NETAJI SUBHAS UNIVERSITY OF TECHNOLOGY

BACHELOR OF ENGINEERING
(2016-2020)

DIVISION OF COMPUTER ENGINEERING

OPEN SOURCE TECHNOLOGIES PROJECT

TITLED

Jhapki 👀
Drowsiness Detection

IF(Snooze) THEN lose;

Submitted by:
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INTRODUCTION

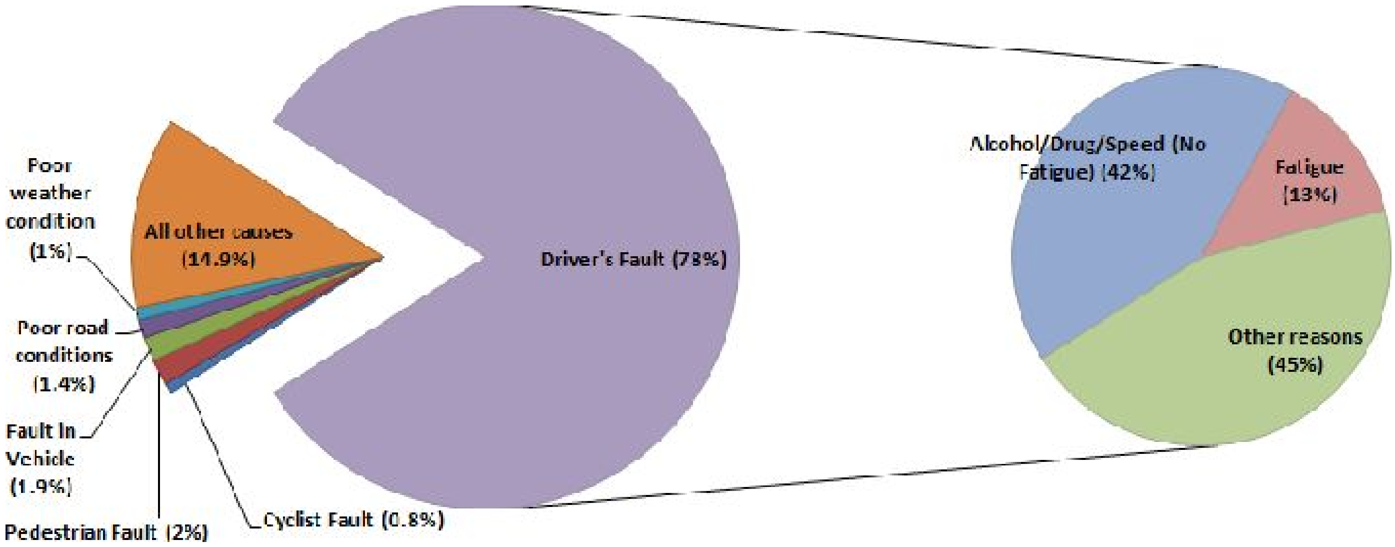
Fatigue and microsleep at the wheel are often the cause of serious accidents.

Various studies have suggested that around 20% of all road accidents are fatigue-related, up to 50% on certain roads.

According to Global status report on road safety by World Health Organization, there were 1.25 million road traffic deaths worldwide in 2013, out of which 1,42,485 road traffic deaths happened in India. Therefore increasing safety standards would benefit the vulnerable road users (pedestrians, cyclists and motorcyclists) as well as the non-vulnerable road users and vehicles.

On Indian roads, approximately 140,000 people die every year of road accidents, largely caused due to ignorance of safety norms and rules and poor driving habits. Also, drivers of medium and heavy commercial vehicles generally drive for over 12 hours at a stretch, which makes them prone to cause accidents.

However, the initial signs of fatigue can be detected before a critical situation arises. A substantial percentage of road accidents occur due to driver inattentiveness and having an inexpensive yet efficient driving assistance warning system can prove to be of great advantage to overcome the loss of life and property.

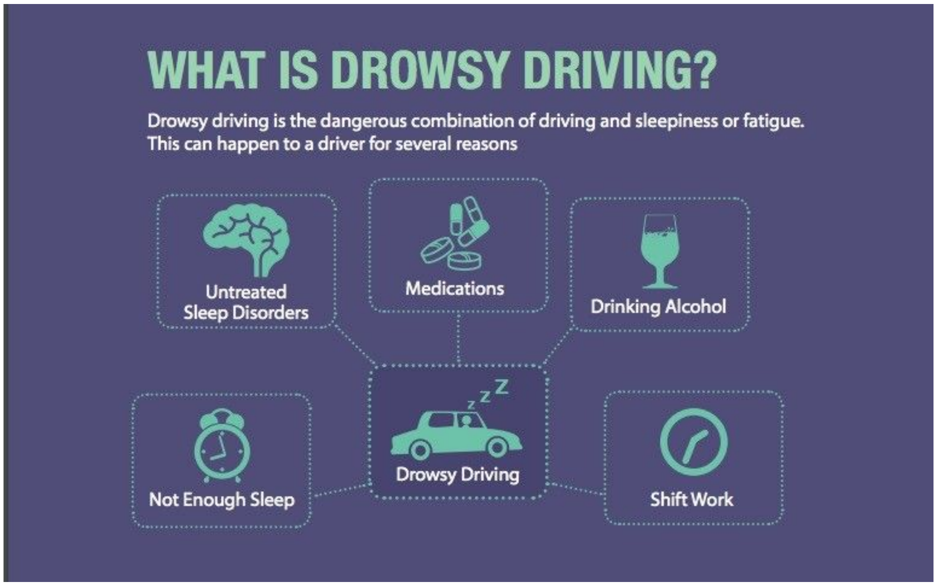


PROBLEM STATEMENT

There are several instances of road accidents recorded every day due to the negligence of the driver. Usually, long road trips, especially at night, tend to induce drowsiness. People from almost all occupational backgrounds including truck drivers, cab drivers, or even a normal user, face this problem. But, the truth is that not everyone can afford expensive cars with built-in support for drowsiness detection.

Owning such cars is still a luxury for the majority of the masses. Hence, there is an urgent need to come up with an easy, cost-effective and affordable solution to the stated problem.

Right now, only a handful of very high-end luxury cars like Tesla support this feature. Bringing it to an average driver on the highway is what our main objective is.



WHAT IS DROWSY DRIVING?

