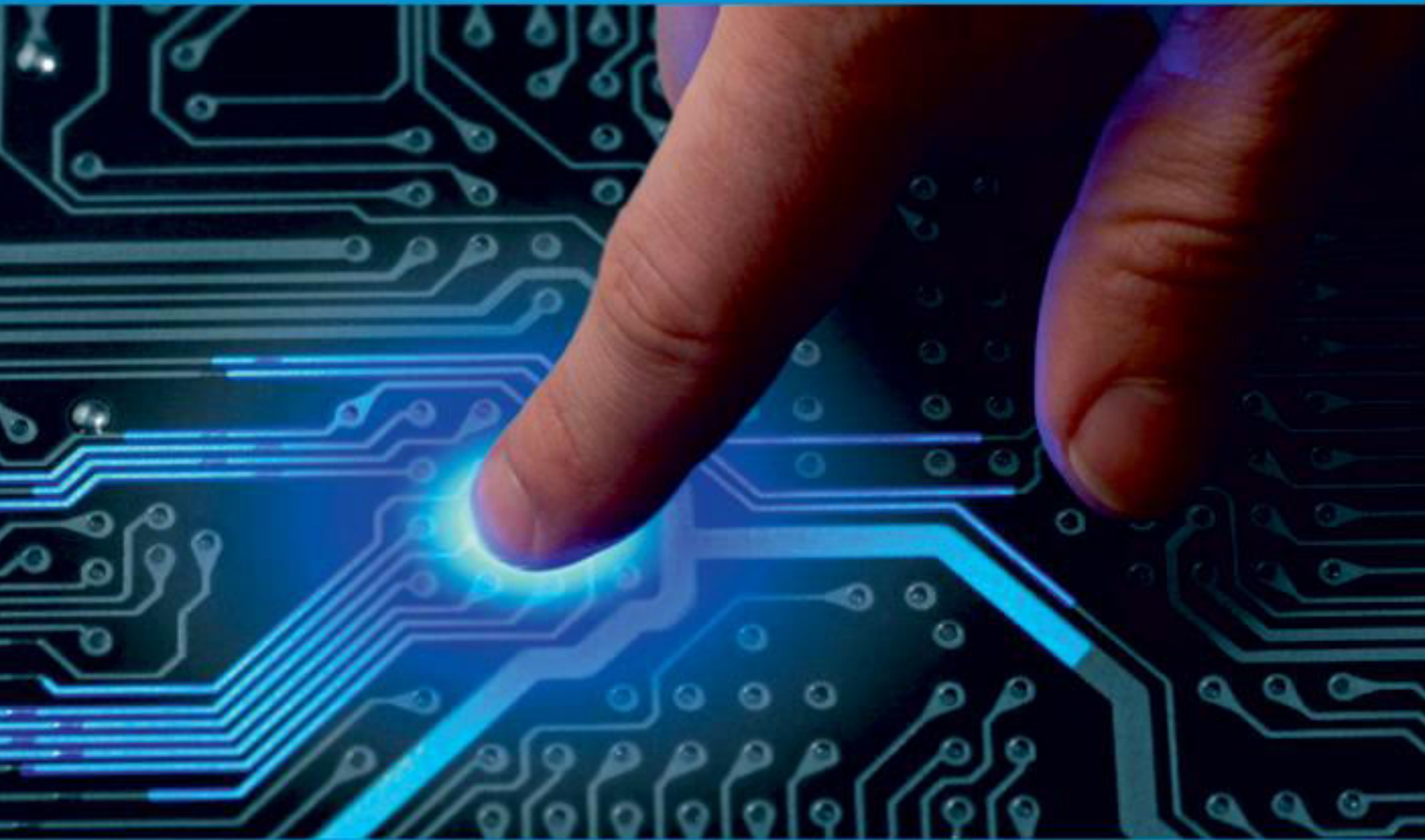
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 10, Issue 5, May 2022

