EYE BLINK DETECTION

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AGENDA

- OVERVIEW
- SOFTWARE REQUIREMENTS
- EYE DETECTION PROGRAM
- USER INSTRUCTIONS
- RESULTS
- CONCLUSION

OVERVIEW

- Estimate the facial landmark positions
- Extract the ratio between horizontal & vertical distance between eyelids -- EAR
- Examine the open and closed state of eyelids in each frame
- Create an interface to test the robustness of the system
- Create csv file for storing user data

SOFTWARE REQUIREMENTS

Compatible with both Windows and Mac.

- PYTHON/ANACONDA Latest Version
- OPENCV Latest Version
- CMAKE
- DLIB, SCIPY, NUMPY, IMUTLIS Libraries
- 68 point iBUG 300-W dat file

FACE DETECTION

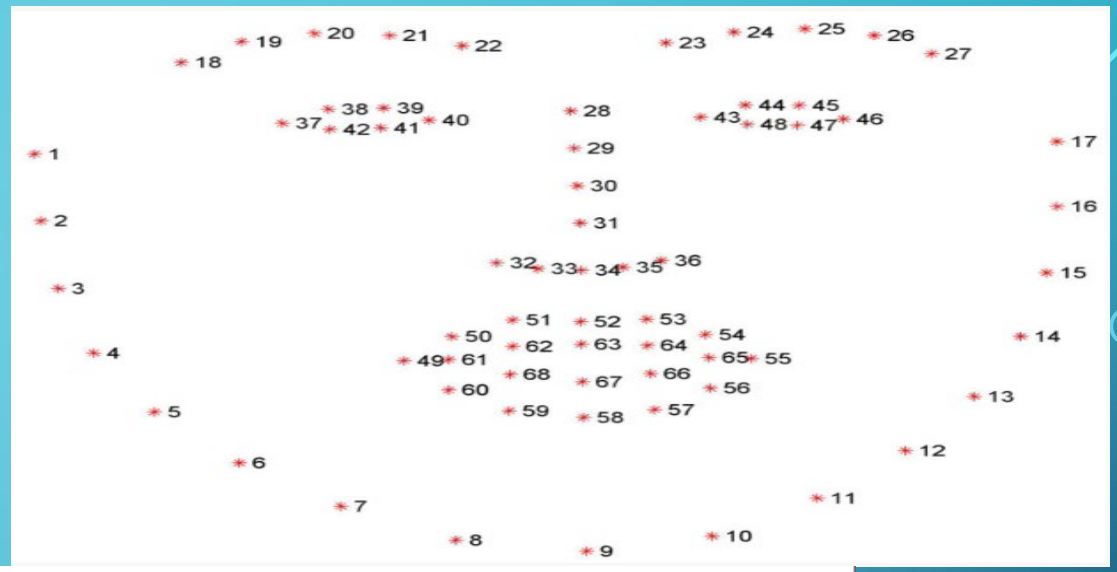
- Use dlib's pre-trained face detector based on a modification to the standard Histogram of Oriented Gradients + Linear SVM method for object detection.
- detect facial landmarks
- Detect eye coordinates

