FINAL YEAR PROJECT 2 REPORT

Driver's Fatigue Level Detection

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Executive Summary:

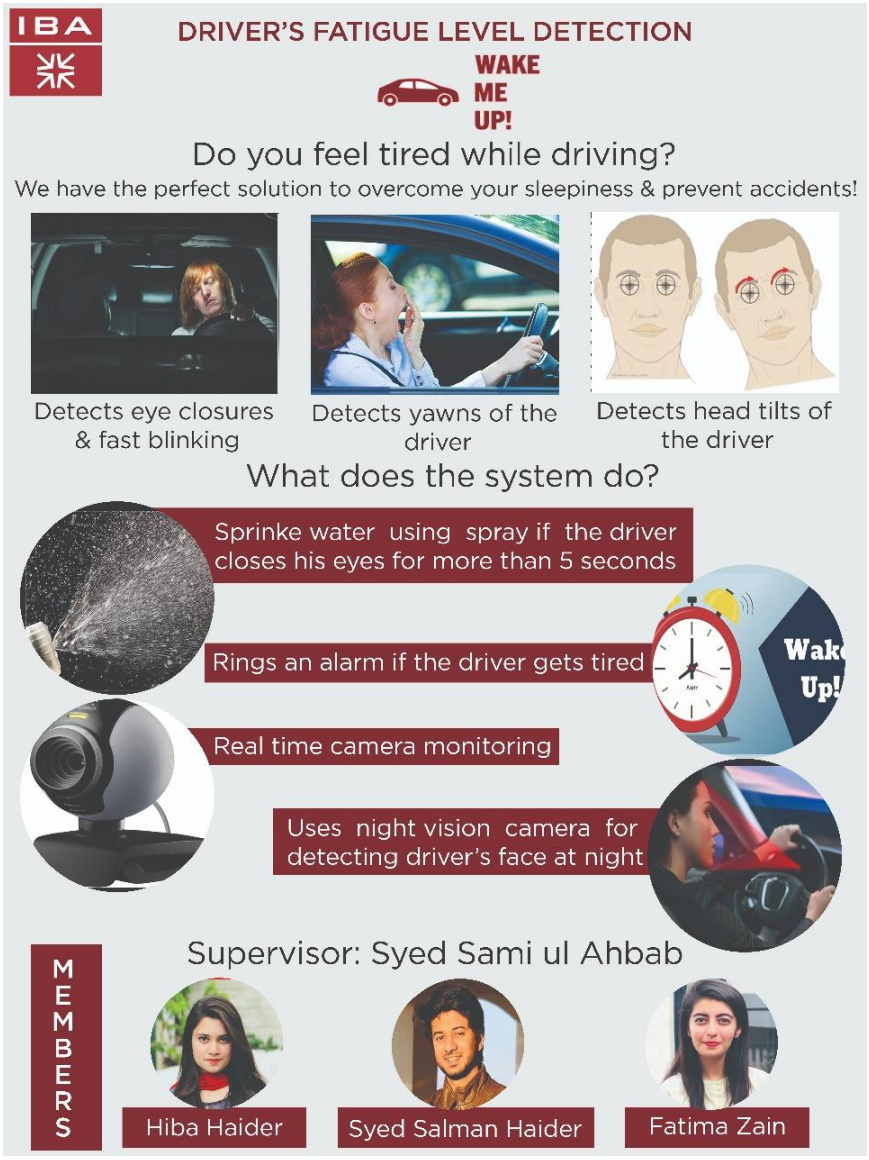
Road accidents are suspected to be a primary concern nowadays and the key cause is the fatigue level of the driver which is a subject of intense research today. However, effective driver fatigue monitoring in environments with little or no light has been thought-provoking since the state of the driver is hard to identify.

The automobile business also has tried to build several systems to predict driver drowsiness but there are only a few commercial products available today. The systems oversee driver capability and features but do not focus at driver's performance. For this our project emphases on building a facial recognition system for driver sleepiness which can be due to long hours, shift work, lack of sleep or sleep apnoea that may exhaust the driver and cause him/her to sleep while driving. It will include a dashboard mounted camera that will be able to detect tiredness level of the driver in real time video stream and then play a sound with vibration using warning.

The system will track driver's facial features like fast blinking, eye closures, head poses and yawning. We will try to achieve accuracy during the day, at night and under illuminated conditions through night vision camera.

Classifiers like Haar Cascade Classifiers or HOG + linear SVM will be chosen depending on their accuracy and shortest time of computation. EAR (eye aspect ratio) and facial expressions will be used to sense the tiredness of the car driver which will stimulate the system to ring

alarms and send warnings consequently. The technical facets of the project will rely on OpenCV and python for facial recognition with Raspberry pi for hardware port connections.



