**Somniferous Recognition: Driving System**

**A Project Report**

Submitted in the partial fulfillment of the

Requirements for the award of

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**In**

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Under the Supervision of:

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**DECLARATION**

We/I hereby certify that the work which is presented in the Major Project-II entitled “**Somniferous Recognition: Driving System**” in fulfillment of the requirement for the award of the **Degree of Bachelor of Technology in Engineering Physics** and submitted to the Department of Physics, Delhi Technological University, Delhi is an authentic record of my/our own, carried out during the period from January to May 2022, under the supervision of Prof. Srinivas Rao Allam (Professor, EP Department).

The matter presented in this report has not been submitted by us/me for the award of any other degree of this or any other Institute/University. The work has been published/accepted/communicated in SCI/ SCl expanded/SSCI/Scopus indexed journal OR peer-reviewed Scopus indexed conference with the following details:

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To the best of my knowledge, this work has not been submitted in part or full for any Degree or Diploma to this University or elsewhere. I, further certify that the publication indexing information given by the students is correct.

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Date: May 12th, 2022

**CERTIFICATE**

I hereby certify that the Project Dissertation titled, “**Somniferous Driving Recognition System**” which is submitted by **Vinay Yadav** **(2K18/EP/090), Amit Seth (2K18/EP/012) and Ayush Kishore (2K18/EP/019)**, to the Department of Engineering Physics, Delhi Technological University, Delhi in partial fulfillment of the requirement for the award of the degree of Bachelor of Technology, is a record of the project work carried out by the students under my supervision. To the best of my knowledge this work has not been submitted in part or full for any Degree or Diploma to this University or elsewhere.

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**ABSTRACT**

Every year, human errors result in an increasing number of deaths and injuries in traffic accidents around the world. Somniferous driving has been identified as a major contributor to car accidents. It has been proven that as one's fatigue level rises, so does one's driving ability, with crashes accounting for more than 20% of all vehicle accidents. However, once a life is lost, it cannot be recovered. In this paper, I discuss the fundamentals of somniferous driving. It starts by explaining what "somniferous driving" means. Its problems, as well as the consequences of not getting enough sleep, who is at risk of sleepy driving, and how to avoid it.

Each year, road accidents caused by human error result in a growing number of deaths and injuries around the world. Somniferous driving plays an important role in automobile collisions. It has been proven that as tiredness increases due to workload issues, driving ability deteriorates, with crashes accounting for more than 20% of all vehicle accidents. However, life is lost once it can’t be regained again. I mentioned some basics of somniferous driving in this paper. It begins with an introduction to somniferous driving, its characteristics problems, possibilities of risk of somniferous driving, and the preventions which minimize the risk factor of accidents caused by somniferous driving .

**somniferous Driving**

Somniferous driving, also called as sleepy driving or driving when u feel exhausted or tired, can be caused by a number  of factors, including severe sleepiness, sleep deprivation, shift work-related load and mismatch of schedule , exhaustion, and consuming alcohol while feeling tired . These elements have a significant impact on performance, alertness, memory, concentration, and reaction speeds when all comes together.

Even every driver has a past experience of driving when somniferous. It's an insidious problem because it may affect any driver and sneak up on you. The motorist will often refuse to admit to falling asleep because doing so would put them at fault and make them liable. Furthermore, if the driver dies before giving a statement, we will never know if they were asleep when the car crashed. According to a 1999 poll, 24% of adults had fallen asleep behind the wheel. Male drivers admit to falling asleep while driving twice as often as female drivers.

**Driving While somniferous(problems)**

According to reports of statistics , drivers with somniferous issues are much more responsible for roughly a third of all fatal car accidents, and a study from the University of Pennsylvania Health System backs up this claim. Accidents caused by sleeping are many more serious and scary nightmare crashes than drinking. says Dr. Michael Grandner.while we all heard of drunk driving we rarely heard about the somniferous driving but it is a more serious health and safety issue. A survey of over 17,000 persons revealed that most people require at least seven hours of sleep each night: While distracted driving has received a lot of attention recently, sleepy driving is still a major cause of car accidents.

Two in every five drivers (41%) admit to falling asleep, behind the wheel at some point. According to a new Traffic Safety study, one in ten people stated they had done so in the previous year.

A somniferous deprived  driver was involved in one out of every six (16.5 percent) fatal crashes, one out of every eight crashes that resulted in hospitalization, and one out of every fourteen crashes that required a vehicle to be towed.Somniferous driving is estimated to cause 1,650 deaths, 69,000 injuries, and more than 100,120 accidents per year, according to the National Highway Safety Administration.More than half (54%) of drivers who fell asleep while driving in the previous year indicated they had been driving for less than an hour when they fell asleep.Many traffic experts believe that somniferous driving is under-reported and undervalued.Date and Time

Due to circadian cycles, sleep-related accidents are most common in the early morning, between 02:00 and 06:00 a.m. , and in the late afternoon, between 03:00 and 04:00 p.m. According to Horne24, drivers are 50 times more likely to fall asleep behind the wheel at 02:00 a.m. than they are at 10:00 a.m. Between 03:00 and 04:00 p.m., the danger is three times higher than between 10:00 and 11:00 a.m.

There seems to be a relationship between the driver's age and the period when they are most tired.25 Younger drivers are more likely to get fatigued early in the morning, while senior drivers are more likely to fall asleep behind the wheel during the afternoon nap time. The peak time period for drivers aged 70 and above was between 10:00 and 11:00 a.m.Maycock8 discovered a relationship between sleep-related accidents and the time of day, with the early morning hours being the most dangerous. According to research, the temporal pattern of sleep-related accidents is similarly connected to the driver's age. Those under 45 years old were most at danger in the early hours, those 45 to 65 years old were most at risk around 07:00 a.m., and those over 70 years old were most at risk around 03:00 p.m.

**Somniferous The following characteristics define driving:**

Driving after a lack of sleep is less than 6-7 hours.

If you need to stay awake for more than 12 hours, you don't need to drive.

Frequently yawning

Difficult to hold your head up.

Focusing problems, frequent blinking, and heavy eyelids.

You can't recall the past few kilometers you drove.

Drifting out of your lane, swerving, or following too closely

**somniferous Driving (risk)**

Sleepiness, exhaustion, drowsiness, weariness, and somniferous driving are caused by too many factors. Sleep loss due to restriction, interruption, or fragmentation; chronic sleep debt; circadian factors related to driving patterns or work schedules; time on task; the use of sedating drugs; and the use of alcohol when already sleepy are just a few examples. These factors have progressive effects, and combining any of them considerably increases the probability of a collision. The chances of a car accident caused by somniferous driving is not equally distributed all over the inhabitants. There are two reasons for this. First, crashes tend to happen at times consistent with one's circadian rhythms, such as during the night and in the midafternoon. As a result, people who drive late at night are far more likely to have an accident. Second, those who are overly sleepy during the day, either because of lifestyle circumstances or because of an untreated sleep issue, are more prone to suffer crashes. Young youth males,  time-shift workers, commercial vehicle drivers, and persons not treated with sleep problems or short-term or chronic sleep deprivation have all been linked to an increased risk of falling asleep behind the wheel. Those who are at a higher risk of driving when somniferous include. Have slept for fewer than 7 to 8 hours. After being awake for more than 12 hours, drive. Take a sleepiness-inducing drug.

Drive late at night or early in the afternoon. Have trouble falling asleep or staying asleep at night on a regular basis. Have untreated organic sleep disorders including sleep apnea, or periodic limb movement disorder. Drive for lengthy periods of time on monotonous highways or country roads. Work the night time shift, especially when driving home after the work shift. Furthermore, drivers aged 16 to 24 are nearly twice as likely as drivers aged 40 to 59 to be involved in a sleepy driving accident. Men (48 percent) are also more likely than women (28 percent) to admit to falling asleep behind the wheel.

**somniferous Driving (preventions)**

somniferous driving is something that causes major loss to a driver and their family and these practices can be prevented in multiple ways. The main symptoms of slow stimulation, are lack of judgment, lack of concentration, blurry vision due to sleep, and short processing time. So getting an adequate amount of sleep for 7-9 hours is the most important and greatest way to avoid somniferous driving which most people are not able to get. if you are going for a long driving trip it's better to avoid getting up early and try to make a good night sleep habit try to on the radio while driving and try to do daily workout try to get a good amount of caffeine while starting a long drive it is very beneficial but most important you should develop a good sleeping habit that will help you more in getting rid of somniferous driving.

**Chapter No. 1**

**INTRODUCTION**

* 1. **RESEARCH MOTIVATION**

Throughout the globe, people and things move from one location to another by a variety of modes of transportation. Raw materials must go to the factory, completed items must get to the point of sale or consumption, and people must move about to administer a firm, among other things. It's a part of every stage of our lives. All of us and our businesses would be unable to go forward without transportation.

Transport may be accomplished primarily by land, air, or water. Trucks, tractors, etc., are used to transport things on land, whereas railroads, buses, and vehicles are used to transport people. There are aircraft and helicopters for transporting people and commodities in the sky. Similarly, ships, steamers, and other waterborne conveyances transport cargo and people. In the world of transportation, they are referred to as distinct modes of transportation. Land, water, and air transportation all fall under the same broad category of mode of transportation.

Physical movement of products and persons on land is referred to as land transportation. Road, rail, rope, or pipe may all be used for this kind of transportation. As a result, land transportation may be further broken down into road, rail, ropeway, and pipeline transport.

Roads are the physical conduits that allow people to travel from one part of the land to another. Village, town, and city roads are not all the same. They may be made of sand, chips, cement, or coal tar. Motorized vehicles including bullock carts, motorbikes and automobiles may be seen on the highways. All of them are distinct modes of transportation on the road. There are three forms of road transportation: Man-powered, animal-powered, and motor-powered vehicles all exist. Motor-driven vehicles have grown in importance throughout time relative to human- and animal-driven vehicles on the road. This is owing to the fact that they can move quickly and carry a lot of weight. Increased access to roads across the nation has also led to an increase in motorized transportation. Auto-rickshaws, scooters, vans, buses, tempos, and trucks are some of the vehicles used to transport goods and people. The following are some benefits of driving instead than flying:

In comparison to other means of transportation, it is a more affordable option.

•Road carriers can move perishable items at a quicker rate across short distances.

As it may be loaded and unloaded anywhere, it's a very adaptable form of transportation. It's a door-to-door service that's available.

Hilly regions, where other modes of transportation aren't available, might benefit from the use of this mode of transportation to get people and products from one location to another.

Vehicle crashes are the most serious drawback of this mode of transportation, despite its numerous positives. Collisions may lead to injuries, destruction of property, and even death. Many people die and are left with long-term disabilities as a result of motor vehicle crashes across the world. Crash risk is affected by several variables, including vehicle design, speed of operation and road layout. Inattentiveness and sleepiness are the main symptoms of an impaired driver. Somniferousdriving is a major issue that results in tens of thousands of collisions every year, according to the NHTSA.

Recent years have shown a rise in the prevalence of driver weariness and sleep deprivation among heavy-vehicle drivers.'

Driving when tired, distracted, or irritated is a leading cause of car accidents. Over 1,500 people are killed and 40,000 injured each year because of sleepiness, which costs the government and companies an enormous amount of money every year. It is possible to save many lives, people's sufferings, and companies by detecting drivers' alertness early enough to notify them of their lack of awareness due to weariness.

In today's world, transportation is a necessity for almost everything we do. Drowsiness when driving may be caused by a lack of sleep, a change in physical state, or extended travels. The driver's degree of alertness is decreased as a result of sleepiness, which raises the risk of an accident. One of the most common causes of car accidents is somniferousor fatigued driving. Every year, the number of deaths and fatalities throughout the world rises.

Using new technology to develop and create systems that can monitor and quantify drivers' levels of attention during the course of driving is critical in this context.

According to this research, the frequency of accidents caused by driver drowsiness may be reduced and road safety can be improved by implementing a module for ADAS (Advanced Driver Assistance System). Driver sleepiness may be detected using optical information and artificial intelligence in this approach.

In order to quantify PERCLOS, we offer an algorithm that locates, tracks, and analyzes the driver's face and eyes (percentage of eye closure).

As technology advances, more cutting-edge solutions may be implemented into daily life. This reduces the burden of labor on workers, and it also improves the workplace's safety. Increasingly, vision-based technologies are being employed in a broad range of industries and applications. Suspect detection systems, for example, may be found in airport security at major airports, as well as in industrial applications like sorting systems and traffic monitoring, as well as in end-user sophisticated goods like automobiles (car parking camera). Systems like this may be used to identify driver drowsiness in vehicles using vision-based methods. Fatigue is a mental and physical state that prevents a person from fully concentrating. In comparison to a rested individual, the reaction time of a fatigued person is much slower. If you're in a job like driving, the first indications of weariness may be deadly.

In today's world, a growing number of vocations need a long-term focus. Transportation workers (such as truckers, drivers, and pilots) are expected to pay great attention to the road at all times in order to be able to respond quickly in the case of an emergency (such as a traffic accident or an animal in the road). [1] Driving over long periods of time generates weariness, which diminishes the driver's ability to respond quickly. In a research presented at the International Symposium on Sleep Disorders, 30 percent of traffic accidents were attributed to driver weariness. The findings of a driving simulator experiment published in the British magazine "What Car?" showed that a sleepy driver is much more risky than someone whose blood alcohol level is 25 percent higher than the legal limit [2]. Driving when tired may lead to micro sleep (a brief sleep lasting from one to thirty seconds) and actual sleepiness behind the wheel.

As a result, a system for detecting and alerting drivers to their poor psychophysical state is urgently needed, with the potential to drastically decrease the frequency of automobile accidents caused by weariness. It is, however, these issues that provide the greatest challenge in the construction of a fatigue-monitoring system. It is essential that a car be equipped with a tiredness detection system in order to prevent accidents on the road because of the rising number of cars on the road. The employment of a vision-based method is one of the technological options for implementing such a system. Imaging techniques and procedures, as well as ready-to-use components (such as high-resolution cameras, embedded systems, and sensors), make it possible to implement these systems in a broad manner. Drivers of automobiles, trucks, and taxis should be permitted to use their cellphones while on the road. This.

**1.2.** **EXISTINGDRIVER FATIQUE DETECTION SYSTEMS 1**

One 1 of 1 the 1 examples 1 of 1 a 1 system 1 detecting 1 a 1 driver’s 1 fatigue 1 is 1 the 1 system 1 implemented 1 into 1 the 1 Driver Assistant 1 in 1 Ford 1 cars 1 [3]. 1 It 1 analyzes 1 rapid 1 steering 1 movements, 1 driving 1 onto 1 lines 1 separating 1 lanes, 1 irregular 1 and 1 rapid 1 braking 1 or 1 acceleration. 1 The 1 system 1 collects 1 and 1 processes 1 these 1 data, 1 assigns 1 the 1 driver 1 using 1 one 1 of 1 the 1 5-degree 1 concentration 1 levels 1 (5 1 – 1 the 1 driver 1 is 1 concentrated, 1 drives 1 properly, 1 1 1 – 1 the 1 driver 1 is 1 very 1 tired, 1 should 1 immediately 1 stop 1 driving 1 and 1 rest) 1 [3]. 1 When 1 the 1 rating 1 falls 1 to 1 level 1 1, 1 the 1 driver 1 is 1 notified 1 by 1 beeps 1 and 1 warnings 1 on 1 the 1 instrument 1 panel's 1 middle 1 screen. 1 The 1 system 1 can 1 be 1 reset 1 and 1 the 1 warnings 1 will 1 disappear, 1 only 1 when 1 the 1 driver 1 stops 1 and 1 opens 1 the 1 door. 1 Skoda 1 cars 1 uses 1 a 1 similar 1 system. 1 It 1 analyzes 1 the 1 steering 1 movements 1 and 1 compares 1 them 1 to 1 the 1 movements 1 in 1 normal 1 driving. 1 The 1 system 1 begins 1 to 1 analyze 1 how 1 the 1 vehicle 1 performs 1 15 1 minutes 1 after 1 starting 1 the 1 engine 1 and 1 at 1 the 1 speeds 1 of 1 more 1 than 1 65 1 km/h 1 [4]. 1 When 1 the 1 system 1 detects 1 that 1 driving 1 is 1 abnormal, 1 the 1 driver's 1 fatigue 1 status 1 is 1 displayed 1 on 1 the 1 screen, 1 followed 1 by 1 a 1 beep, 1 informing 1 the 1 driver 1 to 1 take 1 a 1 break 1 [4, 1 5]. 1 Volkswagen 1 uses 1 the 1 Bosch 1 Driver 1 Drowsiness 1 Detection 1 system 1 (Fig. 1 1). 1 It 1 also 1 analyses 1 how 1 a 1 car 1 behaves 1 on 1 the 1 road. 1 Based 1 on 1 the 1 information 1 from 1 the 1 power 1 assisted 1 steering 1 sensor 1 and 1 the 1 steering 1 angle 1 sensor, 1 the 1 system 1 detects 1 sudden 1 changes 1 in 1 the 1 trajectory 1 of 1 the 1 vehicle, 1 which 1 translates 1 into 1 driver’s 1 fatigue 1 [6]. 1

Some 1 driver 1 fatigue 1 detection 1 methods 1 use 1 the 1 heart 1 rate 1 analysis 1 [7]. 1 The 1 psychophysical 1 state 1 is 1 determined 1 by 1 the 1 HRV 1 (heart 1 rate 1 variability). 1 DENSO 1 (manufacturer 1 of 1 car 1 parts 1 and 1 systems) 1 at 1 the 1 Detroit 1 Auto 1 Show 1 presented 1 a 1 system 1 that 1 relies 1 on 1 a 1 driver's 1 heart 1 rate 1 analysis 1 and 1 the 1 use 1 of 1 the 1 cameras 1 to 1 observe 1 a 1 driver’s 1 eyes. 1 Such 1 a 1 solution 1 allows 1 detecting 1 a 1 fatigue 1 at 1 the 1 operator 1 of 1 the 1 vehicle. 1 There 1 are 1 also 1 ideas 1 for 1 the 1 use 1 of 1 electroencephalogram 1 (EEG) 1 to 1 detect 1 the 1 driver's 1 brain 1 wave 1 changes, 1 which 1 may 1 indicate 1 the 1 first 1 symptom 1 of 1 fatigue. 1 The 1 panel 1 view 1 implemented 1 in 1 Android 1 is 1 shown 1 in 1 Figure 1 2.

