DROWSINESS DETECTION AND AUTO ALERTING SYSTEM USING IMAGE PROCESSING

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ABSTRACT

Developing intelligent systems to prevent car accidents can be very effective in minimizing accident death toll. One of the factors which play an important role in accidents is the human errors including driving fatigue relying on new smart techniques; this application detects the signs of fatigue and sleepiness in the face of the person at the time of driving. The proposed system is based on three separate algorithms. In this model, the person's face is filmed by a camera in the first step by receiving 14-16 fps video sequence. Then, the images are transformed from RGB space into YCbCr and HSV spaces. The face area is separated from other parts and highly accurate HDP is achieved. That the eyes are open or closed in a specific time interval is determined by focusing on threshold and equations concerning the symmetry of human faces.

The proposed system has been implemented on more than thirty different video sequences with average accuracy of 93.18% and detection rate (DR) of 92.71 % out of approximately 2500 image frames. High accuracy in segmentation, low error rate and quick processing of input data distinguishes this system from similar ones. This system can minimize the number of accidents caused by drivers' fatigue.

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CHAPTER 1

INTRODUCTION TO IMAGE PROCESSING

1.1. IMAGE :

An image is a two-dimensional picture, which has a similar appearance to the object or the person, such as a photograph, screen display, and three dimensional objects, such as a statue. They may be captured by optical devices—such as cameras, mirrors, lenses, telescopes, microscopes, etc. Our eyes also captures natural objects and phenomena.

The word image is also used in the broader sense of any two-dimensional figure such as a map,a graph, a pie chart, or an abstract painting. In this wider sense, images can also be rendered manually, such as by drawing, painting, carving, rendered automatically by printing or computer graphics technology, or developed by a combination of methods, especially in a pseudo- photograph.

Figure.1.1 General Image

An image is a rectangular grid of pixels. It has a definite height and a definite width counted in pixels. Each pixel is square and has a fixed size on a given display. However different computer monitors may use different sized pixels. The pixels that constitute an image are ordered as a grid (columns and rows); each pixel consists of numbers representing magnitudes of brightness and colour.

Each pixel has a color. The color is a 32-bit integer. The first eight bits determine the redness of the pixel, the next eight bits the greenness, the next eight bits the blueness and the remaining eight bits the transparency of the pixel.

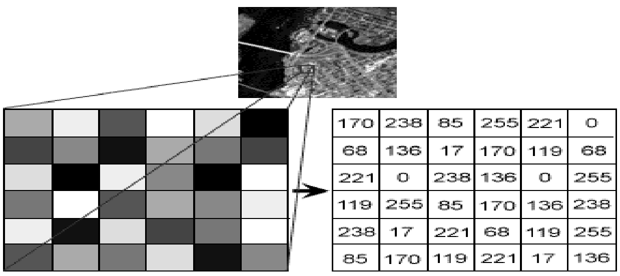


Figure.1.2. Image Pixel

1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1
Transparency	Red	Green	Blue

Figure.1.3. Transparency Image

1.2. IMAGE FILE SIZES:

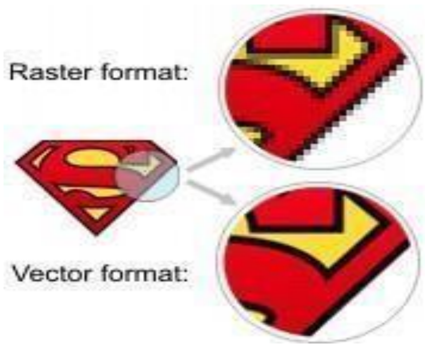
Image file size is expressed as the number of bytes that increases with the number of pixels composing an image, and the colour depth of the pixels. The greater the number of rows and columns, the greater the image resolution, and the larger the file. Also, each pixel of an image increases in size when its colour depth increases, an 8-bit pixel (1 byte) stores 256 colours, a 24-bit pixel (3 bytes) stores 16 million colour, the latter known as true colour.

Image compression uses algorithms to decrease the size of a file. High resolution digital cameras record 12 megapixel (1MP = 1,000,000 pixels / 1 million) images, or more, in true color.

1.3. IMAGE FILE FORMATS:

Image file formats are standardized means of organizing and storing images. This entry is about digital image formats used to store photographic and other images. Image files are composed of either pixel or vector (geometric) data that are rasterized to pixels when displayed (with few exceptions) in a vector graphic display. Including proprietary types, there are hundreds of image file types. The PNG, JPEG, and GIF formats are most often used to display images on the Internet.

Figure.1.4 Resolution Image



In addition to straight image formats, Metafile formats are portable formats which can include both raster and vector information.

1.3.1. RASTER FORMATS:

These formats store images as bitmaps

- **JPEG/JFIF**:

JPEG (Joint Photographic Experts Group) is a compression method. JPEG compressed images are usually stored in the JFIF (JPEG File Interchange Format) file format. JPEG compression is lossy. Nearly every digital camera can save images in the JPEG/JFIF format, which supports 8 bits per color (red, green, blue) for a 24-bit total, producing relatively small files. Photographic images may be better stored in a lossless non-JPEG format if they will be re-edited, or if small "artifacts" are unacceptable. The JPEG/JFIF format also is used as the image compression algorithm in many Adobe PDF files.