Project Description:

1. Background and Motivation:

The rise in road accidents has caused frequent number of disastrous expiries not only in Pakistan but a lot more around the world which is a serious matter of study currently. According to a research paper (December- 2014) in www.researchgate.net, According to World Health Organization (W.H.O) more than 1.3 million people die every year and many more are injured in Road Traffic Crashes (RTC). Fatality rate due to RTC in Pakistan is significantly higher as compared to other countries. It has been assessed that about 90 percent accidents in Pakistan occur due to the mistake of drivers. Which is why it is extremely necessary for the driver to take all possible safety mechanisms to avoid such incidents to happen as the death of one person can have an emotional impact on the lives of the entire family. Hence, to overcome this issue our project focuses on making a "Driver's fatigue level detection system" which is a safety technology that can help the driver awakened in uncertain conditions. Our system will be able to detect drowsy driving patterns like eye closures, blinking, yawning and head postures and alert drivers to not to sleep or take a break as prevention is better than cure. A lot of well-known automobiles companies have tried making this system but there are very less commercial systems available today. The major challenge we have here is to make a system that can work in little or no light which we will try to deal with through our project.

2. Project Goal:

Our project aims to reduce the number of accidents and deadly losses by making a Technical system that can work in day light, night and in illuminated conditions as well. This will be installed on the dashboard of the cars to detect driver's fatigue levels in real time and help and prevent sleepiness of the drivers through red signal alarms, warnings and we might add water spray shots to avoid uncertain situations also.

3. Project Requirements:

a. Functional Requirements:

1. A Camera which will be mounted on the dashboard to capture Facial features such as Eye closures, Blinking speed, head poses and yawning.
2. An Infrared light for vision at night
3. A Speaker for alert signals with adjustable volume
4. A Screen to show warning messages
5. Machine learning algorithms and software's used for analysis and accurate results

b. Constraints:

1. If the system doesn't work at night with failed computation.
2. If cost management gets failed for both hardware and software requirements.
3. If precision and accuracy doesn't turn out to be what we planned.
4. If the driver gets shocked with High volume frequency alarm voices which will in return can make the driver annoyed.
5. If the display timings of the warning messages don't match the time of computation of the drowsiness.
6. If the infrared light makes the driver unconscious.

c. Objectives:

1) To reduce road accidents and fatal conditions.
2) To make the alert system work at night, day and under illuminated conditions
3) To detect fatigue level of the driver and validate and measure the progress by using Specific algorithms
4) To send warning alerts with sounds and vibrations to the drivers if the behavior gets beyond the thresholds
5) To achieve high accurateness for detecting tiredness levels of the driver

4. Validation and Acceptance Tests:

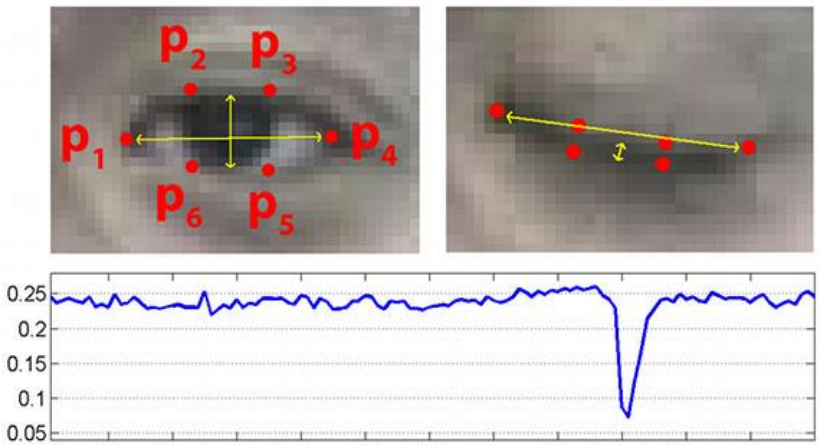
1. Checking if the face detection algorithms are accurate and fast
2. Checking functionality of raspberry pi
3. To check whether camera is working fine
4. Checking whether night vision camera is working fine and detecting faces at night
5. Checking alarm buzzer and water sprinkler conditions.