The 1 PSA 1 Group 1 (formerly 1 PSA 1 Peugeot 1 Citroën), 1 in 1 collaboration 1 with 1 the 1 Lausanne 1 University 1 of 1 Technology, 1 are 1 working 1 on 1 a 1 camera-based 1 system 1 to 1 analyze 1 the 1 facial 1 expressions 1 of 1 a 1 driver. 1 It 1 is 1 interesting 1 to 1 note 1 that 1 the 1 very 1 early 1 aim 1 of 1 this 1 system 1 was 1 a 1 detection 1 of 1 emotions 1 of 1 a 1 driver, 1 but 1 they 1 decided 1 to 1 develop 1 it 1 into 1 the 1 fatigue 1 detection 1 system) 1 [9, 1 10, 1 11]. 1 It 1 is 1 based 1 on 1 the 1 analysis 1 of 1 eye 1 movement, 1 the 1 closing 1 and 1 opening 1 of 1 the 1 eyelids 1 as 1 well 1 as 1 the 1 movement 1 of 1 the 1 mouth. 1 It 1 allows 1 detecting 1 the 1 first 1 symptoms 1 of 1 a 1 fatigue. 1 Information 1 provided 1 by 1 this 1 system 1 will 1 inform 1 a 1 driver 1 on 1 the 1 state 1 of 1 her/his 1 psychophysical 1 state

**Chapter No. 2**

**EXISTINGSYSTEM**

**2.1. FACIAL RECOGNITION**

Some facial recognition algorithms pull landmarks or characteristics from a picture in order to identify a person's face. Algorithms may, for example, look at how the eyes, nose, cheekbones, and jawline sit in relation to one another. These traits are then used to search other photographs with similar characteristics. The data in a picture that is important for face identification is only saved by other algorithms, which normalize and compress a gallery of photos of faces. The facial data is compared to a probing picture. Based on a collection of facial traits, one of the first effective systems uses template matching to create a compressed representation of the face.

**2.1.1.** **Facial Recognition methods**

There are two primary approaches to recognition algorithms: I Geometric, which focuses on distinguishing characteristics (feature based); and (ii) Photometric, which employs statistical analysis to reduce image data to numerical values and then compares the numerical values to predefined templates to eliminate variances (view based);

Recognition algorithms that are widely used. The geometric technique is used in Principal Component Analysis and Linear Discriminate Analysis. Hidden Markov model and Elastic Bunch Graph Matching are statistical approaches.

**Principal Component Analysis (PCA)**

Principle component analysis (PCA) is a mathematical process that turns many potentially-correlated variables into a smaller number of uncorrelated variables called principle components. The first principal component accounts for as much of the data's variability as feasible, and each subsequent component accounts for as much of the remaining variability.

Predictive models are often built using PCA, which is utilized for exploratory data analysis as well as data exploration. A data covariance matrix or a singular value decomposition of a data matrix must be calculated as part of PCA.

PCA is the most basic kind of multivariate eigenvector analysis. Sometimes, it is looked of as providing the best explanation for variation in data by showing the underlying structure of the data. A "shadow" of a multivariate dataset is provided to the user by PCA when seen from its most informative perspective, if the dataset is displayed as a collection of coordinates in a high-dimensional data space.

**Linear Discriminate Analysis(LDA)**

Two or more classes of objects or events may be distinguished by using a linear combination of characteristics. A linear classifier may be constructed using the resultant combination. Each face is represented by a huge number of pixel values in computerized face recognition. Before classification, linear discriminant analysis is most often employed to minimize the number of features. In the new dimensions, pixel values are linearly combined into a template to generate the new dimensions.

**Elastic bunch graph mapping**

It is a computer science pattern recognition method known as Elastic Matching (EM). Additionally, it is referred to as flexible matching or non-linear template matching.

For example, elastic matching is a two-dimensional warping issue that specifies equivalent pixels between two pictures.

**Hidden Markov Model(HMM)**

Modeling systems as Markov processes with unseen states is called a hidden Markov model (HMM). The simplest dynamic Bayesian network is an HMM.

There are several applications for hidden Markov models in temporal pattern recognition, including voice recognition, handwriting analysis, gesture analysis, part of speech tagging, partial discharge analysis, bioinformatics, and more.

**2.1.2.****ThreeDimensionfaceRecognition**

Three-dimensional facial recognition is a new trend that claims to attain previously unmatched accuracy. This method makes use of 3-D sensors to gather data on a person's facial features. Using this information, one may then determine the shape of an individual's eye sockets, nose, and chin from the surface of their face.

It's possible that even the most advanced 3D-matching technology might be affected by facial emotions. Tools from metric geometry are used to make expressions isometric.

**Skintextureanalysis**

Additionally, skin texture analysis, which is based on conventional digitized or scanned photographs, is becoming increasingly popular. A person's distinctive lines, patterns, and spots are transformed into a mathematical space using this approach.

**2.2. DRIVER SOMNIFEROUS DETECTION SYSTEM**

**2.2.1Somniferous detection method**

There are two types of sleepy detecting systems: incursion and non-intrusion.

Sensors are utilized to activate an alert system in intrusive approaches that detect sleepiness. The use of temperature sensing electrodes or invasive instrumentation devices is common in these systems. Brain waves, heart rate, and eye blinking as well as slouched posture, head tilt, and the open/closed position of the eyes are some of the most invasive approaches.

Drivers find these gadgets physically and mentally upsetting. This is the most accurate description, yet it is also the least likely. Because the driver's body would have to be physically connected to the sensing electrodes. The motorist gets irritated and distracted as a result. In addition, sweat on the sensors would reduce their capacity to monitor precisely after a lengthy period of driving.

Drowsiness may be detected using this method without disrupting the driver's physical state. There are a number of non-intrusive techniques that may be used to monitor a driver's reaction to stimuli such as yawns and lane departures, as well as yawn rates and eyelid movements. These gadgets aren't the most precise, but they're the most lifelike.

There is no standard technique for measuring tiredness and quantifying the amount of automatic sleep in people who are driving. There are, however, five main methods of recording. Electroencephalographic (EEG) brain waves are used in one method. One can measure brain waves using an EEG. A polygraph machine monitors the activity of sensors attached to the head on both sides. Electroculogram (EOG) is the most often utilized test. The EOG uses a voltage differential between the cornea and the retina to capture eye movements. A reference electrode is used to measure the eye's position in relation to this electric field's vector. The difficulty with this approach is at least two channels are necessary when capturing eye movements to aid in separating eye movement potentials from other signal distortions.

Electromyography is used to quantify muscle tension (EMG). Typical EMG electrode locations include the underside of the chin and the bottom of the legs. Because of the potential for interfering with one's ability to drive or do other work-related duties, this activity is often avoided.

The use of cameras to monitor drivers' eye movements is another popular method for studying driver fatigue. In many driving studies, contactless, inconspicuous, and suited for online analysis make this technique1more viable. The driver's eyes are captured by cameras in order to get video pictures. Visual indicators of tiredness, such as blink frequency, blink length, extended closure time (response) and eye gaze, are mostly eye blinking.

These include bodily motions, facial expressions and head movements that indicate a person is in need of a nap. Cameras are used to take measurements of the head, which are then analyzed via video image analysis or rated by observers. A somniferous and expressionless facial tone, yawning, nodding (head tilts), and a slouching body posture are all signs of tiredness.

The fourth category includes driving factors connected with tired driving. Examples of signs of driver fatigue include higher lateral position variability and specific steering wheel characteristics (such as a lack of micro adjustments and massive steering wheel reversals).

Subjective assessments of tiredness fall under the fifth classification. It is important to know how drivers perceive tiredness and if their perception coincides with objective indicators of sleepiness. Ratings are the easiest technique to measure driver sleepiness. Let's take each one step at a time.

**2.2.2 Brain waves**

An EEG monitor keeps tabs on the activity of the brain. EEG monitors brain activity directly, thus it's a good way to discover just how aware someone is. It is possible to tell the difference between someone who is fully awake and attentive and someone who is sleepy and in danger of falling asleep at the wheel using electroencephalography (EEG). EEG is often used to investigate sleep in those who are making an effort to doze off. A research by [14] found that an EEG algorithm for predicting weariness and sleepiness under simulated settings had a strong correlation with the EEG data.

On the road, the most significant downside of EEG is the difficulty in collecting recordings under normal driving situations, making this a relatively unreliable method of detecting weariness. In many cases, an off-line study of EEG data is the best option because of the difficulty of quantifying the data.

**2.2.3 Heart beat signal rate**

Cardiopulmonary resuscitation (CR) signal may be used to quantify heart rate variability (HRV), the amount of effort a person does to avoid falling asleep, and may be a useful parameter in this kind of research. High-frequency HRV (HF) in the range of 0.15–0.4 Hz; low-frequency HRV (LF) in the range of 0.04–0.15 Hz; and very low-frequency HRV in the range of 0.0033–0.04 Hz are all shown to exist in humans using frequency domain spectrum analysis. When a person transitions from a wakeful to somniferous/sleep state, the LF/HF power spectral density ratio (LF/HF ratio) falls, while the HF power rises. It is thus possible to use HRV analysis to identify driver sleepiness. Because of this, the HRV approach has a major drawback: It is heavily affected by stress.

**2.2.4 Tracking of gaze**

It has been widely accepted that the eyes are the best place to look for signs of tiredness. Infra-red light and appearance-based object1 identification are used to detect and track the eyes. Pupil-glint vectors may be detected using an alternative approach in which an eye camera tracks head motions while maintaining the pupil central. Another method makes use of the unique features of human skin color to follow the eye. Additionally, video cameras collect pictures of the driver's face, and a variety of indicators, such as eye gaze direction and the driver's facial expression, are utilized to infer driving states such as weariness.

A majority of these methods have been developed in the laboratory or have had minimal on-road use. Low-light or frequent head motions might make it difficult for these procedures to identify the eye.

**2.2.5 Blink Behavior**

Video monitoring methods may also be used to measure the blink rate of drivers' eyes. Having a driver with glasses makes it more difficult for the system to get the value it needs. Drivers' facial expressions can be analyzed using image processing, however the amount of processing power required and the lighting conditions within the car are critical to the reliability of the data, and the system may challenge personal privacy. In addition to harming the driver's privacy, the expense is prohibitive.

Another option is to use real-time motion image processing to determine a driver's blink rate and, from there, their current condition. [11]

**2.2.6 Eye Closure**

Real-world applications are possible for the PERCLOS (Percent Eye Closure) approach, which stands out. Eye closure is measured using a video-based approach. One of the advantages of PERCLOS is that it has been tested to see whether it can accurately identify weariness. Many different performance metrics were used to assess the system. The correlation between eye closure and gaps in attention was found to be satisfactory, offering some convergent evidence when a measure correlates with other tests assumed to evaluate the same construct of the system's capacity to identify the present condition of the driver. When compared to other possible sleepiness detection systems, PERCLOS had the clearest correlation with driving performance on a driving simulator.

In a second form, video imaging of the face is used to identify eye closure by calculating the location of the eyes and intensity variations to determine whether the eyes are open or closed. An alert is sounded if the driver's eye is closed for more than five frames in a driver.

**2.2.7Facial Tracking**

As part of the first PERCLOS approach, trained observers recorded video of the driver's eyes, which were then graded afterwards. In contrast to most other methods of assessing the closure of the eyes and gaze direction, Seeing Machines' OpenCv technique is unique. This approach seems to have the benefit of being able to deal with low light circumstances, head movement, and tracking of gaze direction when the driver is wearing sunglasses. OpenCv has been tested against the PERCLOS approach in simulated driving circumstances.

Another variant employs Infra-red light to find pupils and track head movement. After that, Kalmann filtering is utilized to make educated guesses about the positions of various face features. Predictive analysis is used to deal with face occlusion issues in this technique.

**2.2.8 Sensing Arterial Blood supply**

Such non-intrusive technologies that monitor arterial blood supply in the driver's body may help determine the driver's state of health.

In order to monitor cranial blood flow, this approach needs a custom-made equipment that has sensors that specifically monitor the cranial blood flow.

**2.2.9Driver Response method**

By asking the driver for a response every five seconds to indicate their level of alertness, certain non-intrusive ways monitor the driver's state of alertness. Eventually, the driver will become tired of and annoyed with this method of communication.

**2.2.10 Yawn Rate Calculation**

Detection of yawning is done in two major ways: It is possible to identify the yawn component in the face without looking at the mouth. This part is essentially the opening in the mouth caused by the widening of the mouth. The authenticity of the identified component is verified using the ii) mouth location. The candidate for the yawning mouth is chosen from among the skin segments after the greatest hole in the face has been segmented. A non-skin part of the face that may be linked to the eyes, mouth, or open mouth is the source of this hole. In a yawning condition, the open mouth is expected to be the biggest of the three. This is how you find a potential yawning mouth candidate. Finally, this data is utilized to validate the discovered yawning mouth. Verification criteria include the ratio of the yawning mouth's pixel count to the total number of pixels in the mouth, as well as the open mouth's relative placement in relation to the lips' pixels.

The distance between the midpoint of the nostrils, or the nasal channel, and the chin is another way to tell whether someone is yawning. In order to determine the midpoint of the nostrils using the directional integral projection approach, the facial area must be divided. A driver's yawn may be identified by measuring the distance between the midpoints of the nostrils and the chin.

Geometric aspects of the mouth can't be used to identify yawning because of various drawbacks. First, the corners of the mouth, on the left and right sides, are clear, but the hole in the mouth is more difficult to see. As a second point, geometric aspects are more likely to pose and vary for each person.

**2.2.11 Lane tracking**

For quick identification and monitoring of road boundaries, two-dimensional LADAR (Laser Detection and Ranging) sensors and extended Kalman filtering are utilized. In order to overcome the limitations of prior lane tracking methods, which rely on a single indication, such as center lines or edge markers, to determine the boundaries of the lane, several methods have been developed. This method makes use of the Distillation Algorithm to combine various visual cues (such as color/grayscale, intensity, lane edge, edge mark, lane texture, shape, and contours) that together provide reliable estimates of the location of the vehicle in the lane, even when some of the main features are missing.

The use of geometrical transformation and morphological processing to create yet another variety is also an option. Roadway lines on flat and structured roadways may be detected even in low-light situations by the system. It's possible to identify driver weariness by monitoring the vehicle's lateral position and steering wheel input. [23], [5], [6] other types use a vision-based system that monitors the view in front of the automobile to identify lane departure.

**Optical sensors**

The next type of eye motion sensors makes use of a non-contact optical technique.

Infrared light, often reflected from the eye, is picked up by a camera or other optical sensor. Analysis of the data yields the eye's position based on variations in reflections. The corneal reflection and the center of the pupil are often used as characteristics to monitor over time in video-based eye trackers.

**Light emitting diodes**

In certain cases, light emitting diodes may be used to detect changes and estimate face orientation without being invasive. At the center of the camera lens, a low-power, infrared light emitting diode (LED) gives a direct reflection off the cornea of the eyes. If the Eye gazing System is to be used to detect and warn about sleepy driving, it should be installed in the vehicle's cab. This way, drivers may be warned before they lose control of the car and cause an accident.

