

Real-time Driver Drowsiness detection using Embedded system

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AGENDA:

Objective of project work



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graph TD; A[Objective of project work] --> B[Existing system]; B --> C[Proposed system]; C --> D[Expected outcome];
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Existing system

Proposed system

Expected outcome

INTRODUCTION:

- ▶ Vehicles accidents due to driver drowsiness –40% of highway accidents.
- ▶ Drowsiness- fatigueness, lack of sleep.
- ▶ Existing methods for drowsiness detection are not efficient.

AIM: To design a real time embedded system for drowsiness detection with minimized memory and computational overheads.

Raspberry pi Model:

Picamera: to capture real time video



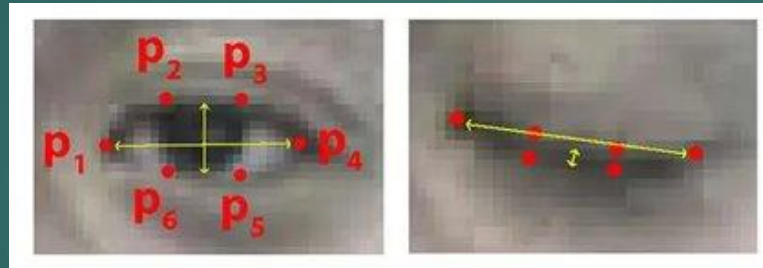
Buzzer: to alert drowsy driver



Raspberry pi 4 board



EYE ASPECT RATIO:
An eye blink detection method.



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

Reduced overheads



Arduino mega board



Buzzer: to alert drowsy driver



IR sensor



Arduino Model:

BACKGROUND AND RELATED WORK

➤ 2016

- Tereza Soukupova et al in 2016 used the eye-aspect ratio to detect the drowsiness of the driver
- In paper "Arduino based real time driver drowsiness detection and mobile art sysem using bluetooth" they proposed a system for detecting drivers drowsiness on Arduino microcontroller board based on Atmega328P for real-time monitoring
 - Used IR sensor for detecting
 - Used low power and have low cost

■ 2018

- Rateb et al in 2018 detected drowsiness of a driver using neural networks
- Archana et al detected driver drowsiness using eye blink sensor.

➤ 2019

- In paper "The detection of drowsiness using a driver monitoring system" drowsiness system classified drivers' into drowsiness into low, moderate, and severe levels of drowsiness.
 - Limitations - could not classify drowsiness into moderate and severe levels of drowsiness.

- In paper “Drowsiness Detection Based on Eye Closure and Yawning Detection” driver's eye movements and mouth movements are tracked using Haar cascade classifiers.

Results detected accurately in 85% of cases

HAAR Cascade : Machine learning approach where a lot of positive and negative images are used to train the classifier

Limitation :High false positive detection, Less accurate, Training custom object is hard

➤ 2020

In paper “Driver Drowsiness Detection System Using Computer Vision.” analyzing the eye blinks of humans using facial landmark detection by calculating eye aspect ratio

Results showed that system effectively detected level of eye openness.

Performance cost is low

PROBLEM STATEMENT

FROM PREVIOUS WORK

To detect drowsiness of driver fingerprint, behavioral and physiological measures are used which need physical contact and are costly

☐ **We need an approach which is :**

- Has no human intervention
- Process which is simpler and faster
- Reliable
- Accurate
- Can be widely used
- Low performance cost

☐ Eye blinking detection is key to drowsiness detection

☐ Here comes dlib library for face detection and facial landmarks detection - more accurate than Opencv.

- ❑ Use eye aspect ratio to determine eye openness

OUR DROWSINESS DETECTION SYSTEM

- Detect drowsiness – EAR in every frame in real time
- Buzzer sound

CHALLENGES

- ❑ Might have memory and computational overheads
- ❑ Pi model cant be used 24/7
- ❑ Consumes large memory
- ❑ Gets heated early
- ❑ Costlier
- ❑ Need to overcome them

Raspberry Pi

Proposed Solution

Arduino Mega



Input Video (Live stream) From Camera



Face detection algorithm(Dlib) and Uses Machine Learning Dataset to train



EYE Aspect Ratio (Calculate) using EYE detection of each frame from video



If Drowsiness detected BUZZER else Repeat the process Continuously



This is **very Inefficient** and there are computational and memory overheads ,not affordable too

Microprocessor

Uses Infrared Sensor(IR) to capture eye blinking detection



Based on the eye blinking it sends signal to receiver ,doesn't require to train the model



Just counts the signals or (0,1)



if 0 attains continuously it means driver is sleeping raise BUZZER else repeat the process in the case of 1 .




Simple computation and **very efficient** ,It works **24/7** and overheads are removed easily



Micro controller

Did we Optimize ?