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.165

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005289 |

A Novel Approach for Three Levels of Drowsiness Detection

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ABSTRACT: The major goal of this research is to create a non-intrusive technology that can detect human weariness and deliver an early warning. Drivers who do not take regular stops while driving long distances are at a high risk of becoming drowsy, a condition they frequently fail to detect. According to the expert, drowsy drivers in need of a rest are responsible for one-quarter of all serious motorway accidents, implying that drowsiness causes more road accidents than drunk driving. This device will use a camera to monitor the driver's eyes and lips, and by using an algorithm, we will be able to detect signs of driver weariness early enough to prevent the individual from sleeping. Driver weariness is the leading cause of drowsiness and lack of focus when driving. This may result in traffic collisions, car crashes, and fatalities. As a result, detecting drowsiness is critical in preventing these tragedies. This research presents a highly accurate sleepiness detection system that warns the driver of weariness while driving. The development of an unique drowsiness detection system based on facial, eye, and mouth movement detection. The technology informs the driver by evaluating important indicators such as eyelid opening and shutting and head motions.

I. INTRODUCTION

Many traffic accidents and wrecks have been reported in recent days. According to the WHO Global Report on Road Safety 2018, the number of people killed in traffic accidents has risen to 1.35 million, with the fatality rate rising year after year. Drowsiness or exhaustion is one of the top four causes of accidents worldwide, accounting for 8.8% of all collisions in the US. Sleep deprivation is the leading cause of distraction, indecisiveness, lethargy, and exhaustion. According to a research conducted by the Centers for Disease Control and Prevention (CDC), more than a third of adults in the United States get less than seven hours of sleep per night. Drowsiness is a fatigued feeling caused by mental and physical exhaustion. It causes drivers to be less alert on the road and has an impact on their decision-making abilities. This has recently become a threat, and it is thus the primary source of concern today. The goal of this project is to reduce the number of fatalities caused by driver weariness. Automakers such as Volkswagen and Nissan have developed clever systems for detecting fatigue based on the vehicle's speed, steering wheel movements, and braking mechanisms used by the driver.

II. RELATED WORK

W. L. Ou, M. H. Shih, C. W. Chang, X. H. Yu, C. P. Fan, "Intelligent Video-Based Drowsy Driver Detection System under Various Illuminations and Embedded Software Implementation"

This research develops an intelligent video-based drowsy driver detection system that is unaffected by various illuminations. Even if a driver wears glasses, the suggested technology efficiently detects drowsy driving circumstances. The suggested method is divided into two cascaded computing operations using a near-infrared ray (NIR) camera: driver eyes detection and drowsy driver detection. The accuracy of drowsy status identification is up to 91 percent, and the average open/closed eyes detection rates without/with spectacles are 94 percent and 78 percent, respectively. After software modifications, the processing speed of the 640480 format video can reach 16 frames per second (fps) when implemented on an FPGA-based integrated platform.

"Driver Fatigue Detection based on Eye Tracking and Dynamic Template Matching," W. B. Horng, C. Y. Chen, Y. Chang, and C. H. Fan.

For safe driving, a vision-based real-time driver fatigue monitoring system is presented. Using the characteristic of skin hues, the driver's face is located from colour photos collected in an automobile. After that, edge

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detection is utilised to locate the ocular regions. The collected eyes' images are used for fatigue detection in order to generate some warning alerts for driving safety, in addition to being used as dynamic templates for eye tracking in the next frame. A Pentium III 550 CPU with 128 MB RAM is used to test the system. The outcomes of the experiment appear to be both positive and hopeful. The system can track eyes at a rate of 20 frames per second, and on four test videos, the average accurate rate for eye localization and tracking was 99.1%. On the test films, the accuracy rate for fatigue detection is 100%, although the average precision rate is 88.9%.

"Monitoring Driver Fatigue Using Facial Analysis Techniques," S. Singh and N. P. Papanikolopoulos.

We present a non-intrusive vision-based approach for detecting driver weariness in this work. The device detects micro-sleeps by using a colour video camera that is pointed directly at the driver's face and monitors the driver's eyes (short periods of sleep). In order to find the face in the input space, the algorithm uses skin-color information. We use blob processing to detect the exact position of the face after segmenting the pixels with a skin-like colour. We narrow the search space by examining the face's horizontal gradient map, taking into account the fact that eye regions have a large shift in horizontal intensity gradient. Gray scale model matching is used to locate and track the pupil's location. To detect if the eye is open or closed, we apply the same pattern recognition technique. If the eyelids are closed for an unusually long duration (5-6 seconds), the system assumes the user is going asleep and sends a warning signal..

