Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 5- Issue 1, Paper 32 January 2022

Driver's Drowsiness Detection using Deep Learning

Guide: Mudit Saxena
Electronics and Communication
ABES Engineering College (AKTU)
Ghaziabad, India
mudit.saxena@abes.ac.in

Kunal Gautam
Electronics and Communication
ABES Engineering College (AKTU)
Ghaziabad, India
Kunal.18bec1154@abes.acin

Harsh Gangwar
Electronics and Communication
ABES Engineering College (AKTU)
Ghaziabad, India
harsh.18bec1088@abes.ac.in

Co-Guide: Shahbaz Alam
Electronics and Communication
ABES Engineering College(AKTU)
Ghaziabad, India
Shahbaz.alam@abes.ac.in

Kshitiz Chaudhary
Electronics and Communication
ABES Engineering College (AKTU)
Ghaziabad, India
kshitiz.18bec1132@abes.ac.in

Nimish Yadav
Electronics and Communication
ABES Engineering College (AKTU)
Ghaziabad, India
nimish.18bec1027@abes.ac.in

Abstract—

As per the Automobile industry is growing every year, new technologies and innovations are also playing a major role in its growth, whether it is about automotive performance or new features added to it. The Driver Drowsiness Detection System using Deep Learning is a feature of Active Safety that is installed on vehicles to prevent accidents that occur due to driver drowsiness, drowsiness or inability to concentrate on the road due to fatigue. Various studies around the world have shown that more than 40% of all road accidents are caused by these problems and in order to reduce these accidents while driving, various new methods have been developed and introduced in modern vehicles to deal with the effects of such accidents. Many tech bullies have worked really hard for a long time to create a system that detects and prevents losses that occur due to driver fatigue or drowsiness. This paper is based on an example of finding a solution to this problem. The purpose of this paper is to help create an automated driver safety system that can detect the physical condition of the driver and take appropriate steps to maintain safety**.** The Driver Drowsiness Detection System here uses Raspberry Pi and Deep Learning and is a union of sensor, buzzer, cameras, etc. The system is designed to detect any actions that the driver may be taking, and the system can detect when a driver is awakened or not by the blinking of an eye. This paper explains the need of Drowsiness Detection system, its benefits and the latest technology used how this leads to the reduction in accidents Finally, the paper concludes on the future scope of Drowsiness Detection system.

Keywords—Driver Drowsiness Detection System, OpenCV, Raspberry Pi.

I. INTRODUCTION

Drowsiness can be a state of feeling sleepy or abnormal all the time. Drowsiness may be caused by a variety of medical conditions, medications and lifestyle changes.

Fatigue can also affect the driving ability of all the drivers. Some of the common causes of drowsiness are:

1) Insufficient sleep

2) Changes in sleep schedule and sleep disorders

3) Unhealthy lifestyle

4) Stress or worry

Due to drowsiness the accident ratio is rising day by day. As per the new statistics 21 percent of all fatal accidents are due to driving in drowsy condition and according to NHTSA 1,00,000 accidents in the country are the result of driver fatigue every year. Past year statistics estimates that 60 % of drivers and about 168 million drivers have met with accidents due to drowsy driving.

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 5- Issue 1, Paper 32 January 2022

A study conducted in 2020 by SafeLife Foundation and Mahindra revealed that truck drivers in India drive 12 hours covering a distance of about 500km and 60% of them admitted that they felt sleepy while driving and due to which some of them have met an accident. This is a serious issue which is increasing day by day. Our main motive of the project is to make safe system and ensure safety. In this way, a system is designed that checks driver's drowsiness condition and alert the driver as soon as possible before it's too late. In addition to this the system also checks whether the driver is drunk or not so that the driver should be alert. For this there is a need of a system which can scan the driver's eyes and detect whether the eyes of the driver are open or closed by monitoring the state of eyes. As real- time detection is very difficult in the field of accident prevention system. The study mainly focuses on providing a real time monitoring system which uses video processing and also movement and eye detection techniques. Here system captures the video via camera and after processing it depending on the state of eyes it will alert the driver. This system will capture the video with the help of camera and starts processing it, and it will alert the driver based on the results. This system has overcome few of the limitations of the existing systems. This system will provide an alert to driver with the help of a buzzer if the driver is feeling sleepy.

