International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

DRIVER DROWSINESS MONITORING SYSTEM USINGMACHINE LEARNING

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ABSTRACT

Drowsy driving is one of the major causes of road accidents and death. Hence, detection of driver‟s fatigue and its indication is an active research area. Most of the conventional methods are either vehicle based, or behavioural based orphysiological based. Few methods are intrusive and distract the driver, some require expensive sensors and data handling. Therefore, in this study, a low cost, real time driver‟s drowsiness detection system is developed with acceptable accuracy. In the developed system, a webcam records the video and driver‟s face is detected in each frame employing image processing techniques. Facial landmarks on the detected face are pointed and subsequently the eye aspect ratio, mouth opening ratio and nose length ratio are computed and depending on their values, drowsiness is detected based on developed adaptive thresholding.

1. INTRODUCTION

Fatigue and loss of vigilance (hypovigilance) among the drivers are very common problems. This problem assumes even acute significance for long-haul logistics drivers. These risks can potentially translate into hazardous accident situations. During the last few years, researchers have developed many hardware and software-based techniques to avoid such risks [1]. In particular, an effort has been to develop techniques for automated monitoring of the drivers' activities. These systems have the ability to provide intelligent feedback and generate alert messages to the drivers for recognition the uncontrollable situations. According to a report published by World Health Organization (WHO) [2], more than 1 million people lose their lives due to traffic accidents, and approximately 50 million more get injured causing severe disabilities.

OBJECTIVE

In particular, more than seven thousand death and thirty-eight thousand injuries are recorded due to road accidents every year in Kingdome of Saudi Arabia (KSA). The development of real-time driver fatigue detection and prediction system is a challenging task related to computer vision technologies. In such systems, detection of low vigilance and high fatigue level results in the generation of alerts and warnings to the driver about his/her poor state of driving through an alarm.

PROBLEM STATEMENT

In this system we try to apply multi class SVM Algorithm along with face recognition techniques to find out the visual pattern of driver and detect the current state of driver while driving. If this type of

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ISSN: 2457-0362

application is deployed successfully then there are a lot of accidents reduced in real world.

2. LITERATURE SURVEY

INRODUCTION

Literature survey is the most important step in software development process. Before developing the tool, it is necessary to determine the time factor, economy and company strength. Once these things are satisfied, ten next steps are to determine which operating system and language used for developing the tool. Once the programmers start building the tool, the programmers need lot of external support. This support obtained from senior programmers, from book or from websites.

Before building the system the above consideration r taken into for developing the proposed system.

Related Work

1. W. B. Horng, C. Y. Chen, Y. Chang, C. H. Fan, "Driver Fatigue Detection based on Eye Tracking and Dynamic Template Matching", IEEE International Conference on Networking,, Sensing and Control, Taipei, Taiwan, March 21-23, 2004.

A vision-based real-time driver fatigue detection system is proposed for driving safely. The driver's face is located, from color images captured in a car, by using the characteristic of skin colors. Then, edge detection is used to locate the regions of eyes. In addition to being used as the dynamic templates for eye tracking in the next frame, the obtained eyes' images are also used for fatigue detection in order to generate some warning alarms for driving safety. The system is tested on a Pentium III 550 CPU with 128 MB RAM. The experiment results seem quite encouraging andpromising. The system can reach 20 frames per second for eye tracking, and the average correct rate for eye location and tracking can achieve 99.1% on four test videos. The correct rate for fatigue detection is l00%, but the average precision rate is 88.9% on the test videos.

2. B. Alshaqaqi, A. S. Baquhaizel, M. E. A. Ouis, M. Bouumehed, A. Ouamri, M. Keche, "Driver Drowsiness Detection System", IEEE International Workshop on Systems, Signal Processing and their Applications, 2013.

Drowsiness and Fatigue of drivers are amongst the significant causes of road accidents. Every year, they increase the amounts of deaths and fatalities injuries globally. In this paper, a module for Advanced Driver Assistance System (ADAS) is presented to reduce the number of accidents due to drivers fatigue and hence increase the transportation safety; this system deals with automatic driver drowsiness detection based on visual information and Artificial Intelligence. We propose an algorithm to locate, track, and analyze both the drivers face and eyesto measure PERCLOS, a scientifically supported measure of drowsiness associated with slow eye closure.