III. PROPOSED SYSTEM

The suggested system uses the driver's optical cues, which are gathered using a camera, to develop a non-intrusive monitoring strategy that does not divert the driver while yet ensuring precision.

A small CCD camera mounted behind the steering wheel in front of the driver will record continuous videos of the driver's face. The camera should be positioned so that the driver's face fills the majority of the image, and that the driver's face is roughly in the middle of the image.

The video will be converted to frame-by-frame data and sent to the image processor's frame memory. Each image will be saved in an appropriate pixel format in the frame memory.

A personal computer will be connected to the image processor in order to control the image processing process and ensure that the processed results are accurate. To identify tiredness, the system's functions can be divided into face and eye detection functions, as well as a yawn detection function.

Using the fuzzy of the automobile, an automatic braking system was designed using an Arduino mega 8051 microcontroller.

When the input speed of the potentiometer is Pulse Width Modulation (PWM) and ultrasonic sensors detect the presence of obstacles within a certain distance, automatically fuzzy logic integrated with Arduino mega 8051 processes the sensor input to determine the output of the braking angle on the protype of the car.

The fuzzy logic approach is used to create an automatic breaking system, which allows the variables that can impact the final conclusion to be identified and used as a reference.

The design of an automatic breaking system using the fuzzy logic method leads to determine the variables that can influence and become a reference for the final result.

The camera continuously recognises the driver's face, and the dataset extracts data from videos, which is then transmitted to preprocessing. Data is cleaned in preprocessing using techniques such as the Medium filter and the Gabber filter to eliminate image noise and convert to database. Face detection was conducted after preprocessing. Face identification uses a 68-point landmark visualisation to map the source image and extract the eyes and mouth points for later extraction. It estimates the Aspect ratio after extracting face points such as the eye and mouth. If the ratio is less than the threshold value (precisely 0.5), the alert goes off for the eyes and even the mouth.

An alarm is raised if the ratio continues to be less than the threshold value. Both the left and right eyes' aspect ratios are calculated separately. Finally, this ratio is employed in the assessment of drowsiness.

The region retrieved for Mouth Movement (yawning) will include points from both the upper and lower parts of the lips. If a person yawns, the Euclidean distance between the topmost and the most bottom marker points is measured. An alarm is triggered if the number of yawns surpasses a specified threshold.

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IV. IMPLEMENTATION

Image Quality Assessment

1. Preprocessing
2. Face detection
3. Feature Extraction
4. Aspect Ratio and Drowsiness Detection

1. Image Quality Assessment: Image quality assessment (IQA) or image sharpness metric is generally used to analyse the quality of the acquired images. The captured images can be subjected to distortions during acquisition, compression and transmission. Hence the quality of the image is deteriorated. This affects the accuracy and performance of the detection system. From the literature, it was observed that IQA is performed by 3 different methods such as:

- **Full Reference (FR-IQA)**
  A Reference image is used to analyse the quality of test image.
- **Reduced Reference (RR-IQA)**
  Specific features from the reference image is used to analyse the quality of test image.
- **No Reference (NR-IQA)**

No reference image is compared with the test image to analyse the quality.

The real time applications cannot have a perfect reference image to compare with the test image. Therefore, NR-IQA techniques are preferred to determine the quality of images.

2. Preprocessing:

If the quality of the image is compromised, pre-processing is carried out. Pre-processing consists of filtering and image enhancement. Different techniques are used to improve the quality of an image by reducing or eliminating noise present in an image.

Techniques are as follows:

- Gabor filter
- Median filter
- Weiner filter

Gabor Filter:

The **Gabor filter** is a linear filter used for texture analysis, which means that it basically analyzes whether there are any specific frequency content in the image in specific directions in a localized region around the point or region of analysis.

Median Filter:

The **Median Filter** is a non-linear digital filtering technique, often used to remove noise from an image or signal. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image).