Also, if the driver is drunk the sensor will detect and again the driver will get an alert.

II. LITERATURE SURVEY

A lot of steps have been taken in the development of the systems for drowsiness detection based on the factors like movement of eyes, blinking of eyes. A drowsiness detection system has been developed which scans the eyes of driver and check the level of drowsiness and a sensor which will detect the drunk state of the driver. In this detection technique, in accordance with the parameters the system will work according to the steps as Camera is used to detect whether the eyes of the person are open or closed and when image is detected a Region of Interest is created which is fed to the classifier where it identifies and checks whether if the eyes of the person are open or closed. At a certain point where the eyes of the person are closed for about 7-8 seconds, a warning sign is issued to the driver also with the help of MQ3 it can be easily detected whether the person is drunk or not and if the person is detected as drunk a warning alarm or a notification is issued to the driver. This system monitors drowsiness and provides an early warning system, it uses deep learning technique, based on vehicle telemetry data. This proposed system ensures safe driving by real time detection.

- L. Satish, A. Lalitesh in IEEE conference 2020 proposed a paper on Driver's drowsiness detection which proposed CNN model which detects the drowsiness based on the closing of the eyelids of the driver and this model can be easily installed inside the vehicles easily when integrated Raspberry Pi and powered with vehicle's battery. [1]
- Ashish Pondit, Ashim Dey & Annesha Das in IEEE conference in Dec 2020 has proposed "Real time driver monitoring system based on visual cues" which leverages precise graphs representing program execution flows and deep neural networks for automatically learning defect features and control flow graphs and multi- view and layered directed CNNs are also constructed to observe the drowsiness.[2]
- Bettina llie, Oana Ursulescu in IEEE Conference Oct 2020 has introduced the idea only for eye detection Driver Drowsiness Detection Based on Eye Analysis in which they suggested different architectures for the drowsiness detection with the help of different algorithms: Viola Jones, DLib and Yolo V3 for face detection.[3]
- Tariq Jamil, Medhat H. Awadalla in IEEE Conference of July 2016 presented "Drowsiness and Alcohol Detection" using Machine Learning and Raspberry Pi which proposed machine learning techniques which support vector support machines, CNN and also Marcov techniques which can help in accurate face detection. [4]
- Harshit Meda, Ashish Sahani in IEEE conference in 2021 introduced Machine Learning Models for Drowsiness Detection proposed for a model enough compatible to detect the driver's eyes by calculating the EAR so that an alert can be generated which can avoid number of road accidents.[5]
- Dung Chin Lin, Cheng Jia Wang in 2018 IEEE conference gave Real-Time Car Detection and Driving Safety Alarm System with Google TensorFlow which uses Tensor Flow object detection API which makes a rectangular region around eyes and then calculates the ratio which defines that the alert should be generated or not.[6]
- Halina Hassan, Shazali Yaacob IEEE conference in 2017 proposed Eye state detection for driver inattention based on Lucas Kanade optical flow algorithm which can easily detect changing facial expressions and which works as by measuring optical flow on eye region with the help of video sequences. Results have shown high precision.[7]
- KU Anjali, N Jeffy James in IEEE conference 2017 idea on Real-time nonintrusive monitoring and detection of eye blinking in view of accident prevention due to drowsiness which uses Viola-Jones face detection algorithm. Stacked

DCNN network is used to extract features and easy detection. This proposed method shows better accuracy of about 96.52% as compared to traditional CNN.[8]