3. A. Abas, J. Mellor, and X. Chen, "Non-intrusive drowsiness detection by employing Support Vector Machine," 2014 20th International Conference on Automation and Computing (ICAC), Bedfordshire, UK, 2014, pp. 188- 193.

3 .SYSTEM ANALYSIS

FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a

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very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out.

This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are :

- ECONOMICAL FEASIBILITY
- TECHNICAL FEASIBILITY
- SOCIAL FEASIBILITY

ECONOMICAL FEASIBILITY:

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited.

The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

TECHNICAL FEASIBILITY:

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

SOCIAL FEASIBILITY:

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it.

His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.

EXISTING SYSTEM3.3EXISTING SYSTEM

Generally, the existing methods to detect drowsy drivers are classified in three types;

1. Vehicle Based,
2. Behavioural Based and
3. Physiological Based.

In vehicle-based method, a number of metrics like steering wheel movement, accelerator or brake pattern, vehicle speed, lateral acceleration, deviations from lane position etc. are monitored continuously. Detection of any abnormal change in these values is considered as driver drowsiness. This is a nonintrusive measurement as the sensors are not attached on the driver. In behavioural based method, the visual behaviour of the driver i.e., eye blinking, eye closing, yawn, head bending etc. are analysed to detect drowsiness. This is also nonintrusive measurement as simple camera is used to detect these features,but this type of application is not present in the current system. In physiological based method,

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the physiological signals like Electrocardiogram (ECG), Electrooculogram (EOG), Electroencephalogram (EEG), heartbeat, pulse rate etc. are monitored and from these metrics, drowsiness or fatigue level is detected.

This is intrusive measurement as the sensors are attached on the driver which will distract the driver. Depending on the sensors used in the system, system cost as well as size will increase.

LIMITATION OF EXISTING SYSTEM

1. More Time Delay in finding the drowsiness state of driver
2. It is very costly to deploy sensors physically for the drivers.
3. There is no accurate technique or method which can find out the drowsiness based on his visual pattern.
4. There is always monitored manually and if any abnormal change is present in driving state, then drowsiness is estimated.
5. This may not generate always accurate results.

PROPOSED SYSTEM

In this system at first, the video is recorded using a webcam. The camera will be positioned in front of the driver to capture the front face image. From the video, the frames are extracted to obtain 2-D images. Face is detected in the frames using histogram of oriented gradients (HOG) and linear support vector machine (SVM) for object detection. After detecting the face, facial landmarks like positions of eye, nose, and mouth are marked on the images. From the facial landmarks, eye aspect ratio, mouth opening ratio and position of the head are quantified and using these features and machine learning approach, a decision is obtained about the drowsiness of the driver. If drowsiness is detected, an alarm will be sent to the driver to alert him/her.

Advantages of the Proposed System

1. By using proposed application it takes less time Delay in finding the drowsiness state of driver
2. It is very less cost to deploy the application using software programming.
3. This will generate very accurate results to find out the drowsiness based on his visual pattern.
4. There is always identified from the user web camera which is attached in the laptop and if any abnormal change is present in driving state,then drowsiness is estimated.
5. This will generate always accurate results.

SYSTEM MODULES

DATA COLLECTION MODULE

A webcam (Sony CMU-BR300) is used to capture the footage, and the frames are captured and stored on a laptop. Following the extraction of the pictures, data processing methods are appliedto these 2D images. Synthetic driver data is currently being developed. The volunteers are instructed to look at the webcam while blinking their eyes, shutting their eyes, yawning, and bending their heads. The video is recorded for 30 minute

DETECTION OF FACES MODULE

The individual faces are identified first after the frames have been extracted. There are several online face recognition algorithms. A histogram of directed gradients (HOG) and the linear SVMsystem [10] are used in this analysis. Positive samples of a fixed window size are taken from the photographs and HOG descriptors are computed on them in this process. Following that, negative samples of the same size are taken (samples that do not include the

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requisite item to be observed, i.e., human face here) and HOG descriptors are measured. Typically, the number of negative samples far outnumbers the number of positive samples. Following the set of features for both groups, a linear SVM is trained for the classification role.