Drowsy driving is the dangerous combination of driving and sleepiness or fatigue. This can happen to a driver for several reasons

SOLUTION POINTERS

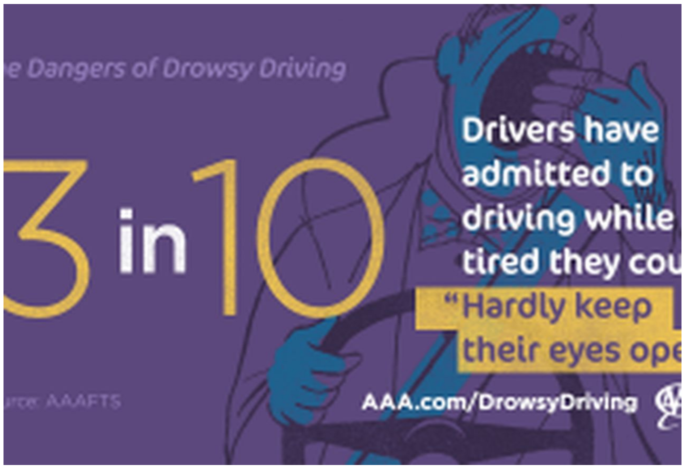
- Monitor user’s eyes continuously while driving.
- To ring an alarm bell as soon as drowsiness is detected.
- If user doesn’t wakes up even after a certain threshold number of times the alarm rings, a message alert is sent to the saved Emergency contact numbers.
- The alert message consists of the user’s current location.
- ‘My profile’ tab keeps a record of the user’s total number of trips, total number of drowsy alerts and the percentage of alert trips.

INSPIRATION

We felt the need for this product in long range driving as it is natural for a driver to feel sleepy during such times but is indeed fatal for him and others as well. Our inspiration stems from a desire to combat this problem at a feasible level.

WHAT IT DOES?

Jhapki helps the driver stay safe by looking out for symptoms of drowsiness. It timely alerts them of this development so that immediate actions can be taken to remedy the situation on the road.


e Dangers of Drowsy Driving
3 in 10
Drivers have admitted to driving while tired they cou
“Hardly keep their eyes ope
urce: AAAFTS
AAA.com/DrowsyDriving

BASIC WORKING OVERVIEW

The user first has to sign up on the website. After that, the user is directed to the profile page where he has to fill in the details of his 5 emergency contacts. Then the website redirects the user to the login page.

After logging in, the user has to click on the “Start driving” button. The camera of the device starts monitoring the user’s eyes. As soon as drowsiness is detected, an alarm plays and if the user doesn’t open his eyes even after a threshold number of times of alarm, an alert is sent to the user’s emergency contact numbers along with his location.

User also has an option to check his profile using the “My profile” tab which keeps a record of the user’s total number of trips, total number of drowsy alerts and the percentage of alert trips.

ALGORITHM

The first step in building a blink detector is to perform facial landmark detection to *localize the eyes* in a given frame from a video stream.

Once we have the facial landmarks for both eyes, we compute the *eye aspect ratio* for each eye, which gives us a singular value, relating the distances between the vertical eye landmark points to the distances between the horizontal landmark points.

Once we have the eye aspect ratio, we can threshold it to determine if a person is blinking — the eye aspect ratio will remain approximately constant when the eyes are open and then will rapidly approach zero during a blink, then increase again as the eye opens.

To build our blink detector, we used a metric called the *eye aspect ratio* (EAR), introduced by Soukupová and Čech in their 2016 paper, *Real-Time Eye Blink Detection Using Facial Landmarks*.

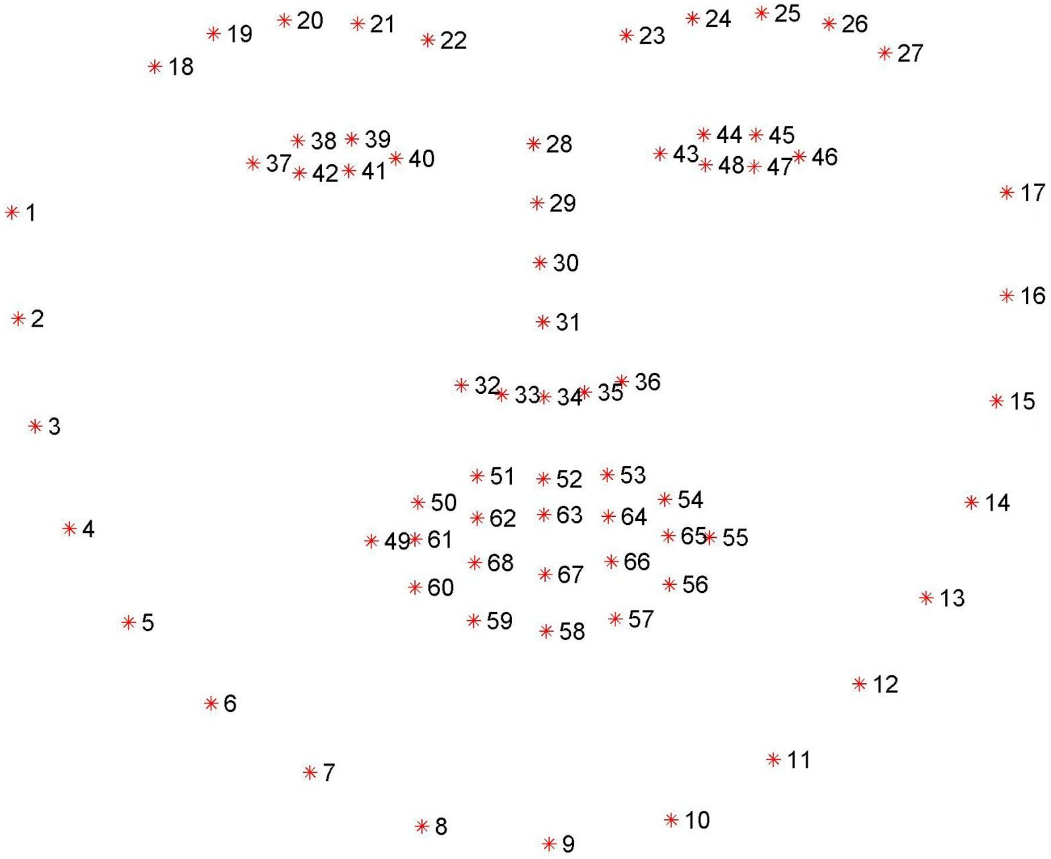
Unlike traditional image processing methods for computing blinks which typically involve some combination of:

1. Eye localization.
2. Thresholding to find the whites of the eyes.
3. Determining if the “white” region of the eyes disappears for a period of time (indicating a blink).