- Janki Chandiwala, Shrusthi Agrawal IEEE conference in 2021 introduced Driver's real-time Drowsiness Detection using Adaptable Eye Aspect Ratio and Smart Alarm System which uses EM-CNN network to detect eyes and mouth state with the help of Region Of Interest which is created around the eyes so that an alarm can be issued which turned to provide a 90% accuracy. [9]

- Pranshu Jain, Dibakar Barua in IEEE conference in 2019 idea of Road Accident Prevention Unit (R.A.P.U) in which the proposed system which observes the person's state with the help of many sensors whether the person is drunk or not by sensing through sensors by person's breath and calculating the drunk level so that an alarm can be generated.[10]

- Ali Nahvi, "Driver drowsiness based on steering data using adaptation to CNN", in IEEE conference in 2019 proposed a method which uses particle swarm optimization technique which is an effective method than other algorithm techniques as it provides high accuracy.[17]

- H. Varun Chand in UGC conference 2021 gave the idea of "CNN-Based Driver Sleep Program Uses Emotional Analysis" which defines a system that detects a ROI around eyes and calculates EAR depending upon the expressions of person and this method provided an accurate result.[18]

III. PROBLEM STATEMENT

Driver's sleepiness detection using Python and Deep Learning and detect the driver's drunk state.

Developing driver alert system, which gives an alert to the driver by observing driver's eyes for drowsiness or sensing whether the driver's drunken state while driving a vehicle and alarming the driver.

Requirements of the Project:

- Making a real time system that monitors and ensures accuracy in detections.
- A non- intrusive monitoring system that does not disturb the driver.
- A system that woks both in day and night.

Approach:

- Camera takes image as input.
- Face detection from image and a ROI (Region of Interest) is created
- Eyes detection from ROI which is fed into the classifier.
- Categorization with the help of classifier whether the eyes are open or closed.
- Checking whether the person is drowsy or not.
- If detected drowsy the system will alarm and alert the driver.
- Use of MQ-3 detects whether the driver is drunk or not and if detects again alerts the driver.

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 5- Issue 1, Paper 32 January 2022

IV. RELEVANT THEORY:

Components used:

Fig.1 Web Camera [2]

Fig.2 Raspberry Pi [2]

Fig.3 MQ3 Gas Sensor [3]

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 5- Issue 1, Paper 32 January 2022

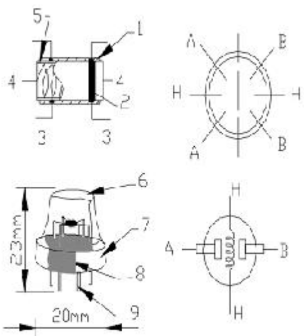
Fig.4 Buzzer [3]

Fig. 5 Connector Pins [3]

V. THEORY:

Raspberry Pi: It is a low-cost credit card sized computer which is attached to a monitor or TV, and using a keyboard and mouse as it has its own display screen. It is a very small device which enables people of all ages so that they can scan a computer, and learn to edit in languages like Scratch and Python.[2] It is able to do everything whatever is expected by a desktop computer, from browsing the Internet and playing high-definition video, creating spreadsheets, word processing, and playing games.[2]

MQ3 Gas Sensor: MQ-3 module ready to receive Alcohol, Benzine, CH4, Hexane, LPG, CO. The critical component of the MQ-3 gas sensor is SnO2, which has low conductivity in fresh air.[20] When targeted alcohol is present, the sensory conduction becomes higher and the gas rises. The MQ-3 gas sensor has a high sensitivity to Alcohol, and is well tolerated by the disruption of fuel, smoke and vapor.