Hard negative mining is used to increase the precision of SVM. After testing, the classifier is checked on labelled results, and the false positive sample function values are used for training again. The fixed-size window is translated over the image for the test image, and the classifier computes the output for each window position. Finally, the full value output is used to identify the identified face, and a bounding box is drawn around it. This non-maximum suppression measure eliminates the overlapping and unnecessary bounding boxes.

4. SYSTEM REQUIREMENT SPECIFICATION

Functional Requirements

A functional requirement defines a function of a system or its components. Functional requirements may be calculations , technical details, data manipulation and processing and other specific functionality that defines what a system is supposed to accomplish the functional requirement specification documents the operation and activities that a system able to perform. Functional requirements include functions performed by specific screens, outlines of work flows performed by the system, and other business compliance requirements the system must meet. This project has three modules. There are SVM, LOGISTIC REGRESSION, and DECISION TREE.

Non Functional Requirements

Non-functional requirements define the overall qualities or attributes of the resulting System Non-functional requirements place restrictions on the product being developed, the development process, and specify external constraints that the product must meet. Examples of NFR include safety, security, usability, reliability and performance Requirements. Project management issues (costs, time, and schedule) are often considered as non-functional requirements.

Performance requirements

Requirements about resources required, response time, transaction rates, throughput, benchmark specifications or anything else having to do with performance. In this project, Data publisher (or data holder, who collects data from record owner ex. Alice and bob) and data miner or the public, called the data recipient and record owners like patients and doctors.

Modifiability

Requirements about the effort required to make changes in the software. Often, the measurement is personnel effort (person- months).

Portability

The effort required to move the software to a different target platform. The measurement is most commonly person-months or % of modules that need changing.

Reliability

Requirements about how often the software fails. The measurement is often expressed in MTBF (mean time between failures). The definition of a failure must be clear. Also, don't confuse reliability with availability which is quite a different kind of requirement. Be sure to specify the consequences of software failure, how to protect from failure, a strategy for error detection, and a strategy for

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correction.

Security

One or more requirements about protection of your system and its data. The measurement can be expressed in a variety of ways (effort, skill level, time) to break into the system. Do not discuss solutions (e.g. passwords) in a requirements document.

Usability

Requirements about how difficult it will be to learn and operate the system. Therequirements are often expressed in learning time or similar metrics.

Legal

There may be legal issues involving privacy of information, intellectual propertyrights, export of restricted technologies, etc.

HARDWARE REQUIREMENTS

- Hardware - Processor Core I3
- RAM - 4 GB (Minimum)
- Hard Disk - 500 GB
- Key Board - Standard Windows Keyboard
- Mouse - Optical Mouse

SOFTWARE REQUIREMENTS

- Operating system : Windows 7 Ultimate.
- Coding Language : Python with ML ALGORITHMS
- Front-End: Python.

5 .SYSTEM DESIGN

5.1 INPUT DESIGN:

Input Design plays a vital role in the life cycle of software development, it requires very careful attention of developers. The input design is to feed data to the application as accurate as possible. So inputs are supposed to be designed effectively so that the errors occurring while feeding are minimized. According to Software Engineering Concepts, the input forms or screens are designed to provide to have a validation control over the input limit, range and other related validations.

This system has input screens in almost all the modules. Error messages are developed to alert the user whenever he commits some mistakes and guides him in the right way so that invalid entries are not made. Let us see deeply about this under module design.

Input design is the process of converting the user created input into a computer-based format. The goal of the input design is to make the data entry logical and free from errors. The error is in the input are controlled by the input design. The application has been developed in user-friendly manner. The forms have been designed in such a way during the processing the cursor is placed in the position where must beentered. The user is also provided with in an option to select an appropriate input from various alternatives related to the field in certain cases.

Validations are required for each data entered. Whenever a user enters an erroneous data, error message is displayed and the user can move on to the subsequent pages after completing all the entries in the current page.

OUTPUT DESIGN:

The Output from the computer is required to mainly create an efficient method of communication within the company primarily among the project leader and his team members, in other words, the administrator and the clients. The output of VPN is

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the system which allows the project leader to manage his clients in terms of creating new clients and assigning new projects to them, maintaining a record of the project validity and providing folder level access to each client on the user side depending on the projects allotted to him. After completion of a project, a new project may be assigned to the client. User authentication procedures are maintained at the initial stages itself. A new user may be created by the administrator himself or a user can himself register as a new user but the task of assigning projects and validating a new user rests with the administrator only.