The eye aspect ratio is instead a *much more elegant solution* that involves a *very simple calculation* based on the ratio of distances between facial landmarks of the eyes.
This method for eye blink detection is fast, efficient, and easy to implement.

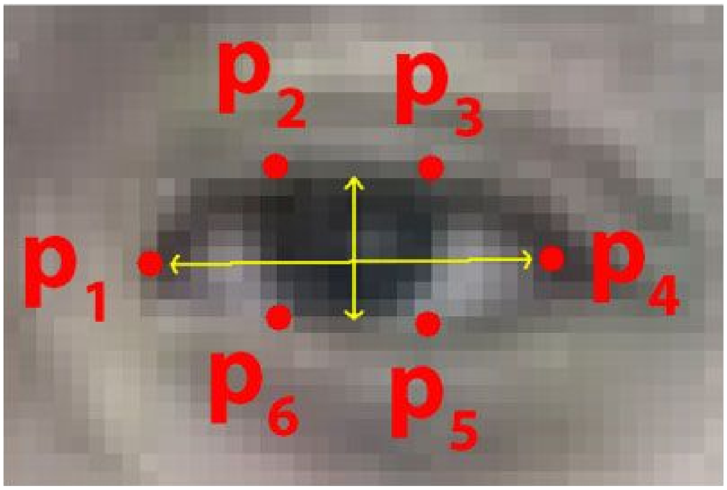
The facial landmark detector included in the dlib library is an implementation of the *One Millisecond Face Alignment with an Ensemble of Regression Trees* paper by Kazemi and Sullivan (2014).

The pre-trained facial landmark detector inside the dlib library is used to estimate the location of *68 (x, y)-coordinates* that map to facial structures on the face.The indexes of the 68 coordinates can be visualized on the image below:



In terms of blink detection, we are only interested in two sets of facial structures — *the eyes.*

Each eye is represented by 6 *(x, y)*-coordinates, starting at the left-corner of the eye (as if you were looking at the person), and then working clockwise around the remainder of the region:

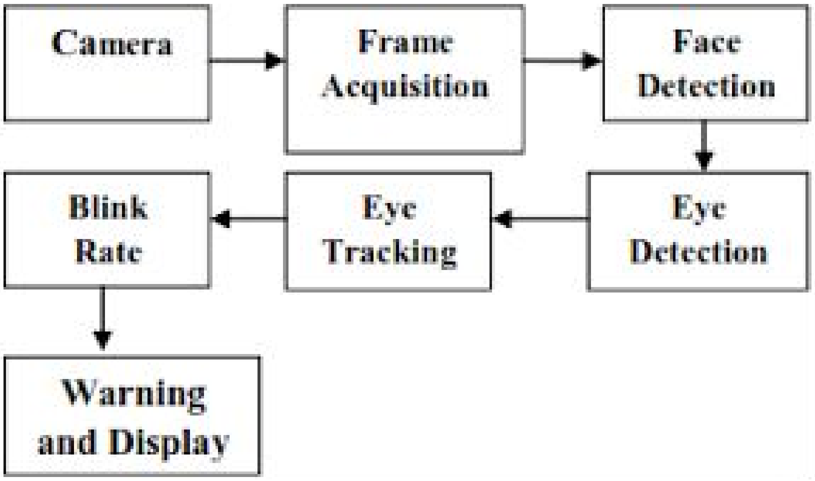


There is a relation between the *width* and the *height* of these coordinates.

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

Where *p1, …, p6* are 2D facial landmark locations.

The numerator of this equation computes the distance between the vertical eye landmarks while the denominator computes the distance between horizontal eye landmarks, weighting the denominator appropriately since there is only *one* set of horizontal points but *two* sets of vertical points.



TECHNOLOGIES AND PACKAGES USED

1. **THE FRAMEWORK USED: Django (2.1.7)**

   Django is a Python-based free and open-source web framework, which follows the model-view-template (MVT) architectural pattern. It is maintained by the Django Software Foundation (DSF), an independent organization established as a 501(c)(3) non-profit.

   Django's primary goal is to ease the creation of complex, database-driven websites. The framework emphasizes reusability and "pluggability" of components, less code, low coupling, rapid development, and the principle of don't repeat yourself. Python is used throughout, even for settings files and data models. Django also provides an optional administrative create, read, update and delete interface that is generated dynamically through introspection and configured via admin models.

2. **geocoder (1.38.1)**

   Geocoder is a simple and consistent geocoding library written in Python. Dealing with multiple different geocoding provider such as Google, Bing, OSM & many more has never been easier.

   We’ve used it to get the latitude and the longitude of the user system using it’s IP Address.

3. **geopy (1.19.0)**

   geopy is a Python 2 and 3 client for several popular geocoding web services.

   geopy makes it easy for Python developers to locate the coordinates of addresses, cities, countries, and landmarks across the globe using third-party geocoders and other data sources.

   geopy includes geocoder classes for the OpenStreetMap Nominatim, Google Geocoding API (V3), and many other geocoding services. The full list is available on the Geocoders doc section. Geocoder classes are located in geopy.geocoders.

   It has been used here to get the location address using the latitude and longitude coordinates obtained through geocoder as explained above.

4. **imutils (0.5.2)**

   This consists of a series of convenience functions to make basic image processing functions such as translation, rotation, resizing, skeletonization, displaying Matplotlib images, sorting contours, detecting edges, and much more easier with OpenCV and both Python 2.7 and Python 3.

5. **numpy (1.16.2)**

   NumPy is a library for the Python programming language, adding support for large, multi-dimensional arrays and matrices, along with a large collection of high-level mathematical functions to operate on these arrays. The ancestor of NumPy, Numeric, was originally created by Jim Hugunin with contributions from several other developers.

   NumPy is open-source software and has many contributors.

6. **opencv-contrib-python (4.0.0.21)**

   OpenCV (*Open source computer vision*) is a library of programming functions mainly aimed at real-time computer vision.Originally developed by Intel, it was later supported by Willow Garage then Itseez (which was later acquired by Intel). The library is cross-platform and free for use under the open-source BSD license.