	Parts	Materials
1	Gas sensing layer	SnO_2
2	Electrode	Au
3	Electrode line	Pt
4	Heater coil	Ni-Cr alloy
5	Tubular ceramic	Al_2O_3
6	Anti-explosion network	Stainless steel gauze (SUS316 100-mesh)
7	Clamp ring	Copper plating Ni
8	Resin base	Bakelite
9	Tube Pin	Copper plating Ni

Fig.6 MQ3 sensor internal Architecture [20]

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 5- Issue 1, Paper 32 January 2022

System Architecture

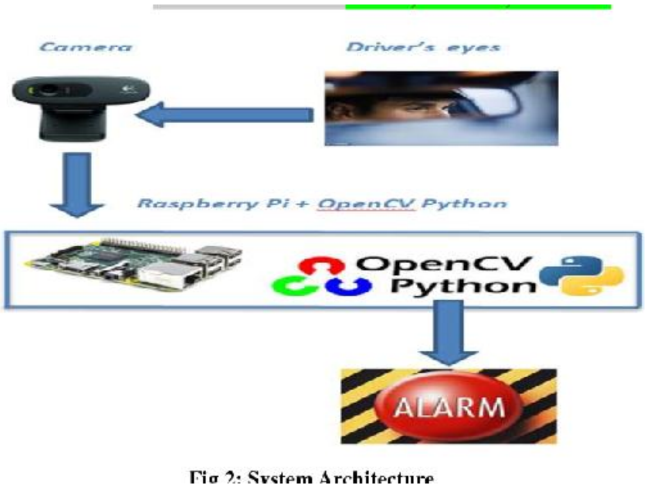
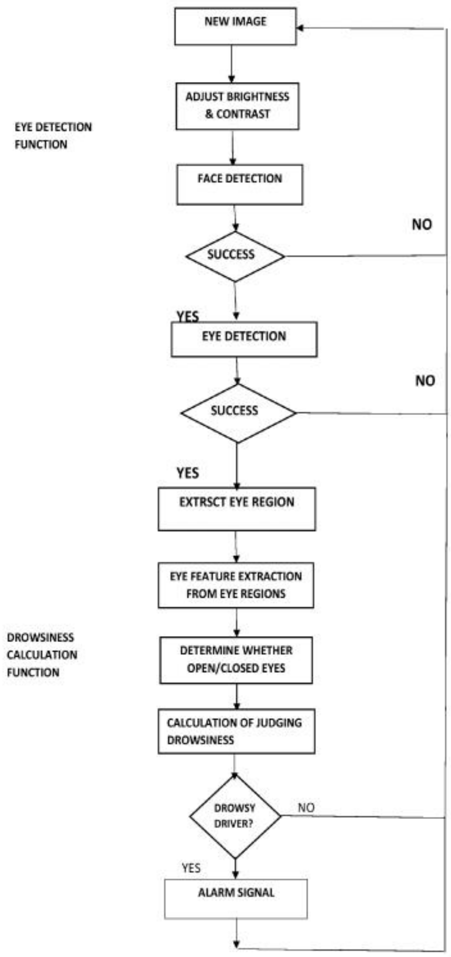


Fig.7 System Architecture [11]

VI. METHODOLOGY AND WORKING PRINCIPLE

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 5- Issue 1, Paper 32 January 2022

A. Flow chart for Drowsiness

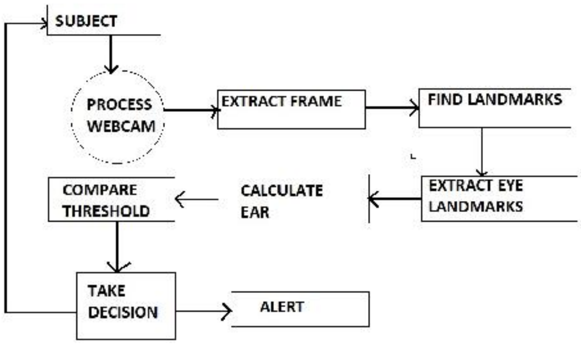


Detection

B. Flow chart for Alcohol detection

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 5- Issue 1, Paper 32 January 2022

BLOCK DIAGRAM



Block diagram for drowsiness detection.[6]