**A camera with a video recorder**

Camera-based driver sleepiness detection is the most used approach, but it requires a lot of computing resources to analyze the data.

**The jerking of the chin**

Several dubious claims are made about a technology that uses sensors in digital type cameras to monitor for head movements and to sound warnings when threshold levels are reached. This method would not operate if the driver's head was rotated or otherwise occluded for an extended period of time.

**As the eyelids move**

There is a method that uses digital cameras to monitor eyelid movement, and when threshold levels are met, an alert is triggered. The device uses the closure of the eyelids to determine the current condition of the driver. The photos may also be shown in real time, if that is needed.

**Measurement of the Doppler Effect**

A number of other systems, such as the applied physical laboratory driver somniferous detection system, analyze the reflected signal for Doppler components (angle, velocities) to monitor and quantitatively measure various indices, such as general activity, eyelid closure frequency and speed, heart rate and respiration.

**Numerous indicators of a driver's attentiveness**

Head position sensor, Eye-gaze system, and Pupil measurements are all utilized to notify the driver. A seat vibration mechanism is also used to try to keep the driver more aware of the present situation.

There are a variety of physiological markers used to predict collisions in simulations including high stress driving (fog) and extended driving sessions (e.g. pulse and oxygen saturation in the blood, breathing frequency and head motions, eye closure and lane tracking).

While driving, tiredness may be detected in real time using a variety of criteria. Additionally, driving behavior and eyelid changes may be used as indicators of driver hypo vigilance, as well as other indicators like as lane tracking. Digital navigation maps, a positioning system, anti-collision radar, odometer, and a driver gaze direction sensor are used to correlate this information with data on traffic danger. A warning is sent to the driver if any of these indicators indicate that the driver is tired. The trial program is now underway.

In a simulator test, no one measure of driver weariness was shown to be sensitive or trustworthy. To include several measurements of alertness change, a neural-fuzzy hybrid system has been proposed. As a result, a non-invasive vision-based condition monitoring system that is more dependable and resilient is needed. A Driver Somniferous Detection System that does not have the difficulties/advantages mentioned above and that also solves other problems is desired. The invention's goals, benefits, and unique characteristics may be achieved and gained by using the specific instruments and combinations described in detail in the appendices and their supporting drawings.

**2.2.2DriverMonitoringdevices**

Many new ways to detecting and monitoring unsafe levels of driver fatigue are now being developed, validated, or are in the early phases of application, according to researchers. It is now feasible to monitor a driver's level of alertness in real time under all driving situations because to developments in video camera and computer processing technology and robust, non-intrusive eye recognition and tracking systems. This section identifies and describes some of the existing sleepy driver monitoring equipment. A variety of approaches, including literature searches in technical/scientific periodicals and the Internet, were used to gather this data.

**2.2.2.1 The Driver Fatigue Monitor.**

In an exhaustive field operating test, Attention Technology, Inc. has conceived and developed the DD850 Driver Fatigue Monitor (DFM), the first real-time, on-board sleepiness monitor. Measures delayed eyelid closure using a video-based sleepiness detection system, The1DFMisa. It may be mounted on the dashboard to the right of the steering wheel and continuously measures the location of the eyes and the closing of the eyelids in real time. Allowing the driver to alter the camera angle, the camera module is positioned on a rotatory base. An adequate amount of space is provided for typical head movements. The gadget provides an auditory warning when the driver reaches a certain degree of sleepiness, which is shown by a visual gauge on the device. The DFM uses a simple and efficient pupil detection method based on a differential lighting scheme: the bright pupil effect. Improved eye tracking may be achieved by a strong contrast between pupils and the rest of the face.

But the effectiveness of the bright pupil approach is heavily dependent on the brightness and size of the pupils, which typically function by face orientation, external light interference and the distance of picture from camera. This technique also has problems and limits. The reflections from eyeglasses may cause distracting bright spots around the eyes, while sunglasses tend to distort IR light and distort the appearance of the pupils in real-world, in-car applications.

**Driver Status Monitor**

Currently, Delphi Electronics is working on a real-time, vision-based driver status monitoring system for automobiles, with the goal of increasing driver safety by reducing the likelihood of them dozing off or becoming more distracted. Somniferous driver alert and driver distraction alert are integrated into a complete driver state monitor in the system (DSM). Computer vision system DSM employs a camera on the dashboard in front of the driver, as well as two IR lighting sources. The technology examines the driver's facial traits, including eye closures and head attitude, to determine if the driver is fatigued or distracted.

**In this section, we will discuss video-based sensors.**

Being Able to See Mechanical Devices OpenCv uses a non-contact video sensor to monitor the head, face, eyelids, and gaze of a person's picture. Without the need of any cables or magnets, OpenCv's mobile tracking technology and broad field of vision make it possible to observe naturalistic behaviors such as head posture, gaze direction, and eyelid closure in real time. Consequently, it is a promising method for studying driver behavior in simulations and test cars. Real-time drowsiness detection using OpenCv's thorough blink analysis and PERCLOS evaluation is possible, as is raw data on eyelid behavior. A bright pupil or corneal occlusion are not taken into account when determining eyelid position. The data may be reused in future studies thanks to OpenCv's ability to automatically calibrate each picture. In order to accurately determine the location of the eyelid, this procedure requires a series of measurements.

**Eye-tracking technology**

Software developed by Smart Eye AB makes it possible for computers and other machinery to detect the movements of people's faces, heads, and eyes, as well as the direction in which they look. Remote and inconspicuous sensor Smart Eye Pro 3.0 has been created and tested by Smart Eye for a number of applications, including transportation safety studies (drowsiness, alertness) as well as simulators. Using a simple and robust technique based on monitoring individual face characteristics and a three-dimensional (3D) head model, Smart Eye Pro 3.0 uses computer vision to estimate head posture. First, the user's head is modified to the general model. The 3D feature locations are calculated using their prior positions and a motion model while the system is in tracking mode. A rapid face identification mechanism enables the system to quickly regain the probe face and restart tracking if tracking is unexpectedly lost. 1 Using picture edge information and 3D eye and lid models, the tracking system determines the gaze direction and eyelid positions. This approach has a flaw in that it fails to create an algorithm that can detect signs of fatigue.

**2.2.2.5 Sensors and Motoric Instruments (SMI)**

Computer vision-based operator monitoring system InSight developed by SMI (located in Berlin) is presently under development. It detects head position and orientation, gaze direction, eyelid opening and pupil size in a noninvasive manner. High-speed technology that measures eyelid closure and blink rate at 20 Hz, head posture and gaze rate at 60 Hz and a combination of all three at 60 Hz. With the help of InSightTM, PERCLOS is calculated. Tracking algorithms that can be used in any lighting situations, from sunshine to complete darkness, are supposedly used by the system.

**The eye tracking system (see 2.2.2.6)**

At Applied Science Laboratories (ASL), eye tracking systems and gadgets for applications have been designed and developed for over a decade. Pupil/corneal reflection is the method used to measure eye movements in their video-based eye trackers. A vivid pupil picture is used in the majority of ASL applications. Eyelashes, light colored eyes, dark environs, contact lenses, and distance from the camera have been found to have no effect on the bright pupil picture.

Because sunlight may interfere with infrared lighting, the bright pupil approach has a significant drawback when used outside.

**2.2.2.7 System for analyzing the gaze of the subject**

Eye tracking technology created by LC Technologies, Inc. is both an eye driven computer for control and communication, as well as an eye-tracking device that monitors eye movements and other eye data. Technology, known as the Eye Gaze Analysis System, may be used to detect a user's gaze point or enable an operator to interact with their surroundings using just their eyes. It is hands-off, inconspicuous, and remote. Using the Eyegaze Analysis System, a person's eye movements may be measured, recorded, replayed, and analyzed. Eyegaze software is included, as well as the required camera equipment, computer hardware, and Eyegaze operating system. The PCCR technique (Pupil Center Corneal Reflection) is used to detect the direction of the gaze.

**A computer vision system**

A prototype computer vision system for measuring driver alertness has been created by RPI researchers. Remotely located charge coupled device (CCD) video camera; hardware system for real-time image acquisition and control of illuminator and alarm system; various computer vision algorithms for simultaneous, real-time non-intrusive monitoring of various visual bio behaviors that typically characterize a driver's level of vigilance A person's degree of attention while driving may be tracked in real time using a device that can concurrently and unobtrusively detect multiple visual activities. Eyelid and gaze movement, pupil movement, head movement, and facial expressions are a few examples of these visual signals. As a result of combining these visual cue characteristics in a Bayesian Networks model, a composite index is created that can reliably, correctly, and consistently assess a driver's attentiveness state.

Active near-infrared lighting brightens the probe face to provide the bright pupil effect for eye recognition and tracking. When driving in bad lighting situations, as well as throughout the day and night, this assures a high-quality picture and reduces the risk of driver distraction. RPI envisions installing two tiny CCD cameras in the dashboard of a car to utilize with their technology. In order to keep tabs on the driver's eyelid and gaze motions, one camera has a limited field of view, while the other has a large field of view, allowing it to follow and monitor the driver's head movement and facial expression. Measures like as blink frequency, closure length, closure speed and PERCLOS may all be used to define the movement of the eyelids.

Using a Bayesian network model and many factors such as eyelid, gaze movements, head movement, and facial expression to monitor a driver's behavior is a downside of this technology.

**2.3. 1 ImageenhancementandSegmentation**

**2.3.1 1 ImageEnhancement**

The aim of image enhancement is to improve the interpretability or perception of information in images for human viewers or to provide ‘better’ input for other automated image processing techniques. Image enhancement techniques can be divided into two broad categories:

Spatial domain methods which operate directly on pixels and Frequency domain methods which operate on the Fourier transform of an image.

Unfortunately there is no general theory for determining what good image enhancement is when it comes to human perception. If it looks good, it is good! However, when image enhancement techniques are used as pre-processing tools for other image processing techniques, then quantitative measures can determine which techniques are most appropriate.

There 1 are 1 huge 1 amount 1 of 1 image 1 enhancement 1 methods 1 by 1 considering 1 processing 1 methods 1 that 1 are 1 based 1 only 1 on 1 the 1 intensity 1 of 1 single 1 pixel. 1 Single 1 point 1 processes 1 are 1 among 1 the 1 simplest 1 of 1 all 1 image 1 enhancement 1 techniques. 1 Enhancement 1 is 1 normally 1 done 1 by 1 point 1 processing, 1 spatial 1 filtering 1 and 1 in 1 the 1 frequency 1 domain. 1 Intensity 1 transformation, 1 histogram 1 processing, 1 image 1 subtraction 1 and 1 image 1 averaging 1 comes 1 under 1 point 1 processing. 1 The 1 use 1 of 1 spatial 1 mask 1 for 1 image 1 processing 1 usually 1 is 1 called 1 spatial 1 filtering 1 and 1 the 1 mask 1 themselves 1 is 1 called 1 spatial 1 filters. 1 Smoothing 1 and 1 sharpening 1 filter 1 comes 1 under 1 the 1 spatial 1 filter 1 method. 1 Enhancement 1 in 1 the 1 frequency 1 domain 1 in 1 principle 1 is 1 straightforward. 1 We 1 simply 1 compute 1 the 1 Fourier 1 transfer 1 function 1 and 1 take 1 the 1 inverse 1 transform 1 to 1 produce 1 the 1 enhanced 1 image. 1 Low 1 pass 1 filtering 1 High 1 pass 1 filtering 1 and 1 Homomorphic 1 filtering 1 come 1 under 1 this 1 method.

**2.3.2 Histogram 1 equalization**

Histogram 1 equalization 1 is 1 a 1 method 1 in 1 image 1 processing 1 of 1 contrast 1 adjustment 1 using 1 the 1 image's 1 histogram.

This 1 method 1 usually 1 increases 1 the 1 global 1 contrast 1 of 1 many 1 images, 1 especially 1 when 1 the 1 usable 1 data 1 of 1 the 1 image 1 is 1 represented 1 by 1 close 1 contrast 1 values. 1 Through 1 this 1 adjustment, 1 the 1 intensities 1 can 1 be 1 better 1 distributed 1 on 1 the 1 histogram. 1 This 1 allows 1 for 1 areas 1 of 1 lower 1 local 1 contrast 1 to 1 gain 1 a 1 higher 1 contrast 1 without 1 affecting 1 the 1 global 1 contrast. 1 Histogram 1 equalization 1 accomplishes 1 this 1 by 1 effectively 1 spreading 1 out 1 the 1 most 1 frequent 1 intensity 1 values.

The 1 method 1 is 1 useful 1 in 1 images 1 with 1 backgrounds 1 and 1 foregrounds 1 that 1 are 1 both 1 bright 1 or 1 both 1 dark. 1 In 1 particular, 1 the 1 method 1 can 1 lead 1 to 1 better 1 views 1 of 1 bone 1 structure 1 in 1 x-ray 1 images 1 and 1 to 1 better 1 detail 1 in 1 photographs 1 that 1 are 1 over 1 or 1 under-exposed. 1 A 1 key 1 advantage 1 of 1 the 1 method 1 is 1 that 1 it 1 is 1 a 1 fairly 1 straightforward 1 technique 1 and 1 an 1 invertible 1 operator. 1 So 1 in 1 theory, 1 if 1 the 1 histogram 1 equalization 1 function 1 is 1 known, 1 then 1 the 1 original 1 histogram 1 can 1 be 1 recovered. 1 The 1 calculation 1 is 1 not 1 computationally 1 intensive. 1 A 1 disadvantage 1 of 1 the 1 method 1 is 1 that 1 it 1 is 1 indiscriminate. 1 It 1 may 1 increase 1 the 1 contrast 1 of 1 background 1 noise, 1 while 1 decreasing 1 the 1 usable 1 signal.

Histogram 1 equalization 1 often 1 produces 1 unrealistic 1 effects 1 in 1 photographs; 1 however 1 it 1 is 1 very 1 useful 1 for 1 scientific 1 images 1 like 1 thermal, 1 satellite 1 or 1 x-ray 1 images, 1 often 1 the 1 same 1 class 1 of 1 images 1 that 1 user 1 would 1 apply 1 false-color 1 too. 1 Also 1 histogram 1 equalization 1 can 1 produce 1 undesirable 1 effects 1 (like 1 visible 1 image 1 gradient) 1 when 1 applied 1 to 1 images 1 with 1 low 1 color 1 depth. 1 For 1 example, 1 if 1 applied 1 to 1 8-bit 1 image 1 displayed 1 with 1 8-bit 1 gray-scale 1 palette 1 it 1 will 1 further 1 reduce 1 color 1 depth 1 (number 1 of 1 unique 1 shades 1 of 1 gray) 1 of 1 the 1 image. 1 Histogram 1 equalization 1 will 1 work 1 the 1 best 1 when 1 applied 1 to 1 images 1 with 1 much 1 higher 1 color 1 depth 1 than 1 palette 1 size, 1 like 1 continuous 1 data 1 or 1 16-bit 1 gray-scale 1 images.

There 1 are 1 two 1 ways 1 to 1 think 1 about 1 and 1 implement 1 histogram 1 equalization, 1 either 1 as 1 image 1 change 1 or 1 as 1 palette 1 change. 1 The 1 operation 1 can 1 be 1 expressed 1 as 1 P(M(I)) 1 where 1 I 1 is 1 the 1 original 1 image, 1 M 1 is 1 histogram 1 equalization 1 mapping 1 operation 1 and 1 P 1 is 1 a 1 palette. 1 If 1 we 1 define 1 new 1 palette 1 as 1 P'=P(M) 1 and 1 leave 1 image 1 I 1 unchanged 1 then 1 histogram 1 equalization 1 is 1 implemented 1 as 1 palette 1 change. 1 On 1 the 1 other 1 hand, 1 if 1 palette 1 P 1 remains 1 unchanged 1 and 1 image 1 is 1 modified 1 to 1 I'=M(I), 1 then 1 the 1 implementation 1 is 1 by 1 image 1 change. 1 In 1 most 1 cases 1 palette 1 change 1 is 1 better 1 as 1 it 1 preserves 1 the 1 original 1 data.

Generalizations 1 of 1 this 1 method 1 use 1 multiple 1 histograms 1 to 1 emphasize 1 local 1 contrast, 1 rather 1 than 1 overall 1 contrast. 1 Examples 1 of 1 such 1 methods 1 include 1 adaptive 1 histogram 1 equalization 1 and 1 Contrast 1 Limiting 1 Adaptive 1 Histogram 1 Equalization 1 (CLAHE).

