SOMNOLENCE DETECTION USING FACIAL MOVEMENT ANALYSIS

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Abstract-Drivers who don't take regular breaks when handle extended-distance run the high hazard of becoming somnolence. A state which they often crash to admits early enough compatible with the specialist. Studies show that around one-quarter of all serious motorway accidents are due to sleepy drivers in need of a rest, meaning that drowsiness causes more road accidents than drink- driving. Recognition aid can warn of distraction and somnolence in an increased speed range and notify drivers of their present state of somnolence and therefore, the driving time since the final break offers adaptable reactivity and, if caution is a discharge, indicating close by service areas within the INSTRUCT navigation system, many technologies exist to detect driver somnolence. This paper tries to seems at the emerging technologies and determine the simplest approaches in trying to stop the amount one explanation for fatal vehicle crashes. The current market and technologies are in their infancy mode. New technologies keep emerging using different techniques, where this product has been deployed in the form of website with new facilities for upcoming generations study purpose. This will aware our future generations about road safety.

I.INTRODUCTION

The development of technology allows introducing more advanced solutions in lifestyle. This makes work less exhausting for employees, and also increases work safety. Vision-based systems are getting more popular and are more widely utilized in different applications.

These systems can be used in industry (e.g. sorting systems), transportation (e.g. traffic monitoring), the end-user complex products like cars (car stopping camera). Such complex systems could even be wont to detect vehicle operator fatigue using vision-based solutions. Fatigue is such a psycho-physical condition of a person, which doesn't leave a full concentration. It influences the human reaction time, because the tired person reacts much slower, compared to the rested one. The appearance of the first signs of fatigue can become very dangerous, especially for such professions as drivers. Nowadays, more and more professions require long-term concentration. People, who work for carriage jobs (car and truck drivers, steersmen, flight pilots), must keep an extensive eye on the road, (e.g. road accidents, animals on the road, etc.) immediately. Long hours of driving cause the driver fatigue and, consequently, reduces her/his response time. According to the results of the study handover at the International Symposium on Sleep Disorders, the somnolence of drivers is responsible for 30% of road hazards. The British journal "What Car?" granted results of the inquiry conducted with the steering simulator ended that an exhausted driver is much more (threatening) than an individual whose alcohol in the blood is 25% above the permissible limit. Driver somnolence can cause microsleep (e.g. loss of concentration, a brief sleep lasting from 1 to 30 seconds), and falling asleep behind the wheel. Hence, there's a command to progress a system that will regulate and notify a driver of her/him bad psycho-physiological condition, which could notably reduce the amount of somnolence-related car accidents. However, the most important difficulties within the development of such a system are associated with fast and proper recognition of a driver's fatigue symptoms. Due to the increasing amount of vehicles on the road, which translates into road accidents directly, providing a car with the somnolence detection system is necessary

One of the technical possibilities to implement such a system is to use a vision-based approach. With the rapid development of image analysis techniques and methods, and several ready Component-on-the-Shelf solutions (e.g. high-resolution cameras, embedded systems, sensors), it is often envisaged, and that introducing such systems into widespread use should be easy. Car drivers, truck drivers, taxi drivers, etc. should be allowed to use this solution to increase the safety of the passengers, other road users, and the goods they carry.

Driver somnolence detection maybe a car welfare technology that prevents accidents when the operating force is getting tired. Some research has proposed that around 20% of all road tragedies are somnolence-related, up to 50% on definite roads. Driver fatigue may be a significant thing about an outsized number of auto accidents. Driver fatigue may be a significant thing about an outsized number of auto accidents. Current statistics evaluate that yearly 1,200 deaths and 76,000 damages are often attributed to somnolence-related crashes. Road safety awareness is one of the most important aspects of safety concerning traffic rules among adolescent children. The youthful age group is fastly developing as a major population of vehicle owners and may obtain a thrill out of taking risks on the road without perceiving the results, hence it's vital to assess awareness and practice on the road safety rules.