- This model is built with Keras with the help of CNN (Convolutional Neural Networks). CNN can be a special type of a deep neural network that provides extremely well classification of images.[2]
- Webcam takes the images as input. So, we will create an infinite loop which will capture each frame with the help of command: **cv2.VideoCapture(o),** this accesses the camera and **cap. read ()** reads each frame and image is stored in a frame variable.
- The image is going to be converted into grayscale as OpenCV takes gray images as input.
- We are using haar cascade classifier which is used to detect faces. For setting the classifier:[4]
 face =cv2.CascadeClassifier("this is the path to haar cascade xml file").
- Face detection is done using the command:
 faces = face.detectMultiScale(gray).
- This results an detections of array with "x" and "y" co-ordinates with the "h" height and "w" width of the object.
- The procedure to detect eyes is similar to the process of detecting faces.
- Cascade classifier is set both eyes as for left eye: "**lieye"** and for right eye: **"rieye"** using commands:
 left_eye = lieye. detectMultiscale(gray).
 right_eye = rieye.detectMultiScale(gray).
- Now, this provided data is fed into the CNN classifier which predicts whether the eyes are open or not.

- Some operations are performed to fed the image into the CNN classifier and for that the color image is converted to grayscale using the following command:
 r_eye= cv2.cvtColor(r_eye,cv2.COLOR_BGR2GRAY).[5]
- Similarly, for the left eye same command is used.
- Now, resize the image to 24*24 pixels using
 cv2.resize(r_eye, (24,24)) and same for the left eye.
- Normalization of data is performed using the command: **r_eye = (r_eye/255).**
- Now model is loaded using the command:
 model = load_model("models/cnnCat2.h5").

- Now this model starts predicting using the command:
 lpred = model.predict_classes(l_eye).

- If the value of lpred is 0 it means eyes are closed and vice versa.
- Based upon the computations we will determine for time that for how much long the person has closed his eyes.
- If the eyes are detected closed for a while for about 7-8 sec, the score gets increased continuously and vice versa when the eyes are open the score gets decreased.
- The result detected is drawn on the screen with the help of command which will display the real time status of that person:
 cv2.putText().[7]

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 5- Issue 1, Paper 32 January 2022

- For an instance, if a score is greater than 15 it means eyes are closed for a time period of more than 7-8 secs. In that case, an ALERT is generated.
- After the code is ready we connect the Pi Camera and and buzzer to the Raspberry Pi and it will start tracing the eye movement as soon as it detects the face. Now, if we close our eyes for more than 7-8 seconds then a triggering alarm will alert the person.
- Alcohol detection is done using MQ3 sensor which is a Metal Oxide sensor which are also called Chemiresistors.
- MQ3 liquor sensor is set over the controlling so that at whatever point if a driver breath through his mouth and our sensor computes liquor level, if the liquor is in the scope of 0.02- 0.03% the system will lock the engine and an alert is generated with a beeping sound.

Eye aspect ratio:
It is the estimate of an eye-opening state and it determines whether the white region of the eye disappears for a sufficient period of time and it indicates that there is a blink.
Eye Aspect Ratio is a very simple solution which involves a a simple calculation based on the ratio of distances between the facial landmarks of the eyes, as this is a very fast, efficient and easy way to implement.[28]

The eye aspect ratio value changes when the person closes his eyes for a short period of time and gives a constant value if the eyes are kept open and the value gets decreased if there is a blink.
The figure below shows the exact presentation of eye open and closing as ideally the EAR was constant, then it starts increasing which indicates a blink. As in this system we will observe EAR to see if the value falls and does not increase it means that the person has closed his eyes for a short period of time and the alert is generated.

