust Algorithm for Eye Detection on Gray Intensity Face without Spectacles. The objective was to present a robust eye detection algorithm for gray intensity images. The technique involved was storing a template of eyes and matching with the existing templates. Its advantages were detection accuracy is 95.2%. In addition, the average execution time of the proposed algorithm shows that this approach is also quite efficient and the future work included finding the method which can work well with faces with spectacles.

3. HARDWARE & SOFTWARE COMPONENTS

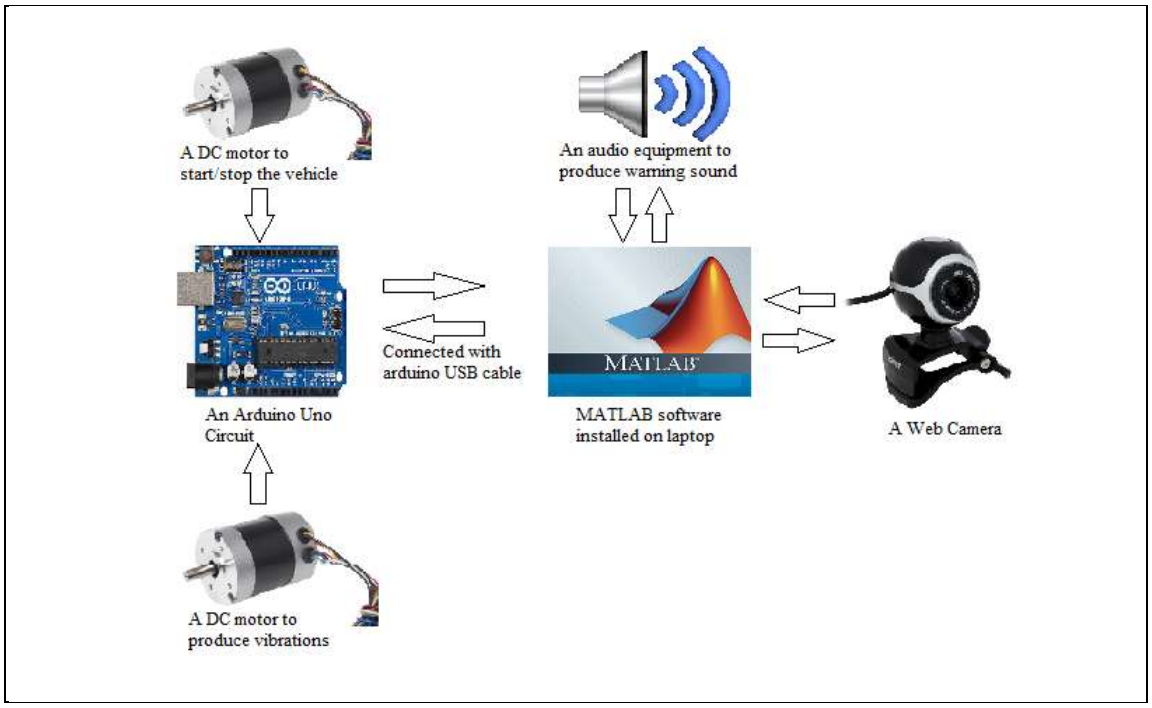

Fig -1: Hardware and Software Connection setup

4. PROPOSED WORK

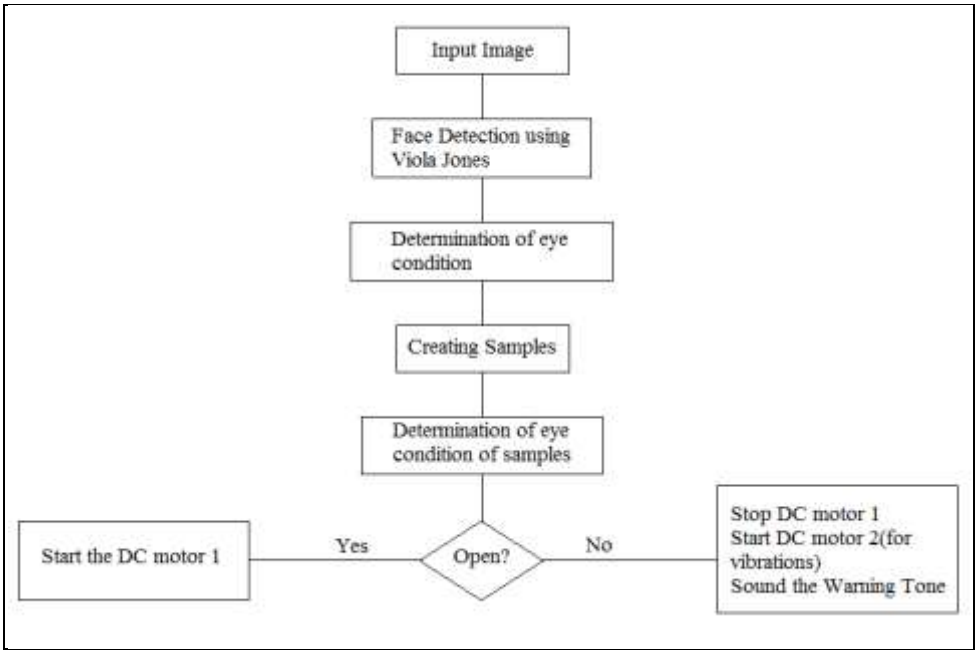

Fig -2: A Flowchart of the algorithm

i. Image Acquisition

The first task is to obtain an image of the Automobile driver. We can get these images with the help of a camera installed in front of the driver. The live image is taken as its input and then it converts those images into the series of images that are further processed to make various operations.

ii. Face Detection

Face detection activity takes one of the frames at a time't' from frame grabber which later tries to detect the face of the Automobile driver in every frame. And it can be done with the help of Vision Cascade samples.

iii. Eye Detection

Next, we need to detect the eyes of the automobile driver, the eyes detection can be done with the help of eyes detection function "vision.CascadeObjectDetector()" that uses Voila Jones Algorithm.

iv. Drowsiness Detection

Once the eyes of the Automobile driver are detected, the driver's sleepiness is classified on the basis of comparison of form factors of the samples with the reference form factor. If the form factor of samples is within specified range then the driver is awake else the driver is asleep.

v. Warning Mechanism

If the Automobile driver falls asleep, a warning tone and vibrations (with the help of DC motor2) are produced in order to wake up the driver.

vi. Security Mechanism

If the System detects that the Automobile driver is asleep it Stops the vehicle (by stopping the DC motor1) to minimize accidents

5. PROBLEMS ASSOCIATED WITH PROJECT

The fact that the eyes are closed or open in one image doesn't mean the driver is sleeping or awake. The driver might blink or turn his head left and right which will reflect on the detected state.

To overcome this problem we decided to judge the state of the driver using a ratio of the open and closed images.

Samples = 4
Ratio = Eyes open frames / Eyes closed frames
If the ratio is >= 2, the driver is awake.
If it's lower, the driver is sleeping

6. RESULTS

i. Form Factor

The System display's "open your eyes" and calculates initial values of Form Factors.