- **EXIF:**

The EXIF (Exchangeable image file format) format is a file standard similar to the JFIF format with TIFF extensions. It is incorporated in the JPEG writing software used in most cameras. Its purpose is to record and to standardize the exchange of images with image metadata between digital cameras and editing and viewing software. The metadata are recorded for individual images and include such things as camera settings, time and date, shutter speed, exposure, image size, compression, name of camera, color information, etc. When images are viewed or edited by image editing software, all of this image information can be displayed.

- **TIFF :**

The TIFF (Tagged Image File Format) format is a flexible format that normally saves 8 bits or16 bits per colour (red, green, blue) for 24-bit and 48-bit totals, respectively, usually using either the TIFF or TIF filename extension. TIFFs are lossy and lossless. Some offer relatively good lossless compression for bi-level (black & white) images. Some digital cameras can save in TIFF format, using the LZW compression algorithm for lossless storage. TIFF image format is not widely supported by web browsers. TIFF remains widely accepted as a photograph file standard in the printing business. TIFF can handle device-specific color spaces, such as the CMYK defined by a particular set of printing press inks.

- **PNG :**

The PNG (Portable Network Graphics) file format was created as the free, open- source successor to the GIF. The PNG file format supports true color (16 million colors) while the GIF supports only 256 colors. The PNG file excels when the image has large, uniformly colored areas. The lossless PNG format is best suited for editing pictures, and the lossy formats, like JPG, are best for the final distribution of photographic images, because JPG files are smaller than PNG files. PNG, an extensible file format for the lossless, portable, well- compressed storage of raster images. PNG provides a patent-free replacement for GIF and can also replace many common uses of TIFF. Indexed-color, grayscale, and true color images are supported, plus an optional alpha channel. PNG is designed to work well in online viewing applications, such as the World Wide Web. PNG is robust, providing both full file integrity checking and simple detection of common transmission errors.

- **GIF :**

GIF (Graphics Interchange Format) is limited to an 8-bit palette, or 256 colors. This makes the GIF format suitable for storing graphics with relatively few colors such as simple diagrams, shapes, logos and cartoon style images. It is still widely used to provide image animation effects.

- **BMP :**

The BMP file format (Windows bitmap) handles graphics files within Microsoft Windows OS. Typically, BMP files are uncompressed, hence they are large. The advantage is their simplicity and wide acceptance in Windows programs.

1.3.2. VECTOR FORMATS:

As opposed to the raster image formats above, vector image formats contain a geometric description which can be rendered smoothly at any desired display size. At some point, all vector graphics must be rasterized in order to be displayed on digital monitors.

- **CGM :**

CGM (Computer Graphics Metafile) is a file format for 2D vector graphics, raster graphics, and text. All graphical elements can be specified in a textual source file that can be compiled into a binary file or one of two text representations. CGM provides a means of graphics data interchange for computer representation of 2D graphical information independent from any particular application, system, platform, or device.

- **SVG :**

SVG (Scalable Vector Graphics) is an open standard created and developed by the World WideWeb Consortium to address the need for a versatile, scriptable and all purpose vector format for the web . The SVG format does not have a compression scheme of its own, but due to the textual nature of XML.An SVG graphic can be compressed using a program such as gzip.

1.4. IMAGE PROCESSING:

Digital image processing is the manipulation of images by computer .There is relatively recent development in terms of man's ancient fascination with visual stimuli. In its short history, it has been applied to practically every type of images with varying degree of success. The inherent subjective appeal of pictorial displays attracts perhaps a disproportionate amount of attention from the scientists and also from the layman.