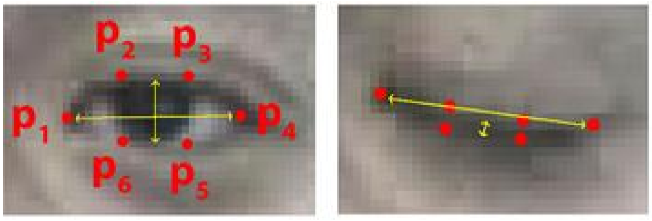


Fig.8 Left: Region of eye landmarks when eyes are open.
Right: Region of eyes when eyes are closed.[15]

The formula used for calculation of EAR is as follows:[6]

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

VII. RESULTS AND ANALYSIS

The subjects were tested on different occasions for drowsiness and alcohol detection and the system's performance was found to be consistent and the all the tests performed were recorded.

The following table 1 shows the result for the drowsiness detection and the readings were recorded when the eyes were open or closed.

Eye close duration	3 sec.	7 sec.	9 sec.
Buzzer	Off	On	On

Table 1.

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 5- Issue 1, Paper 32 January 2022

The following table 2 shows the result which contains the alcohol readings and engine status system and response of different samples in ppm. In between 400 to 1000 ppm alcohol level is high.

Alcohol level in breath	100-200ppm low	200-300 ppm Medium	300-400 ppm high
Engine status	On	Off	off
Alert	Not sent	Sent	Sent

Table 2

Fig.9 Result when eyes are open.[12]

Fig. 10 When eyes are closed.[12]

VIII. CONCLUSION

In this project we have made a system which will help to reduce number of accidents and fatalities caused due to drowsy driving and due to drinking driving. The features added to this project are enough smart in themselves for proper functioning of the whole system so that number of accidents will decrease. The purpose of this paper is to highlight the importance of the need of systems and also how to implement such systems. This real time project will give approximate accurate results.

IX. ACKNOLEDGEMENT

We would like to express our special thanks of gratitude to Professor Mudit Saxena for his guidance and assistance which has greatly benefited in making this paper, and secondly, to all the team members for providing their appreciable support and insight. We would also like to thank ABES Engineering College for providing support and labs with all the required tools and equipment’s required in making this project which has greatly improved this manuscript.

X. REFERENCES

[1] L. Satish, A. Lalitesh, T. Anjali, “Driver Sleep Discovery”, Department of Computer Science and Engineering, Amrita School of Engineering, Amrita Vishwa Vidyapeetham, Amritapuri, India, IEEE Conference July 2020.

[2] Ashish Pondit, Ashim Dey, Annesha Das, “Real-time driver monitoring system based on visual cues”, Chittagong University of Engineering and Technology, Chittagong-4349, Bangladesh, IEEE Conference, December 2020.

[3] Bettina llie, Oana Ursulescu, Georgian Simion, “Driver Sleep Discovery Based on Eye Analysis”, Applied Electronics Department, Politehnica University, Timişoara, Romania, IEEE Conference, December 2018.

[4] Tariq Jamil, Medhat H. Awadalla, “Designing and implementing a car accident detection system”, Department of Electrical Engineering, Sultan Qaboos University, AlKhod, Muscat, OMAN, IEEE Conference, July 2016.

[5] Harshit Meda, Ashish Sahani, “Model Sleep Learning Models”, Institute of Health Engineering, Indian Institute of Technology, Ropar, Rupnagar, India, IEEE Conference, May 2021.

[6] Dung Chin Lin, Cheng Jia Wang, “Real-Time Car Detection and Driving Safety Alarm System with Google TensorFlow Object Detection API”, Chaoyang University of Technology, Taichung, Taiwan, IEEE Conference, July 2019.

[7] Halina Hassan, Shazali Yaccob, “Driver care detection based on Lucas Kanade optical flow algorithm”, Electrical Electronics & Automation Division, University Kuala Lumpur, Malaysia, IEEE Conference, January 2017.