***2.3.2.1 Histogram 1 equalization 1 of 1 color 1 images***

The 1 above 1 histogram 1 equalization 1 describes 1 on 1 a 1 gray scale 1 image. 1 However 1 it 1 can 1 also 1 be 1 used 1 on 1 color 1 images 1 by 1 applying 1 the 1 same 1 method 1 separately 1 to 1 the 1 Red, 1 Green 1 and 1 Blue 1 components 1 of 1 the 1 RGB 1 color 1 values 1 of 1 the 1 image. 1 Still, 1 it 1 should 1 be 1 noted 1 that 1 applying 1 the 1 same 1 method 1 on 1 the 1 Red, 1 Green, 1 and 1 Blue 1 components 1 of 1 an 1 RGB 1 image 1 may 1 yield 1 dramatic 1 changes 1 in 1 image's 1 color 1 balance 1 since 1 the 1 relative 1 distributions 1 of 1 the 1 color 1 channels 1 change 1 as 1 a 1 result 1 of 1 applying 1 the 1 algorithm. 1 However 1 if 1 the 1 image 1 is 1 first 1 converted 1 into 1 another 1 color 1 space, 1 Lab 1 color 1 space, 1 or 1 HSL/HSV 1 color 1 space 1 in 1 particular, 1 then 1 the 1 algorithm 1 can 1 be 1 applied 1 to 1 the 1 luminance 1 or 1 value 1 channel 1 without 1 resulting 1 in 1 changes 1 to 1 the 1 hue 1 and 1 saturation 1 of 1 the 1 image.

***2.3.2.2 Median 1 filter***

In 1 image 1 processing, 1 it 1 is 1 usually 1 necessary 1 to 1 perform 1 a 1 high 1 degree 1 of 1 noise 1 reduction 1 in 1 an 1 image 1 before 1 performing 1 higher-level 1 processing 1 steps, 1 such 1 as 1 edge 1 detection. 1 The 1 median 1 filter 1 is 1 a 1 non-linear 1 digital 1 filtering 1 technique, 1 often 1 used 1 to 1 remove 1 noise 1 from 1 images 1 or 1 other 1 signals.

Median 1 filtering 1 is 1 a 1 common 1 step 1 in 1 image 1 processing. 1 It 1 is 1 particularly 1 useful 1 to 1 reduce 1 speckle 1 noise 1 and 1 salt 1 and 1 pepper 1 noise. 1 Its 1 edge-preserving 1 nature 1 makes 1 it 1 useful 1 in 1 cases 1 where 1 edge 1 blurring 1 is 1 undesirable.

The 1 idea 1 is 1 to 1 calculate 1 the 1 median 1 of 1 neighboring 1 pixels 1 values. 1 This 1 can 1 be 1 done 1 by 1 repeating 1 the 1 following 1 steps 1 for 1 each 1 pixel 1 in 1 the 1 image.

•Store 1 the 1 neighboring 1 pixels 1 in 1 an 1 array. 1 The 1 neighboring 1 pixels 1 can 1 be 1 chosen 1 by 1 any 1 kind 1 of 1 shape, 1 for 1 example 1 a 1 box 1 or 1 a 1 cross. 1 The 1 array 1 is 1 called 1 the 1 window 1 and 1 it 1 should 1 be 1 odd 1 sized.

•Sort 1 the 1 window 1 in 1 numerical 1 order.

•Pick 1 the 1 median 1 from 1 the 1 window.

***2.3.2.3 Homomorphic 1 filter***

Homomorphic 1 filtering 1 is 1 a 1 generalized 1 technique 1 for 1 nonlinear 1 image 1 enhancement 1 and 1 correction. 1 It 1 simultaneously 1 normalizes 1 the 1 brightness 1 across 1 an 1 image 1 and 1 increases 1 contrast.1 An 1 image 1 can 1 be 1 expressed 1 as 1 the 1 product 1 of 1 illumination 1 and 1 reflectance:

|  |  |
| --- | --- |
| f 1 ( 1 x, 1 y 1 ) 1 = 1 i( 1 x, 1 y 1 ) 1 \* 1 r( 1 x, 1 y 1 ) | (1) |

When 1 the 1 illumination 1 is 1 uniform, 1 i( 1 x, 1 y 1 ) 1 is 1 considered 1 to 1 be 1 a 1 constant, 1 and 1 the 1 image 1 is 1 considered 1 to 1 be 1 the 1 reflectance 1 of 1 the 1 object. 1 However, 1 the 1 lighting 1 condition 1 is 1 usually 1 unequal. 1 The 1 illumination 1 component 1 tends 1 to 1 vary 1 slowly, 1 and 1 therefore 1 is 1 represented 1 by 1 the 1 lower 1 frequency 1 components 1 in 1 the 1 frequency 1 domain. 1 The 1 reflectance 1 component, 1 on 1 the 1 other 1 hand, 1 tends 1 to 1 vary 1 rapidly 1 and 1 is 1 represented 1 by 1 the 1 higher 1 frequency 1 components 1 in 1 the 1 frequency 1 domain. 1 If 1 the 1 illumination 1 and 1 reflectance 1 can 1 be 1 acted 1 upon 1 separately, 1 the 1 illumination 1 problem 1 will 1 be 1 solved, 1 and 1 the 1 image 1 will 1 be 1 enhanced. 1 Hence, 1 the 1 log 1 transform 1 is 1 used 1 in 1 equation 1 (1):

|  |  |
| --- | --- |
| ln 1 f 1 ( 1 x, 1 y 1 ) 1 = 1 ln 1 i( 1 x, 1 y 1 )+ 1 ln 1 r( 1 x, 1 y 1 ) | (2) |

Then 1 the 1 Fourier 1 transform 1 is 1 applied 1 in 1 equation 1 (2) 1 and 1 filtering 1 is 1 done 1 in 1 the 1 frequency 1 domain. 1 The 1 basic 1 Homomorphic 1 filtering 1 procedure 1 is 1 as 1 follows:

f 1 ( 1 x, 1 y 1 ) 1 → 1 ln 1 → 1 FFT→ 1 H( 1 u,v 1 ) 1 → 1 ( 1 FFT 1 )-1→ 1 exp→ 1 g( 1 x, 1 y 1 ) 1 .

The 1 illumination 1 and 1 reflectance 1 turn 1 to 1 additive 1 through 1 log 1 transform. 1 Then, 1 2-D 1 Fourier 1 transform 1 is 1 used. 1 The 1 coordinate 1 variables 1 become 1 u 1 and 1 v. 1 H(u, 1 v 1 ) 1 is 1 the 1 Homomorphic 1 filter 1 function 1 applied 1 to 1 the 1 illumination 1 and 1 reflectance. 1 After 1 taking 1 the 1 inverse 1 Fourier 1 transform 1 and 1 the 1 exponent 1 transform, 1 an 1 enhanced 1 image 1 g(x, 1 y) 1 is 1 obtained. 1 H( 1 u, 1 v) 1 has 1 the 1 following 1 form:

|  |  |
| --- | --- |
| *H( 1 u, 1 v 1 ) 1* = *1 (HH 1* - *1 HL 1 ) 1* × *1 ( 1* - *1 exp( 1* -*C 1* × *1 D( 1 u 1 ,v 1 )/D0 1 )) 1* + *1 HL* | (3) |

where 1 D( 1 u, 1 v 1 ) 1 is 1 the 1 distance 1 between 1 point 1 ( 1 u, 1 v 1 ) 1 and 1 point 1 of 1 origin 1 in 1 frequency 1 domain; 1 D0 1 is 1 the 1 threshold; 1 C 1 is 1 sharpen 1 parameter. 1 If 1 the 1 parameters 1 HL 1 and 1 HH 1 are 1 chosen 1 to 1 be 1 HL 1 < 1 1 1 and 1 HL 1 > 1 1, 1 then 1 the 1 filter 1 H( 1 u, 1 v 1 ) 1 will 1 decrease 1 the 1 contribution 1 of 1 the 1 low 1 frequency 1 (illumination) 1 and 1 amplify 1 the 1 contribution 1 of 1 the 1 mid- 1 and 1 high 1 frequencies 1 (reflectance).

**2.3.3 1 Segmentation**

Segmentation 1 refers 1 to 1 the 1 process 1 of 1 partitioning 1 a 1 digital 1 image 1 into 1 multiple 1 segments. 1 The 1 goal 1 of 1 segmentation 1 is 1 to 1 simplify 1 and/or 1 change 1 the 1 representation 1 of 1 an 1 image 1 into 1 something 1 that 1 is 1 more 1 meaningful 1 and 1 easier 1 to 1 analyze. 1 Image 1 segmentation 1 is 1 typically 1 used 1 to 1 locate 1 objects 1 and 1 boundaries 1 in 1 images. 1 More 1 precisely, 1 image 1 segmentation 1 is 1 the 1 process 1 of 1 assigning 1 a 1 label 1 to 1 every 1 pixel 1 in 1 an 1 image 1 such 1 that 1 pixels 1 with 1 the 1 same 1 label 1 share 1 certain 1 visual 1 characteristics.

The 1 result 1 of 1 image 1 segmentation 1 is 1 a 1 set 1 of 1 segments 1 that 1 collectively 1 cover 1 the 1 entire 1 image 1 or 1 a 1 set 1 of 1 contours 1 extracted 1 from 1 the 1 image. 1 Each 1 pixel 1 in 1 a 1 region 1 is 1 similar 1 with 1 respect 1 to 1 some 1 characteristic 1 or 1 computed 1 property, 1 such 1 as 1 color, 1 intensity 1 or 1 texture. 1 Adjacent 1 regions 1 are 1 significantly 1 different 1 with 1 respect 1 to 1 the 1 same 1 characteristic(s).

***Clustering 1 methods***

The 1 K-means 1 algorithm 1 is 1 an 1 iterative 1 technique 1 that 1 is 1 used 1 to 1 partition 1 an 1 image 1 into 1 K 1 clusters. 1 The 1 basic 1 algorithm 1 is:

1.Pick 1 K 1 cluster 1 centers, 1 either 1 randomly 1 or 1 based 1 on 1 some 1 heuristic

2.Assign 1 each 1 pixel 1 in 1 the 1 image 1 to 1 the 1 cluster 1 that 1 minimizes 1 the 1 variance 1 between 1 the 1 pixel 1 and 1 the 1 cluster 1 center

3.Re-compute 1 the 1 cluster 1 centers 1 by 1 averaging 1 all 1 the 1 pixels 1 in 1 the 1 cluster

4.Repeat 1 steps 1 2 1 and 1 3 1 until 1 convergence 1 is 1 attained 1 (e.g. 1 no 1 pixel 1 changes 1 clusters)

In 1 this 1 case, 1 variance 1 is 1 the 1 squared 1 or 1 absolute 1 difference 1 between 1 a 1 pixel 1 and 1 a 1 cluster 1 center. 1 The 1 difference 1 is 1 typically 1 based 1 on 1 pixel 1 color, 1 intensity, 1 texture 1 and 1 location 1 or 1 a 1 weighted 1 combination 1 of 1 these 1 factors. 1 K 1 can 1 be 1 selected 1 manually, 1 randomly, 1 or 1 by 1 a 1 heuristic.

This 1 algorithm 1 is 1 guaranteed 1 to 1 converge, 1 but 1 it 1 may 1 not 1 return 1 the 1 optimal 1 solution. 1 The 1 quality 1 of 1 the 1 solution 1 depends 1 on 1 the 1 initial 1 set 1 of 1 clusters 1 and 1 the 1 value 1 of 1 K.

In 1 statistics 1 and 1 machine 1 learning, 1 the 1 K-means 1 algorithm 1 is 1 clustering 1 algorithm 1 to 1 partition 1 n 1 objects 1 into 1 K 1 clusters 1 where 1 K 1 < 1 n. 1 It 1 is 1 similar 1 to 1 the 1 expectation-maximization 1 algorithm 1 for 1 mixtures 1 of 1 Gaussians 1 in 1 that 1 they 1 both 1 attempt 1 to 1 find 1 the 1 centers 1 of 1 natural 1 clusters 1 in 1 the 1 data. 1 The 1 model 1 requires 1 that 1 the 1 object 1 attributes 1 correspond 1 to 1 elements 1 of 1 a 1 vector 1 space. 1 The 1 objective 1 is 1 to 1 achieve 1 the 1 minimum 1 total 1 intra-cluster 1 variance 1 or 1 the 1 squared 1 error 1 function.

***Threshold***

Thresholding 1 is 1 the 1 simplest 1 method 1 of 1 image 1 segmentation. 1 From 1 a 1 grayscale 1 image, 1 thresholding 1 can 1 be 1 used 1 to 1 create 1 binary 1 images.

***Method***

During 1 the 1 thresholding 1 process, 1 individual 1 pixels 1 in 1 an 1 image 1 are 1 marked 1 as 1 “object” 1 pixels 1 if 1 their 1 value 1 is 1 greater 1 than 1 some 1 threshold 1 value 1 (assuming 1 an 1 object 1 to 1 be 1 brighter 1 than 1 the 1 background) 1 and 1 as 1 “background” 1 pixels 1 otherwise. 1 This 1 convention 1 is 1 known 1 as 1 threshold 1 above. 1 Variants 1 include 1 threshold 1 below, 1 which 1 is 1 opposite 1 of 1 threshold 1 above; 1 threshold 1 inside, 1 where 1 a 1 pixel 1 is 1 labeled.

"object" 1 if 1 its 1 value 1 is 1 between 1 two 1 thresholds; 1 and 1 threshold 1 outside, 1 which 1 is 1 the 1 opposite 1 of 1 threshold 1 inside. 1 Typically 1 an 1 object 1 pixel 1 is 1 given 1 a 1 value 1 of 1 “1” 1 while 1 a 1 background 1 pixel 1 is 1 given 1 a 1 value 1 of 1 “0.” 1 Finally 1 a 1 binary 1 image 1 is 1 created 1 by 1 coloring 1 each 1 pixel 1 white 1 or 1 black, 1 depending 1 on 1 a 1 pixel's 1 label.

***Threshold 1 selection***

The 1 key 1 parameter 1 in 1 the 1 thresholding 1 process 1 is 1 the 1 choice 1 of 1 the 1 threshold 1 value 1 (or 1 values, 1 as 1 mentioned 1 earlier). 1 Several 1 different 1 methods 1 for 1 choosing 1 a 1 threshold 1 exist; 1 users 1 can 1 manually 1 choose 1 a 1 threshold 1 value, 1 or 1 a 1 thresholding 1 algorithm 1 can 1 compute 1 a 1 value 1 automatically, 1 which 1 is 1 known 1 as 1 automatic 1 thresholding. 1 A 1 simple 1 method 1 would 1 be 1 to 1 choose 1 the 1 mean 1 or 1 median 1 value, 1 the 1 rationale 1 being 1 that 1 if 1 the 1 object 1 pixels 1 are 1 brighter 1 than 1 the 1 background, 1 they 1 should 1 also 1 be 1 brighter 1 than 1 the 1 average. 1 In 1 a 1 noiseless 1 image 1 with 1 uniform 1 background 1 and 1 object 1 values, 1 the 1 mean 1 or 1 median 1 will 1 work 1 well 1 as 1 the 1 threshold, 1 however, 1 this 1 will 1 generally 1 not 1 be 1 the 1 case.

A 1 more 1 sophisticated 1 approach 1 might 1 be 1 to 1 create 1 a 1 histogram 1 of 1 the 1 image 1 pixel 1 intensities 1 and 1 use 1 the 1 valley 1 point 1 as 1 the 1 threshold. 1 The 1 histogram 1 approach 1 assumes 1 that 1 there 1 is 1 some 1 average 1 value 1 for 1 the 1 background 1 and 1 object 1 pixels, 1 but 1 that 1 the 1 actual 1 pixel 1 values 1 have 1 some 1 variation 1 around 1 these 1 average 1 values.

However 1 this 1 may 1 be 1 computationally 1 expensive, 1 and 1 image 1 histograms 1 may 1 not 1 have 1 clearly 1 defined 1 valley 1 points, 1 often 1 making 1 the 1 selection 1 of 1 an 1 accurate 1 threshold 1 difficult. 1 One 1 method 1 that 1 is 1 relatively 1 simple, 1 does 1 not 1 require 1 much 1 specific 1 knowledge 1 of 1 the 1 image, 1 and 1 is 1 robust 1 against 1 image 1 noise, 1 is 1 the 1 following 1 iterative 1 method:

1.An 1 initial 1 threshold 1 (T) 1 is 1 chosen; 1 this 1 can 1 be 1 done 1 randomly 1 or 1 according 1 to 1 and 1 other 1 method 1 desired.