1.5. FUNDAMENTAL STEPS IN IMAGE PROCESSING:

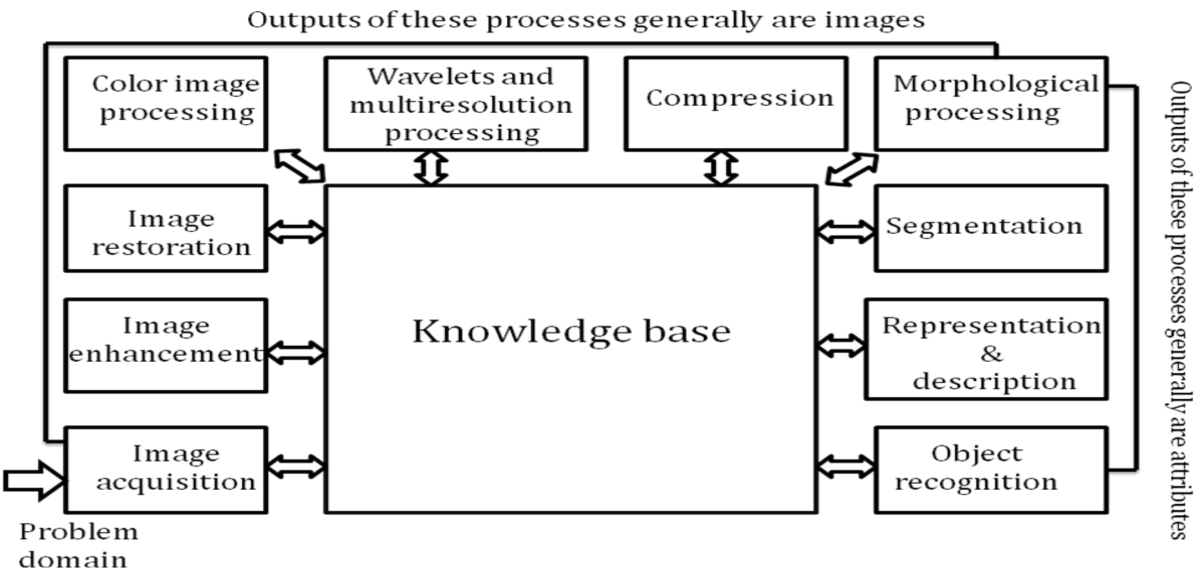


Figure.1.5.Image Fundamentals

1.5.1. Image Acquisition:

Image Acquisition is to acquire a digital image. To do so requires an image sensor and the capability to digitize the signal produced by the sensor. The sensor could be a monochrome or colour TV camera that produces an entire image of the problem domain every 1/30 sec. The image sensor could also be a line scan camera that produces a single image line at a time. Scanner produces a two-dimensional image. If the output of the camera or other imaging sensor is not in digital form, an analogue to digital converter digitizes it.

1.5.2 Image Enhancement:

Image enhancement is among the simplest and most appealing areas of digital image processing. Basically, the idea behind enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interesting an image. It is important to keep in mind that enhancement is a very subjective area of image processing.

Fig.1.6.Enhancement

1.5.3. Image Restoration:

Image restoration is an area that also deals with improving the appearance of an image. However, unlike enhancement, which is subjective, image restoration is objective, in the sense that restoration techniques tend to

Fig.1.7.Restoration

be based on mathematical or probabilistic models of image degradation. Enhancement, on the other hand, is based on human subjective preferences regarding what constitutes a “good” enhancement result. For example, contrast stretching is considered an enhancement technique because it is based primarily on the pleasing aspects it might present to the viewer, where as removal of image blur by applying a deblurring function is considered restoration technique.

1.5.4. Colour Image Processing:

The use of colour in image processing is motivated by two principal factors. First, colour is a powerful descriptor that often simplifies object identification and extraction from a scene. Second, humans can discern thousands of colour shades and intensities, compared to about only two dozen shades of gray. This second factor is particularly important in manual image analysis**.**

Fig.1.8.Colour & gray scale image

1.5.5. Wavelets and Multiresolution Processing:

Wavelets are the formation for representing images in various degrees of resolution. Although the Fourier transform has been the mainstay of transform based image processing since the late1950’s, a more recent transformation called the wavelet transform is now making it even easier to compress, transmit, and analyze many images.

Fig.1.9.RGB Histogram Image

1.5.3. Compression:

Compression, as the name implies, deals with techniques for reducing the storage required saving an image, or the bandwidth required for transmitting it. Although storage technology has improved significantly over the past decade, the same cannot be said for transmission capacity.

1.5.7 Morphological processing:

Morphological processing deals with tools for extracting image components that are useful in the

representation and description of shape. The language of mathematical morphology is set theory. The morphology offers a unified and powerful approach to numerous image processing problems. Sets in mathematical morphology represent objects in an image. For example, the set of all black pixels in a binary image is a complete morphological description of the image.

1.5.8. Segmentation:

Segmentation procedures partition an image into its constituent parts or the objects. In general,

autonomous segmentation is one of the most difficult tasks in digital image processing. A rugged segmentation procedure brings the process a long way toward successful solution of imaging problems that require objects to be identified individually.

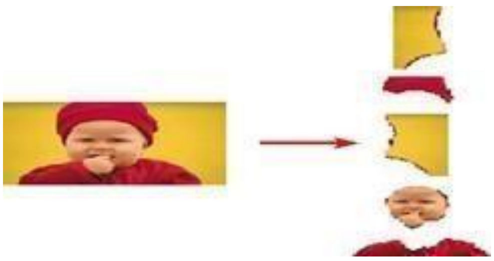


Fig.1.11.Segmentation

1.5.9. Representation and description:

Representation and description almost always follow the output of a segmentation stage, which usually is raw pixel data, constituting either the boundary of a region (i.e., the set of pixels separating one image region from another) or all the points in the region itself. In either case, converting the data to a form suitable for computer processing is necessary. The first decision that must be made is whether the data should be represented as a boundary or as a complete region. Boundary representation is appropriate when the focus is on external shape characteristics.

1.5.10. Object Recognition:

The last stage involves recognition and interpretation. Recognition is the process that assigns a label to an object based on the information provided by its descriptors. Interpretation involves assigning meaning to an ensemble of recognized objects.

1.5.11 Knowledge base:

Knowledge about a problem domain is coded into image processing system in the form of a knowledge database. This knowledge may be as simple as detailing regions of an image when the information of interests is known to be located, thus limiting the search that has to be conducted in seeking that information. The knowledge base also can be quite complex, such as an inter related to list of all major possible defects in a materials inspection problem or an image data base containing high resolution satellite images of a region in connection with change deletion application.