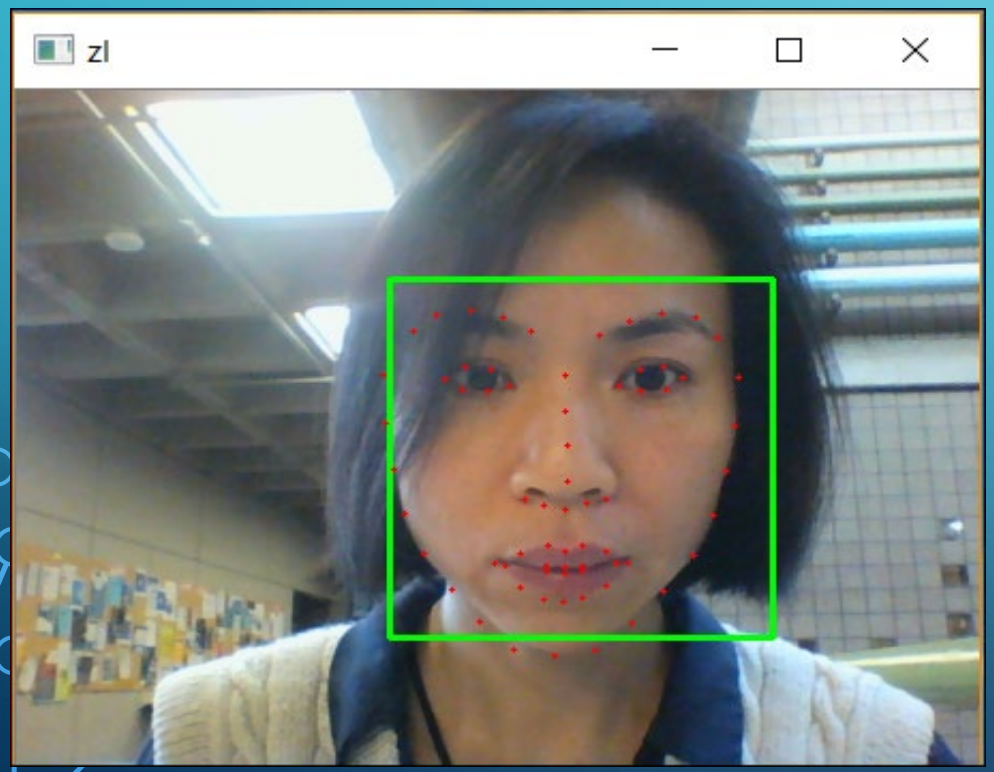
```
# initialize dlib's face detector (HOG-based)
print("[INFO] loading facial landmark predictor...")
detector = dlib.get_frontal_face_detector()
```

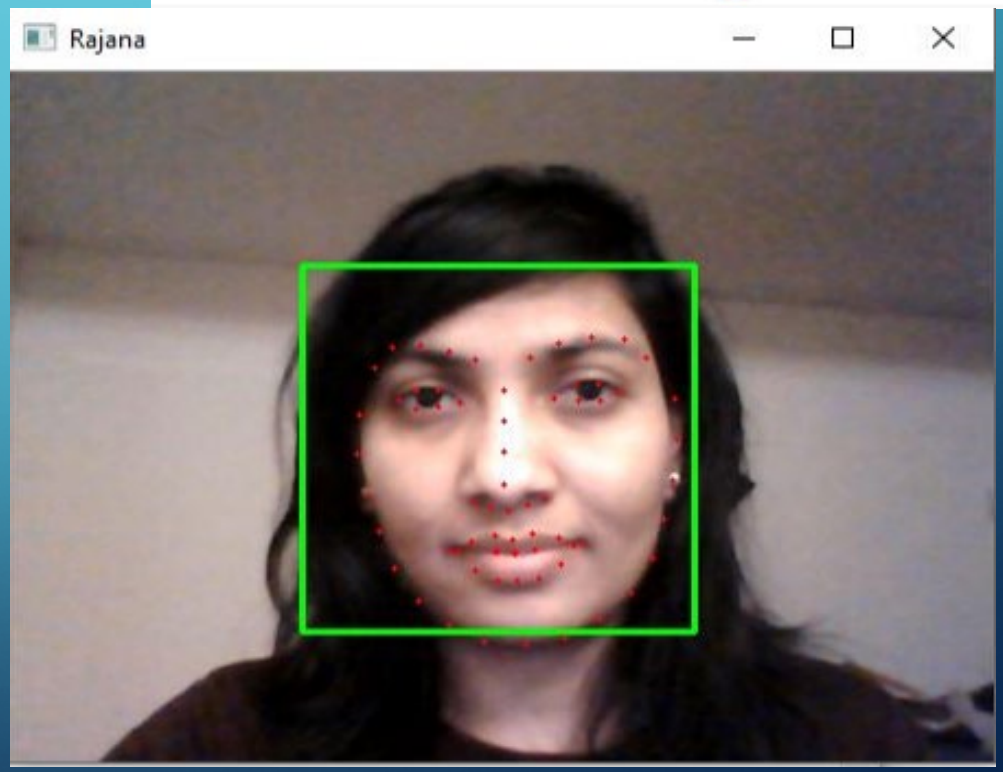
```
void headTracing(Mat grayImage, Mat image, CascadeClassifier casceye, CascadeClassifier cascFace, Rect &faceA

    Rect face = detectLargestObject(grayImage, cascFace);
    if (face.width == 0 && face.height == 0) {
        imshow("Rajana", image);
        return;
    }

    calibrationFace = calibrationFace - 1;

    if (faceArea.height == 0 || calibrationFace < 1) {
        faceArea = face;
        lastFace = grayImage(face);
```