   OpenCV supports the deep learning frameworks TensorFlow, Torch/PyTorch and Caffe.

   Opencv-contrib-python is the Wrapper package for OpenCV python bindings.

7. **pygame (1.9.5)**

   pygame (the library) is a Free and Open Source python programming language library for making multimedia applications like games built on top of the excellent SDL library. Like SDL, pygame is highly portable and runs on nearly every platform and operating system. Millions of people have downloaded pygame itself, which is a whole lot of bits flying across the interwebs.

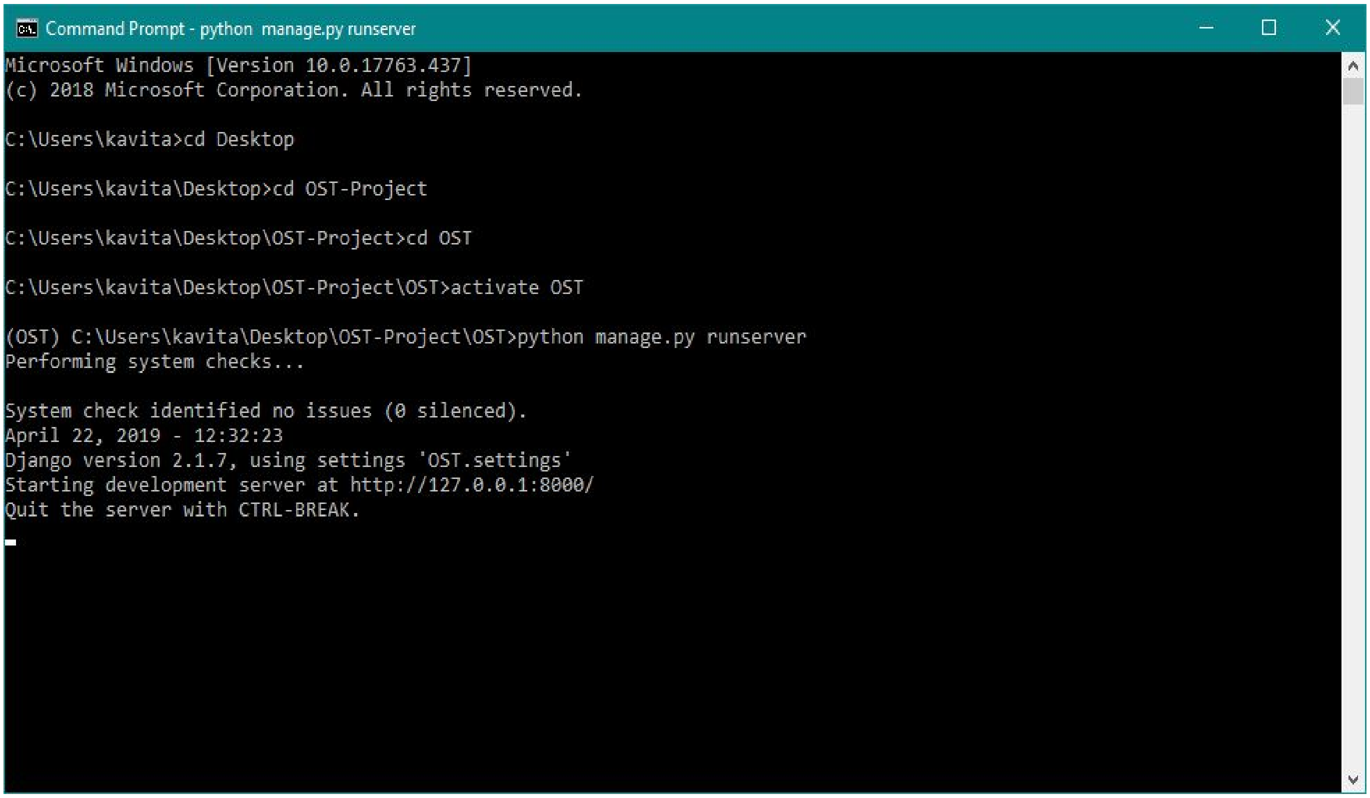
   pygame.org (the website) welcomes all Python game, art, music, sound, video and multimedia projects.
   It has been used in this project to provide the alarm tune played to alert the driver.

8. **twilio (6.26.0)**

   Twilio is a cloud communications platform as a service (CPaaS) company based in San Francisco, California. Twilio allows software developers to programmatically make and receive phone calls, send and receive text messages, and perform other communication functions using its web service APIs.

HOW TO RUN:

- cd into the respective project folder.
- activate the environment
- (if applicable) having all the packages installed (as listed above) using the command "activate my_env"
- run the command: "python manage.py runserver".
- copy the url and paste it in your favourite browser window.