2.The 1 image 1 is 1 segmented 1 into 1 object 1 and 1 background 1 pixels 1 as 1 described 1 above, 1 creating 1 two 1 sets:

1.G1 1 = 1 {f(m,n):f(m,n)>T} 1 (object 1 pixels)

2.G2 1 = 1 {f(m,n):f(m,n)<T} 1 (background 1 pixels) 1 (note, 1 f(m,n) 1 is 1 the 1 value 1 of 1 the 1 pixel 1 located 1 in 1 the 1 mth 1 column, 1 nth 1 row)

3.The 1 average 1 of 1 each 1 set 1 is 1 computed.

1.m1 1 = 1 average 1 value 1 of 1 G1

2.m2 1 = 1 average 1 value 1 of 1 G2

4.A 1 new 1 threshold 1 (T1) 1 is 1 created 1 that 1 is 1 the 1 average 1 of 1 m1 1 and 1 m2

1.T1 1 = 1 (m1 1 + 1 m2)/2

5.Go 1 back 1 to 1 step 1 two, 1 now 1 using 1 the 1 new 1 threshold 1 computed 1 in 1 step 1 four, 1 keep 1 repeating 1 until 1 the 1 new 1 threshold 1 matches 1 the 1 one 1 before 1 it 1 (i.e. 1 until 1 convergence 1 has 1 been 1 reached).

This 1 iterative 1 algorithm 1 is 1 a 1 special 1 one-dimensional 1 case 1 of 1 the 1 K-means 1 clustering 1 algorithm, 1 which 1 has 1 been 1 proved 1 to 1 converge 1 at 1 a 1 local 1 minimum, 1 meaning 1 that 1 a 1 different 1 initial 1 threshold 1 may 1 give 1 a 1 different 1 final 1 result.

***Adaptive thresholding***

* Thresholding 1 is 1 called 1 adaptive 1 thresholding 1 when 1 a 1 different 1 threshold 1 is 1 used 1 for 1 different 1 regions 1 in 1 the 1 image. 1 This 1 may 1 also 1 be 1 known 1 as 1 local 1 or 1 dynamic 1 thresholding. Categorizing 1 thresholding 1 Methods Thresholding 1 methods 1 are 1 categorized 1 into 1 the 1 following 1 six 1 groups 1 based 1 on 1 the 1 information:
* Histogram 1 shape 1 based 1 methods 1 where 1 (for 1 example) 1 the 1 peaks, 1 valleys 1 and 1 curvatures 1 of 1 the 1 smoothed 1 histogram 1 are 1 analyzed.
* Clustering 1 based 1 methods 1 where 1 the 1 gray-level 1 samples 1 are 1 clustered 1 in 1 two 1 parts 1 as 1 background 1 and 1 foreground 1 (object) 1 or 1 alternately 1 are 1 modeled 1 as 1 a 1 mixture 1 of 1 two 1 Gaussians.
* Entropy 1 based 1 methods 1 result 1 in 1 algorithms 1 that 1 use 1 the 1 entropy 1 of 1 the 1 foreground 1 and 1 background 1 regions, 1 the 1 cross-entropy 1 between 1 the 1 original 1 and 1 binarized 1 image 1 etc.
* Object 1 attribute 1 based 1 methods 1 search 1 a 1 measure 1 of 1 similarity 1 between 1 the 1 gray-level 1 and 1 the 1 binarized 1 images 1 such 1 as 1 fuzzy 1 shape 1 similarity, 1 edge 1 coincidence, 1 etc.
* Spatial 1 methods 1 [that] 1 use 1 higher-order 1 probability 1 distribution 1 and/or 1 correlation 1 between 1 pixels.
* Local 1 methods 1 adapt 1 the 1 threshold 1 value 1 on 1 each 1 pixel 1 to 1 the 1 local 1 image 1 characteristics."

**2.4 STUDY ON EYE DETECTION**

Sobattka 1 et. 1 al. 1 [21] 1 use 1 thresholding 1 in 1 HSV 1 color 1 space 1 for 1 skin 1 color 1 extraction. 1 However, 1 this 1 technique 1 is 1 sensitive 1 to 1 illumination 1 changes 1 and 1 race. 1 Huang 1 et. 1 al. 1 [12] 1 perform 1 the 1 task 1 of 1 eye 1 detection 1 using 1 optimal 1 wavelet 1 packets 1 for 1 eye 1 representation 1 and 1 radial 1 basis 1 functions 1 for 1 subsequent 1 classification 1 of 1 facial 1 areas 1 into 1 eye 1 and 1 non-eye 1 regions. 1 Sirohey 1 et. 1 al. 1 [20] 1 use 1 filters 1 based 1 on 1 Gabor 1 wavelets 1 to 1 detect 1 eyes 1 in 1 gray 1 level 1 images. 1 Sobattka 1 et. 1 al. 1 [21] 1 adopt 1 a 1 similar 1 approach 1 using 1 the 1 vertical 1 and 1 horizontal 1 reliefs 1 for 1 the 1 detection 1 of 1 the 1 eye 1 pair 1 requiring 1 pose 1 normalization. 1 Feng 1 et. 1 al. 1 [9] 1 employ 1 multiple 1 cues 1 for 1 eye 1 detection 1 on 1 gray 1 images 1 using 1 variance 1 projection 1 function. 1 However, 1 the 1 variance 1 projection 1 function 1 on 1 an 1 eye 1 window 1 is 1 not 1 very 1 consistent.

**2.5 DRAWBACKS**

A 1 moving 1 vehicle 1 presents 1 challenges 1 like 1 variable 1 lighting 1 and 1 changing 1 backgrounds 1 that 1 is 1 not 1 easily 1 solvable. 1 The 1 detection 1 of 1 drowsiness 1 effects 1 and 1 the 1 driver’s 1 current 1 state 1 has 1 specifically 1 focused 1 on 1 changes 1 and 1 movements 1 in 1 the 1 eyes. 1 Many 1 devices 1 are 1 included 1 this 1 concept 1 to 1 assess 1 changes 1 in 1 the 1 driver’s 1 direction 1 of 1 gaze, 1 rate 1 of 1 blinking 1 and 1 actual 1 eye 1 closure. 1 Almost 1 all 1 of 1 these 1 methodologies 1 have 1 had 1 limited 1 application 1 on-road 1 or 1 have 1 only 1 been 1 developed 1 in 1 the 1 laboratory, 1 not 1 implemented.

Two 1 important 1 methodologies 1 are 1 the 1 Percent 1 Eye 1 Closure 1 (PERCLOS) 1 methodology 1 and 1 is 1 electroencephalographic 1 (EEG) 1 for 1 detecting 1 drowsiness. 1 The 1 problem 1 associated 1 with 1 the 1 PERCLOS 1 is 1 deciding 1 on 1 the 1 point 1 at 1 which 1 the 1 driver 1 is 1 unsafe 1 and 1 when 1 a 1 warning 1 should 1 be 1 applied. 1 The 1 biggest 1 drawback 1 associated 1 with 1 EEG 1 is 1 the 1 difficulty 1 in 1 obtaining 1 recordings 1 under 1 natural 1 driving 1 conditions, 1 making 1 it 1 a 1 somewhat 1 unrealistic 1 option 1 for 1 the 1 detection 1 of 1 fatigue. 1 Due 1 to 1 illumination 1 variation, 1 all 1 this 1 traditional 1 method 1 has 1 some 1 issues. 1 So, 1 the 1 proposed 1 system 1 uses 1 new 1 developed 1 preprocessing 1 and 1 eyes 1 detection 1 methods 1 which 1 are 1 explained 1 in 1 Chapter 1 4 1 and 1 5. 1 The 1 key 1 drawbacks 1 of 1 the 1 existing 1 systems 1 are

•Sun 1 light 1 can 1 interfere 1 with 1 IR 1 illumination

•Some 1 devices 1 use 1 the 1 external 1 memory 1 to 1 store 1 the 1 frame

•The 1 existing 1 device 1 gives 1 more 1 percentage 1 false 1 alarm

•The 1 existing 1 methods 1 such 1 as 1 PERCLOSURE, 1 AVGCLOSURE 1 are 1 not 1 reliable

•Many 1 existing 1 systems 1 use 1 intrusive 1 method

•The 1 traditional 1 devices 1 are 1 not 1 reliable 1 at 1 day 1 or 1 night 1 time 1 traveling.

All 1 the 1 above 1 drawbacks 1 are 1 removed 1 in 1 the 1 proposed 1 system. 1 The 1 new 1 device 1 is 1 reliable 1 and 1 work 1 all 1 the 1 time 1 day 1 and 1 night.

**2.6 1 LITERATURE REVIEW**

Some 1 efforts 1 have 1 been 1 reported 1 in 1 the 1 literature 1 on 1 the 1 development 1 of 1 the 1 not-intrusive 1 monitoring 1 drowsiness 1 systems 1 based 1 on 1 the 1 vision.

**Malla 1 et 1 al. 1 [1]** 1 develop 1 a 1 light-insensitive 1 system. 1 They 1 used 1 the 1 Haar 1 algorithm 1 to 1 detect 1 objects 1 [2] 1 and 1 face 1 classifier 1 implemented 1 by 1 [3] 1 in 1 OpenCV 1 [4] 1 libraries. 1 Eye 1 regions 1 are 1 derived 1 from 1 the 1 facial 1 region 1 with 1 anthropometric 1 factors. 1 Then, 1 they 1 detect 1 the 1 eyelid 1 to 1 measure 1 the 1 level 1 of 1 eye 1 closure.

**Vitabile 1 et 1 al. 1 [5]** 1 implement 1 a 1 system 1 to 1 detect 1 symptoms 1 of 1 driver 1 drowsiness 1 based 1 on 1 an 1 infrared 1 camera. 1 By 1 exploiting 1 the 1 phenomenon 1 of 1 bright 1 pupils, 1 an 1 algorithm 1 for 1 detecting 1 and 1 tracking 1 the 1 driver's 1 eyes 1 has 1 been 1 developed. 1 When 1 drowsiness 1 is 1 detected, 1 the 1 system 1 warns 1 the 1 driver 1 with 1 an 1 alarm 1 message.

**Bhowmick 1 et 1 Kumar 1 [6]** 1 use 1 the 1 Otsu 1 thresholding 1 [7] 1 to 1 extract 1 face 1 region. 1 The 1 localization 1 of 1 the 1 eye 1 is 1 done 1 by 1 locating 1 facial 1 landmarks 1 such 1 as 1 eyebrow 1 and 1 possible 1 face 1 center. 1 Morphological 1 operation 1 and 1 K-means 1 is 1 used 1 for 1 accurate 1 eye 1 segmentation. 1 Then 1 a 1 non-linear 1 SVM 1 to 1 get 1 the 1 status 1 of 1 the 1 eye.

**Hong 1 et 1 al. 1 [8]** 1 define 1 a 1 system 1 for 1 detecting 1 the 1 eye 1 states 1 in 1 real 1 time 1 to 1 identify 1 the 1 driver 1 drowsiness 1 state. 1 The 1 face 1 region 1 is 1 detected 1 based 1 on 1 the 1 optimized

**Jones 1 and 1 Viola 1 method 1 [2].** 1 The 1 eye 1 area 1 is 1 obtained 1 by 1 an 1 horizontal 1 projection. 1 Finally, 1 a 1 new 1 complexity 1 function 1 with 1 a 1 dynamic 1 threshold 1 to 1 identify 1 the 1 eye 1 state.

**Tian 1 et 1 Qin 1 [9]** 1 build 1 a 1 system 1 that 1 checks 1 the 1 driver 1 eye 1 states. 1 Their 1 system 1 uses 1 the 1 Cb 1 and 1 Cr 1 components 1 of 1 the 1 YCbCr 1 color 1 space. 1 This 1 system 1 locates 1 the 1 face 1 with 1 a 1 vertical 1 projection 1 function, 1 and 1 the 1 eyes 1 with 1 a 1 horizontal 1 projection 1 function. 1 Once 1 the 1 eyes 1 are 1 located 1 the 1 system 1 calculates 1 the 1 eyes 1 states 1 using 1 a 1 function 1 of 1 complexity.

Under 1 the 1 light 1 of 1 what 1 has 1 been 1 mentioned 1 above, 1 the 1 identification 1 of 1 the 1 driver 1 somniferous1 state 1 given 1 by 1 the 1 PERCLOS 1 is 1 generally 1 passed 1 by 1 the 1 following 1 stages:

1) 1 Face 1 detection,

2) 1 Eyes 1 Location,

3) 1 Face 1 and 1 eyes 1 tracking,

4) 1 Identification 1 of 1 the 1 eyes 1 states,

5) 1 Calculation 1 of 1 PERCLOS 1 and 1 identification 1 of 1 driver 1 state.

In 1 this 1 paper, 1 we 1 presented 1 the 1 conception 1 and 1 implementation 1 of 1 a 1 system 1 for 1 detecting 1 driver 1 drowsiness 1 based 1 on 1 vision 1 that 1 aims 1 to 1 warn 1 the 1 driver 1 if 1 he 1 is 1 in 1 somniferous1 state.

This 1 system 1 is 1 able 1 to 1 determine 1 the 1 driver 1 state 1 under 1 real 1 day 1 and 1 night 1 conditions 1 using 1 IR 1 camera. 1 Face 1 and 1 eyes1 detection 1 are 1 implemented 1 based 1 on 1 symmetry. 1 Hough 1 Transform 1 for 1 Circles 1 is 1 used 1 for 1 the 1 decision 1 of 1 the 1 eyes 1 states.

The 1 results 1 are 1 satisfactory 1 with 1 an 1 opportunity 1 for 1 improvement 1 in 1 face 1 detection 1 using 1 other 1 techniques 1 concerning 1 the 1 calculation 1 of 1 symmetry. 1 Moreover, 1 we 1 will 1 implement 1 our 1 algorithm 1 on 1 a 1 DSP 1 (Digital 1 Signal 1 Processor) 1 to 1 create 1 an 1 autonomous 1 system 1 working 1 in 1 real 1 time.

**CHAPTER 1 - 1 3**

**PROPOSED 1 RESEARCH 1 WORK**

**3.1. 1 Problem 1 statement**

Somniferous driving is a major issue nowadays, resulting in tens of thousands of collisions every year. Motor vehicle crashes cause a large number of deaths and disabilities as well as huge financial losses for both the government and the individual. This is because of the negligence of the drivers. Collisions may be exacerbated by drowsiness. A driver's sleepiness level is not monitored in India. Systems such as driver tiredness monitors, real-time vision based on driver state monitoring systems, seeing driver assistance systems, and driver drowsiness detection and functioning system user centers are already in use abroad. For all of the systems, either changes in eye movement, physiological measurements, or driving performance are the primary emphasis points. The old methods have certain flaws as a result of illumination variance, which has previously been described in the literature study.

**3.2. 1 Feasibility 1 Study**

Vehicle 1 driving 1 has 1 been 1 playing 1 a 1 very 1 important 1 role 1 in 1 avoiding 1 the 1 accidents 1 over 1 millions 1 of 1 people 1 in 1 the 1 country, 1 whose 1 livelihood 1 is 1 more 1 important 1 to 1 their 1 children. 1 The 1 following 1 table 1 3.1 1 shows 1 losses 1 of 1 life 1 and 1 vehicle 1 value 1 in 1 the 1 months 1 of 1 October 1 2008. 1 Only 1 few 1 examples 1 are 1 shown 1 in 1 the 1 table.

Accident 1 of 1 October 1 6, 1 2008 1 caused 1 greater 1 devastation 1 in 1 Erode 1 district. 1 In 1 this 1 accident 1 9 1 died 1 including 1 two 1 children 1 because 1 of 1 lorry 1 driver 1 had 1 fallen 1 asleep. 1 Nowadays, 1 more 1 than 1 one-thousandth 1 of 1 high 1 ways 1 accidents 1 were 1 affected 1 by 1 massive 1 accidents 1 that 1 destroyed 1 large 1 parts 1 of 1 vehicles 1 and 1 human 1 lives.

I 1 propose 1 to 1 undertake 1 Techno-Economic 1 Feasibility 1 studies 1 to 1 assess 1 the 1 techno-economic 1 feasibility 1 and 1 viability 1 to 1 develop 1 a 1 somniferous1 driver 1 system.

**3.3. 1 Objectives**

The 1 primary 1 objective 1 of 1 the 1 proposed 1 system 1 is 1 to 1 overcome 1 one 1 or 1 more 1 problems 1 of 1 the 1 existing 1 systems.

