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Research Article

A Novel Approach for Driving Fatigue Statue Recognition Using Side Face Contour Extraction Algorithm

Rishika Yadav
Department of Computer Science & Information Technology, Graphic Era Hill University, Dehradun Uttarakhand India 248002

Abstract
In this procedure, a novel colour space modelling is introduced that improves face skin extraction performance by using multiple thresholds as decision criteria. A three-step technique is also used to reduce noise and other negative impacts. The first critical stage in automated facial image analysis is frequently face identification, which tries to identify the existence along with subsequent location of human faces in an image. For the purpose of enhancing the effectiveness of extracting the colour of the face's skin, this procedure adopts a novel colour space modelling that employs several thresholds as decision criteria. Additionally, a three-step approach is employed to reduce noise and other negative impacts. The results of the experiments demonstrate that the suggested method could efficiently extract the side face contour line and should offer a theoretical foundation for the real-time tracking of fatigue applications.

1. Introduction

Less sleep, lengthy periods of nonstop driving, or any other physical problem, such as brain abnormalities, can all affect a driver's ability to pay attention. According to several studies on traffic accidents, driver weariness is a factor in about 30% of collisions. When a driver drives for a longer amount of time than is typical for a person, this causes excessive exhaustion and also leads in tiredness, which causes the driver to get sleepy or lose consciousness. Drowsiness is a complicated phenomenon that indicates a drop in the driver's alertness and consciousness levels. Detecting sleepiness cannot be done directly, however there are a number of indirect ways that may be employed. A variety of techniques for gauging a driver's sleepiness are described in the first few chapters, including vehicle-based assessments, physiological measures, and behavioural measures. These techniques can be used to create an intelligence system that warns the driver when they are sleepy and helps to avoid accidents. A description of the benefits and drawbacks of each system is provided. The best approach is selected and suggested in accordance with benefits and drawbacks.

The method for developing the full system is then described using a flow chart, which involves continually recording the image in real-time before framing it. The next step is to evaluate each frame to determine face first. The next step is to find the eyes if a face is found. Following a positive eye detection result, the degree of eye closure is assessed and compared to the standards for eyes in a sleepy condition. If drowsiness is discovered, the driver is alerted; otherwise, the cycle of looking for faces and recognising drowsiness is repeated. Later parts provide a full explanation of object detection, face detection, eye detection, and eye detection. A few experiments on object detection are conducted since faces are a sort of object. Different methods are suggested and discussed for both face detection and eye detection. The theoretical foundation for system design, which includes Eigen face method and Principal Component Analysis (PCA), is discussed. We are aware that the face has a complex, multifaceted structure. To recognise a face, one requires excellent calculation methods and methodologies. A face will be treated as a two-dimensional structure in this technique, and as such, it should be identified. Face recognition in this instance uses Principal Component Analysis (PCA). The projection of facial pictures into that specific face area is the aim here.

The variation or disparity between the required known faces is then encoded. The face space is decided and defined by the Eigen face. These faces are represented by eigen vectors. Each set of faces is included in these vectors. There are instances where the nose, eyes, lips, and other facial characteristics resemble one another. The Raspberry Pi serves as the system's primary piece of hardware. In order to better understand the theoretical method, which covers the Haar Cascade, Forming Integral Image, Adaboost, and Cascading, a quick introduction to the Raspberry Pi is provided. The algorithm for determining the condition of the eyes was created using all four of the aforementioned approaches. The recommended approach was then implemented using the correct code. the appropriate preparation for implementation In order to document how the system responded and operated, many individuals were taken. The form of a circle denoted the opening of the eyes. If a motorist is found to be sleepy, the circle that would normally indicate an eye closure will not display. Results were displayed using a number of images that showed both closed and opened eyes. In chapter 6, flaws in the system were described, and it was underlined that more work would need to be done in the future to fix them and create a reliable intelligent driver aid system. The performance of the suggested and realised system overall is included in the concluding section.