Technical Design:

1. Possible Solutions and Design Alternatives

- **HOG + Linear SVM:**

HOG which stands for histogram of oriented gradients and linear support vector machines can be used in conjunction as a classifier. HOG will use a positive sample P from the training data of the objects that needed to be detect and then it will extract HOG descriptors from these samples. Later it will sample N negative samples and extract HOG descriptors from these samples as well. Finally it will train Linear support vector machines on the positive and negative samples to detect facial features. HOG along with facial landmark predictor will be used to detect facial landmarks from that we can extract the eye region then calculate EAR (eye aspect ratio) using the equation:
EAR =||p2-p6 ||+ ||p3-p5 || / 2||p1-p4 ||

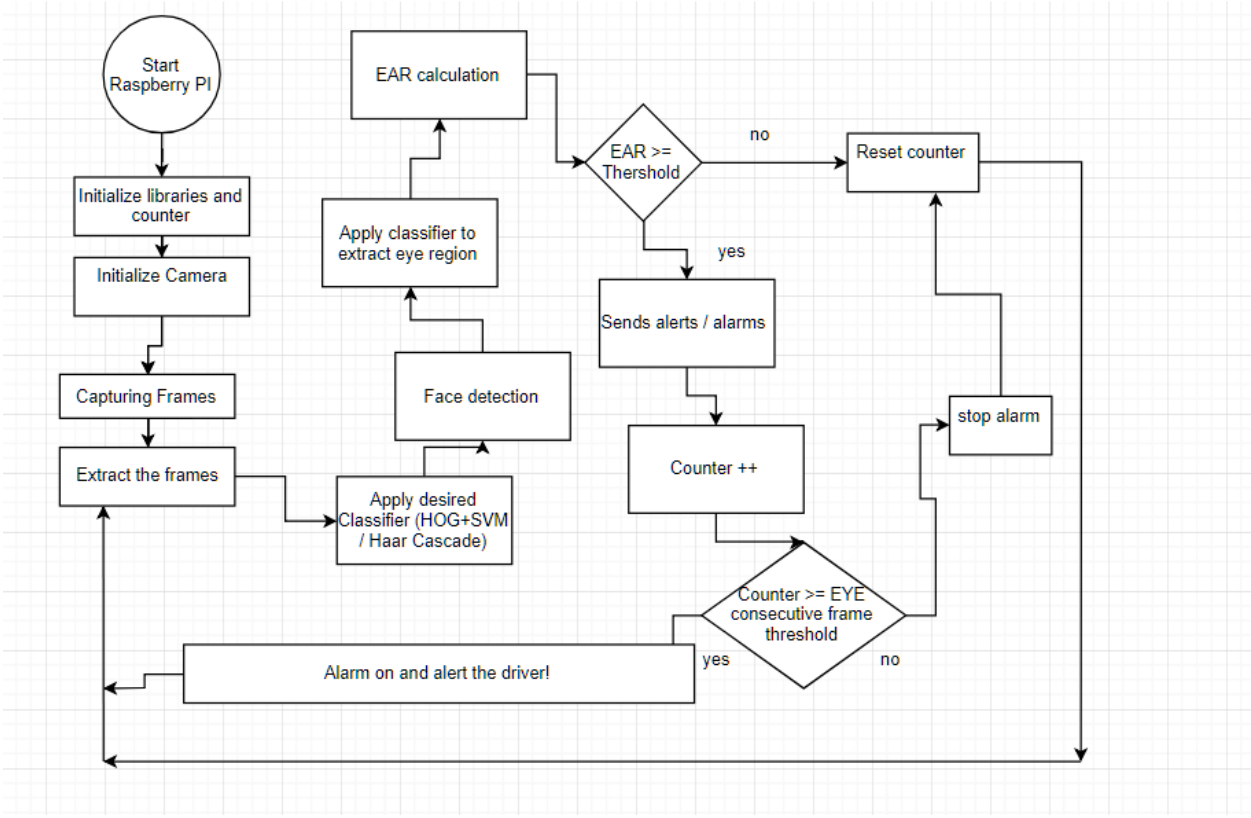


- **HAAR CASCADES:**

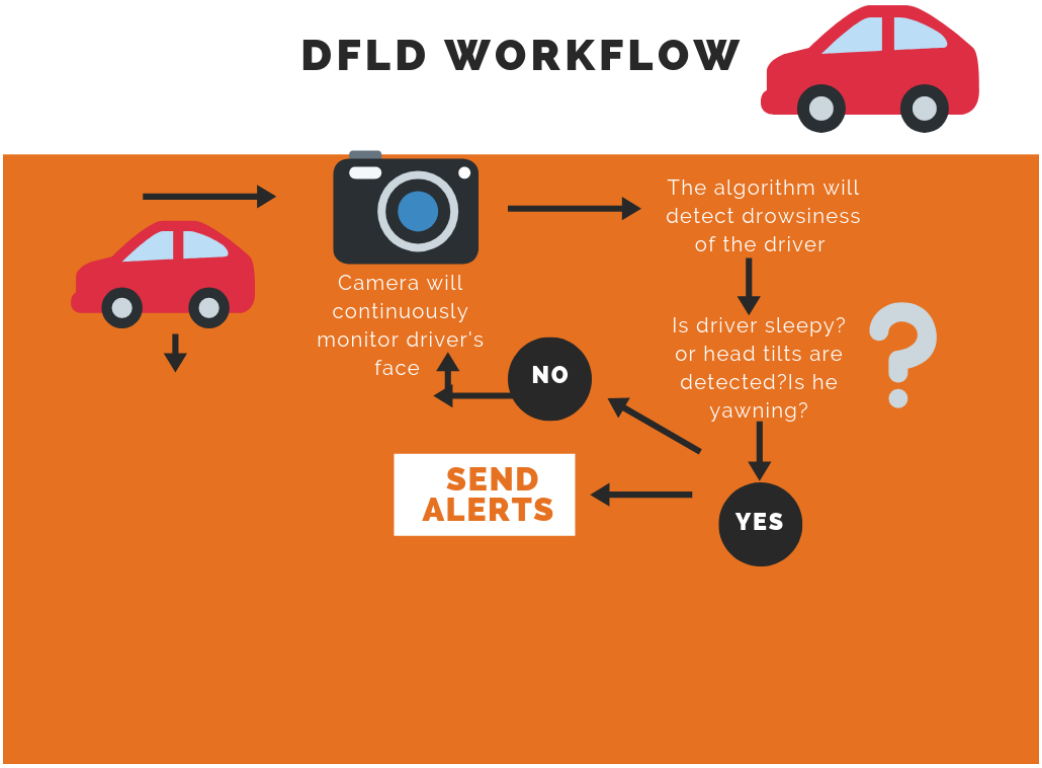
Haar cascade is a machine learning algorithm to identify the objects in images. It is another approach as opposed to another approach of using HOG+linear SVM. It is a faster but usually slight less accurate than HOG. Haar cascade will be applied to detect face in an image which will help to detect the coordinates surrounding the face in an image. Later facial landmark predictor will be used to extract facial landmarks after that EAR will be calculated with the equation as discussed above.
Both techniques are there to be followed. Haar cascades are usually faster but less accurate than HOG+ linear svm classifier, so we'll perform tests on both of algorithm then select the best classifier.

2. System Level Overview:

Our program will be running on Rasperry Pi. A python script along with OpenCV will be used. Different set of libraries would be used, like numpy, OpenCV, play sound, argparse, dlib, distance, timer, client, ApiClient, and picamera. A camera along with the buzzer for alarm and water sprinkler will be connected to raspberry Pi for continuous monitoring of driver's fatigue level detection. An algorithm for complete scenario of our system is shown below in the form of flowchart:



Workflow model:



3. Module Level Descriptions:

a. Graphical User Interface Modules:

- There will be a screen to display warning labels or to show alerts depending on driver's facial landmarks. A camera will continuously monitor driver's fatigue levels and depending on that suitable texts or warnings will be displayed on the screen.
- Front end messages or alert signals will be controlled by python program.

b. Control Modules:

- Raspberry PI will be used as a control unit. The algorithm which will be written using python and OpenCV will run in raspberry pi. Camera and buzzer will be connected to raspberry pi for face detection and sending alarms/alerts respectively.

c. Miscellaneous Modules:

- Buzzer for alarm will be used to alert the driver. Night vision camera will also be used to ensure our system works at night as well.

4. Assessment of Proposed Solution:

Our main assessment will be based on usability testing. We'll see if our system is easy to use by anyone and will test its reliability. We'll test accurateness of facial detection. We'll see if our system is easy to use by anyone. One of our aims is to ensure that our system works at night as well, so we'll be testing this system at night as well.

Work Plan:

1. Feasibility Assessment

a. Skills and Resources:

Our project requires some skill set and knowledge about the required hardware and software to be used in this project. It also requires machine learning skills to apply suitable algorithms for face detection then extract eye region. Main hardware resources to be used are Raspberry PI, camera, night vision camera, alarm buzzer and water sprinkler. The main software resources we'll be using are OpenCV and python, So the knowledge of all these resources are mandatory.

b. Risk Assessment:

Potential Risks:

- Technical risks: if raspberry Pi stops working or camera stops working.
- Budget risks: The night vision camera might be costly.

One of our task is to create a system in a way to avoid such risks. We'll aim to make our system efficient and less costly.

Future Plans:

We will consider moving this project ahead with more innovations like detecting lane change as if the car is moving constantly in wrong direction and lane it might be danger other changes we can consider is by using sensors we can use information of human heart beat and other measures to detect fatigue level of the driver and then send alerts accordingly.