FACIAL LANDMARKS DETECTION

- Use 68 point [iBUG 300-W dataset]
- dlib facial landmark predictor was trained on



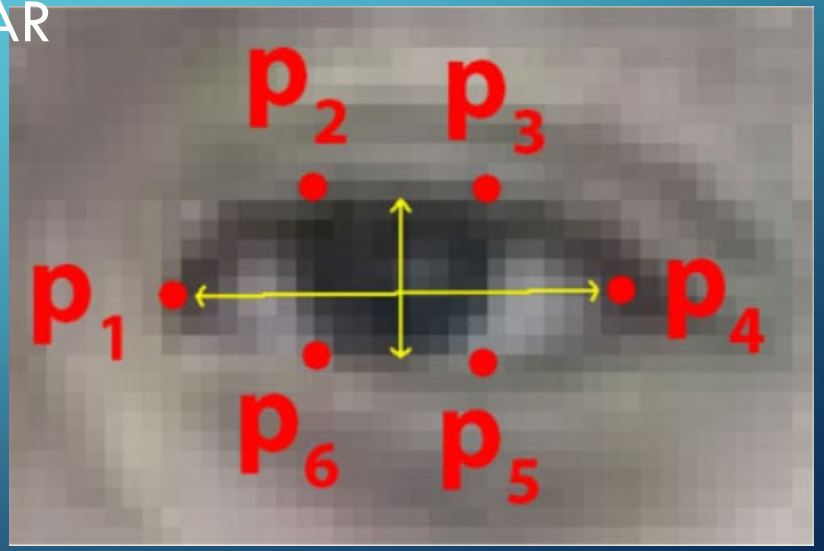




EYE ASPECT RATIO

- 6 x, y coordinates for each eye
- Default EAR Threshold at 0.28
- Users can press key to increase/decrease EAR
- Value < EAR Threshold indicates Blink
- Value > EAR Threshold indicates Open Eye

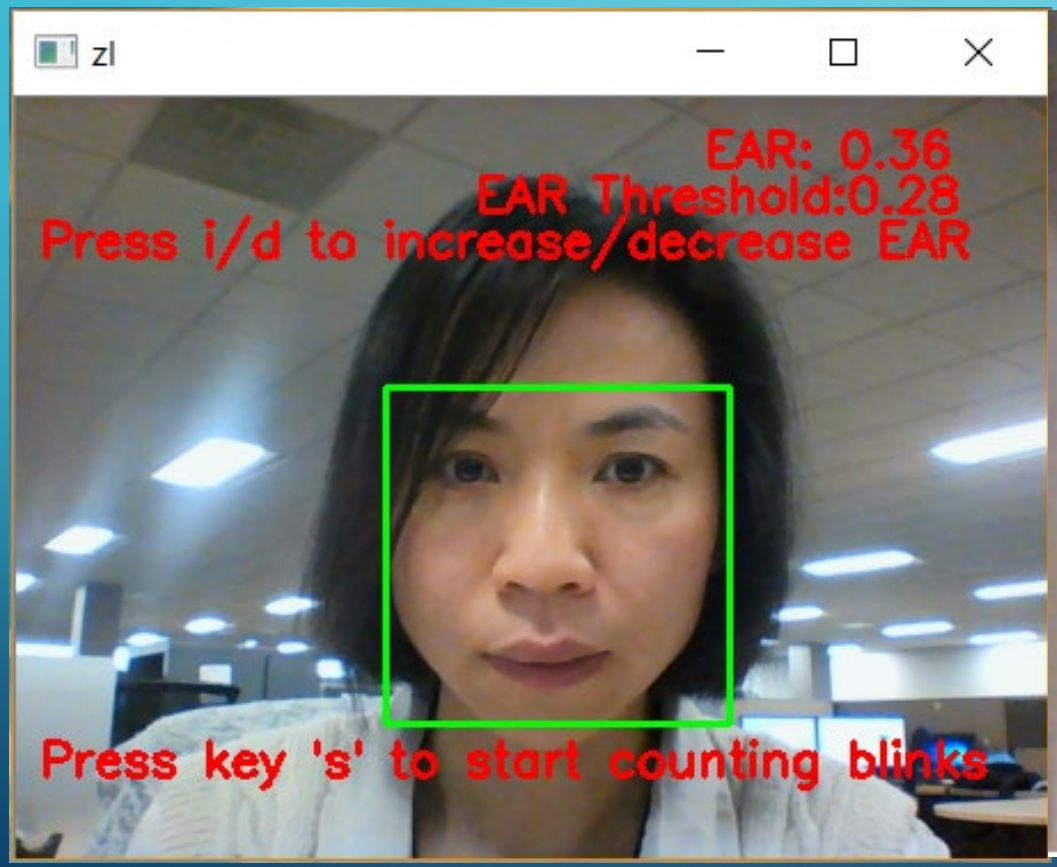
$$\text{EAR} = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