The findings of the present study showed that the majority of secondary school students i.e. 68.7% had average awareness and only 25.3% had good awareness. This finding is similar to the study conducted among school 7 – 10 children in Indore, Chandigarh, Chennai, and Guntur city. 65.3% of the students were aware of the traffic rules. This finding is the contradictory study conducted among medical students in Barabanki, Uttar Pradesh where the notice was high. This finding is similar to the studies conducted in Indore, Chandigarh, Guntur city, and rural Tamil Nadu.Because of the risk that somnolence presents on the road, techniques got to be developed for preventing its reaction. Driver inattention could be the result of a scarcity of alertness when driving thanks to driver drowsiness and distraction. Unlike driver diversion, driver somnolence involves no activate event but, instead, is distinguished by a continuous withdrawal of notice from the road, and traffic commands. And with the topic of drowsy driving, there are still some rules, regulations, and awareness about safety driving where students and youngsters still not aware of that, and because of this issue many accidents were happened by youngsters who were involved in rash driving Driver fatigue is often caused by four main factors: sleep, work, time of day, and physical. Often people attempt to do much during a day and that they lose precious sleep thanks to this often by taking caffeine or other stimulants people still stay up, the lack of sleep builds up over several days and the next thing that happens is the body finally collapses, and the person falls asleep. time of day factors often affects the body. The human brain is trained to think there are times the body should be sleep, these are often associated with seeing the sunrise and sunset, between the hours of 2 am and 6 am, the brain notifies the body it should be rest

II. RELATED WORKS

Ralph Oyini Mbouna, Seong G. Kong, and Myung-Geun Chun et al. [1] presented a visual analysis of eye state, and HP using a single camera for continuous monitoring of alertness of a vehicle driver. The suggested scheme brings out visual features from the eyes and head gestures of a driver in a real outdoor steering state. EI measures eye closures, PA finds dynamic motion of the eye, and HP calculates all directional head gestures. EI, PA, and HP are extracted in every video frame and mean for a video chunk of 120 frames, following the "four seconds rule" according to the Pennsylvania Driver's instruction book. Four authorities and the driver evaluated the video segments and assigned a label to the alertness level. Later, the closing label class was obtained using the major vote. An SVM classifier was then used to identify the alert level of each individual driver for every video chunk of 4 s. The categorization results specify that merging eye and head information achieves the highest categorization accuracy. Using the three statistically significant attributes, namely, EI, PA, and HP, the SVM classifier shows a low Type-I error, which is more critical than a Type-II error or a false alarm.

SalvatoreVitabile, Alessandra De Paola, Filippo Sorbello et al. [2] presented an embedded monitoring system to detect symptoms of driver's drowsiness. Close by utilizing the bright pupils' occurrence, an algorithm to locate and follow the driver's eyes has been progressed. The system has correctly determined driver somnolence symptoms. Due to the use of infrared camera, the drowsiness monitoring system can be used with low light conditions when the IR CCD camera is installed on the car dashboard, the system encountered some problems with light poles, Also, other faulty operations have been detected when the driver is wearing glasses or earring IR- reflecting objects.

Arun Sahayadhas, Kenneth Sundaraj, and Murugappan et al. [3] assessed the different techniques available to decide the somnolence state. This paper also discusses the different ways in which somnolence can be handled in a reviving domain. Different calculations used to detect somnolence include subjective, vehicle-based, physiological, and behavioral measures; these were also explained in detail and the pros, and cons of each calculation were described. While the precision rate of using physiological measures to detect somnolence is high, these are highly invasive. However, this invasive nature can be settled by using contactless electrode placement. Therefore, it would be credit for fusing physiological measures, such as ECG, with behavioral and vehicle-based measures in the development of a structured somnolence recognition system.

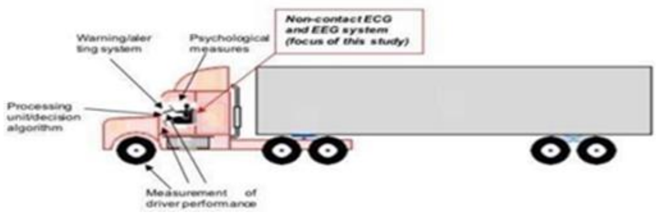
Anirban Dasgupta, Anjith George, S L Happy, and Aurobinda Routray et al. [4] presented a robust real-time system for monitoring the loss of attention in automotive drivers. In this approach, the face of the driver is detected at a lower resolution using a Haar classifier. An optimal down Sampling Factor (SF) of 6 is chosen as a trade-off between speed and accuracy.
The in-plane and off-plane rotations have been remunerated using perspective transformations of the input frame. To compensate for the effect of variation in illumination, BHE has been performed. Further, a superscribed rectangular region over the detected face has been tracked using a Kalman Filter thereby making use of the temporal information resulting in a reduction of the search space and improvement in real-time performance. An ROI based on face morphology has been marked and remapped onto the original frame where PCA is used during the day, and the LBP feature is used during the night with NIR illumination to