[8] IN Anjali, N Jeffy James, “Non-disruptive real-time monitoring and detection of cataracts due to sleep apnea”, Department of Electrical Engineering and Communications, Jyothi College of Engineering, Cheruthuruthy Thrissur, Kerala, India, IEEE Conference, August 2017.

[9] Janki Chandiwala, Shrusthi Agrawal & Narsee Monjee, “Real Driver Sleep Acquisition using Adaptable Eye Aspect Ratio and Smart Alarm System”, Institute of Management Studies, Mumbai, India, IEEE Conference, March 2021.

[10] Himanshu Arora, Neha Yadav, Samyak Jain, “Real-Time Motor Vehicle Safety System”, Jaypee Institute of Information Technology, Noida, India, UGC Conference, March 2019,

[11] Amorpan Phornaicharoen, “Face recognition using Transferred Deep Learning for Feature Extraction”, King Mongkut's University of Technology Thonburi, Bangkok, Thailand, IEEE Conference, February 2019.

[12] Sarthak Mishra, Saurabh Mishra, Prajwal Verma, “Driver sleep detection system”, IIT Delhi, India, UGC, November 2021.

[13] P.E Kekong, I.A Ajah, “Real-Time Driver Monitoring System Evaluating System Based on Deep Learning”, Department of Computer Science, Ebonyi State University, Nigeria December 2019.

[14] M.E. Expert, “Driver Sleep Discovery Using a Non-Disruptive Method”, Department of EXTC, V.E.S. Institute of Technology, Mumbai, India, October 2017.

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)

Volume 5- Issue 1, Paper 32 January 2022

[15] Praisan Padunweang, “Face recognition using Transferred Deep Learning for Feature Extraction”, School of Information Technology, King Mongkut's University of Technology Thonburi, Bangkok, Thailand, IEEE Conference, April 2019.

[16] Madhav Tibrewal, Aayush Srivastava, “In-Depth Study to Get Driver Drowsiness”, Department of Computer Science and Engineering SRM Institute of Science & Technology, Kattankulathur, Chennai, India, JERT, May 2021.

[17] Ali Nahvi, “Driver drowsiness based on steering data using adaptation to CNN”, Austria, Institute of Automotive Engineering. February 2019.

[18] H. Varun Chand, “CNN-Based Driver Sleep Program Uses Emotional Analysis”, Vellore Institute of Technology, Vellore, India, UGC Conference, June 2021.

[19] Rateb Jabbar, Khalifa Al-Khalifa, “Getting Real-Driver Sleeping App for Android Application Using Deep Neural Network Strategies”, The State University of New Jersey, USA, ANT 2018.

[20] P.E Kekong, I.A Ajah, “Real Time Drowsy Driver Monitoring and detection system using Deep Learning based Behavioural Approach”, International Journal of Computer Science and Engineering, 31 Jan 2021.

[21] Manishi and Naveen Kumari, “A Comprehensive Study on Behavioural parameters-based drowsiness detection system”, International Journal of Computer Science and Engineering, 30 April 2020.

[22] Prabal Gupta, Gaurav Goel, “Drivers Drowsiness Detection using Machine Learning” IJCRT, September 2021.

[23] Ashutosh Dalvi, Neha Bhondve, “Drowsiness Detection using Machine Learning using Visual Behaviour”, IJCRT, June 2020.

[24] Swapnil Titare, K.N Hande, “Driver Drowsiness and Alert System” International Journal of Computer Science and Engineering, UGC, June 2021.

[25] Elena Magan, Araceli Sanchis, “Drowsiness Detection by applying Deep Learning techniques to Sequence of Images”, CSE Department, Madrid, IEEE Conference, 22 Jan 2022.

[26] Mala Ahmed, Rohit Agrawal, “Driver Alertness Detection System”, CSE Department, IJCRT, UGC Journal, 6 Sep 2019.

[27] Vivek Nair and Nadir Charniya, “Drowsiness Detection using Non- Intrusive Technique”, IJCRT, UGC Journal, 11 Sep 2017.