1.6 COMPONENTS OF AN IMAGE PROCESSING SYSTEM:

The lowering costs, this market shift also served as a catalyst for a significant number of new companies whose specialty is the development of software written specifically for image processing. Although large-scale image processing systems still are being sold for massive imaging applications, such as processing of satellite images, the trend continues toward miniaturizing and blending of general-purpose small computers with specialized image processing hardware.

- **Image Sensors:**

With reference to sensing, two elements are required to acquire digital images. The first is a physical device that is sensitive to the energy radiated by the object we wish to image. The second, called a digitizer, is a device for converting the output of the physical sensing device into digital form. For instance, in a digital video camera, the sensors produce an electrical output proportional to light intensity. The digitizer converts these outputs to digital data.

- **Specialized Image Processing Hardware:**

Specialized image processing hardware usually consists of the digitizer just mentioned, plus hardware that performs other primitive operations, such as an arithmetic logic unit (ALU), which performs arithmetic and logical operations in parallel on entire images. One example of how an ALU is used is in averaging images as quickly as they are digitized, for the purpose of noise reduction. This type of hardware sometimes is called a front-end subsystem, and its most distinguishing characteristic is speed.

- **Computer:**

The computer in an image processing system is a general-purpose computer and can range from a PC to a supercomputer. In dedicated applications, sometimes specially designed computers are used to achieve a required level of performance.

- **Image Processing Software:**

Software for image processing consists of specialized modules that perform specific tasks. A well-designed package also includes the capability for the user to write code that, as a minimum, utilizes the specialized modules. More sophisticated software packages allow the integration of those modules and general-purpose software commands from at least one computer language.

- **Mass storage:**

Mass storage capability is a must in image processing applications. An image of size 1024*1024 pixels, in which the intensity of each pixel is an 8-bit quantity, requires one megabyte of storage space if the image is not compressed. Digital storage for image processing applications fall into three principal categories:
(1) short-term storage for use during processing, (2) on-line storage for relatively fast recall, and (3) archival storage, characterized by infrequent access. Storage is measured in bytes (eight bits), Kbytes (one thousand bytes), Mbytes (one million bytes), Gbytes (meaning giga, or one billion, bytes), and Tbytes (meaning tera, or one trillion, bytes)

- **Image displays :**

Image displays in use today are mainly color (preferably flat screen) TV monitors. Monitors are driven by the outputs of image and graphics display cards that are an integral part of the computer system.

- **Network :**

Networking is almost a default function in any computer system in use today. Because of the large amount of data inherent in image processing applications, the key consideration in image transmission is bandwidth Colour and texture are two low-level features widely used for image classification, indexing and retrieval. Colour is usually represented as a histogram, which is a first order statistical measure that captures global distribution of colour in an image One of the main drawbacks of the histogram- based approaches is that the spatial distribution and local variations in colour are ignored. Local spatial variation of pixel intensity is commonly used to capture texture information in an image. Grayscale Co- occurrence Matrix (GCM) is a well-known method fortexture extraction in the spatial domain. A GCM (Grayscale Combination Matrix) records the count of pixel neighborhoods in an image that exhibit a specific grayscale combination. Consider an image denoted as I, with p representing any random pixel and Np being its neighboring pixel in a defined direction. If GL represents the total number of quantized gray levels and gl stands for individual gray levels, where gl belongs to the set {0, . . . , GL - 1}, each element of the GCM can be expressed as follows:

gcm(i, j) is the number of times the gray level of a pixel p denoted by glp equals i, and the gray level of its neighbour Np denoted by gl Np equals j, as a fraction of the total number of pixels in the image. Thus, it estimates the probability that the gray level of an arbitrary pixel in an image is i, and that of its neighbour is j. One GCM matrix is generated for each possible neighbourhood direction, namely, 0, 45, 90 and 135.Average and range of 14 features like Angular Second Moment, Contrast, Correlation, etc., are generated by combining all the four matrices to get a total of 28 features. In the GCM approach for texture extraction, color information is completely lost since only pixel gray levels are considered.

CHAPTER 2

INTRODUCTION ABOUT PROJECT

Drowsiness is a state of near sleep, where the person has a strong desire for sleep. It has two distinct meanings, referring both to the usual state preceding falling asleep and the chronic condition referring to being in that state independent of a daily rhythm. Sleepiness can be dangerous when performing tasks that require constant concentration, such as driving a vehicle. When a person is sufficiently fatigue while driving, they will experience drowsiness and this leads to increase the factor of road accident.

Figure.2.1: Illustrations of Fatigue and Drowsiness Instances

Creating technologies to detect and mitigate drowsiness during driving represents a significant challenge within the domain of accident avoidance systems. Given the perilous nature of drowsiness on the road, it is imperative to devise methods to effectively counter its detrimental effects.

This project's objective is to create a drowsiness detection system simulation, with a primary emphasis on crafting a system capable of precisely tracking the driver's eye and mouth states. By closely monitoring the driver's eyes, the goal is to identify early signs of drowsiness, potentially preventing automobile accidents. Yawning detection serves as a fatigue assessment method, while PERCLOS, which relies on measuring the duration of eye closure as a percentage of a specific time, is employed to detect eye closures.