localize the eyes. At last, SVM is used to segregate the eye states into open and closed to calculate the PERCLOS values over a window of 3 minutes break. Linear SVM shows a success rate of 98.6% while quadratic SVM features a hit rate of 97.3%. The overall speed of the algorithm is found to be 9.5 fps, which is good enough for correctly evaluating the eye state. The algorithm has been cross-validated using EEG signals. Onboard, as well as testing, has been carried out for both days and night driving. The system was found to be quite robust both regarding speed, accuracy.

III.EXISTINGSYSTEM

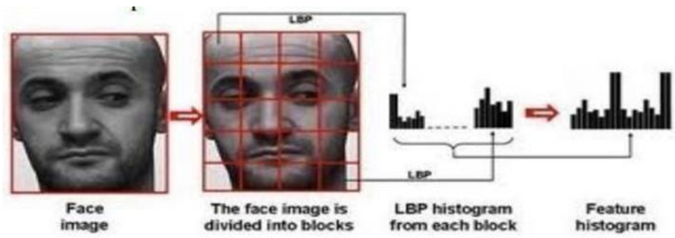
ECG and EEG-based Spatio-temporal convolutional neuralnetwork for somnolenceevaluation:

Many researchers have considered the subsequent physiological signals to detect drowsiness: electrocardiogram (ECG), electroencephalogram (EEG). The pulse (HR) also varies significantly between various stages of drowsiness, like alertness and fatigue. Therefore, heart rate, which may be easily determined by the ECG signal, also can be wont to detect drowsiness. Others have measured drowsiness using Heart Rate Variability (HRV), in which the low (LF) and high (HF) frequencies fall in the range of 0.04–0.15 Hz and 0.14–0.4 Figure given below, shows physiological signal sensing system that can be integrated into vehicles to detect driver drowsiness. Electroencephalogram is the physiological signal regularly used to calculate somnolence. Which corresponds to sleep activity, which corresponds to alertness? A decrease within the power changes within the alpha waveband and a rise within the theta waveband indicate drowsiness.



LBP (Local Binary Pattern):

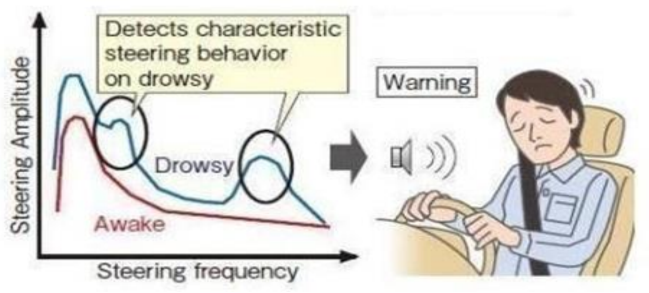
Local binary patterns (LBP's) have induced growing interest in image processing and computer vision. As a non-parametric method, LBP sums up local structures of images easily by comparing each pixel with its adjoining pixels. The major features of LBP are its tolerance regarding monotonic illumination changes. This approach is mainly used for locating emotions on the face like cheerfulness, sorrow, anticipation, etc. LBP (local binary pattern) is used in drowsiness detection for detecting the face of the driver, it divides the image into four quadrants then the top and bottom parts are detected.



Steering Wheel Movement (SWM):

Calculated using a steering angle sensor which is a commonly used vehicle-based calculation for observing the level of the driver's somnolence. Steering behavior has been measured using an angle sensor mounted on the steering column.to normal driving. The difference that sleep-deprived drivers made fewer wheel reversals than normal drivers was founded by Furlough, and Graham. To eliminate the effect of lane changes, the researchers considered only small wheel movements (between 0.5° and 5°), which are needed to regulate the lateral position within the lane. The figure given below shows the SWM-based detection. In general, steering behavior is influenced by characteristics of the driving task, driver traits, and driver states. Drivers are always applying small, smooth, navigating accommodation to correct for little road bumps and crosswinds by turn-off the wheel in small increments.