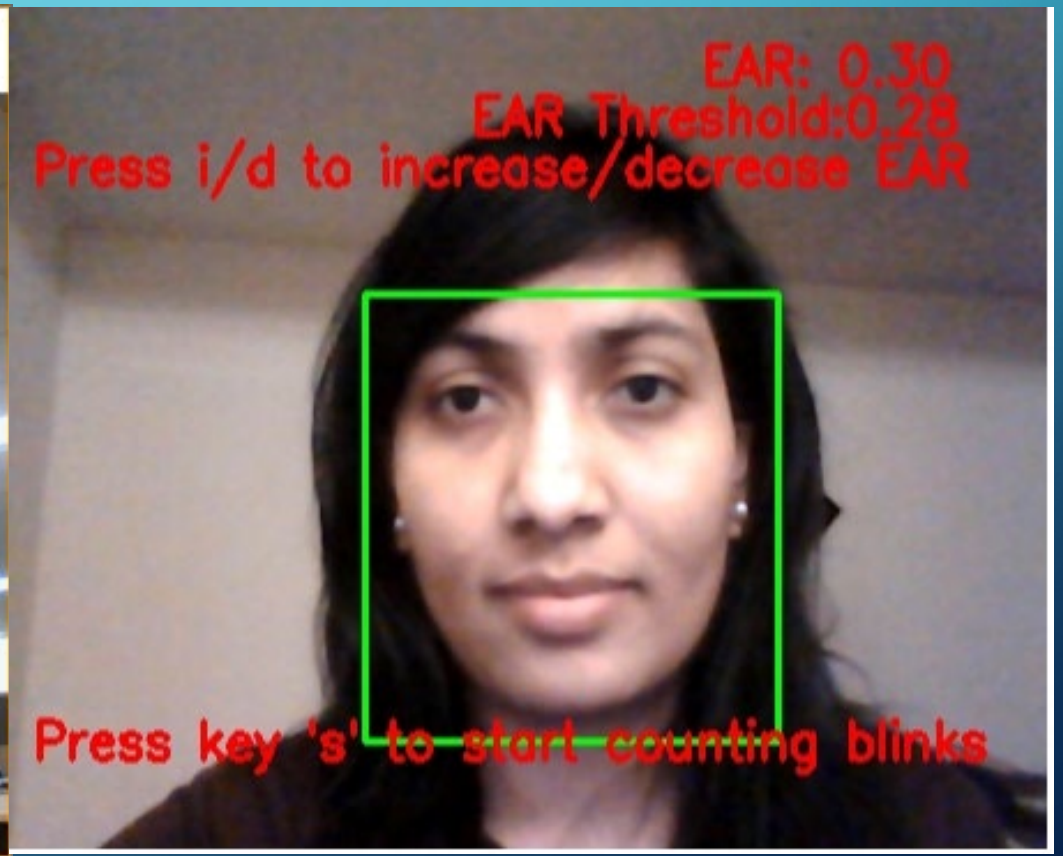


USER INSTRUCTIONS

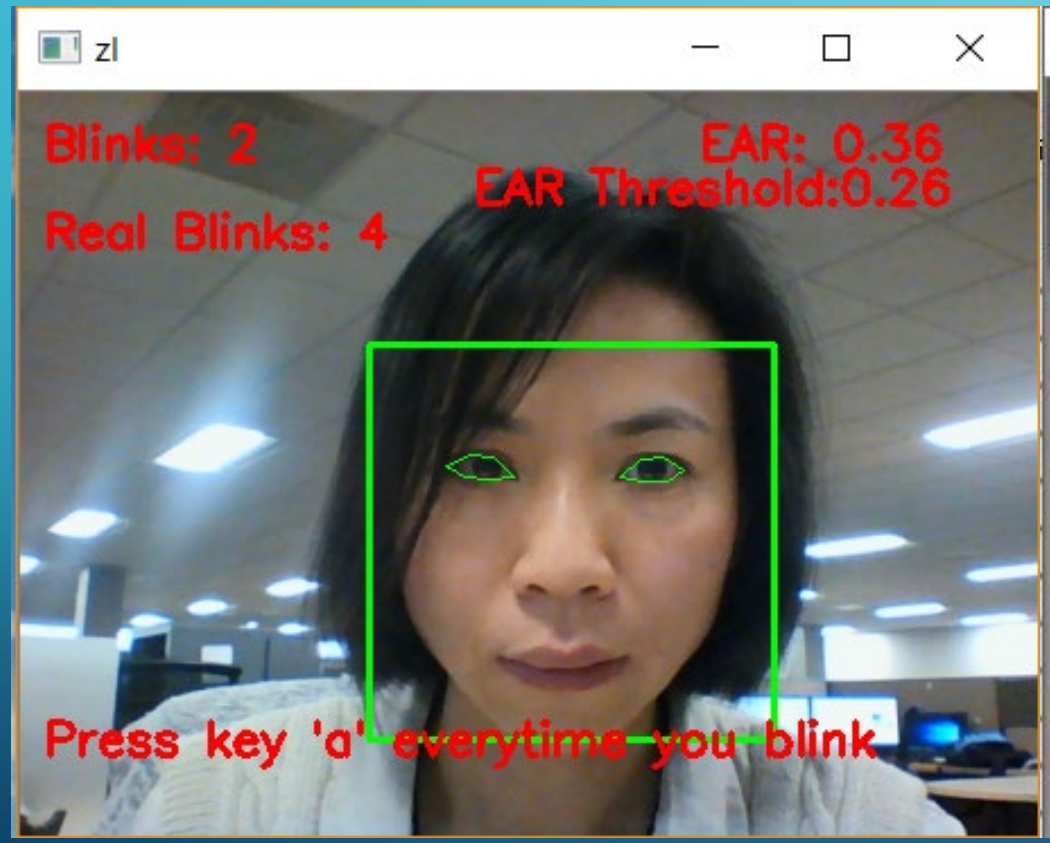
- Run Program
- Enter Name & Gender
- Live video frame opens, Press Key I to increase EAR, D to decrease EAR
- Press Key S to start the Eye Blink Test
- Press Key A to keep a count of real blink every time you blink
- Press P to pause for 10 secs and Restart again
- Press Q to Quit