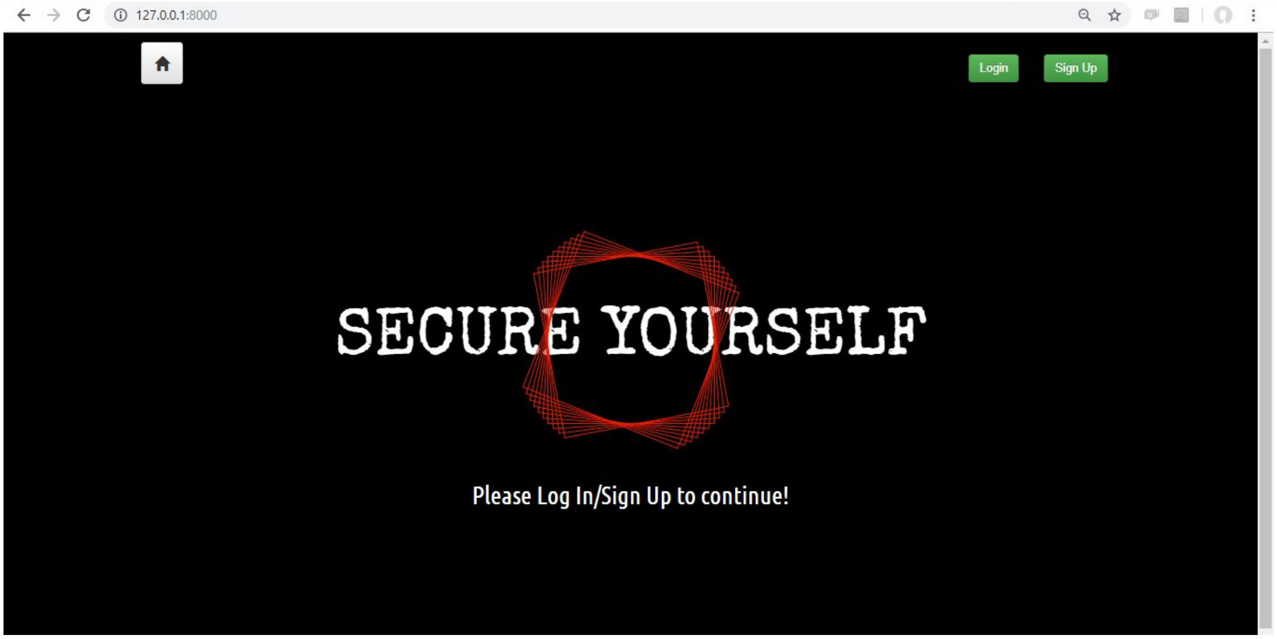


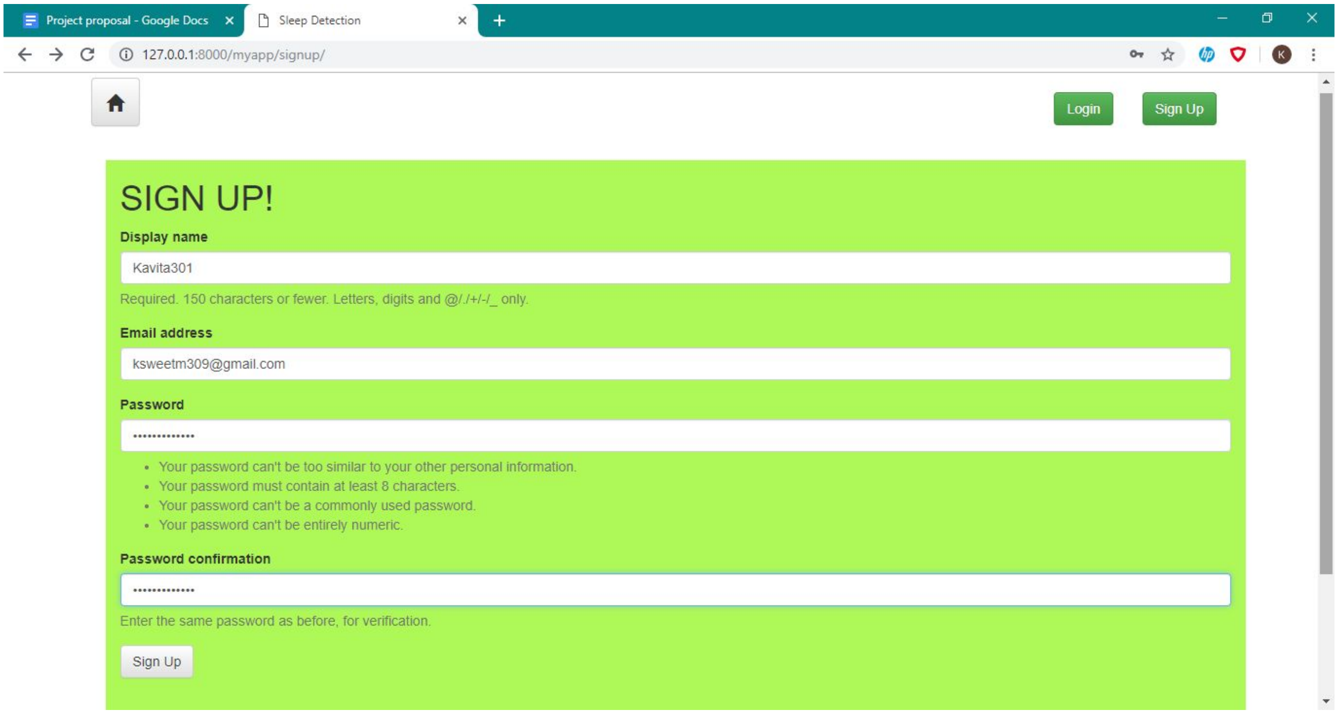
```
Microsoft Windows [Version 10.0.17763.437]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\kavita>cd Desktop

C:\Users\kavita\Desktop>cd OST-Project

C:\Users\kavita\Desktop\OST-Project>cd OST

C:\Users\kavita\Desktop\OST-Project\OST>activate OST

(OST) C:\Users\kavita\Desktop\OST-Project\OST>python manage.py runserver
Performing system checks...

System check identified no issues (0 silenced).
April 22, 2019 - 12:32:23
Django version 2.1.7, using settings 'OST.settings'
Starting development server at http://127.0.0.1:8000/
Quit the server with CTRL-BREAK.
```

SEE FOR YOURSELF:

Step 1: SignUp/Login

If you are a new user, then you have to Sign Up first. It is necessary before going further to prevent our site from unauthorized access. If you had already Sign Up before then you can continue by login directly.





SIGN UP!

Display name

Kavita301

Required. 150 characters or fewer. Letters, digits and @/./+/-/_ only.

Email address

ksweetm309@gmail.com

Password

•••••••••••••

- Your password can't be too similar to your other personal information.
- Your password must contain at least 8 characters.
- Your password can't be a commonly used password.
- Your password can't be entirely numeric.