* To 1 capture 1 and 1 preprocess 1 the 1 driver 1 image
* To 1 find 1 eye 1 detection 1 fastly 1 using 1 non-intrusive 1 method
* To 1 find 1 eye 1 state 1 fastly
* To 1 wake 1 up 1 the 1 driver 1 to 1 avoid 1 accidents
* To 1 protect 1 the 1 people 1 and 1 vehicle
* To 1 provide 1 a 1 system 1 that 1 concentrates 1 on 1 a 1 non-intrusive 1 vision 1 based 1 system
* To 1 provide 1 a 1 Driver 1 Somniferous1 Detection 1 System 1 that 1 will 1 work 1 well 1 in 1 Day 1 and 1 night 1 irrespective 1 of 1 lighting 1 condition
* To 1 provide 1 for 1 increased 1 efficiency 1 by 1 avoiding 1 frame 1 loss
* To 1 provide 1 a 1 Driver 1 Somniferous1 Detection 1 System 1 that 1 uses 1 customized 1 image 1 processing 1 algorithm 1 to 1 concentrate 1 on 1 the 1 eyes 1 detection
* To 1 provide 1 knowledge 1 based 1 method 1 to 1 authenticate 1 the 1 eyes 1 movement 1 using 1 the 1 image-processing 1 algorithm 1 to 1 reduce 1 the 1 chance 1 of 1 misdetection 1 or 1 wrong 1 alarm
* To 1 protect 1 the 1 inmates, 1 driver, 1 people 1 outside 1 the 1 vehicle, 1 vehicle, 1 the 1 surrounding 1 environment 1 and 1 other 1 vehicles 1 which 1 are 1 coming 1 in 1 the 1 opposite 1 direction
* Finding 1 vehicle 1 driver 1 who 1 is 1 sleepy 1 and 1 tired 1 to 1 stop 1 the 1 driving 1 in 1 order 1 to 1 avoid 1 accidents

**3.4 1 Technology 1 and 1 tools 1 used**

**3.4.1 1 Digital 1 Image 1 Processing**

The 1 term 1 monogram 1 image 1 or 1 simply 1 image, 1 refers 1 to 1 a 1 two-dimensional 1 light 1 intensity 1 function 1 f(x, 1 y) 1 where 1 x 1 and 1 y 1 denote 1 spatial 1 coordinates 1 and 1 the 1 value 1 of 1 f 1 at 1 any 1 point 1 (x, 1 y) 1 is 1 proportional 1 to 1 the 1 brightness 1 of 1 the 1 image 1 at 1 the 1 point.

A 1 digital 1 image 1 a(m,n) 1 described 1 in 1 a 1 2D 1 discrete 1 space 1 is 1 derived 1 from 1 an 1 analog 1 image 1 a(x,y) 1 in 1 a 1 2D 1 continuous 1 space 1 through 1 a 1 sampling 1 process 1 that 1 is 1 frequently 1 referred 1 to 1 as 1 digitization. 1 Image 1 function 1 f(x, 1 y) 1 may 1 be 1 regarded 1 as 1 being 1 characterized 1 by 1 two 1 components 1 namely 1 illumination 1 and 1 reflection.

f(x,y) 1 = 1 i(x, 1 y)\* 1 r(x, 1 y)

where 1 i(x, 1 y) 1 is 1 determined 1 by 1 the 1 light 1 source, 1 while 1 r(x, 1 y) 1 is 1 determined 1 by 1 the 1 characteristics 1 of 1 the 1 objects 1 in 1 a 1 scene.

The 1 2D 1 continuous 1 image 1 a(x, 1 y) 1 is 1 divided 1 into 1 N 1 rows 1 and 1 M 1 columns. 1 The 1 intersection 1 of 1 a 1 row 1 and 1 a 1 column 1 is 1 termed 1 as 1 a 1 pixel. 1 The 1 value 1 assigned 1 to 1 the 1 integer 1 coordinates 1 (x, 1 y) 1 with 1 {x=0,1,2,...,M-1} 1 and 1 {y=0,1,2,...,N-1} 1 is 1 a(m, 1 n). 1 In 1 fact, 1 in 1 most 1 cases 1 a(x, 1 y) 1 which 1 we 1 might 1 consider 1 to 1 be 1 the 1 physical 1 signal 1 that 1 impinges 1 on 1 the 1 face 1 of 1 a 1 2D 1 sensor 1 is 1 actually 1 a 1 function 1

**Image 1 Operations**

There 1 is 1 a 1 variety 1 of 1 ways 1 to 1 classify 1 and 1 characterize 1 image 1 operations. 1 The 1 reason 1 for 1 doing 1 so 1 is 1 to 1 understand 1 what 1 type 1 of 1 results 1 we 1 might 1 expect 1 to 1 achieve 1 with 1 a 1 given 1 type 1 of 1 operation 1 or 1 what 1 might 1 be 1 the 1 computational 1 burden 1 associated 1 with 1 a 1 given 1 operation.

**Types 1 of 1 Operations**

The 1 types 1 of 1 operations 1 that 1 can 1 be 1 applied 1 to 1 digital 1 images 1 to 1 transform 1 an 1 input 1 image 1 a(m, 1 n) 1 into 1 an 1 output 1 image 1 b(m, 1 n) 1 (or 1 another 1 representation) 1 can 1 be 1 classified 1 into 1 three 1 categories 1 as 1 shown 1 in 1 Table 1 3.1.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Operation | Characterization | | |  | Generic |
|  | Complexity/Pixel |
|  |  |  |  |  |
|  |  | | | |  |
| Point | The 1 output 1 value 1 at 1 a 1 specific | | | |  |
| coordinate 1 is 1 dependent 1 only 1 on | | | | *constant* |
|  | the 1 input 1 value 1 at 1 that | | | |  |
|  | coordinate. | |  |  |  |
|  | The 1 output 1 value 1 at 1 a 1 specific | | | | *P2* |
| Local | coordinate | is 1 dependent | | on 1 the |  |
| input | values | in | the |  |
|  |  |
|  | neighborhood | | Of | same |  |
|  | coordinate. | |  |  |  |
|  | The 1 output 1 value 1 at 1 a 1 specific | | | | *N2* |
| Global | coordinate 1 is 1 dependent 1 on 1 all | | | |
|  | the 1 values 1 in 1 the 1 input | | |  |  |

Image 1 size 1 = 1 N 1 x 1 N; 1 neighborhood 1 size 1 = 1 P 1 x 1 P. 1 Note 1 that 1 the 1 complexity 1 is 1 specified 1 in 1 operations 1 per 1 pixel

**Table 1 3.1: 1 Types 1 of 1 image 1 operations.**

**3.4.2 1 Fundamental 1 steps 1 of 1 Image 1 Processing**

The 1 following 1 are 1 the 1 fundamental 1 steps 1 in 1 the 1 image 1 processing:

Image 1 acquisition 1 is 1 the 1 first 1 process. 1 Generally 1 the 1 image 1 acquisition 1 stage 1 involves 1 preprocessing 1 such 1 as 1 scaling.

Image 1 enhancement 1 is 1 to 1 bring 1 out 1 detail 1 that 1 is 1 obscured 1 or 1 simply 1 to 1 highlight 1 certain 1 features 1 of 1 interest 1 in 1 an 1 image.

Image 1 restoration 1 is 1 an 1 area 1 that 1 also 1 deals 1 with 1 improving 1 the 1 appearance 1 of 1 an 1 image. 1 Unlike 1 enhancement, 1 which 1 is 1 subjective, 1 image 1 restoration 1 is 1 objective. 1 Image 1 restoration 1 techniques 1 tend 1 to 1 be 1 based 1 on 1 mathematical 1 or 1 probabilistic 1 models 1 of 1 image 1 degradation. 1 Enhancement 1 on 1 the 1 other 1 hand, 1 is 1 based 1 on 1 human 1 subjective 1 preferences 1 regarding 1 what 1 constitutes 1 a 1 good 1 enhancement 1 result.

* Color 1 image 1 processing.
* Wavelets 1 are 1 the 1 foundation 1 for 1 representing 1 images 1 in 1 various 1 degrees 1 of 1 resolution.
* Compression 1 deals 1 with 1 techniques 1 for 1 reducing 1 the 1 storage 1 required 1 to 1 save 1 an 1 image 1 or 1 the 1 bandwidth 1 required 1 to 1 transmit 1 it.
* Morphological 1 processing 1 deals 1 with 1 tools 1 for 1 extracting 1 image 1 components 1 that 1 are 1 useful 1 in 1 the 1 representation 1 and 1 description 1 of 1 shape.
* Segmentation 1 procedures 1 partition 1 an 1 image 1 into 1 its 1 constituent 1 parts 1 or 1 objects.
* Representation 1 and 1 description 1 almost 1 always 1 follow 1 the 1 output 1 of 1 a 1 segmentation 1 stage, 1 which 1 usually 1 is 1 a 1 raw 1 pixel 1 data, 1 constituting 1 either 1 the 1 boundary 1 of 1 a 1 region. 1 Representation 1 first 1 deals 1 with 1 whether 1 the 1 data 1 should 1 be 1 represented 1 as 1 a 1 boundary 1 or 1 as 1 a 1 complete 1 region. 1 Choosing 1 representation 1 is 1 only 1 part 1 of 1 the 1 solution 1 for 1 transforming 1 raw 1 data 1 into 1 a 1 form 1 suitable 1 for 1 subsequent 1 computer 1 processing. 1 A 1 method 1 must 1 also 1 be 1 specified 1 for 1 describing 1 the 1 data 1 so 1 that 1 features 1 of 1 interest 1 are 1 highlighted. 1 Description 1 or 1 feature 1 selection 1 deals 1 with 1 extracting 1 attributes 1 that 1 result 1 in 1 some 1 quantitative 1 information 1 of 1 interest 1 or 1 basic 1 for 1 differentiating 1 one 1 class 1 of 1 objects 1 from 1 another.

**3.4.3 1 Object1 recognition.**

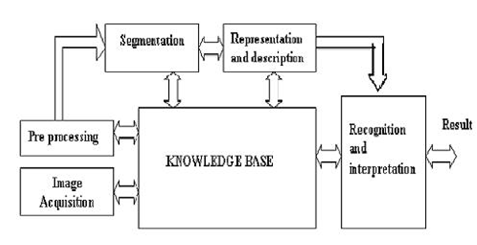


Fig 1 3.1: 1 Image 1 processing 1 steps

**Elements 1 of 1 image 1 analysis**

Dividing 1 the 1 spectrum 1 of 1 techniques 1 in 1 image 1 analysis 1 into 1 three 1 basic 1 areas 1 is 1 conceptually 1 useful. 1 These 1 areas 1 are 1 (1) 1 low 1 level 1 processing, 1 (2) 1 intermediate-level 1 processing 1 and 1 (3) 1 high 1 level 1 processing. 1 Low-level 1 processing 1 deals 1 with 1 functions 1 that 1 may 1 be 1 viewed 1 as 1 automatic 1 reactions, 1 requiring 1 no 1 intelligence 1 on 1 the 1 part 1 of 1 the 1 image 1 analysis 1 system. 1 We 1 treat 1 image 1 acquisition 1 and 1 processing 1 as 1 low 1 level 1 functions. 1 This 1 classification 1 encompasses 1 activities 1 from 1 the 1 image 1 formation 1 process 1 itself 1 for 1 compensation, 1 such 1 as 1 noise 1 reduction 1 or 1 image, 1 deblurring. 1 Low-level 1 functions 1 may 1 be 1 compared 1 to 1 the 1 sensing 1 and 1 adaptation 1 process 1 that 1 a 1 person 1 goes 1 through 1 when 1 trying 1 to 1 find 1 a 1 seat 1 immediately.

After 1 entering 1 a 1 dark 1 theater 1 from 1 bright 1 sunlight, 1 the 1 (intelligent) 1 process 1 of 1 finding 1 an 1 unoccupied 1 seat 1 cannot 1 begin 1 until 1 a 1 suitable 1 image 1 is 1 available. 1 The 1 process 1 followed 1 by 1 the 1 brain 1 in 1 adapting 1 the 1 visual 1 system 1 to 1 produce 1 such 1 an 1 image 1 is 1 an 1 automatic, 1 unconscious 1 reaction.

Intermediate 1 level 1 processing 1 deals 1 with 1 the 1 task 1 of 1 extracting 1 and 1 characterizing 1 components 1 (say, 1 regions) 1 in 1 an 1 image 1 resulting 1 from 1 a 1 low 1 level 1 process. 1 Intermediate-level 1 processes 1 encompass 1 segmentation 1 and 1 description. 1 Some 1 capabilities 1 for 1 intelligent 1 behavior 1 have 1 to 1 be 1 built 1 into 1 flexible 1 segmentation 1 procedures. 1 For 1 example, 1 bridging 1 small 1 gaps 1 in 1 a 1 segmented 1 boundary 1 involves 1 more 1 sophisticated 1 elements 1 of 1 problem 1 solving 1 than 1 mere 1 low-level 1 automatic 1 reactions. 1 Finally 1 high 1 level 1 processing 1 involves 1 recognition 1 and 1 interpretation.

**3.4.4 1 About 1 Mat 1 Lab 1 7.0**

PYTHON 1 is 1 a 1 high-performance 1 language 1 for 1 technical 1 computing. 1 It 1 integrates 1 computation, 1 visualization, 1 and 1 programming 1 in 1 an 1 easy-to-use 1 environment 1 where 1 problems 1 and 1 solutions 1 are 1 expressed 1 in 1 familiar 1 mathematical 1 notation.

The 1 PYTHON 1 system 1 consists 1 of 1 five 1 main 1 parts:

**Development 1 Environment.**

This 1 is 1 the 1 set 1 of 1 tools 1 and 1 facilities 1 that 1 help 1 you 1 to 1 use 1 PYTHON 1 functions 1 and 1 files. 1 Many 1 of 1 these 1 tools 1 are 1 graphical 1 user 1 interfaces. 1 It 1 includes 1 the 1 PYTHON 1 desktop 1 and 1 Command 1 Window, 1 a 1 command 1 history, 1 an 1 editor 1 and 1 debugger 1 and 1 browsers 1 for 1 viewing 1 help, 1 the 1 workspace, 1 files 1 and 1 the 1 search 1 path.

**The 1 PYTHON 1 Mathematical 1 Function 1 Library.**

This 1 is 1 a 1 vast 1 collection 1 of 1 computational 1 algorithms 1 ranging 1 from 1 elementary 1 functions, 1 like 1 sum, 1 sine, 1 cosine, 1 and 1 complex 1 arithmetic 1 to 1 more 1 sophisticated 1 functions 1 like 1 matrix 1 inverse, 1 matrix 1 eigen 1 values, 1 Bessel 1 functions 1 and 1 fast 1 Fourier 1 transforms.

**The 1 PYTHON 1 Language.**

This 1 is 1 a 1 high-level 1 matrix/array 1 language 1 with 1 control 1 flow 1 statements, 1 functions, 1 data 1 structures, 1 input/output, 1 and 1 object-oriented 1 programming 1 features. 1 It 1 allows 1 both 1 "programming 1 in 1 the 1 small" 1 to 1 rapidly 1 create 1 quick 1 and 1 dirty 1 throw-away 1 programs 1 and 1 "programming 1 in 1 the 1 large" 1 to 1 create 1 large 1 and 1 complex 1 application 1 programs.

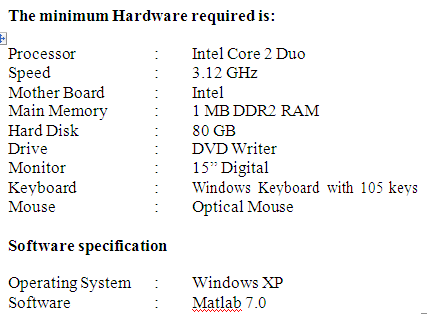
**GRAPHICS.**

PYTHON 1 has 1 extensive 1 facilities 1 for 1 displaying 1 vectors 1 and 1 matrices 1 as 1 graphs 1 as 1 well 1 as 1 annotating 1 and 1 printing 1 these 1 graphs. 1 It 1 includes 1 high-level 1 functions 1 for 1 two-dimensional 1 and 1 three-dimensional 1 data 1 visualization, 1 image 1 processing, 1 animation 1 and 1 presentation 1 graphics.

**The 1 PYTHON 1 Application 1 Program 1 Interface 1 (API).**

This 1 is 1 a 1 library 1 that 1 allows 1 you 1 to 1 write 1 C 1 and 1 Fortran 1 programs 1 that 1 interact 1 with 1 PYTHON. 1 It 1 includes 1 facilities 1 for 1 calling 1 routines 1 from 1 PYTHON 1 (dynamic 1 linking), 1 calling 1 PYTHON 1 as 1 a 1 computational 1 engine 1 and 1 for 1 reading 1 and 1 writing 1 MAT-files

**3.4.5 1 Hardware 1 and 1 Software 1 Selection**



**3.5 1 BENEFITS 1 AND 1 LIMITATIONS**

**BENEFITS**

The 1 somniferous1 driver 1 system 1 detects 1 drowsiness 1 and 1 fatigue 1 prior 1 to 1 the 1 driver 1 falling 1 asleep. 1 The 1 warnings 1 can 1 begin 1 as 1 the 1 driver 1 becomes 1 fatigue 1 and 1 intensify 1 as 1 the 1 system 1 detects 1 increasing 1 drowsiness 1 to 1 avoid 1 endanger 1 himself 1 and/or 1 others.