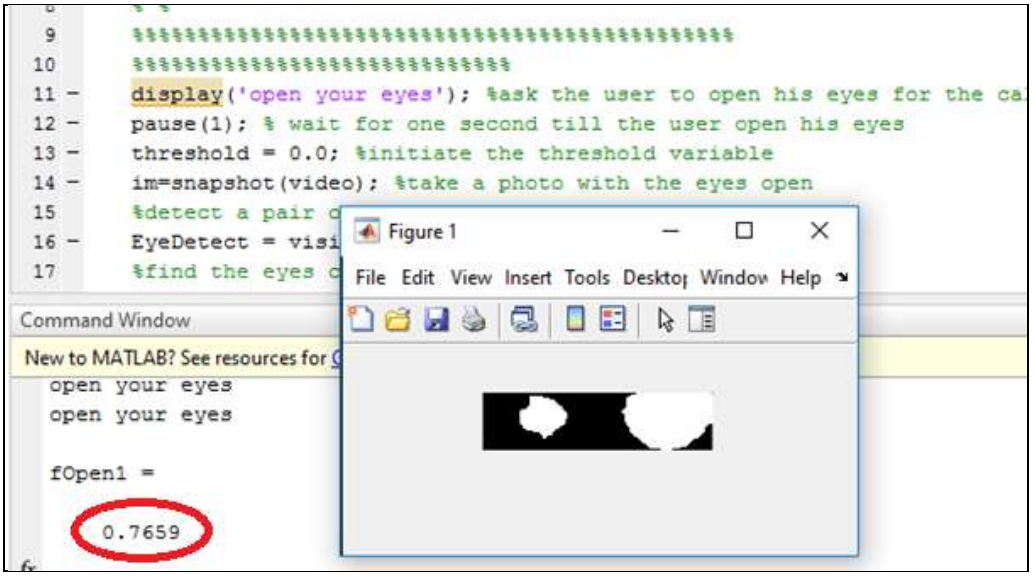

Fig -3: Image shows the value of initial Form Factor 1 used as a reference

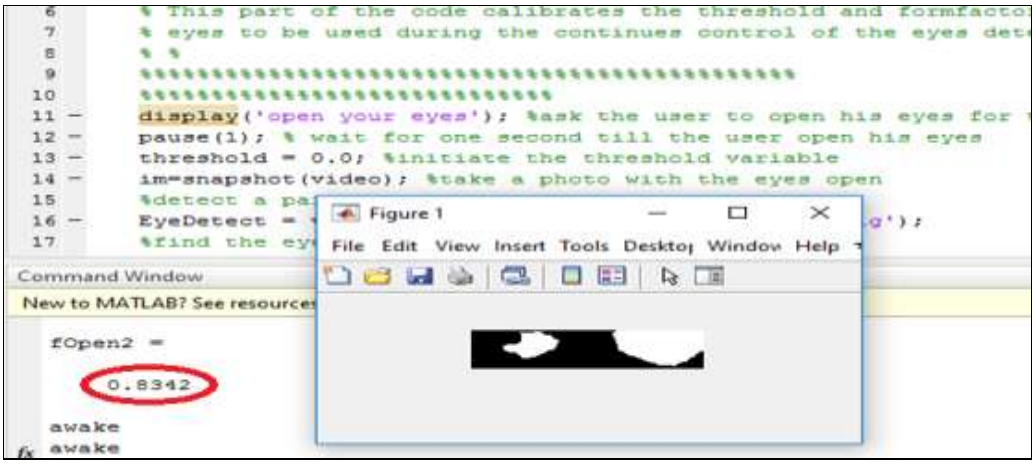

Fig -4: Image shows the value of initial Form Factor 2 used as a reference

ii. Classification of Awake or Sleep

The System compares the values of the Form Factor of samples with the initial Form Factor and based on that comparison it classifies the state of the automobile driver (Awake/Sleep).