Drowsiness is described as a lower degree of consciousness It shows up as fatigue and difficulties staying awake but that is quickly roused by uncomplicated stimuli. Lack of sleep, medicine, drug usage, or a mental illness might be the cause. Fatigue, which can be physical and/or mental, is mostly to blame. Muscle fatigue, sometimes referred to as physical tiredness, is the temporary breakdown in a muscle's capacity to perform at its optimum. Mental fatigue is the temporary incapacity to maintain peak psychological functioning. Mental tiredness develops gradually throughout any intellectual activity and is influenced by a person's psychological ability as well as additional elements like poor sleep and general wellness. Mental fatigue has been linked to decreased physical performance. It may show itself as sluggishness, lethargy, or a lack of mental coherence. Based on the data currently available, driver drowsiness has progressively risen to the top of the list of factors contributing to traffic accidents that result in fatalities, serious physical injuries, and monetary losses. Drivers who fall asleep behind the wheel face the danger of losing control and hitting another car or immovable objects. In order to prevent or significantly reduce the incidence of accidents, it is important to frequently check the driver's level of fatigue.

Drowsy driving refers to a scenario in which the driver is experiencing physical and mental exhaustion, including a loss of mental alertness, a feeling of weariness, and a drop in eye-scanning activities (K lauer et al., 2006). A driver who is severely tired will demonstrate a sustained inability to properly conduct a driving manoeuvre, be unaware of the car's turning radius, perform driving manoeuvres under the mistaken belief that they are safe, suffer eye lid closures, struggle to keep an elevated head position, and have little body and eye movement, and frequent yawning (Lee, 2008). The fact that drivers may be too sleepy to recognise their own degree of alertness is a significant irony of driver tiredness. The motorist frequently ignores this severe issue. Driving when fatigued not only has an impact on the driver but also puts all other road users in danger. It is crucial to leverage modern technology to create systems that can track a driver's degree of alertness throughout the whole driving procedure. Computer vision is an effective and practical solution to this issue that takes advantage of these visual properties. This study introduces a technique for detecting driver weariness by assessing the condition of the eyes and yawning. This project's goal is to create a simulation and algorithm for tiredness detection. The emphasis will be on creating an algorithm and simulation that will properly track the driver's yawning and eye movement patterns and notify (in the case of the simulation, write a warning) the driver if weariness is detected.

2. Literature Survey

The use of smartphone-based fatigue monitoring technologies might significantly reduce crashes caused by drowsy drivers and increase driving security. Technology takes pictures of drivers with a smartphone's front-facing camera, and then utilises sophisticated computer vision algorithms to find and follow the drivers' faces and eyes in the photos. Then, signs of driver weariness are identified, including head nods, head rotations, and eye blinks. According to the National Sleep Foundation, 17% of adult drivers and 51% of sleepy drivers have both passed out at the wheel. The driver's face movement, eye blink frequency, head nod, and mouth yawn, among other things, are all signs of weariness. Driver weariness may be detected in one way: by using electrophysiological signals, such as EEG data. Up to 45% of American adults in 2012 have a smartphone in their possession. A cheaper and more portable alternative to many other tiredness monitoring systems would be a smartphone-based device [1].

With the use of "THE SMART CAP" technology, accidents caused by drunk drivers can be avoided. It is based on the observation that drinking causes a person's alpha activity to drop and their theta activity to rise. The forehead band-shaped smart cap has five integrated electrodes that are used to collect the EEG signal. A microprocessor-based intelligence unit receives the preprocessed, collected EEG signal and sends it via Bluetooth to another device. The recording of electrical brain signals is known as electroencephalography (EEG). This electrical activity is discovered by tiny electrodes applied to the scalp, amplified, and recorded as brain waves (neural oscillations). According to a study of auto accidents, 20% of crashes are caused by drivers who are not prepared, such as via distraction, exhaustion, or lack of sleep. It is quite beneficial to quickly identify tired drivers.