SYSTEM ARCHITECTURE

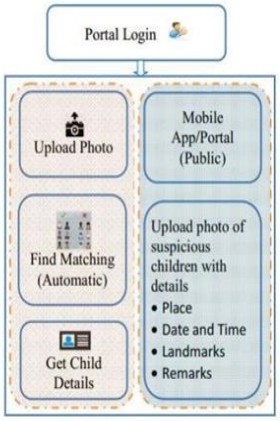

Figure 5.2 Represent the System Architecture

USECASE DIAGRAM

The use case diagram is used to identify the primary elements and processes that form the System.

The primary elements are termed as "actors" and the processes are called "use cases." The use case diagram shows which actors interact with each use case.

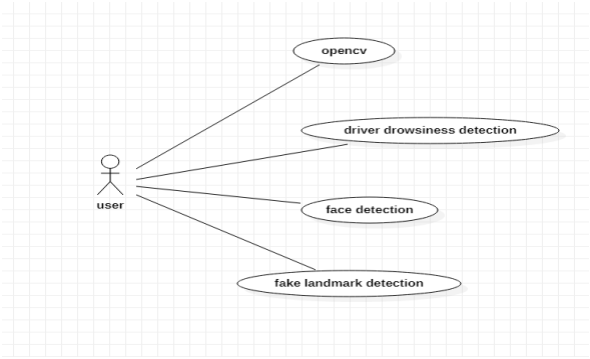

Figure: 5.3 Use case Diagram

SEQUENCE DIAGRAM

A sequence diagram represents the interaction between different objects in the system. The Important aspect of a sequence diagram is that it is time-ordered. Different objects in the sequence diagram interact with each other by passing "messages".

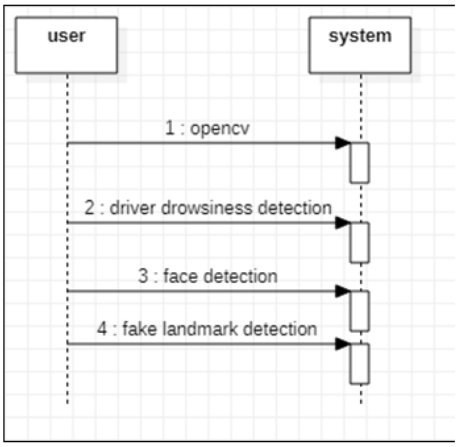

Figure 5.4 Sequence Diagram

COLLABORATION DIAGRAM

A collaboration diagram groups together the interactions between different objects. The Interactions are listed as numbered interactions that help to trace the sequence of the Interactions. The collaboration diagram helps to identify all the possible interactions that each Object has with other

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objects.

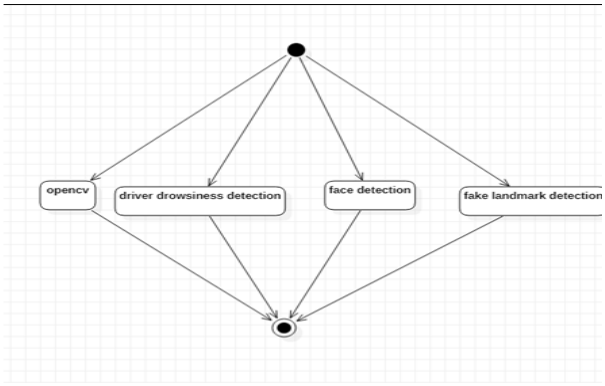

Figure 5.5 Collaboration Diagram

ACTIVITY DIAGRAM

The process flows in the system are captured in the activity diagram. Similar to a state Diagram, an activity diagram also consists of activities, actions, transitions, initial and final States, and guard conditions.