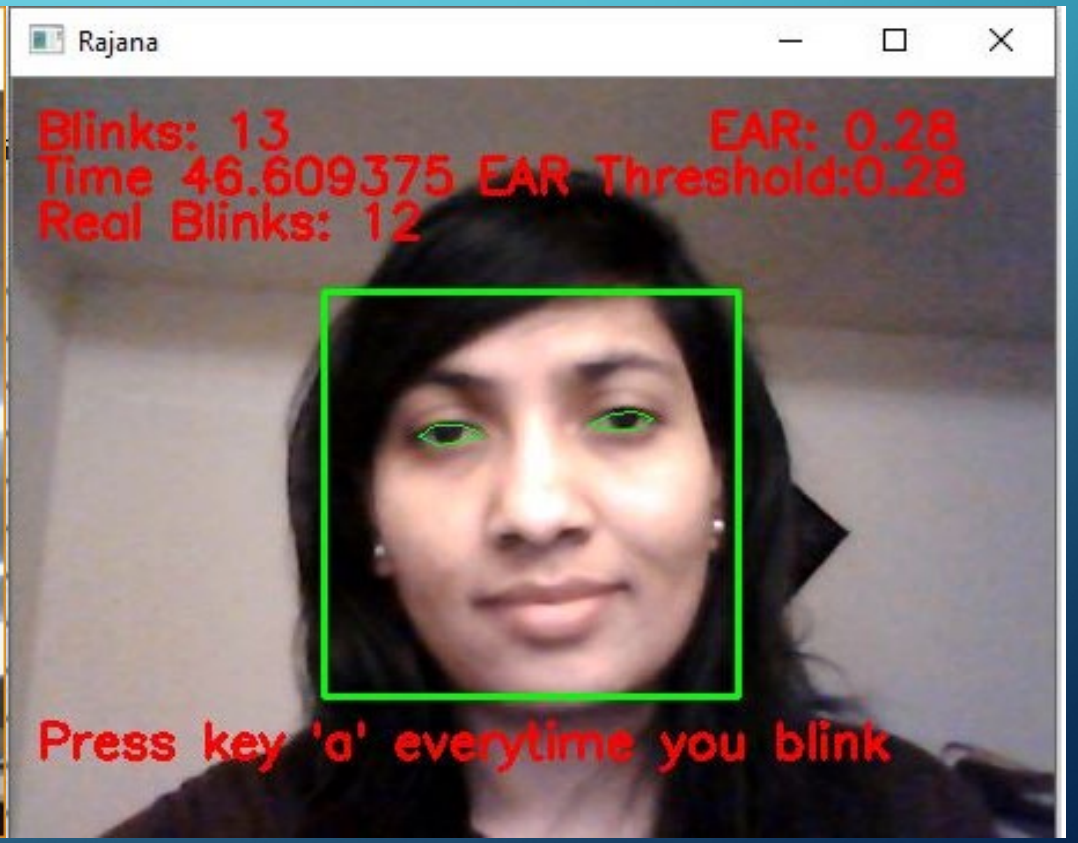
RESULTS


zl
EAR: 0.36
EAR Threshold:0.28
Press i/d to increase/decrease EAR
Press key 's' to start counting blinks

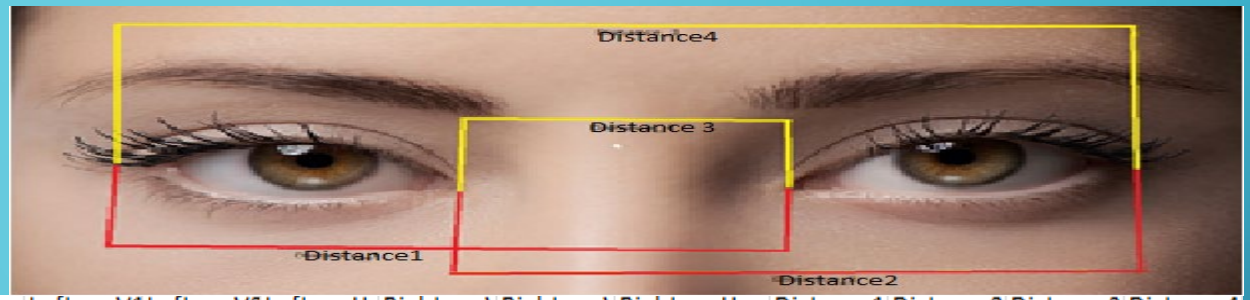

EAR: 0.30
EAR Threshold:0.28
Press i/d to increase/decrease EAR
Press key 's' to start counting blinks

RESULTS


zl
Blinks: 2
EAR: 0.36
EAR Threshold:0.26
Real Blinks: 4
Press key 'a' everytime you blink


Rajana
Blinks: 13
EAR: 0.28
Time 46.609375 EAR Threshold:0.28
Real Blinks: 12
Press key 'a' everytime you blink