Driver's condition and driving behaviour are the two primary sorts of indications used to identify fatigued drivers. The condition of the driver is a clear sign of driving weariness. However, because it incorporates human elements, which may be unexpected, it can be challenging to quantify successfully. On the other side, a vehicle's sensors, which are hard to tamper with, may be used to measure driving behaviour [2].

One of the most frequent reasons of fatal traffic collisions worldwide is driver fatigue. Road accidents are caused by distracted driving, which increases the probability of collision by 4 to 6 times compared to vigilant driving. This study offers a technique for detecting driver sleepiness that employs both mouth and eye and eye and mouth and eye detection to be effective. One of the main factors contributing to the rising accident rate is driver weariness and sleepiness. According to the World Health Organization (WHO), India's roads are the worst in the world, and as a result, there were almost 2.5 lakh fatalities in 2010 and 2011. Daydreaming while driving, crossing the centre line, yawning, feeling irritated, stiff, heavy eyes, and delayed reaction times are some warning signals that can be quantified as indicators of driver tiredness [3].

Driver weariness impacts driving abilities in three ways: (1) coordination is hampered, (2) longer response times result, and (3) judgement is compromised. According to a poll, more than 50% of annual traffic accidents are the consequence of driver weariness. The problem of using technology to identify driver weariness or sleepiness is intriguing. Tracking driving habits and road variables to identify signs of driver fatigue. A few of the criteria employed include the driver's adherence to lane regulations, proper use of the indicators, etc. The technology determines that the driver is sleepy if there are anomalies beyond the tolerance limit. This strategy is intrinsically problematic because it relies too heavily on indirect and inaccurate road surveillance. The frame grabber's delivered frames are taken one at a time by the face detection programme. Utilizing a collection of pre-defined Haarcascade samples, this is accomplished. The drowsiness detection feature determines if a motorist is drowsy or not by analysing the condition of the eyes, namely whether they are open or closed and the blink rate [4].

Alcoholism damages the white and grey matter of the brain, impairing both emotional and cognitive processes. A common technique for examining neuropathology through noninvasive physiological patient monitoring is electroencephalography (EEG). It is suggested to evaluate the complexity of long-range temporal correlation time series EEG of Alcoholic and Control participants using the recently established signal analysis technique known as Multiscale Permutation Entropy (MPE). MPE provides mean rank differences and more significant values overall compared to MSE. A nonlinear method called complexity analysis is used to determine if acupuncture has an impact on the complexity of nonlinear signals in the brain and other nonlinear systems. The most well-known complexity metric, Lempel and Ziv's (LZ) complexity, was created as an alternate tool for EEG analysis. In high-dimensionality non-linear systems like the heart and brain, it is appropriate to define spatiotemporal activity patterns. For each cerebral action, the human brain's millions of neurons generate an electric voltage. When recorded and quantified using electrodes positioned on the scalp of a healthy adult, the EEG signal falls within the range of 1 to 100 microvolts. Many scientists study EEG signals obtained from subjects who were suffering from various mental illnesses, including dementia, Alzheimer's disease, epilepsy, alcoholism, and drowsiness [5].

3. Proposed Approach

Driver sleepiness detection systems may be a significant application of machine vision and image processing given its high relevance. Numerous research initiatives have recently been described in this field's literature. Frontal face recognition systems have some drawbacks, including poor real-time performance, large algorithm complexity, and low recognition accuracy. In order to increase the extraction of the colour of the face's skin and, therefore, the image quality, a new colour space modelling is included in this procedure. Here, the process's output should properly extract the side face contour line and serve as the scientific foundation for an application that tracks fatigue condition in real time. A number of colour spaces have been proposed, offering a simple way to divide skin-color domains. As was already indicated, the majority of these solutions use heuristic techniques to tailor the domain borders for skin colour.