The study of facial images is a widely explored research domain with diverse applications, including face recognition and human identification, as well as tracking for security systems. In this project, the specific objective is to concentrate on the precise localization of the eyes and mouth. This entails examining the entire facial image and utilizing established image-processing algorithms to ascertain the precise positions of the eyes and mouth. Once the eye positions are established, the system is engineered to assess whether the eyes and mouth are in an open or closed state, facilitating the detection of fatigue and drowsiness.

2.1. Background of Study

Annually, there is a rising number of road accidents involving both cars and larger vehicles like buses, lorries, and trucks. Drowsiness and fatigue stand out as significant factors contributing to these accidents. Operating a vehicle under such conditions can lead to catastrophic consequences, as it impairs a driver's judgment and concentration. Preventing instances of nodding off at the wheel is possible if drivers make a conscious effort to ensure they are well-rested before embarking on their journeys, consider consuming caffeine, or take regular breaks when signs of fatigue and drowsiness begin to manifest.

Nevertheless, there are instances where drivers opt not to follow these precautions, even when they are aware of their fatigue, persisting in their journey. Consequently, the identification of drowsiness becomes crucial as a preventive measure against road accidents. This project suggests that detecting yawning and monitoring eye behavior serves as prominent indicators of fatigue and drowsiness.

A drowsiness detection system employing a camera positioned in front of the driver is a preferred choice. However, before creating a reliable and accurate drowsiness detection algorithm, it's essential to identify the physical indicators of drowsiness. Challenges arise, such as variations in lighting intensity and driver head movements to the left or right, which affect the detection of the eyes and mouth regions. As a result, this project seeks to comprehensively review prior research and methodologies, ultimately proposing a novel approach for drowsiness detection utilizing video or webcam technology.

2.2. Objectives

The project centers its attention on the following objectives:

- To propose methods for identifying tiredness and drowsiness during the act of driving..
- To analyze the visual data of participants in the experiment, focusing on their eyes and mouths in video images.
  - To develop a system that use eyes closure and yawning as a way to detect fatigue and drowsiness.

2.3 Scope of Study

In this project, the we will focus on these following procedures:

- Basic concept of drowsiness detection system.
- Familiarize yourself with the signs of drowsiness.
- Determine the drowsiness from these parameters.
- Eye blink.
- Area of the pupils detected at eyes.
- Yawning.
- Data collection and measurement.
- Integration of the methods chosen.
- Coding development and testing.
- Complete testing and improvement.

2.4 IMPLEMENTATION OF THE PROJECT:

Once the face area is found, the eyes are found by computing the horizontal averages in the area. Taking into account the knowledge that eye regions in the face present great intensity changes, the eyes are located by finding the significant intensity changes in the face.

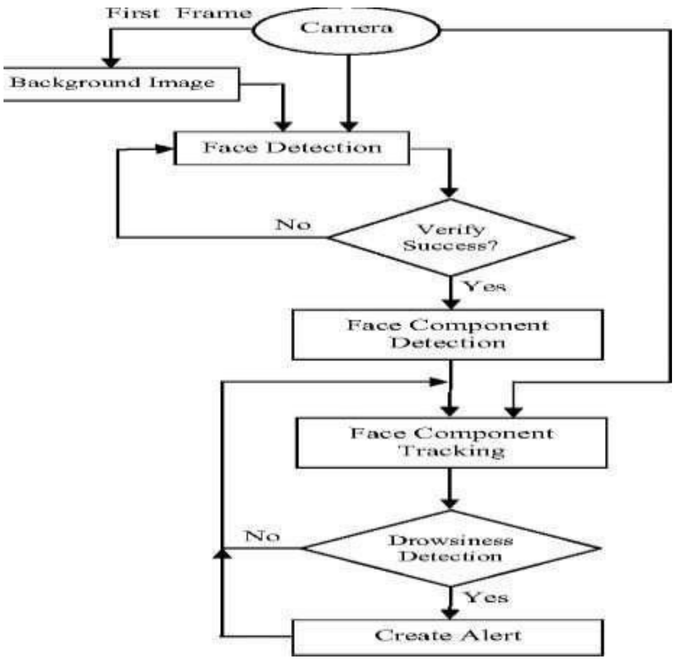


Figure.2.2 Flow Diagram

A large distance corresponds to eye closure. If the eyes are found closed for 5 consecutive frames, the system draws the conclusion that the driver is falling asleep and issues a warning signal. The system is also able to detect when the eyes cannot be found, and works under reasonable lighting conditions.

In this project we use Viola-Jones Algorithm.