Hence, supported small SWMs, it's possible to work out the drowsiness state of the driving force, and thus provide an alert if needed. In a replicated environment, light side winds that move the car to the right side of the road were added along a curved road to create a difference in the sideward position and force the drivers to form corrective SWMs. This is because they will function reliably only especially in environments and are too hooked into the geometric characteristics of the road and to a lesser extent on the kinetic characteristics of the vehicle.



Yawning BasedTechnique:

Detection of driver's somnolence based on yawning measurement. This involves several steps including the real-time detection and tracking of the driver's face, detection and tracking of the mouth contour, and the detection. The figure is given below shows yawning based on measuring both the rate and the number of changes in the mouth contour area. APEX™ the smartest automotive camera which was developed by Connie Corp

In our approach, the driver's face is continuously captured using a video camera that is installed under the front mirror inside the car, as shown in the figure given below. Following, locating somnolence involves two main steps to correctly calculate changes in facial movements that infer drowsiness. Initially, the driver's face is located and followed in the sequence of frame shots taken by the camera. After locating the driver's face, the subsequent step is to detect and track the situation of the mouth. We have chosen to detect and track the face before tracking the mouth as this makes the mouth tracking procedure more robust against false defections.

After the detection of the mouth, the yawning state is detected based on measuring the rate of changes in the area of the mouth contour and the aspect ratio of the mouth area.

Head NoddingDetection:

Another method currently use is head Position Detection. This technology simply determines the head tilt angle. When the top angle goes beyond the particular angle, the audio alarm is transmitted within the driver's ear.

IV.IMPLEMENTATION

Input Video:

The live video taken from the camera is taken as the input video. This Camera captures the eye and the face of the target person who is driving the vehicle. This video is taken as the input for the further process.

Frame Separation:

The frame processing is the initial step within the background subtraction algorithm; this step aims to make the modified video frames by removing the noise and unwanted objects within the frame to extend the quantity of information gained from the frame. Preprocessing of the image may be the process of collecting the simple image processing tasks that change the raw input video info into the format. This could be processed by subsequent steps.

Preprocessing of the video is necessary to enhance the detection of moving objects, for example; by the spatial and temporal smoothing, snow as moving leaves on the tree could be removed by the morphology of the frames after recognition of the active thing. The video stream must be converted into images to processes it. Hence, the video stream is converted into frames per second. These are given as input to the preprocessing.

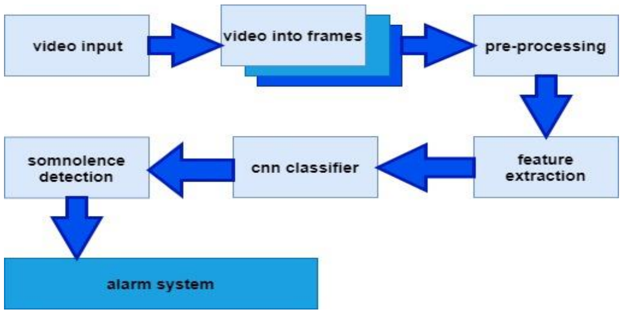


Fig 2. Workflow diagram

Image pre-processing:

Pre-processing is widely used to remove noise from the signaled images. An important preprocessing step to enhance the results of later processing is noise reduction. The major important role of the median filter is to perform through the signal entry by entry, restoring each entry with the median of neighboring entries.

Image processing mainly includes the following steps:

i. Importing the image via image acquisition tools;

ii. Analyzing and manipulating the image;

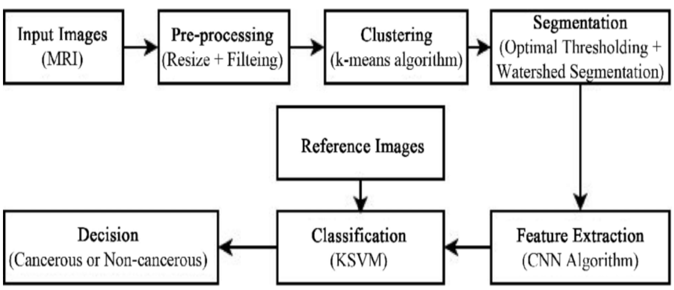
iii. Output in which result can be altered image or a report which is based on analyzing that image.