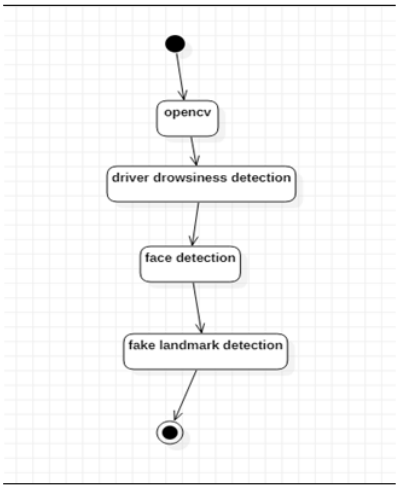

Figure 5.6 Activity Diagram

CLASS DIAGRAM

Class diagrams are the most common diagrams used in UML. Class diagram consists of classes, interfaces, associations, and collaboration. Class diagrams basically represent the object-oriented view of a system, which is static in nature. Active class is used in a class diagram to represent the concurrency of the system. Class diagram represents the object orientation of a system. Hence, it is generally used for development purpose. is is the most widely used diagram at the time of system construction.

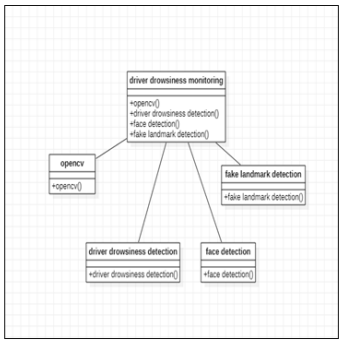

Figure 5.7 Class Diagram

COMPONENT DIAGRAM

The process of this diagram shows the organizations and dependencies among aset of components. It represents the static implementation view of a system.

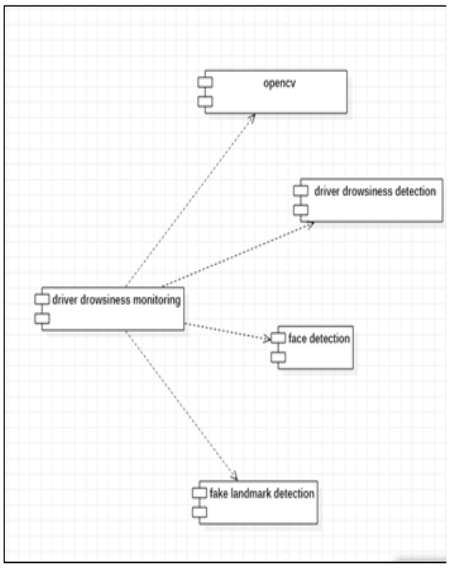

Figure 5.8 Component Diagram

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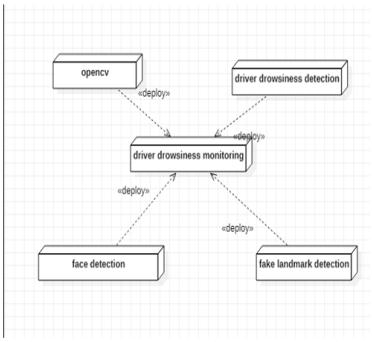
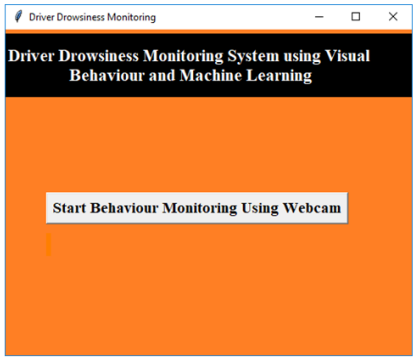


Figure 5.9 Deployment Diagram

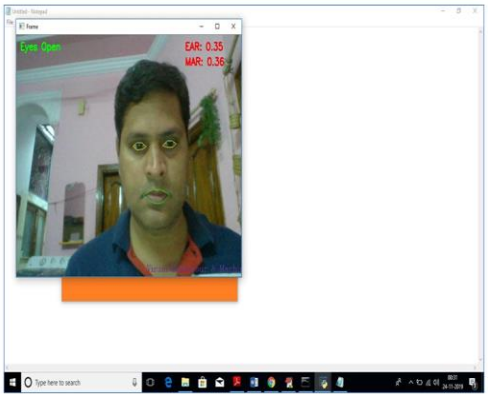
RESULTS AND DISCUSSION

Main window



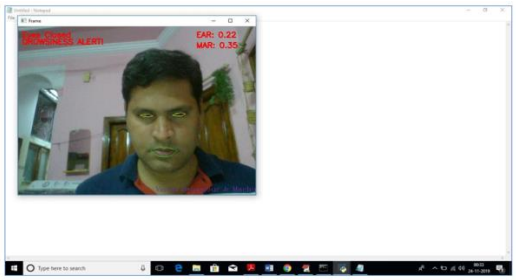
in above screen click on „start behaviour monitoring using webcam" button to connect application with webcam, after clicking button will get below screen with webcam streaming