On the basis of a flexible model developed via the training process, we propose a unified approach. Our adaptive model makes use of a single layer perceptron (SLP) with hidden layer neurons that have sigmoid activation functions and an output neuron that has a linear activation function. The number of inputs is equal to the number of red, green, and blue colour components in RGB space. The training set's complexity can be taken into account when determining the optimal number of neurons for the hidden layer. Each image is divided into layers to speed

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up the segmentation method. Every layer above the base layer—the original image—has a resolution that is halved from that of the one below it. Contrary to the Gaussian pyramid, we do not employ low pass filtering, to blur the pictures in order to shorten the calculation time. Image resolution is simply decimated after every second sample to minimise computation. Consequently, rather than analysing every pixel in an input picture, segmentation is initiated from the top of the pyramid.

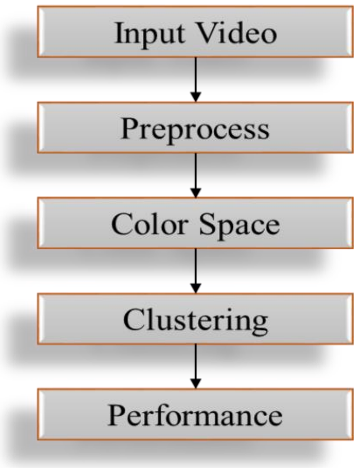

Fig 1: Block Diagram

The top layer of a four-layer pyramid has a side that is eight times smaller than the input image's side. As a result, the computation time is decreased by a factor of 64 on average along with the amount of pixels. A binary map is made for each tier of the pyramid. The binary map is first made up entirely of zeros. The values associated with the coordinates of pixels that are designated as skin tones are all one. The resultant binary map is double-sided interpolated to the lower layer below. Benefits of the suggested strategy include the following:

- Because the method is done for each frame in the video, it is appropriate for detecting tiredness in a matter of seconds.
- Even after being done several times, the technique is quite reliable.
- With little temporal complexity, there is a high rate of recognition.

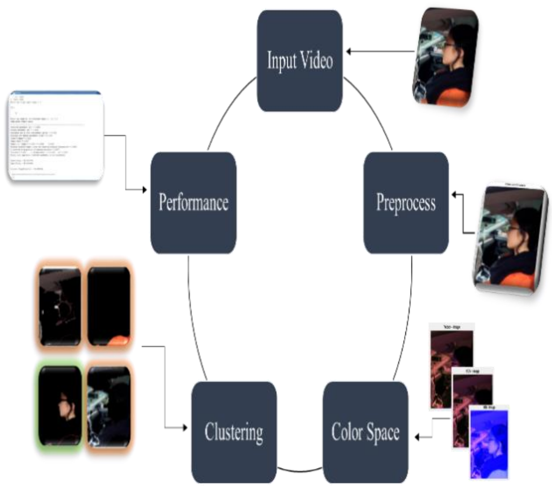

Fig 2: System Architecture

4. Results

A three-step technique is used in this procedure to reduce noise and other negative impacts, while a novel colour space modelling that employs multiple thresholds as Decision-making criteria are employed to improve face skin extraction performance. Automated facial image analysis often begins with face detection, which tries to identify

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the presence and subsequent location of human faces in an image. The major goal of this procedure is to increase the driver fatigue system's precision. By notifying the driver and increasing the accuracy of the facial colour alteration, the main goal of the suggested strategy is to decrease accidents on public roads.

To evaluate the effectiveness of the suggested technique, a number of tests are conducted. To test the effectiveness of the suggested multi-threshold combined decision paradigm, three typical images—a close distance picture with good lighting, a remote image with poor facial area brightness, and a near distance image with poor lighting—are chosen. As contrast object techniques, the YCrCb threshold segmentation algorithm, Gaussian model, along with elliptical model are being utilized. The experiment's findings offer strong empirical support for the effectiveness of the suggested approach.