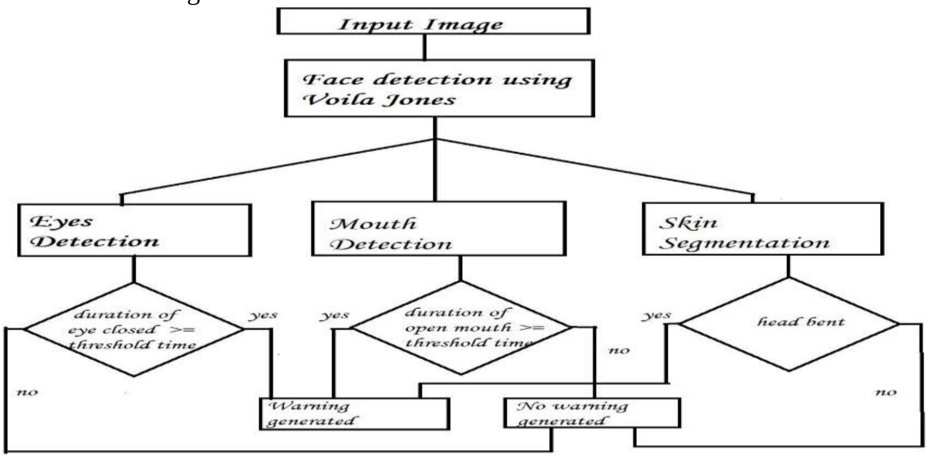


Figure2.3 Flowchart of the Algorithm

2.5 MODULES OF THE APPLICATION:

2.5.1 Data Acquisition:

The video is recorded using a webcam (Sony CMU-BR300) and the frames are extracted and processed in a laptop. After extracting the frames, image processing techniques are applied on these 2D images. Presently, synthetic driver data has been generated. The volunteers are asked to look at the webcam with intermittent eye blinking, eye closing, yawning and head bending. The video is captured for 30 minutes.

2.5.2 Face Detection:

After extracting the frames, first the human faces are detected. Numerous online face detection algorithms are there. In this study, histogram of oriented gradients (HOG).In this method, positive samples of descriptors are computed on them. Subsequently, negative samples (samples that do not contain the required object to be detected i.e., human face here) of same size are taken and HOG descriptors are calculated. Usually the number of negative samples is much greater than the number of positive samples. After obtaining the features for both the classes. To improve the accuracy of VJM, hard negative mining is used. In this method, after training. the classifier is tested on the labelled data and the false positive sample feature values are used again for training purpose.

For the test image, the fixed size window is translated over the image and the classifier computes the output for each window location. Finally, the maximum value output is considered as the detected face and a bounding box is drawn around the face. This non-maximum suppression step removes the redundant and overlapping bounding boxes.

2.5.3 Facial Landmark marking:

After detecting the face, the next task is to find the locations of different facial features like the corners of the eyes and mouth, the tip of the nose and so on. Prior to that, the face images should be normalized in order to reduce the effect of distance from the camera, non-uniform illumination and varying image resolution. Therefore, the face image is resized to a width of 500 pixels and converted to grayscale image. After image normalization, ensemble of regression trees is used to estimate the landmark positions on face from a sparse subset of pixel intensities. In this method, the sum of square error loss is optimized using gradient boosting learning. Different priors are used to find different structures.The red points are the detected landmarks for further processing.

2.5.4 Feature Extraction:

After detecting the facial landmarks, the features are computed. From the eye corner points the eye aspect ratio is calculated as the ratio of height and width of the eye.

2.6 CLASSIFICATION:

After computing all the three features, the next task is to detect drowsiness in the extracted frames. In the beginning, adaptive thresholding is considered for classification. Later using viola jones algorithm is utilized to classify the data. For computing the threshold values for each feature, it is assumed that initially the driver is in complete awake state. This is called setup phase. In the setup phase, the EAR values for first three hundred (for 10s at 30 fps) frames are recorded. Out of these three hundred initial frames containing face, average of 150 maximum values is considered as the hard threshold for EAR. The higher values are considered so that no eye closing instances will be present. If the test value is less than this threshold, then eye closing (i.e., drowsiness) is detected. As the size of eye can vary from person to person, this initial setup for each person will reduce this effect. Similarly, for calculating threshold of MOR, since the mouth may not be open to its maximum in initial frames (setup phase) so the threshold is taken experimentally from the observations. If the test value is greater than this threshold then yawn is detected. Head bending feature is used to find the angle made by head with respect to vertical axis in terms of ratio of projected nose lengths. Normally, NLR has values from 0.9 to 1.1 for normal upright position of head and it increases or decreases when head bends down or up in the state of drowsiness.

Decision Making:

The first frame is used for learning. All the results are calculated taking first frame as ideal frame.

Eyes Closed

When eyes are closed, the number of black pixels in binary image decreases considerably.

If eyes are found closed for atleast 2 consecutive seconds (i.e. 2 * 16 = 32 frames, considering 16 frames per second), then the warning will be generated.

Head Lowering

If the head is lowered, or turned around the number of skin pixels considerably decrease as compared to the ideal frame.

If head is found lowered or found turned in other directions for atleast 2 consecutive seconds (i.e. 2 * 16 = 32 frames, considering 16 frames per second), it means that the person is vulnerable for accident and in response the warning will be generated.