Other 1 technologies, 1 such 1 as 1 those 1 that 1 detect 1 head 1 motion, 1 do 1 not 1 warn 1 the 1 driver 1 of 1 drowsiness 1 and 1 fatigue 1 until 1 the 1 driver 1 has 1 fallen 1 asleep 1 and 1 possibly 1 lost 1 control 1 of 1 the 1 vehicle. 1 The 1 ideal 1 system 1 should 1 begin 1 to 1 warn 1 the 1 driver’s 1 drowsiness 1 early 1 before 1 fatigue 1 significantly 1 impairs 1 driving 1 ability.1 Other 1 benefits 1 include

* An 1 Approximate 1 Reduction 1 In 1 Fuel 1 Consumption 1 Of 1 15 1 Percent.
* Improved 1 Traffic 1 Flow.
* Increased 1 Safety 1 And
* More 1 Comfortable 1 Working 1 Conditions 1 For 1 Drivers.

Driver 1 Drowsiness 1 Detection 1 System 1 (DDDS) 1 has 1 the 1 potential 1 to 1 greatly 1 reduce 1 road 1 accidents 1 in 1 the 1 large 1 commercial 1 vehicle 1 sector 1 where 1 driver 1 fatigue 1 is 1 a 1 significant 1 risk 1 and 1 in 1 turn 1 to 1 provide 1 major 1 benefits 1 to 1 road 1 transportation 1 companies 1 in 1 terms 1 of 1 cost 1 savings 1 and 1 improved 1 safety 1 and 1 reliability.

**LIMITATIONS**

With 1 80% 1 accuracy, 1 it 1 is 1 obvious 1 that 1 there 1 are 1 limitations 1 in 1 the 1 system. 1 The 1 most 1 significant 1 limitation 1 is 1 that 1 there 1 cannot 1 be 1 any 1 reflective 1 object 1 behind 1 the 1 driver. 1 The 1 more 1 uniform 1 the 1 background 1 is, 1 the 1 more 1 robust 1 the 1 system 1 becomes.

For 1 testing, 1 rapid 1 head 1 movement 1 was 1 not 1 allowed, 1 since 1 it 1 can 1 be 1 equivalent 1 to 1 simulating 1 a 1 tired 1 driver. 1 For 1 small 1 head 1 movements, 1 the 1 system 1 rarely 1 loses 1 track 1 of 1 the 1 eyes. 1 When 1 the 1 head 1 is 1 turned 1 too 1 much 1 sideways 1 there 1 were 1 some 1 false 1 alarms.

The 1 system 1 has 1 problems 1 little 1 when 1 the 1 person 1 is 1 wearing 1 eyeglasses. 1 Localizing 1 the 1 eyes 1 is 1 not 1 a 1 problem, 1 but 1 the 1 point 1 is 1 to 1 determine 1 whether 1 the 1 eyes 1 are 1 opened 1 or 1 closed.

**Chapter No. 11 4**

**DESIGN 1 AND 1 DEVELOPMENT 1 OF 1 DDDS 1 PROTOTYPE**

**4.1INTRODUCTION**

Monitoring eye closures is an useful approach to assess sleepiness and avoid an accident since the frequency of eye closures rise considerably in the ten second interval before to an accident. There is a 10 second window in which the system has to decide if the driver is sleepy. There should be as few false alarms (alerting while the driver is not awake) and false discoveries (mistaking other characteristics in the picture for eyes) in the algorithm as feasible.

For the Detecting Driver Drowsiness System (DDDS), the most often used methods are:

• Determination of thresholds and edge detection.

Remove a single pixel and increase the image's resolution.

• Calculating the picture region's feature measurements.

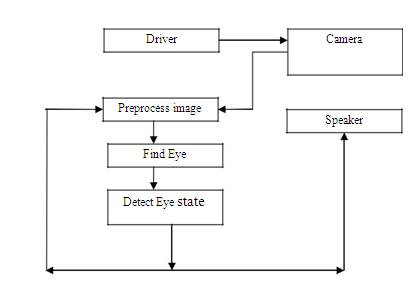
To begin, you need to figure out what you're looking for.

Marking the driver's sight or alerting him or her to the situation.

Version 4.2 of the prototype algorithm design

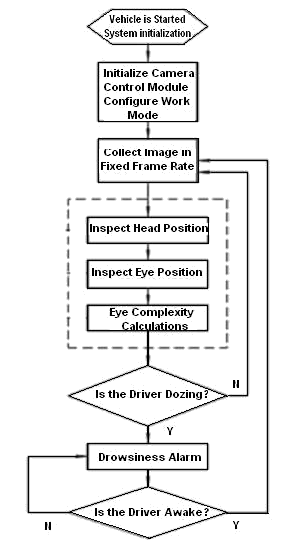
The Driver Somniferous Detection System's design will be discussed in this section. Retinal reflection was the primary goal of this experiment, and later the lack of this reflection was used as an indicator that a person's eyes were closed. Two issues were discovered as a result of using this technique to track the eyes. First, the quantity of retinal reflection is reduced under low illumination, and second, the reflection may not be seen if the individual has tiny eyes.

The foundation of the variations in horizontal intensity was employed as the project proceeded. When it comes to intensity changes, the brows and eyes are the most noticeable in y-direction, while the skin is furthest away in the x-direction. Using this facial trait, the system will be able to track the eyes and identify extended lapses of eye closure. The design of the driver drowsiness detection system is described in the following sections.



**Fig 4.1: Block Diagram of prototype of DDDS**

* Algorithm 4.2.1Prototype Algorithm (Inputs a video image file)
* Decompress the video into individual frames.
* As a rule of thumb:
* Remove the noise via preprocessing.
* Use an edge detector to examine the picture (Edge detector threshold is detected automatically).
* Using a binary picture as input, perform the left, right, and top-finding algorithms (output image of the edge detector).
* Face detection or head detection may be used to locate the center of the face.
* For each eye brow, first locate the biggest valley with the lowest y-coordinate using data from center and top detection; then discover the second largest valley with the next lowest y-coordinate using data from eye brow.
* Smooth the horizontal average intensity change by performing averaging.
* In order to open an eye, the difference between the first valley and the second valley must be less than 50; otherwise, the eye is closed.
* Make a beep sound until the driver responds if the door is closed.
* 4.2.2 Description of a Functional Prototype
* For drivers, this system has the following features in place:
* Determine the level of driver attentiveness based on inputs collected during day and night driving situations and provide that information to the processor for further processing.
* In order to determine whether or not the driver is sleepy, a picture of the driver's eyes must be captured in real time and processed and analyzed. While driving, the vehicle will emit an alerting audio message if it detects the driver is intoxicated or asleep.
* We developed the image processing algorithms in hardware because of the rigorous real-time performance requirements of the system. The algorithm's implementation difficulties and robustness must be thoroughly examined before making a decision on which one to use. Three simple steps are all that is required to implement the simplest image processing method.
* (See Figure 4.2 for an algorithm flow diagram in further detail):
* In order to accurately capture the driver's face, you must first pre-process the driver's original picture. The processing time may be reduced by reducing the size of the picture zone that has to be processed. Face feature assessment is also less affected by a complicated backdrop when using this method.
* In order to capture a driver's picture eyes zone, the eye-zone location must be determined.
* Distracted or sleepy driving may be detected by keeping an eye on the driver's open/closed state.
* Fig. 4.2 shows the image processing method in action. Let's have a look at the process step by step.



**Fig: 4.2 Flow of Driver Drowsiness Detection System**

***Initiating the system***

When the driver flips the switch to the "on" position, the suggested system comes to life. A state-monitoring system is then activated to determine the eyes' condition.

When the driver has made certain that the system isn't being used and has turned the switch to the "off" position, the system is shut off. The vehicle's connection will be cut off. Then the driver may take control of the car.

***Capturing 1 facial 1 image***

The 1 web 1 camera 1 in 1 the 1 system 1 is 1 capturing 1 the 1 facial 1 image. 1 The 1 camera 1 takes 1 every 1 2 1 seconds 1 a 1 snap 1 shot 1 and 1 stores 1 this 1 as 1 temporary 1 image 1 file 1 for 1 processing.

***Pre-processing***

After 1 inputting 1 a 1 facial 1 image, 1 pre-processing 1 is 1 first 1 performed 1 by 1 digitizing 1 the 1 image. 1 Homomorphic 1 filter 1 is 1 used 1 to 1 preprocess 1 the 1 image. 1 This 1 is 1 implemented 1 in 1 section 1 5.3. 1 After 1 preprocessing, 1 the 1 remaining 1 steps 1 are 1 divided 1 into 1 two 1 major 1 parts 1 such 1 as 1 eye 1 detection 1 and 1 drowsiness 1 detection. 1 Eye 1 detection 1 comprises 1 of 1 face 1 top 1 and 1 width 1 detection, 1 noise 1 removal, 1 intensity 1 changes 1 on 1 the 1 face 1 and 1 eye 1 position. 1 The 1 drowsiness 1 detection 1 function 1 finds 1 the 1 state 1 of 1 the 1 eyes 1 and 1 judge 1 drowsiness.

**4.2.3 1 Prototype 1 Algorithm 1 development**

It 1 consists 1 of 1 two 1 key 1 functions 1 called 1 eyes 1 detection 1 function 1 and 1 somniferous1 detection 1 function.

***4.2.3.1 1 Eyes 1 Detection 1 Function***

***4.2.3.1.1Face 1 top 1 and 1 width 1 detection***

After 1 facial 1 image 1 is 1 pre-processed, 1 eye 1 detection 1 procedure 1 is 1 applied 1 to 1 the 1 image. 1 The 1 top 1 and 1 sides 1 of 1 the 1 face 1 are 1 detected 1 to 1 narrow 1 down 1 the 1 area 1 of 1 where 1 the 1 eyes 1 exist. 1 Using 1 the 1 sides 1 of 1 the 1 face, 1 the 1 centre 1 of 1 the 1 face 1 is 1 found, 1 which 1 will 1 be 1 used 1 as 1 a 1 reference 1 when 1 comparing 1 the 1 left 1 and 1 right 1 eyes. 1 Moving 1 down 1 from 1 the 1 top 1 of 1 the 1 face, 1 horizontal 1 averages 1 (average 1 intensity 1 value 1 for 1 each 1 y 1 coordinate) 1 of 1 the 1 face 1 area 1 are 1 calculated. 1 Large 1 changes 1 in 1 the 1 averages 1 are 1 used 1 to 1 define. 1 All 1 images 1 are 1 generated 1 in 1 Mat 1 lab 1 using 1 the 1 image 1 processing 1 toolbox.

**Noise 1 may be removed from 4.2.3.1.2.**

You don't have to be an expert to remove noise from digital images. To travel left on a pixel, decrease x2 and change each y value to white, starting at the top (x2, y2) (for 200 y values). Perform step 1 a second time on the right side of the face. It's crucial that you only stop at the left and right margins of the face, so that you don't lose any information about the face's edges. To find the face's margins, you have to remove the black blob on the face.

**4.2.3.1.3 Changes in facial intensity**

The next stage in identifying the eyes is to look for variations in the brightness of the skin on the head. The original picture is used in this process. The average intensity of each y-coordinate must first be calculated. For example, the horizontal average takes into account just horizontal data, hence it is referred to as the horizontal average. The peaks and dips on the graph of the horizontal values represent shifts in intensity. Modest troughs appeared when the horizontal values were first shown because of small variances in the averages rather than changes in intensity. Implementation of a smoothing method corrected this. As a consequence of the smoothing procedure, the graph is more uniformly smooth. Finding the most prominent valleys, which represent the eye area, comes next after calculating the horizontal average. Assuming the individual has a smooth forehead (i.e., no hair on the forehead), this is based on the idea that the eyebrows and the upper edge of the eye undergo the first and second greatest changes in intensity, respectively, as seen from the top of the face downward. In order to locate the valleys, one must look for a shift in slope from a negative to a positive direction. To find a peak, you need to look for a change in slope. The distance between the peak and the valley determines the valley's size. They are classified according to size after all valleys have been discovered.

**4.2.3.1.4 The location of the eyes.**

With respect to y-coordinate size distribution, the eyebrow is home to our greatest valley, and our eye to our second-largest valley.

1 Once this procedure has been completed on each side of the face independently, it is compared to make sure the eyes have been located appropriately on both sides. To determine the left side of the face, averages are taken from the left edge to the center of the face. Because the driver's head is slanted, the horizontal averages are not correct, the two sides are done independently.

Functionality for Detecting Drowsiness in Users

**4.2.3.2.1The Eye's Condition**

The distance between the first two intensity changes observed in the preceding stage determines the condition of the eyes (whether they are open or closed). A bigger difference in y-coordinates for intensity variations occurs when the eyes are closed as opposed to open. The driver's face can only move so near or far from the camera that this isn't possible. As can be seen in the image below, the distances will change as the amount of pixels occupied by the face changes. That's why it was necessary to design a system in which a camera is always at a fixed distance from the driver's face.

**4.2.3.2.2 Determining the Degree of Tiredness**

A driver's alarm is sent off when the eye is found to be closed for five consecutive frames. Consecutive closed frames are required to prevent blinking-induced eye closures. The number of eyelid closures is used to determine attentiveness. The alert is also triggered if the pressure and rotation of the steering exceeds the usual level.

An overview of the modules in this section

Each module of the prototype is described in turn.

**Module: Acquire ()**

An array, BW, will be used to hold the image's values.

In the beginning, the picture is saved in a buffer, and this buffer is then copied into the BW array. The BW array is declared as a global variable since it will be utilized in many other methods.

**Binarization is a module in this module ()**

To create a binary image of the image.

The picture is reduced to two values, black and white, based on a predetermined threshold. It is set to black or white if a pixel in the BW array is less than or equal to the threshold. The BW1 array is used to hold the binary image.

**Module: Detection of Faces ()**

To locate the face's x-direction center of gravity.

Starting at the position (100,240) of the binary picture, the x-direction borders of the face are discovered. x1 is given to the intersection of the left and right edges. In this case, x1 (the new center of the face) is returned and utilized as the new center.

**Module: Detection at the top of the list ()**

The goal is to locate the apex of the head.

A pair of integers are sent to this function. Both Face Detection Module's output and Detect Centre Module's output may be used to determine x, which can be used at any point in this method. Second, y is the y-coordinate in the center of the 1 face. By counting the amount of black pixels, the y-coordinate is decremented to find the top. Top values are returned as a result of this method (y-coordinate).

**Module: Find the center ( )**

The goal of this exercise is to locate the facial center.

Two integers are sent to this function. Two integers, one for the head's center x-coordinate and the other for the head's y-coordinate, are shown. The left and right sides of the face are discovered by checking for a change in pixel value from white to black at the pixel value of the two provided coordinates. The midpoint between the left and right sides is known as the center. In this case, the value is returned (x-coordinate).

**Module: Detection of a cutting edge ()**

1 To locate the facial left and right margins.

Two integers are sent to this function. The top of the head's x and y coordinates are shown here. The y coordinate is decremented and the left and right sides are located as explained in Detect center. The face's length is roughly equivalent to 200 iterations of the y coordinate being decremented. Two arrays are used to hold the pixel values for the left and right sides. The face's center value has been reset.

**Remove background noise ()**

The goal is to eliminate all of the black blobs from the binary image.

In the x-direction, the left and right sides of the face are both set to white, starting at pixel values at the top of the head. Up until the Detect edge's left and right edges, this is all that is done.

**The horizontal average of the data ()**

Horizontal averages are to be calculated.

There are three arguments sent via the function. The left and right pixel values from the sides detected by Detect edge are stored in the first two arrays. Right and left are both represented by the third parameter, which is a number that indicates which side of the face the computations are being performed on. It is necessary to smooth out any slight variations in horizontal values in order to prevent them from being mistaken for valleys in the subsequent analysis.

**Valley search is the first step in this module ()**

To find the troughs in the horizontal averages.

The side of the face is indicated by an integer sent to this function. To determine the size of a valley, measure the distance between its lowest point and its highest point (in the y-direction). In addition to sorting the valleys by size, this program also sorts them alphabetically. There is a recurrence of the number of valleys discovered.

**4.3 THE PROTOTYPE DESIGN VERSION ALGORITHM 2**

Except for the eye state detection, this approach is identical to the prior one. The difference between the valleys in the intensity changes on faces is used to determine the eye state in eye state detection. The amount of ocular circles will be determined in this edition. Otherwise, the eye remains closed unless there are two circles in the field of vision. Prototype modifications are listed below:

• Decompress the video into individual frames.