Feature Extraction:

The feature extraction sort of the dimensional reduction efficiently represents interesting parts of the picture as the compact feature vector. When the input data to an algorithm are just too large to be processed and it's suspected to be redundant then, it might be transformed into a reduced set of features. Deciding a subset of the inceptive features is termed feature preference. The chosen features are expected to contain the relevant information from the input data in order that the specified task is often performed by using this reduced representation rather than the whole initial data. This approach is favorable when the size of the image is high and turndown attributing characterization is required to quickly complete functions like image matching and retrieval.The drowsiness features are detected from the set of drowsiness images. These features include the position of the attention, and therefore, the time-frame that the attention remains closed. The features are extracted from various instances of people feeling drowsiness within the vehicles.

CNN Algorithm:

Artificial Neural Networks are utilized in various classification tasks like image, audio, words. To get the simplest results using the neural network, it's necessary to choose an appropriate architecture and learning algorithm. Based on the research in previous research papers, a suitable consistent method is used to expand or shrink the neural network size until a reasonable output is obtained. In this work, we tried different sizes for the neural network using python, and that we found that the simplest among them. Different sorts of Neural Networks are used for various purposes, for instance for predicting the sequence of words we use Recurrent Neural Networks more precisely an LSTM, similarly for image classification we use a Convolution Neural Network.
It consists of a put-in layer, middle layers, and an out-turn layer. Middle layers are called hidden layers because their inputs and outputs are hidden by the activation function and final convolution layers that perform convolutions have beenincluded by the hidden layers Typically this includes a layer that does multiplication or other scalar product, and its activation function are usually ReLU. This is followed by other convolution layers like pooling layers, fully connected layers, and normalization layers. The dataset which is created using feature extraction is fed into the CNN algorithm and trained for n iterations. Every training iteration gives accuracy. The best accurate model from the training set is chosen by the CNN algorithm. This model is used by the CNN to provide considerable output.



Working of CNN

Drowsiness Detection:

The drowsiness Detection technology deals to detect the drowsiness of individuals via mathematical algorithms. It is a sub-discipline of computer vision. Fatigue is the physical condition of the body where individuals close their eyes. Current focuses in the field include Driver Drowsiness Detection. Users will be warned when they are feeling drowsy while driving vehicles. Many approaches have been made using cameras and computer vision algorithms to interpret eye closure postures. Drowsiness Detection can be seen as a way for computers to save thousands of human lives by alerting the individual at the appropriate timing. Since CNN Algorithm is already trained with our drowsiness dataset. The CNN Algorithm is fed with the images from the video stream of the vehicle. The CNN compares images with the best accurate trained model it has with it. When both matches it detects the drowsiness of the individual and check the time frame for which the eye of the individual is closed and if it crosses the threshold value it sends the information to the audio system.

AlertSystem:

An Alert system converts textual signals into an audio signal. There are so many technologies involved in creating audio alerts. Among them, PyAudio was the most suitable and accurate component. It provides Python bindings, the cross-platform audio I/O library called port audio. The textual signal generated in the drowsiness detection phase is given as input to the PyAudio. The PyAudio converts this textual signal into an alert which warns the individuals until he opens his eyes and remains open for some stipulated time.

V. PROPOSED SYSTEM

People of this generation almost got comfortable and fully satisfied with the concept of making things easier and creative, although people start to work more and more their health is damaged because of changes in their routine times, some health issues are lack of sleep, blood pressure, etc. and today these health issues play a major role in death, as every year most of the people are dying because of road accidents, and nearly 80 % of that accidents occurred due to lack of sleep(drowsy state), to overcome this issue, drowsy detection software's were introduced and most of the automobiles were unbounded with this drowsiness software which prevents accidents, but the drawback on this is the cost of this car and the software's unbounded in that was high, and it will not be a better and cheapest cost price for middle-class people, so to come out of this issue In this project, we propose a web application known as "web-based somnolence detection software".