CONCLUSION



# name	gender	ear_thresl	blinks_co	actual_bli	face_widt	face_heig	accuracy	LefteyeV1	LefteyeV2	LefteyeH	RighteyeV	RighteyeV	RighteyeH	Distance1	Distance2	Distance3	Distance4
Sivasan	Male	0.29	22	30	104	104	73.33333	5.09902	5.09902	17.11724	5	6.082763	19.02629759	44.10215	42.19005	25.07987	61.20457
Sivasan	Male	0.3	33	30	104	104	90.90909	5	6.082763	16.27882	5	6	18.02775638	44.10215	42.29657	26.07681	60.29925
Sivasan	Male	0.31	30	30	104	103	100	5.09902	5.09902	15.29706	5	5.09902	19.02629759	43.18565	39.45884	24.18677	58.42089
padmin	female	0.28	10	30	124	124	33.33333	8.246211	8.062258	25.17936	8.062258	8.062258	28.16025568	65.03076	62.1289	37.01351	90.00556
padmin	female	0.3	5	30	150	149	16.66667	9	8.062258	20.09975	8.246211	9.219544	25.70992026	59.22837	53.60037	33.54102	79.24645
padmin	female	0.31	9	30	124	125	30	8	8	24	8.062258	8.062258	27.16615541	64.28063	61.07373	37.12142	88.20431
padmin	female	0.3	9	30	150	150	30	9.055385	9.055385	25.07987	9.055385	9.055385	28.16025568	66.1211	63.00794	38.01316	91.02198
padmin	female	0.28	13	30	149	149	43.33333	9.055385	9.055385	26.07681	9.219544	9.219544	27.16615541	65.12296	64.00781	38.01316	91.02198
Yuvaraj	Male	0.26	21	30	179	180	70	8	8	29.01724	8	8	29	71.00704	71.02816	42.0119	100.02
Yuvaraj	Male	0.25	4	30	149	150	13.33333	9	9	31.06445	9.055385	8	31.01612484	74.00676	74.02702	43	105.0048
Yuvaraj	Male	0.27	18	30	179	180	60	8	8.062258	32.01562	8	9.055385	30	74.00676	76.02631	44.01136	106.0189
Yuvaraj	Male	0.24	16	30	179	180	53.33333	8.062258	9.055385	32.06244	8	8	31.01612484	75.00667	76.02631	44	107.042
Kalaiara	Female	0.28	27	30	124	125	90	4.123106	4	22.09072	4	4.123106	23.19482701	55.3263	54.23099	32.14032	77.41447
Kalaiara	Female	0.27	25	30	125	124	83.33333	7	6	21.0238	6	7.071068	22.09072203	53.15073	52.08647	31.06445	74.16873
Kalaiara	Female	0.26	21	30	125	124	70	3.162278	3.162278	21.09502	3	2	21.02379604	51.24451	51.35173	30.26549	72.33948
Kalaiara	Female	0.25	17	30	124	124	56.66667	3	3	19.10497	3	3	20.09975124	50.15974	49.16299	30.06659	69.26038
nithya	female	0.24	20	30	124	124	66.66667	4.123106	4.123106	18.11077	4	4	18	43.04649	43.18565	25.07987	61.13101
nithya	female	0.26	29	30	124	124	96.66667	8.062258	7.071068	17.02939	7.071068	7.071068	15.13274595	35.12834	37	20.02498	52.03845
Vimales	Male	0.26	43	30	124	124	69.76744	4.123106	3.162278	18.24829	3.162278	3.162278	19.02629759	46.17359	45.39824	27.16616	64.38167
Vimales	Male	0.24	19	30	149	150	63.33333	7.071068	7	21	6.082763	6	21.09502311	51.35173	51.15662	30.26549	72.24957

TECHNICAL ISSUES

- Camera latency and system processors not able to detect Involuntary Fast/Short Blinks
- Some false positive blink detected
- Key Press not responsive on certain systems
- Some blinks not counted as blinks

CONCLUSION

- More than 90% accuracy for big & wide eyes with perfect illumination
- Less than 50% accuracy for narrow & small eyes
- Most EAR Threshold between 0.24 to 0.31 varying for types of Eyes
- EAR varies with the distance of the User from Camera
- Environmental factors like illumination, random noise does affect the accuracy of blinks.

FUTURE WORK

- Converting the program into drowsiness/sleep detection system
- Training the output data to find a universal EAR
- Increasing the accuracy of program irrespective of type of eyes
- Detecting and classifying driver's condition
- Real Time Driving system to monitor drivers' senses and change the environmental factors like increasing/decreasing temperature or changing the songs among the many other features with advanced settings for better driving experience