As a rule of thumb:

Remove the noise via preprocessing.

• Use an edge detector to examine the picture (Edge detector threshold is detected automatically).

Make use of the 'Left-to-right' technique and the 'top find' algorithm on the binary image (output image of the edge detector).

• Using a self-defined method for face detection or head detection, find the right center of the face.

• Locate the left and right eye areas.

• Count the circles under each of your eyes.

• Eyes are open if the number of circles equals 2, else they are closed.

Beep until the driver reacts if their eyes are closed.

The previous stage's intensity on the face is replaced by a circle detection step in this phase. The number of concentric circles will be counted in the circle detection stage using our own technique. The states of the eyes step are also being replaced.... If the number of circles equals two (which is discovered in the phase of circle detection), then the eyes stay open; otherwise, they are closed. This is a pretty easy procedure. Replacements have been made for the Horizontal average () and Find valley () modules.

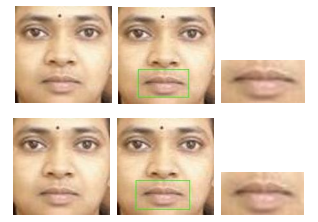
All of these procedures will be put into action in next sections. Chapter 5 details the many preprocess processes and their variants. Chapter 6 introduces eye detection and its variants.

**Chapter No. 5**

**methodology and result**

**5.1 INTRODUCTION**

Using a cascade of classifiers, a picture may be rejected by every classifier. As a result, just a few characteristics are utilized for each position and scale since all classifiers are taught to reject a portion of the potential candidates. In order to minimize the number of mouth candidates to only a single positive detection, a grouping technique is used.



**Fig.5.2:Detectmouth**



**Fig.5.3: Detectedfaceinanimage**



**Fig.5.4: DetectedEyesinanimage**

**5.2 1 MOUTH AND NOSE DETECTION IN AN IMAGE:**

Mouth 1 and 1 Nose 1 detection 1 is 1 shown 1 in 1 figure 1 5(a) 1 & 1 5(b). 1 The 1 purpose 1 of 1 mouth 1 detection 1 is 1 to 1 detect 1 yawning 1 if 1 possible 1 for 1 future 1 scope. 1 In 1 the 1 result 1 of 1 nose 1 detection, 1 the 1 nose 1 is 1 detected 1 in 1 face 1 region 1 correctly, 1 but 1 it 1 is 1 also 1 detected 1 in 1 background, 1 which 1 is 1 error. 1 So 1 we 1 can 1 remove 1 this 1 error 1 by 1 limiting 1 the 1 image 1 search 1 area. 1 First 1 the 1 face 1 will 1 be 1 detected, 1 and 1 from 1 that 1 area 1 of 1 face, 1 the 1 other 1 features 1 like 1 eyes, 1 nose 1 & 1 mouth 1 will 1 be 1 detected. 1 This 1 will 1 solve 1 the 1 problem.



**Fig5.5:DetectedNoseandmouthinanimage**



**Fig.5.6:DetectedMouthinanimage**

**5.3FACE, EYE AND MOUTH DETECTION IN AN IMAGE:**

Figure 6 shows how to recognize a person's face, eyes, and lips. As previously discussed, it is implemented in accordance with that manner. Because the search area is limited to only the facial region, the results are more exact and precise.



**Fig.5.7:Face,Eye &MouthDetectionusingLivewebcam**



**Fig.5.8: Detectmouthispresentornot.**

**5.4THE MOUTH STATUS MONITORING USING BLOB DETECTION**

1 Figure 1 depicts whether or not the mouth has been found. It creates a circle around the mouth, as seen in the illustration. There are Viola jones ways used to identify the face and mouth1. To verify the mouth's health, blob detection is used just to evaluate ocular condition. .

To get rid of the somniferous ness we develop a machine learning AI model that helps to prevent the accidents that would happen in the future. As to make this model possible we use multiple libraries of python language to develop a model that is the scipy.spatial, imutils, threading, numpy, opencv and at last the dlib library, and for playing the sound and vibration using the libraries that are play sound and argparse. And the time library has used the delaying the time to train the model for the correct observation. And from the basic principle of artificial intelligence that is if we want a perfect model for better accuracy we would need to train the model as much as we can. As it gains some experience from the model that it would perform well. Then we can upload the whole code to the Arduino and then the whole model would be placed into the seat belt of the car like a vibrator and for playing the alert sound for the driver. Then the camera would detect the consciousness of the driver that was being placed on the dashboard of that car. That whole of the code would be uploaded on the Arduino or the software that was being installed in the car. And using OpenCV, Keras, and TensorFlow libraries at the backend of the code it would help our model to predict the accurate result. Then the OpenCV would detect the face structure of the human that was sitting in the front of the camera that uses the convolutional neural networking layers to identify its structure. As the convolutional networks use the layers or points on the face in 64 & 128 CNN’s layers format to detect the accurate prediction of the somniferous ness and this process would be fastened by using TensorFlow at the backend. And that would make the whole model possible.

**Chapter No. 6**

**CONCLUSION AND SCOPE FOR FUTURE DEVELOPMENT**

An unobtrusive technique for locating the eyes and monitoring weariness has been devised by researchers. Self-developed image processing techniques are used to gather data on the subject's head and eye location. The technology can tell whether the eyes are open or closed during the monitoring. A warning is delivered when the eyes are closed for two seconds. Automated eye-localization error detection is also available as an option during monitoring. The system has the ability to recover and correctly locate the eyes in the event of such a mistake.

Real-world driver photos were used to evaluate the proposed technology. At 75 separate locations throughout the world, a 480 x 640 pixel video of each of the 75 test subjects was captured.

Preprocessing and recognizing the eye from video pictures are the two fundamental steps of the proposed system, which are discussed in Chapters 5 and 6.

To improve the contrast of dark areas, a novel upgraded approach is employed in preprocessing and compared against an existing algorithm. According to the findings of section 5.5, all video picture noises have been effectively eliminated. The preprocessed picture is re-extracted in the second step using new approaches for extracting the eye. A standard existing approach is also examined, and the comparative findings are provided in Tables 6.1 and 6.2, respectively. In most circumstances, as demonstrated in Fig 6.1, 6.2, and 6.3, the eye pair may be correctly chosen. BTMED, KDKBM, and Color cue and projection function had drowsiness false discovery rates of 21.7%, 4.7%, and 0.3%, respectively, according to Chapter 6. The suggested methodology is more successful than previous techniques since the false finding rate is just 0.3 percent.

We were able to do this:

• DDDS is able to detect sleepiness with great accuracy and reliability.

It is possible to detect1 sleepiness in a non-intrusive way without the inconvenience and distraction of DDDS.

The driver's degree of attentiveness is determined based on the number of times the driver's eyes close.

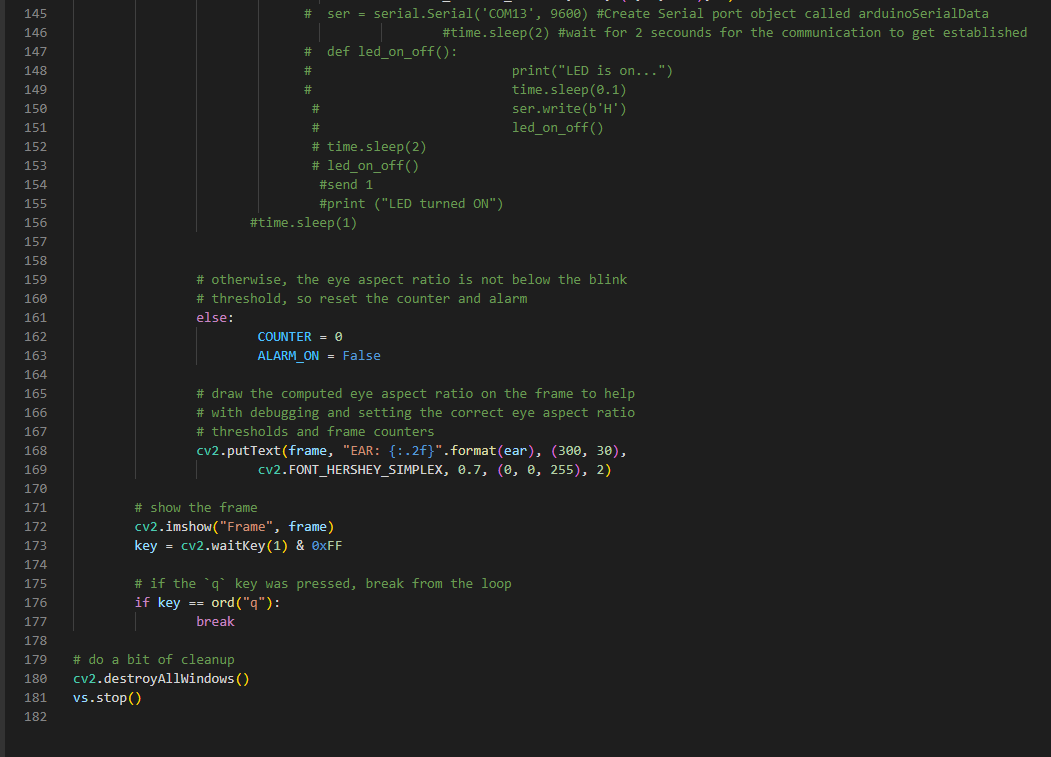
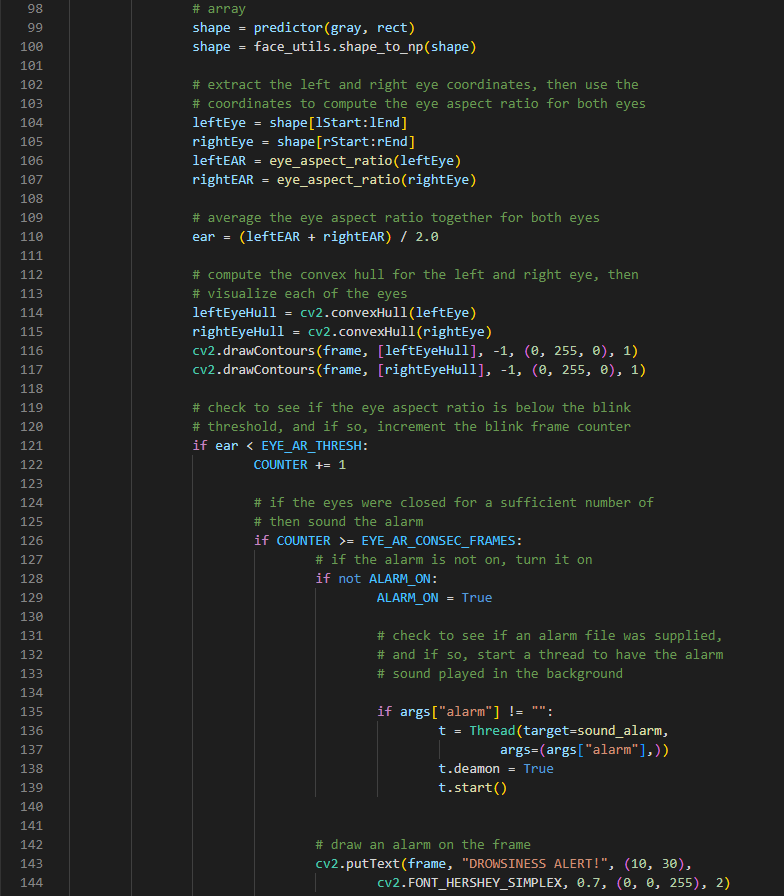
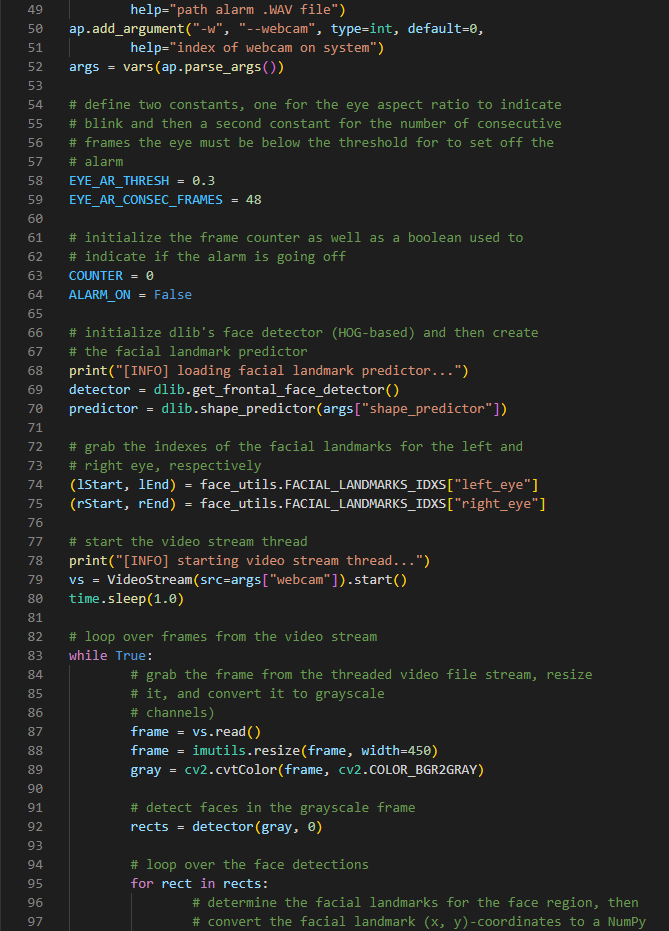
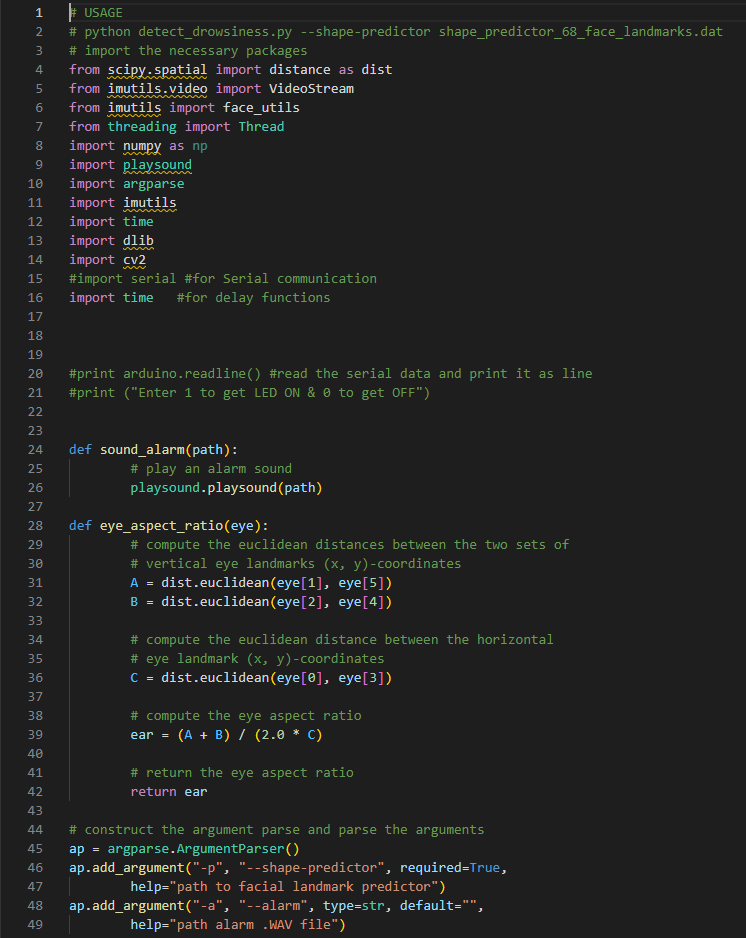
Both day and night are supported by the proposed system.

Section 2.5's downsides have been completely removed. When this prototype is further developed, it will be possible to use modified ECG techniques to issue an alert before going to sleep so that the heartbeat may be measured without any physical disruption. Key sites on the body (such as the chest, the head, the wrist, and so on) are often attached to wires during an ECG. Sticking wire may be prevented using the extended procedure. As a result, we will be able to determine the ideal amount of sleepiness.

A nano-camera system will be added to this prototype to monitor the eye's reflection. As long as there is no reflected beam, the eye is closed. Drowsiness will be easier to identify as a result, in our opinion.

The future is like we should install the whole system in the autonomous vehicle system so that it would be in the braking system if the driver in the system of the somniferous then it would apply brakes automatically and also lower the vehicle speed. And also park the vehicle alongside the road.

**SOURCE CODE**



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