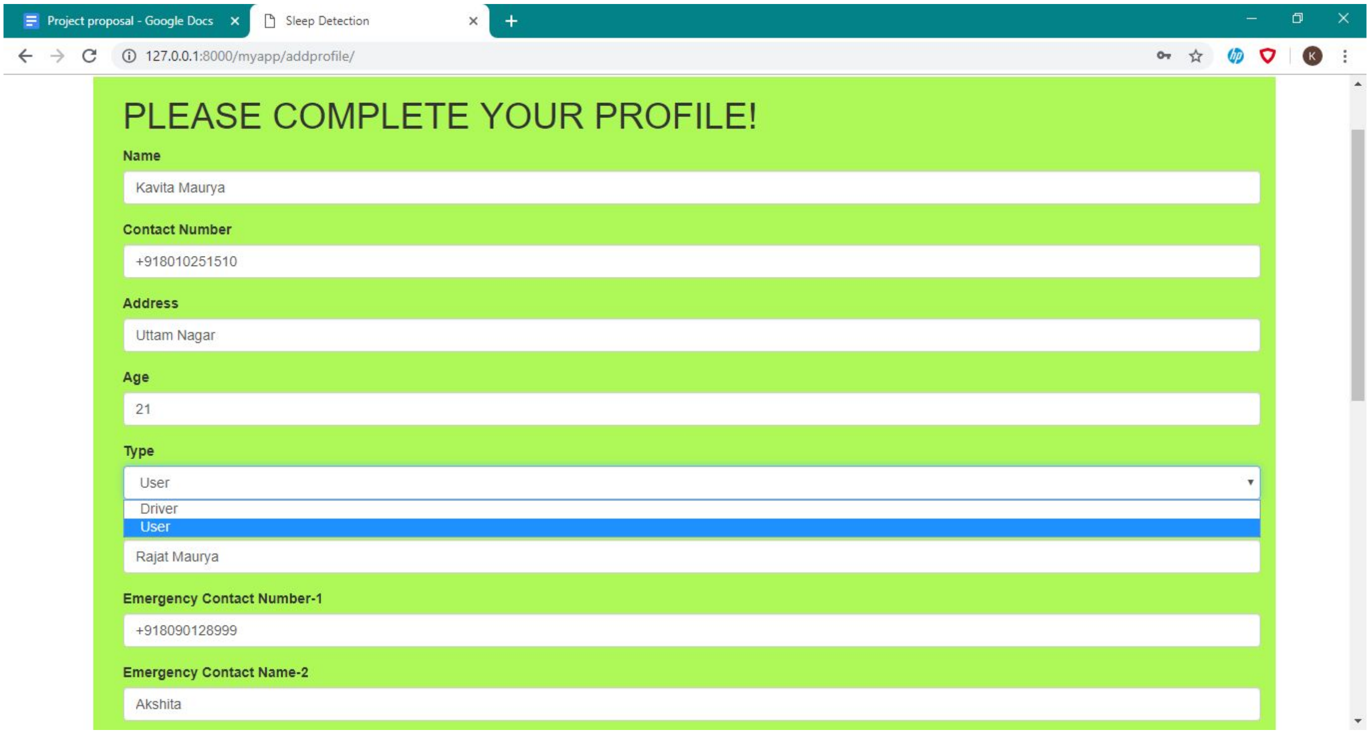
Password confirmation

•••••••••••••

Enter the same password as before, for verification.

Sign Up

After SignUp you will prompted to the “Complete your profile” page, in which you have to give your 5 nearby relative/friends contact details so that our app can send alerts to them if you are in any danger.



Project proposal - Google Docs
Sleep Detection
127.0.0.1:8000/myapp/addprofile/

PLEASE COMPLETE YOUR PROFILE!

Name

Kavita Maurya

Contact Number

+918010251510

Address

Uttam Nagar

Age

21

Type

User

Driver

User

Rajat Maurya

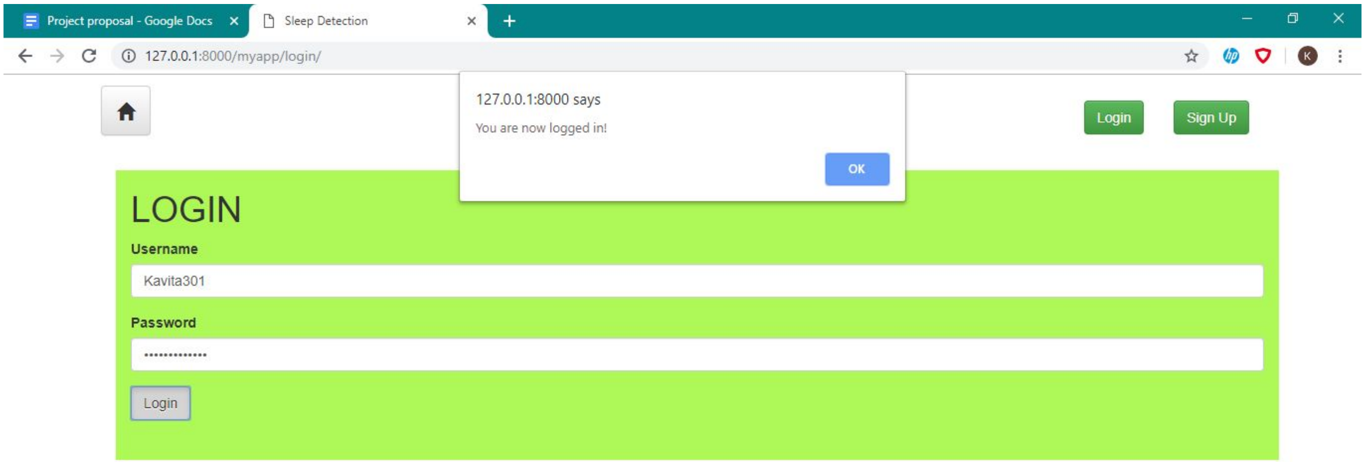
Emergency Contact Number-1

+918090128999

Emergency Contact Name-2

Akshita

After that, you will be redirected to the Login page.



127.0.0.1:8000 says

You are now logged in!