This web application will be very useful for people who was a student, family, educationalist, traffic departments, driving school, and especially in a rehabilitation center, as it is a web-based application people from anywhere can use this with their handheld devices, as the name depicts the major usage of this application is to detect the drowsy state and the level of our eye movements during the drowsy state, the secondary usage is people who are using this website can come to know many things about drowsy driving, how to guard children's during journey, rules, and regulations in driving, punishment in rash driving with the documented format which can be downloaded by the people for further use, this web-based app can also be used by tutors in a rehabilitation center to teach about awareness in driving, and also in traffic departments, they can use this web app in any part of the public roads to make aware of people by making them view the camera and show the difference in alert messages with the eye movements. This web application is developed in python, HTML. This web application consists of both the front end and backend with interactive buttons. As the application can be hosted on the web, the user has the privilege to use the application from anywhere around the globe.

Modules:

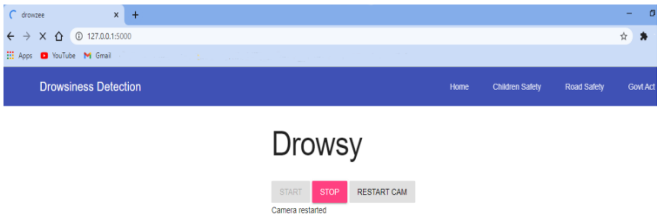
Start module:

Used to start the somnolence backend prototype, which is placed under the home button, when the start button has been clicked, it shows the Classifier status whether it is on or off, and the starting time

Example: Classifier ON - Status 1 Time Start: 2021-04-03 13:58:47.252916

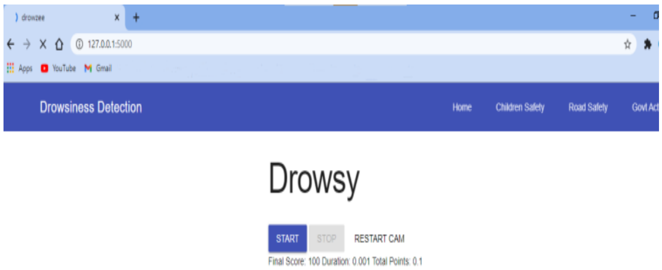
Restart module:

This module is used to restart the prototype once the user has been alerted by the system during a drowsy state, when the module gets restarted then the status of the classifier and the sending time gets back to starting time



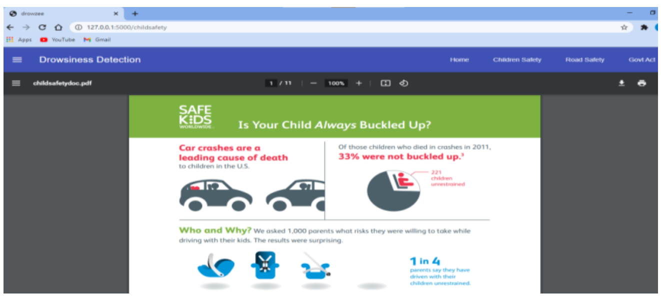
Stop module:

Used to stop the somnolence backend prototype once the user wants to come out of the home module when the stop button has been clicked, it shows the final score out of 100, duration, and total points



Child safety:

This button will provide details about the way to buckle up children within the car and supply safety for them, and it also contains the JPG format about children safety Traveling with children be often fun, both for them and for you. But on the top of the traditional demands of caregiving, you've got another responsibility to stay the youngsters safe on the go which can cause extra stress if you are not sure what to expect. While you'll not have control over other drivers, you'll confirm that children are properly protected in your car. It looks so easy to do, but some people still don't use seat belts in spite of the immense benefit of doing so. Studies have shown that seat belts are liable for saving 329,715 lives within the last 50 years. Additionally, automobile crashes are the leading explanation of death among teenagers. NHTSA data shows that quite half of the teenagers who died in crashes weren't wearing a safety belt.