Weiner Filter:

The **Weiner Filter** is used to reduce the amount of a noise in a signal. This is done by comparing the received signal with a estimation of a desired noiseless signal. Weiner filter is not an adaptive filter as it assumes input to be stationery.

International Journal of Innovative Research in Computer and Communication Engineering

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Among the above-discussed methods, it is observed that **Gabor filter** enhancement gives comparatively better result to have a good-quality image. Hence, pre-processing is performed on the acquired image to facilitate the further process such as feature detection and selection.

3. Face Detection: The next step after pre-processing is the face detection. It is performed using Local Binary Patterns (LBP) algorithm. It is a very simple and efficient texture operator. The algorithm uses a neighborhood of 8 × 8 and computes center pixel value based on value of the neighborhood pixels. It was found to be a powerful tool for capturing the texture of the image. The ease of implementation of the algorithm and its high processing speed in limited resources (computing speed and power) makes it a preferred candidate to implement for face detection.

4. Feature Extraction: The significant features such as eyes and mouth are identified. These features are extracted using the feature descriptor Histogram of Oriented Gradients – HOG technique. It is generally used to detect objects in the region of interest (ROI) by counting the occurrences of gradient orientation in the given region.

5. Aspect Ratio and Drowsiness Detection: Aspect Ratio is used to evaluate the drowsiness of a driver. Once the significant features are identified using the shape predictor model, the marker points that identify the parts that identify the parts are extracted.

V. RESULTS

Initial Stage:

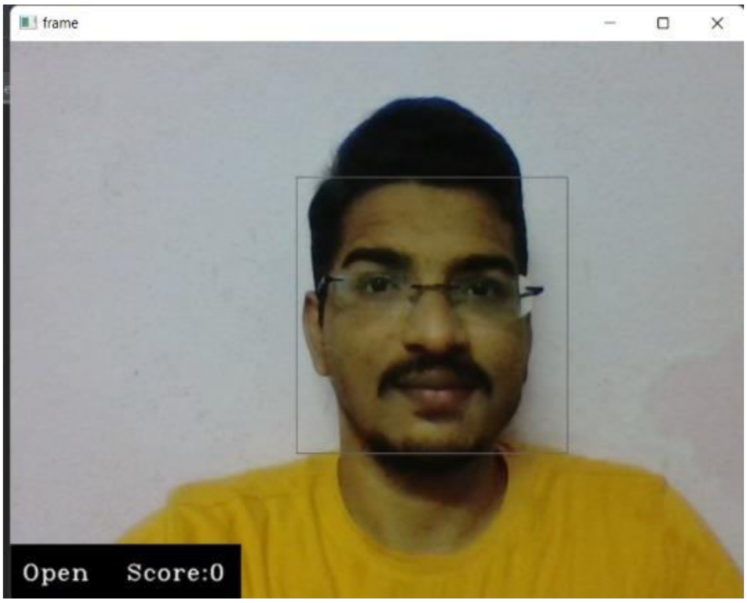

Figure no 1: Output Screenshot1

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Drowsiness Detected :

Stage 1 :

Songs starts playing as the score crosses 15 and reaches till 40.

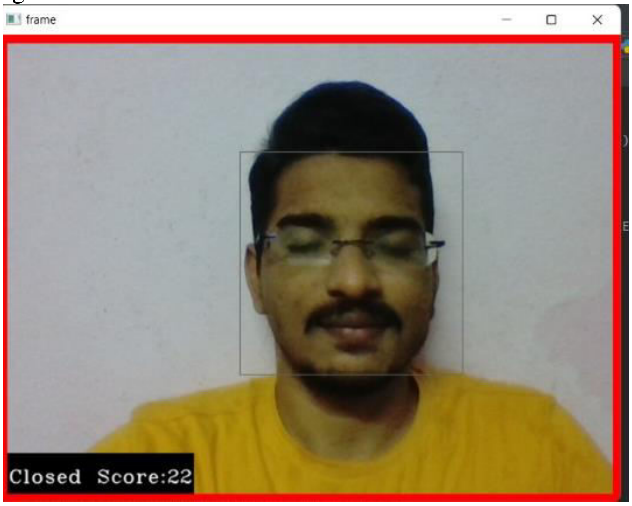

Figure no 2: Output Screenshot2

Stage 2:

As the score crosses 40 now a alaram will be played in the background till the score reaches 60.