LOGIN

Username

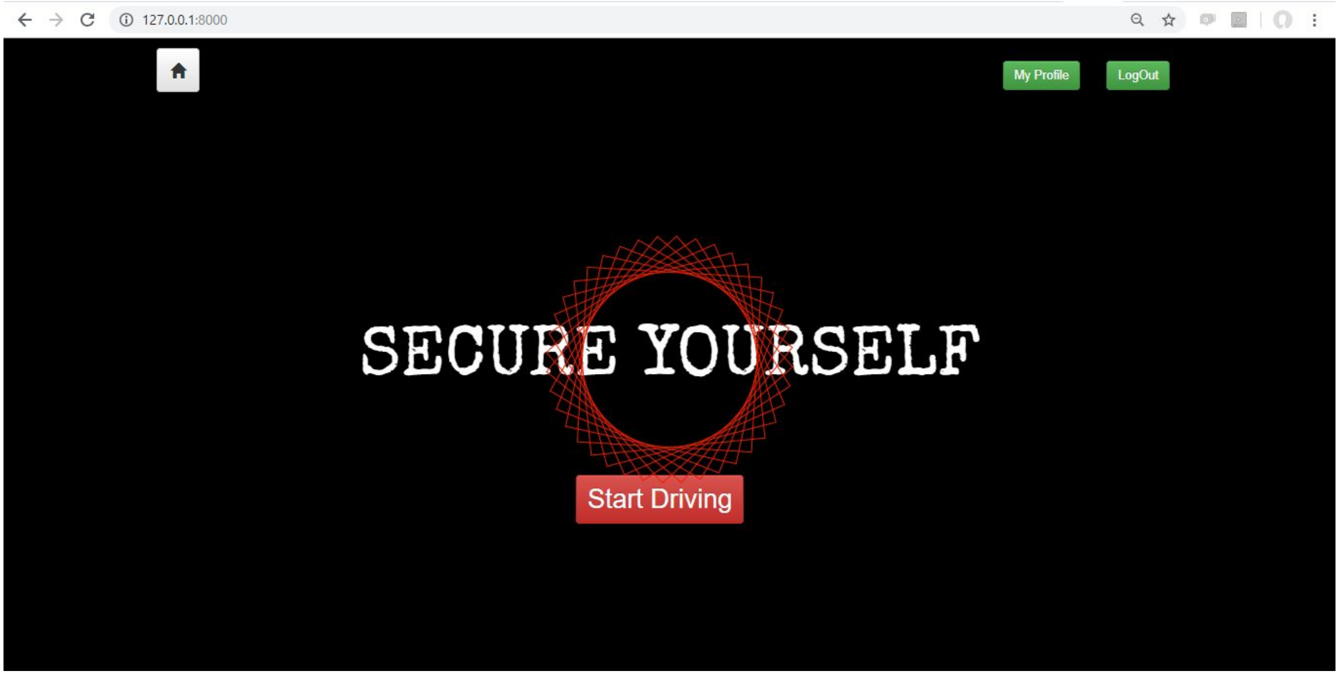
Kavita301

Password

•••••••••••••

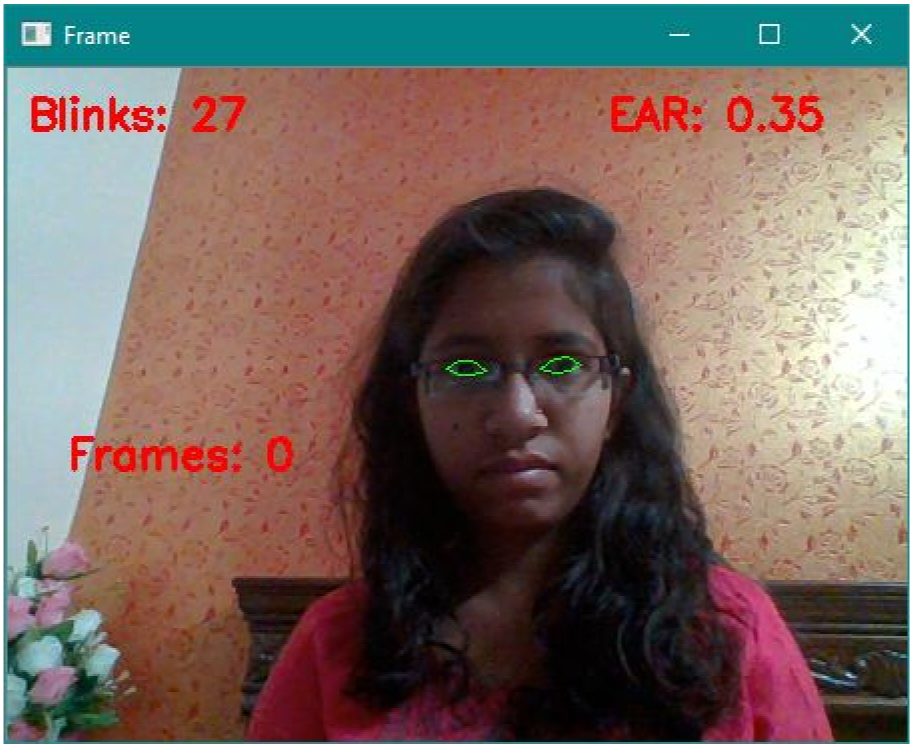
Step 2: Start Driving

Click on the start driving button whenever you start a ride.



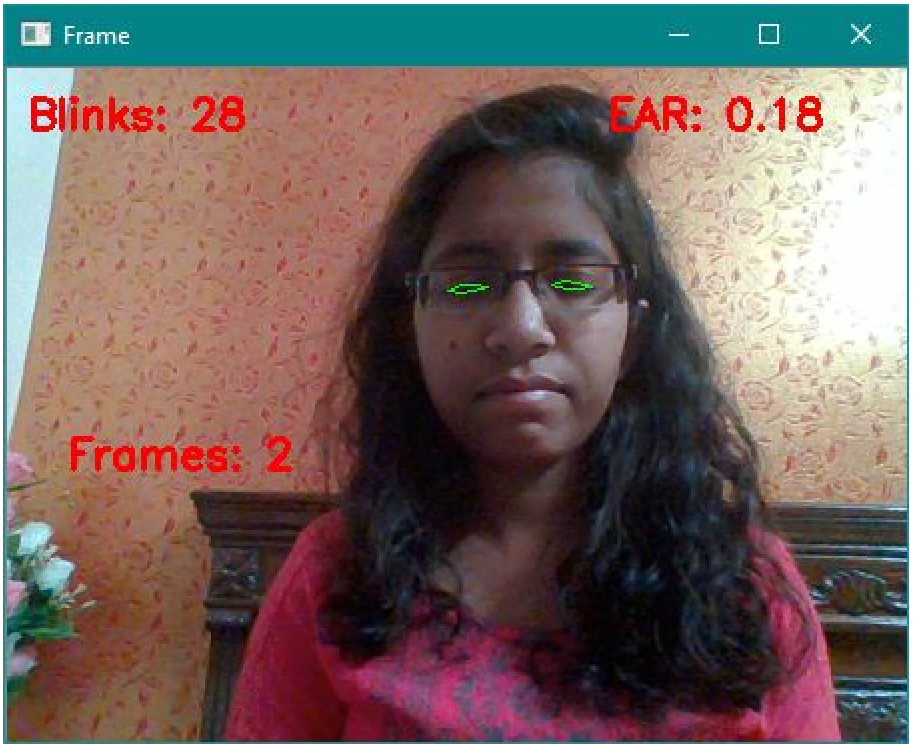
After clicking, a new window open, which will monitor you all the time during driving.