User check his input from laptop web camera

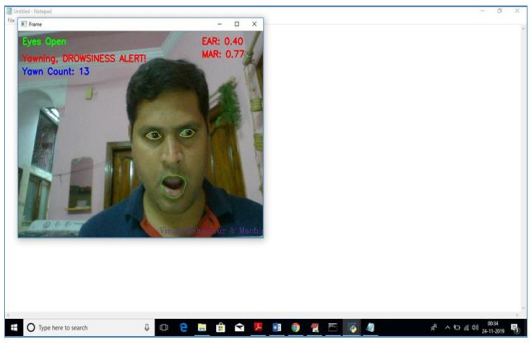


In above screen we can see web cam stream then application monitor all frames to see person eyes are open or not, if closed then will get below message

User try to close his eyes and then check the drowsiness

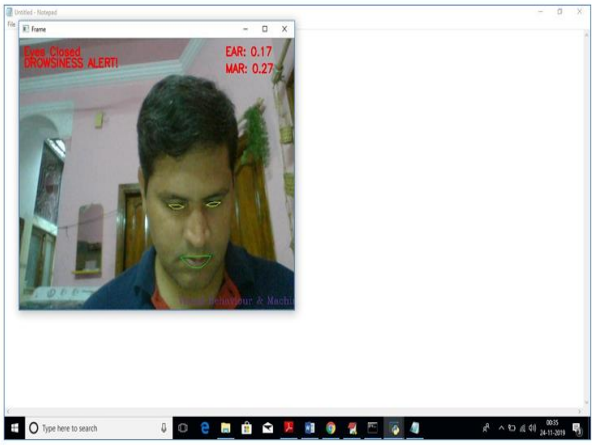


Similarly if mouth starts yawn then also will get alert message



from the above window we can clearly identify if there is mouth opened too large, then it is detected as drowsiness and an alert is shown clearly and also yawn count is also detected

similarly if eyes are closed then also will get alert message



From the above window we can clearly

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identify if there is mouth CLOSED AND EYES ARE ALSO CLOSED, then it is detected as drowsiness and an alert is shown clearly in the above window.

CONCLUSION & FUTURE WORK

In this proposed work, a low cost, real time driver drowsiness monitoring system hasbeen proposed based on visual behavior and machine learning. Here, visual behavior features like eye aspect ratio, mouth opening ratio and nose length ratio are computed from the streaming video, captured by a webcam. An adaptive thresholding technique has been developed to detect driver drowsiness in real time. The developed system works accurately with the generated synthetic data. Subsequently, the feature values are stored and machine learning algorithms have been used for classification. Bayesian classifier, FLDA and SVM have been explored here. It has been observed that FLDA and SVM outperform Bayesian classifier. The sensitivity of FLDA and SVM is 0.896 and 0.956 respectively whereas the specificity is 1 for both.

As FLDA and SVM give better accuracy, work will be carried out to implement them in the developed system to do the classification (i.e., drowsiness detection) online. Also, the system will be implemented in hardware to make it portable for car system and pilot study on drivers will be carried out to validate the developed system.

Drowsy driving is one of the major causes of road accidents and death. Hence, detection of driver‟s fatigue and its indication is an active research area. Most of the conventional methods are either vehicle based, or behavioural based or physiological based. Few methods are intrusive and distract the driver, some require expensive sensors and data handling. Therefore, in this study, a low cost, real time driver‟s drowsiness detection system is developed with acceptable accuracy.

In the developed system, a webcam records the video and driver‟s face is detected in each frame employing image processing techniques. Facial landmarks on the detected face are pointed and subsequently the eye aspect ratio, mouth opening ratio and nose length ratio are computed and depending on their values, drowsiness is detected based on developed adaptive thresholding. Machine learning algorithms have been implemented as well in an offline manner. A sensitivity of 95.58% and specificity of 100% has been achieved in Support Vector Machine based classification

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