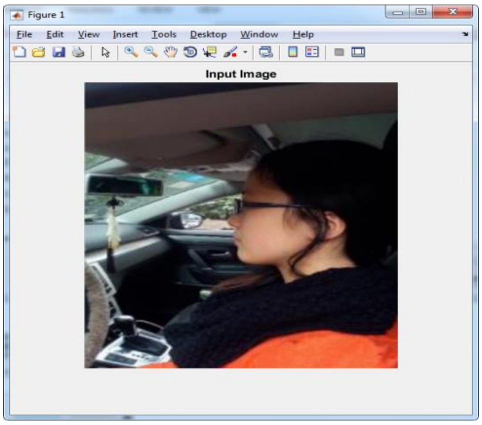

Fig 3: Input Image

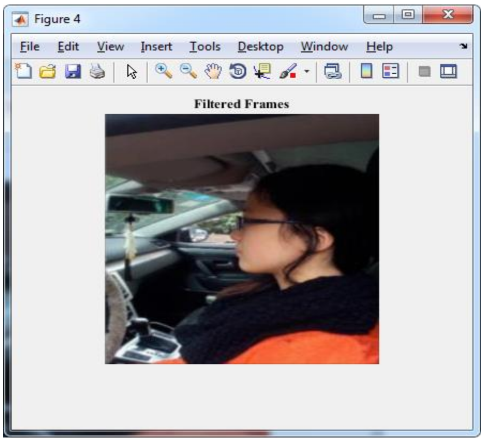

Fig 4: Filtered Frames

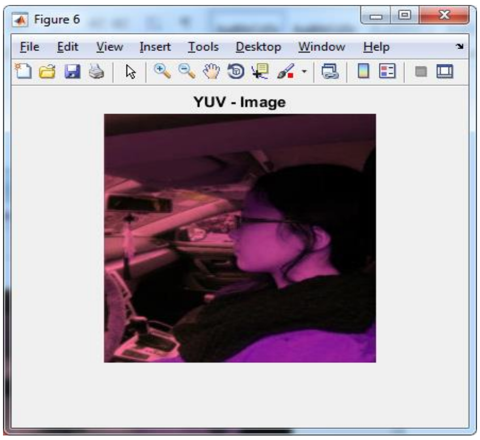

Fig 5: YUV Image

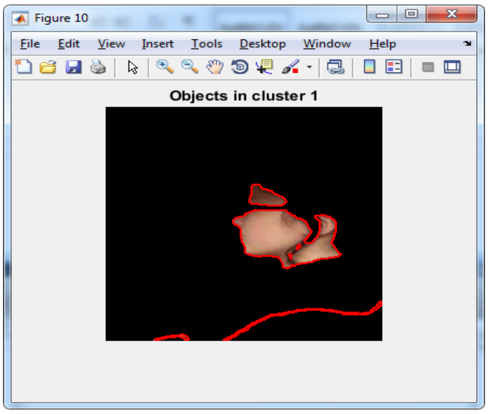

Fig 6: Object in Cluster

5. Conclusion

To evaluate the effectiveness of the suggested technique, a number of tests are conducted. To test the effectiveness of the suggested multi-threshold combined decision model, three typical images—a close distance picture with good lighting, a remote image with poor facial area brightness, also a near distance image with poor lighting—are chosen. As contrast object techniques, the YCrCb threshold segmentation algorithm, Gaussian model, along with elliptical model are utilized. The experiment's findings offer strong empirical support for the effectiveness of the suggested approach.

6. Future Enhancement

What signs does the driver give out that can be identified if automobile technology prevent or at least forewarn about driver fatigue? There are several types of technology that can recognise driver weariness, according to studies. The first is the employment of cameras to observe someone's behaviour. This involves keeping an eye on their eyes, lips to see whether they're yawning, head position, and other other things. Voice recognition is the following in this series of technologies. The tone of a person's voice frequently indicates their level of weariness.

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