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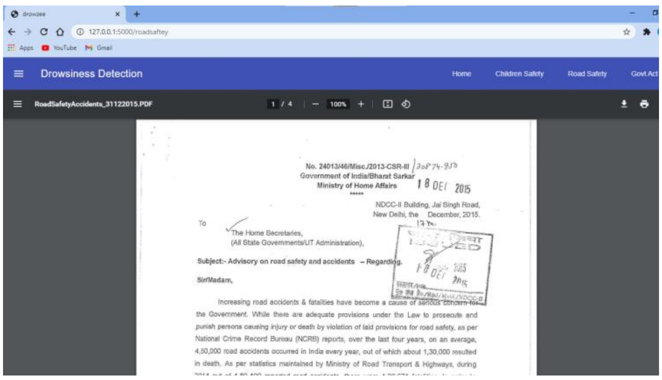
Road safety:

1. This button provides the complete details about the IMPORTANT PROVISIONS OF THE MOTOR VEHICLE ACT 1988. Which consists of the Description of offense, section/rule, maximum of punishment, terms of imprisonment.
2. Everyone must learn about the rules and regulations of road safety.
3. Increasing road accidents and fatalities have become a cause of serious concern for the government. while there are adequate provisions under the law to prosecute and punish persons causing injury or death by violation of laid provisions for road safety, as per the National crime record bureau(NCRB)
4. This government information will be used by people for their study purpose and they can download it from the website.

Govt act:

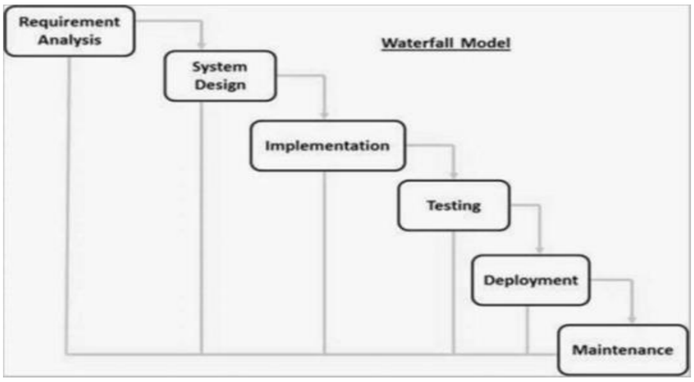
1. Law on Use of Seatbelt: CENTRAL MOTOR VEHICLES RULES 1989
2. This button provides the complete details about As per the provisions of sub-rule (3) of Rule 138 of the Central Motor Vehicle Rules, 1989 'in a motor vehicle, in which seat-belts have been arranged on rule 125 or rule 125A under sub-rule (1) or sub-rule (1A), as the case may be, it shall be made sure that the driver, and the individual placed in the foremost seat of the individuals holding front-facing rear seats, as the case may be, have on the seat belts while the vehicle is in motion.
3. People can download this pdf for their study purpose



Methodology used:

Waterfall model

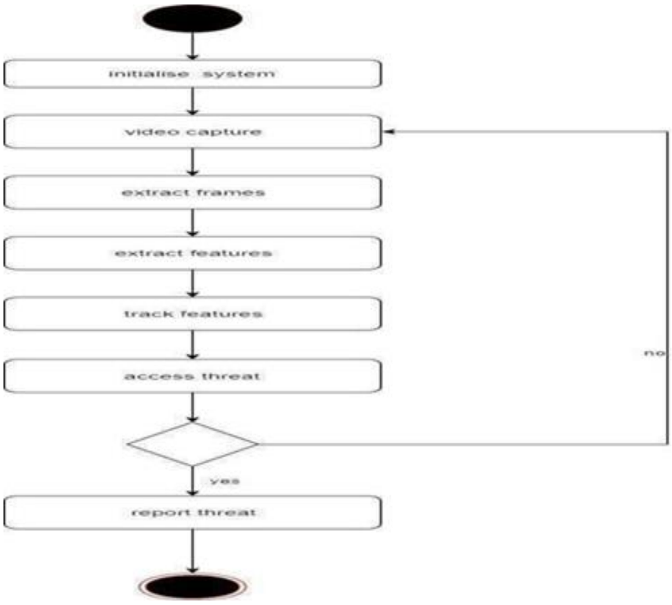
The methodology used to develop this application is the waterfall model. In this approach, the whole procedure of software development is split into separate phases. In this model, the outcome of one-stage acts as the input for the next stage subsequently. It is also referred to as a straightforward(linear)-sequential life cycle model. It is very simple to understand and use. In this model, each stage must be ended before the following phase can start and there are not any overrunning phases.