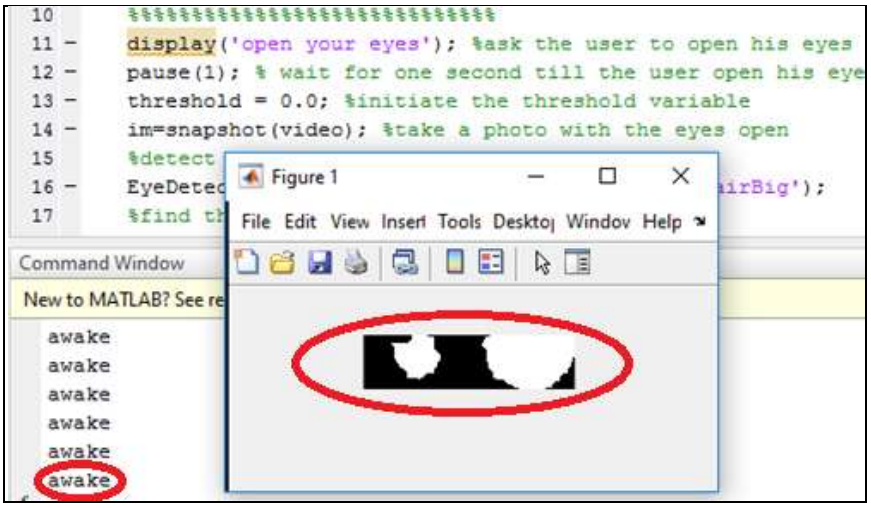

Fig -5: Image shows that the system detects the driver is awake

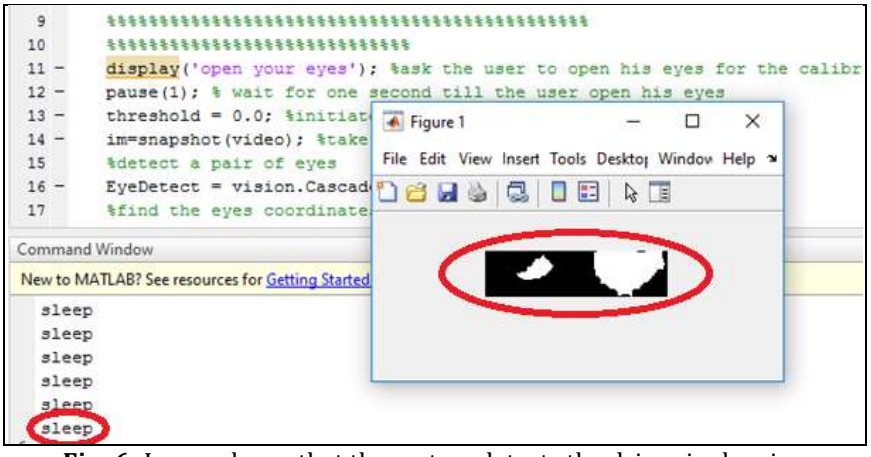

Fig -6: Image shows that the system detects the driver is sleeping

7. CONCLUSION

An image will be processed with the help of the Viola-Jones Algorithm. In the first step, the face is detected with the help of high-quality Web-Camera installed in front of the driver and then the eyes are sectioned and are processed to detect drowsiness/fatigue. With the help of the form factor, we determine the condition of the eyes. The obtained image is then cropped with the help of the 'imcrop( )' command in MATLAB. The colored image is converted into a grey scale image using 'rgb2grey( )' function. The accuracy of the system depends on the quality of the Web-Camera. The processing time is increased with the 'snapshot( )' function in MATLAB. By defining the region of interest for detection is done by using the Viola-Jones Algorithm in order to reduce the computational requirements of the system. Using MATLAB Image processing tools, the sleep detection system can be explained.

LIMITATIONS

Limitations of the proposed system are as follows:

1. If the driver is using sunglasses then the computation doesn't work.
2. If there is the striking light directly on the web-camera the system doesn't work.

FUTURE WORK

Due to the scope of the project, we did not have access to an actual car, so we simulated our system using an Arduino UNO circuit and a couple of DC motors. The control specifics of the systems were a big question from the start. Should the car come to a complete stop, how long should the delay between the eyes closing and the system reaction? At what rate should the car slow down? Should the car pull over, or keep its lane? In a suburban or urban area, the car needs to slow down fast since there could be pedestrians nearby, while on a highway stopping too fast would pose a danger to the other drivers. So we need to focus on the following aspects of our future work. Currently, we decided to simulate an urban setting, where the car needs to stop quickly if the driver does not maintain control of the car.

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