- When EAR > threshold (i.e. 0.3), no blink detected.



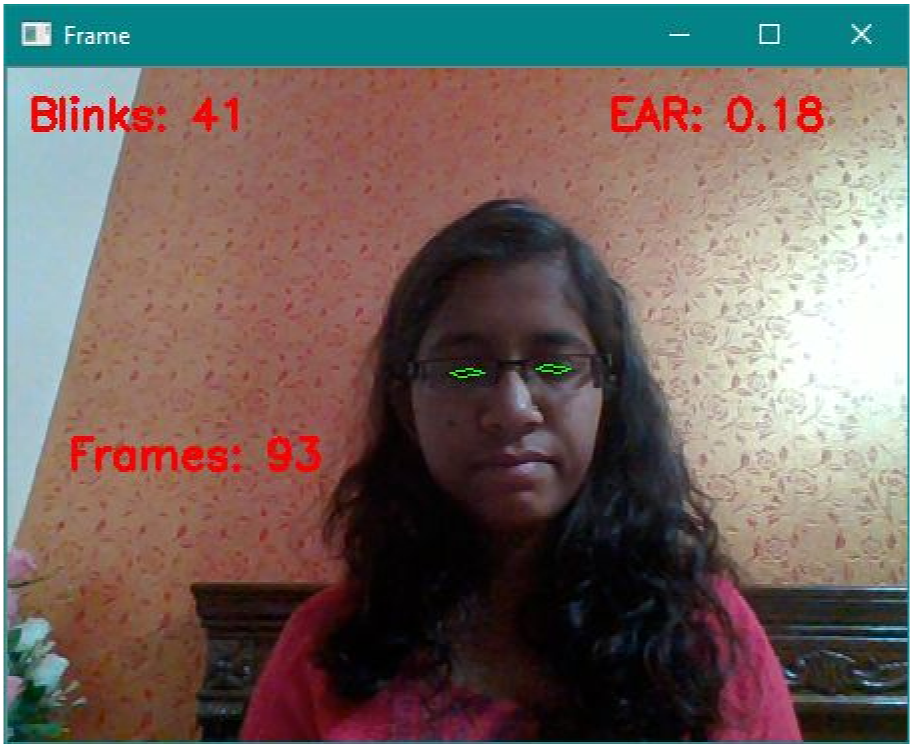
```
Blinks: 27                EAR: 0.35

Frames: 0
```

- When EAR < threshold (i.e. 0.3), blink is detected.



```
Blinks: 28                EAR: 0.18

Frames: 2
```

- Whenever you close eyes for more than 10 seconds(i.e. more than 99 frames, it will start ringing an alert tone which will constantly ring for 5 loops until you don’t wake up.



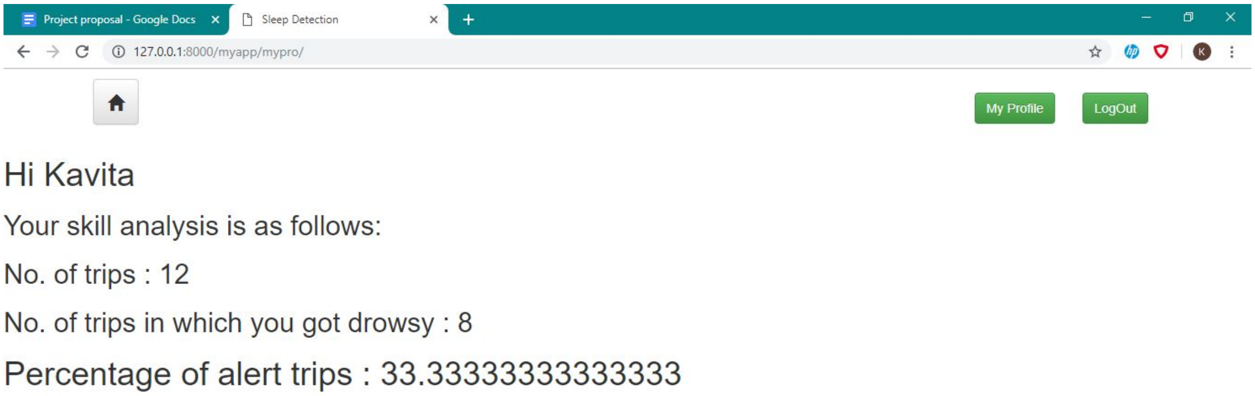
- If even uptil this point, you don’t wake up(open your eyes), then it will send an alert message to all the 5 registered contacts along with your location.

Step 3: Stop Driving

When you complete your ride, click on the stop driving button.

Step 4: Ride Analysis

You can also see your percentage of alert trips by clicking on the “My Profile” Tab.



Hi Kavita

Your skill analysis is as follows:

No. of trips : 12

No. of trips in which you got drowsy : 8

Percentage of alert trips : 33.33333333333333

FUTURE SCOPE

We also want to add support for Android and iOS so that our product can be used for real world scenarios inside phone holders in cars.

CONCLUSION

The Drowsiness detection System is basically a mechanism proposed in order to save the life of the drivers that are continuously riding the car and are not provided the sufficient sleep due which severe accidents take place especially in the developing countries like India, where the number of running vehicles increases every year. The proposed system safeguards the driver from any accident that take place because of the drowsiness of the driver. The proposed system is cheap as compared to other systems that are present only in the luxurious car models. Also, due to its high portability, it can be installed in old cars easily as well. This is one of the most important and effective feature of the system that make it practical. It is able to detect if the eye is closed or open and based on it, issues warning to the driver. The eye detection capability can be increased using a hybrid of different algorithms which uses edge detection techniques, machine learning concepts, and good support from open source libraries like Open CV.

A prototype of the proposed concept is also prepared.
The system is cheap, easy to install and much more efficient.

REFERENCES

- https://www.pyimagesearch.com/2017/04/24/eye-blink-detection-opencv-python-dlib/
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- http://vision.fe.uni-lj.si/cvww2016/proceedings/papers/05.pdf
- https://www.semanticscholar.org/paper/One-millisecond-face-alignment-with-an-ensemble-of-Kazemi-Sullivan/1824b1ccace464ba275ccc86619feaa89018c0ad