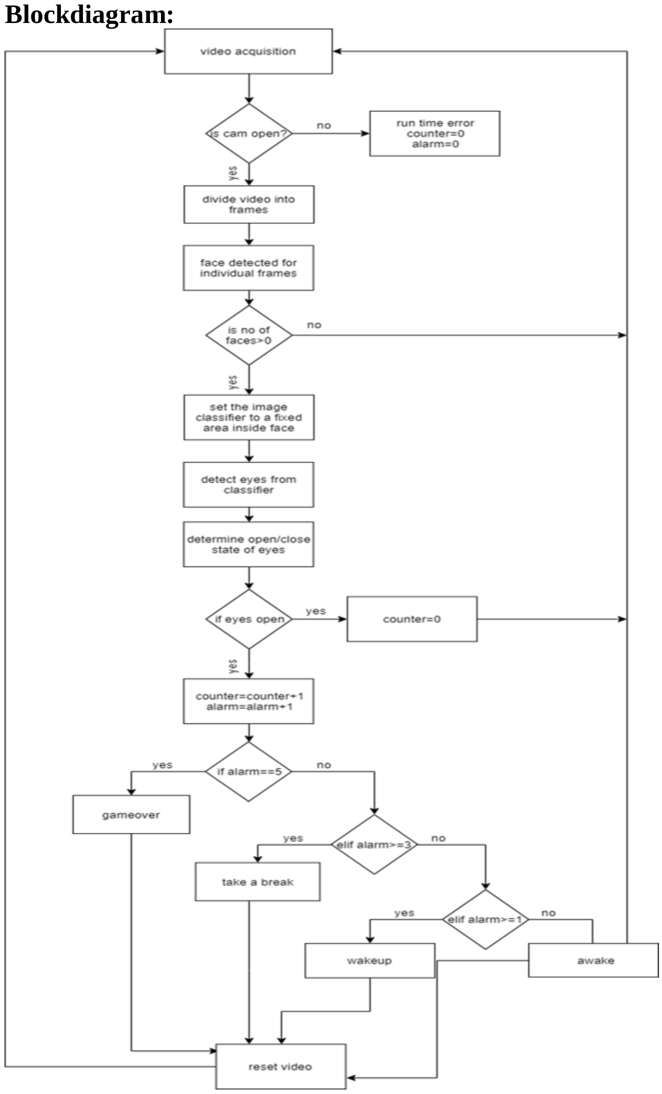
Advantages of the Proposed System:

1. The proposed system is user-friendly as it has a simple-to-understand user interface.
2. Here we didn't use any sensors so it will not affect our eyes
3. The accuracy and time taken by the system to detect drowsiness is fast and high, and it also makes us take a break if our eye blinks more than 3 times

Activity diagram:



Blockdiagram:



VI. RESULT AND ANALYSIS

Our approach ensures a fully automatic solution to detect the drowsiness of the individual who is driving a vehicle. The performance of the proposed approach was accurate and was able to detect the drowsiness of the individuals in different lighting environments. Since we are interested to detect drowsiness, we consider eye detection alone. Facial eye detection is implemented. A bounding box is created around the face of the individual and captures the eye. And the system will check whether eyes are opened or not, if eyes are opened then the counter value becomes zero (0) value, if not counter value increased by 1, and the alarm also updated by 1

1. Here some resource paths have been provided in the name called static i.e. wakeup, take a break, game over, awake
2. The system will detect the number of times the blinking movement of our eyes, and for each resource path, separate values have been provided once the value has been reached then the resource path will be alerted in the form of sounds (alarm).
3. If the person has been blinked 5 times then he will be notified with the sound message called game over
4. If the person has been blinked more than 3 times then he will be notified with the sound message called take break
5. If the person has been blinked more than 1 time then he will be notified with the sound message called wakeup And after that stipulated seconds it turns off.

Fig.4 Results of the proposed system

VII. CONCLUSION

While narrated all around the paper, many technologies remain to detect somnolence. This paper tries to look at emerging technologies and the best ways to prevent deadly vehicle accidents. Presently, the primary selling product in the market is nothing more than the reed switch to detect the head angle tilt. Which is extremely limited and not very effective? The product made by BMW and integrated into their high-end cars to detect driver fatigue behavior is slightly more effective in the detection but lack proper notification to warn a driver. The current market and technologies are in their infancy mode. New technologies keep emerging using different techniques, where this product has been deployed in the form of website with new facilities for upcoming generations study purpose. Which will aware our future generations about road safety.

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