2.7. LITERATURE SURVEY:

Numerous prior studies have delved into driver drowsiness detection systems, serving as valuable references for the development of a real-time drowsiness detection system for drivers. These studies have adopted various approaches and methods to identify signs of drowsiness. For instance, the Malaysia Institute of Road Safety (MIROS) conducted an investigation from 2007 to 2010, revealing 439 road accidents scrutinized by their crash investigation team during that period Antoine Picotetal, Described as a state between wakefulness and drowsiness, drowsiness diminishes a person's ability to fully concentrate on their driving tasks. This condition can result in the driver entering a semi-conscious state, rendering them incapable of maintaining proper control over the vehicle. According to research by Gianluca Borghini and colleagues, mental fatigue contributes to drowsiness, impairing an individual's performance and reducing the brain's efficiency in responding to unexpected events.

Electroencephalography (EEG) is a method that measures the brain electrical activity. It can be used to measure the heartbeat, eye blink and even major physical movement such as head movement. It can be used on human or animal as subjects to get the brain activity. It uses a special hardware that place sensors around the top of the head area to sense any electrical brain activity.

In their study, B. T. Jap, S. Lal, P. Fischer, and E. Bekiaris highlighted the EEG method as the most effective approach among those previously employed to detect signs of drowsiness. This method involves the analysis of four distinct frequency components within the EEG: alpha (α), beta (β), theta (θ), and delta (δ). Elevated power levels in the alpha (α) and delta (δ) frequency bands indicate the presence of driver fatigue and drowsiness. Nonetheless, this method comes with certain drawbacks, particularly its susceptibility to interference from ambient noise in the vicinity of the sensors. For instance, during an EEG experiment, it's crucial for the surrounding environment to be completely silent to avoid disrupting the sensors that capture brain activity. Furthermore, while this method may yield accurate results, its practical application in real-time driving scenarios is impractical. The notion of a person driving with a headgear full of wires raises concerns about inconvenience and safety, as even minor head movements could displace the wires. Despite these limitations, the EEG method remains a valuable tool for experimentation and data collection purposes.D. Liu, P. Sun, Y. Xiao, and Y. Yin stated that the drowsiness can be detected by using face area detection.The methods to detect drowsiness within face area are vary due to drowsiness sign are more visible and clear to be detected at face area. From the face area, we can detect the eyes location. From eyes detection, authors stated that there are four types of eyelid movement that can be used for drowsiness detection. They are complete open, complete close, and in the middle where the eyes are from open to close and vice versa.

The algorithm operates on grayscale images, converting the image color to a binary black-and-white format. This simplifies the process, as it necessitates the measurement of only two parameters. Subsequently, the author conducts edge detection to identify the contours of the eyes, facilitating the calculation of the eyelid area. However, a challenge arises with this approach as the eye size can differ significantly from person to person; for instance, some individuals may have smaller eyes that can appear drowsy, while others may not exhibit this characteristic

Furthermore, the presence of eyeglasses poses a challenge in accurately detecting the eye region. Additionally, it's crucial to maintain a specific distance between the camera and the subject during image capture, as excessive distance can result in blurred images.

According to research by D. F. Dinges and R. Grace, drowsiness can be identified through the detection of eye blinks and the calculation of the percentage of eye closure (PERCLOS). To detect eye blinks effectively, a method is proposed that learns the patterns of eyelid closure duration, as suggested by T. Danisman, I. M. Bilasco, C. Djeraba, and N. Ihaddadene., 'this proposed method measures the time for a person closed their eyes and if they are closed longer than the normal eye blink time, it is possible that the person is falling asleep'. The author mentioned that 'nearly 310.3ms are the average of normal person eye blink'.

PERCLOS method proposes that drowsiness is measured by calculating the percentage of the eyelid 'droops'. Sets of eye open and eye closed have been stored in the software library to be used as a parameter to differentiate either the eyes is fully open or fully closed. For eyelid to droops, it happened in much slower time as the person is slowly falling asleep. Hence, the transition of the driver's drowsy can be recorded. Thus, PERCLOS method put a proportional value where when the eyes is 80% closed, which it is nearly to fully close, it assumed that the driver is drowsy.

This method is not convenient to be used in real-time driving as it needs fix threshold value of eye opening for the PERCLOS method to perform accurately. Both methods to detect drowsiness using eye blink pattern and PERCLOS have the same problem where the camera need to be placed at a specific angle in order to get a good image of video with no disturbance of eyebrow and shadow that covers the eyes.

CHAPTER-3

TECHNOLOGY

This chapter provides an in-depth exploration of the methodology employed to achieve the project's objectives and offers a detailed examination of the project's implementation process. It involves a comprehensive analysis of each stage essential for project completion, shedding light on the rationale behind method selection and their successful implementation throughout the project's progression. The core software utilized in this project is the MATLAB® Computer Vision System, and the methods employed leverage existing MATLAB® commands for the detection of facial features, including the face, eyes, and mouth areas.

Figure.3.1 Flowchart of project progress

3.1. ALGORITHM USED:

Viola-Jones Face Detection Algorithm:

The Viola–Jones object detection framework is to provide competitive object detection rates in real-time proposed in 2001 by Paul Viola and Michael Jones. Although it can be trained to detect a variety of object classes, it was motivated primarily by the problem of face detection. In the detection phase of the Viola–Jones object detection framework, a window of the target size is moved over the input image, and for each subsection of the image the Haar-like feature is calculated.