Board	Raspberry Pi	Pi without GUI	Arduino Mega
CPU %	13.2	1.3	0.4
MEMORY%	4.1	3.8	0.2
WORK	~2hr	~4hr	~24/7
PRICE	~5000Rs	~5000Rs	~1780Rs 

[illegible]

COM13

☒ value 1

Interpolate ☐ **RUN**

Time (s)	Value
9	0
10	1.0
15	1.0
16	0
23	0

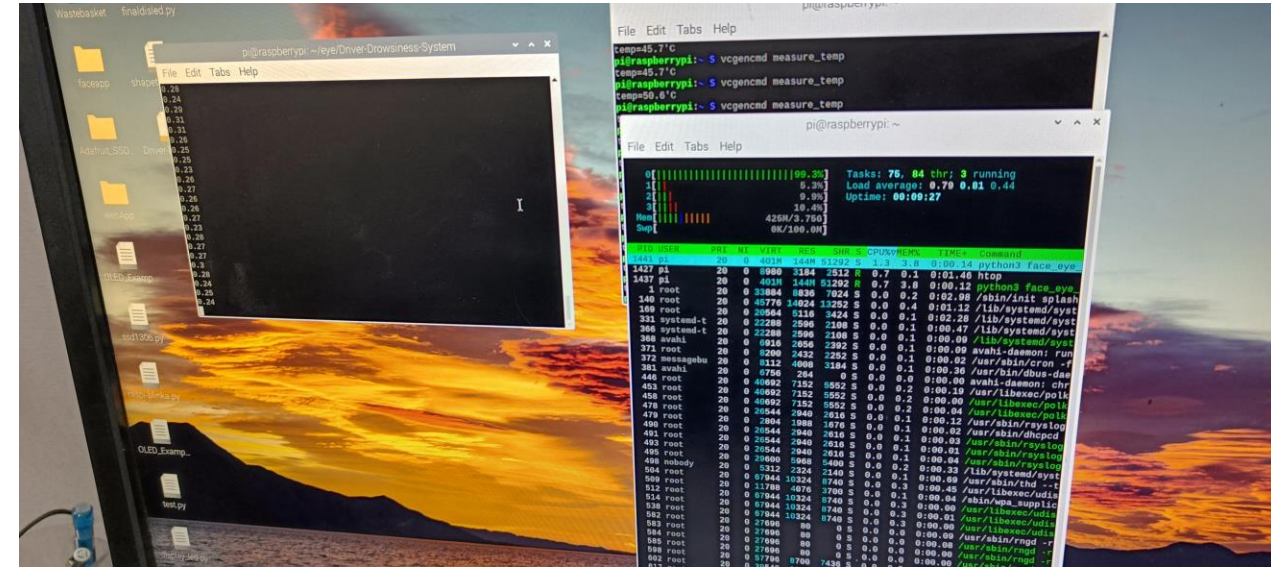
Type Message **SEND** New Line 9600 baud

Output Serial Monitor x

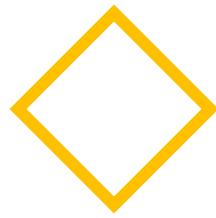
Message (Enter to send message to 'Arduino Mega or Mega 2560' on 'COM13')

New Line

```
18:46:42.076 -> 0
18:46:44.090 -> 0
18:46:46.105 -> 0
18:46:48.068 -> 0
18:46:50.113 -> 0
18:46:52.091 -> 0
18:46:54.120 -> 0
18:46:56.112 -> 0
```

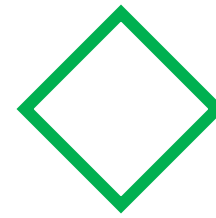


Arduino Mega Board



RASPBERRY PI4

VS



ARDUINO MEGA

Time is ~1.24ms

55%

High Temp > worked less than 2 hrs.

50%

Usage of CPU resources is very high which is inefficient .

50%

Memory overhead is very high

65%

Needed Operating system for monitoring

80%

Usage of ML algorithm and Pi camera is mandatory

20%

2/5 Stars



LOAD AVG TIME



TEMP



CPU %



MEM %



GUI



CAMERA

85%

Time is ~0.30ms

95%

Works continuously for 24x7

65%

Very less Resource is used

80%

As we don't need to process OS it takes less Memory

88%

GUI is not needed to driver ,just BUZZER is enough

50%

We have replaced camera with IR Sensor which saves power consuming



4/5 Stars

CONCLUSION/FUTURE WORK :

- Our model is **cost effective, robust, efficient**, can save lakhs of lives.
- Our Prototype has limitation it doesn't work in night can be extended by **adding night Vision IR Sensor**.
- Can Connect some **alcohol detecting sensor (MQ3)** which detects the **ethanol %** in the air .
- At present the prototype needs to be **connected to power source** continuously ,it can be extended by **adding battery** and other components for making **real time Embedded system**.
- This prototype can be implemented on **Arduino uno or Arduino nano** for more efficiency, less overheads and it is smaller in size which adds **more convenience** to user.

References:

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- 2 . Chris Schwarz, John Gaspar, Thomas Miller & Reza Yousefian, “The detection of drowsiness using a driver monitoring system” , in Journal of Traffic Injury Prevention (Taylor and Francis Online), 2019.
- 3 . Rahul Atul Bhope, “Computer Vision based drowsiness detection for motorized vehicles with Web Push Notifications”, IEEE 4th International Conference on Internet of Things, IEEE, Ghaziabad, India, 2019.
- 4. B.Mohana, C.M.Sheela Rani, “Drowsiness Detection Based on Eye Closure and Yawning Detection”, in International Research Journal of Engineering and Technology(IRJET), 2019.
- 5. Archana Jenis M.R M.E., Assistant Professor Soban Mathew. J “Driver Drowsiness and Alcohol Detection System Using Arduino.
- 6. Lestin Jills Joseph and Dr. Lokesh M, “Arduino based real time driver drowsiness detection and Alert System” september 2016
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