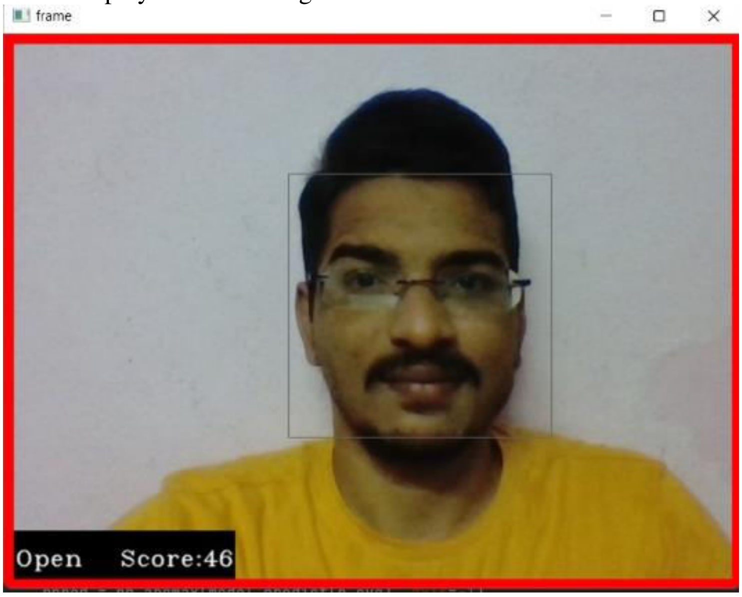

Figure no 3: Output Screenshot3

Stage 3:

Now as the score is above 60,now we calculate the pressure to be applied on the break in order to stop the car.

Figure 4: Output Screenshot4

The acceleration of the car is disabled and due to gradual applying of brakes the car stops smoothly.

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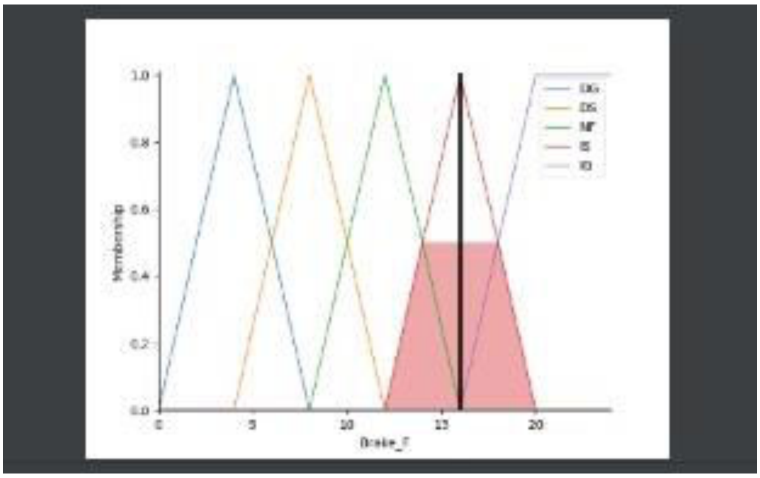

Figure no 5: Graph Representation

The graph here depicts how the newton pressure is calculated in accordance to speed of the car.

VI. CONCLUSION AND FUTURE WORK.

A novel sleepiness detection system is developed in this study by continually monitoring the drivers' eyes and mouth movements. Face detection is done with the help of an efficient algorithm that uses linear binary patterns (LBP). The key features are then extracted using the histogram of gradients (HOG) technique. The gradient boosting tree approach improves the performance of the HOG feature extraction system. The important landmarks were discovered and analysed. Finally, the aspect ratio is determined to determine the driver's tiredness. The system's performance is assessed in a variety of lighting settings and scenarios. Regardless of the lighting quality, the detector performed better in circumstances with and without spectacles, according to the testing. The detection system was also tested against a standard database and proved to be superior to baseline methods that used the same database. The system's average performance is found to be 92 percent. Other non-intrusive features such as behavioural patterns and driving performance can help increase the accuracy of this system.

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