This difference is then compared to a learned threshold that separates non-objects from objects. Because such a Haar-like feature is only a weak learner or classifier (its detection quality is slightly better than random guessing) a large number of Haar-like features are necessary to describe an object with sufficient accuracy. In the Viola–Jones object detection framework, the Haar-like features are therefore organized in something called a classifier cascade to form a strong learner or classifier.

After the face is detected using Viola-Jones, the region containing the eyes and mouth has to be separated. To detect the coordinate from where the region of eye is starting certain calculations are done. After the rectangular window is extracted, we have considered that the eyes are located at a distance of (0.25 * height of window) from the top and (0.15 * width of window) from the left.The size of window is (0.25 * height of window) in height and (0.68 * width of window) in width.

After the eyes are cropped the image is converted to YCbCr. The reason for conversion and way to convert is mentioned in “Skin Segmentation " column. Then image is converted to grayscale and ultimately to binary image by setting a threshold of (minimum pixel value + 10). To detect the coordinate from where the region of mouth is starting certain calculations are done. After the rectangular window is extracted, we have considered that the mouth are located at a distance of (0.67 * height of window) from the top and (0.27 * width of window) from the left.The size of window is (0.20* height of window) in height and (0.45 * width of window) in width.

An image which taken inside a vehicle includes the driver’s face. Typically a camera takes images within the RGB model (Red, Green and Blue). However, the RGB model include brightness in addition to the colours.

When analyzing a human face, RGB model is very sensitive in image brightness. Therefore, to remove the brightness from the images is second step. We use the YCbCr space since it is widely used in video compression standards .Since the skin-tone color depends on luminance, we nonlinearly transform the YCbCr colour space to make the skin cluster luma-independent. This also enables robust detection of dark and light skin tone colours. The main advantage of converting the image to the YCbCr domain is that influence of luminosity can be removed during our image processing.

In the RGB domain, each component of the picture (red, green and blue) has a different brightness. However, in the YCbCr domain all information about the brightness is given by the Y component, since the Cb (blue) and Cr (red) components are independent from the luminosity. **Conversion from RGB to YCbCr:**

Cb = (0.148* Red) - (0.291* Green) + (0.439 * Blue) + 128; Cr = (0.439 * Red) - (0.368 * Green) – (0.071 * Blue) + 128;

Conversion from RGB to HSV:

MATLAB has predefined function for conversion of RGB color space to HSV color space. I’ = rgb2hsv (I);

3.2. Cascade of Classifiers:

Within a typical 24x24 pixel sub-window, a staggering 45,396 potential features can be detected, a quantity that proves excessively vast and cost-prohibitive for evaluation. To enhance detection accuracy, it becomes imperative to augment the classifiers with additional features..

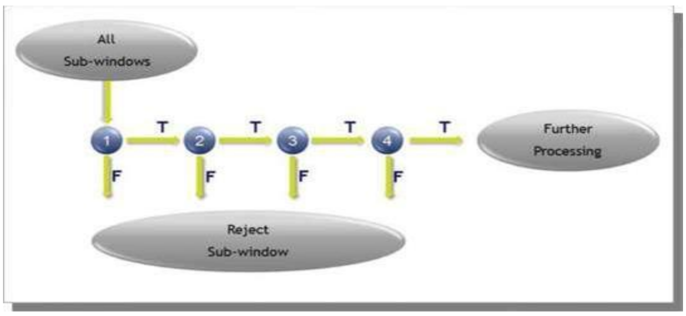


Figure.3.2 Cascade of classifiers

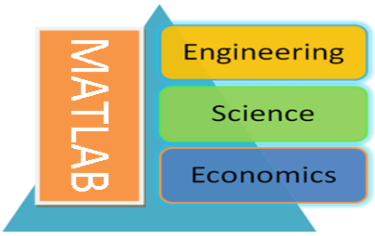
While assessing the strong classifiers produced through the learning process can be conducted with relative swiftness, it falls short of real-time requirements. Consequently, a cascading arrangement is employed, ordered by increasing complexity. Each subsequent classifier undergoes training solely with the selected samples that have been approved by the preceding classifiers. If at any point within the cascade, a classifier rejects the examined sub-window, no additional processing is initiated, and the search proceeds to the next sub-window..

To identify the eye and mouth regions, it is imperative to initially locate the face area. Nevertheless, this preliminary step can potentially compromise the system's efficiency and speed due to the extensive area it covers. The primary goal of this project is to pinpoint drowsiness signs, specifically the eyes and mouth. Consequently, we have constrained the detection scope to these areas, a strategic move aimed at augmenting system performance. We are currently in the process of evaluating the Cascade Object Detector algorithm using MATLAB® software to determine the detection regions for the upcoming system development. Rigorous testing is essential to confirm that it meets the necessary parameters.

3.3 MATLAB:

It is a software package for high-performance mathematical computation, visualization, and programming environment. It provides an interactive environment with hundreds of built-in functions for technical computing, graphics, and animations. MATLAB stands for “Matrix Laboratory”. It was written initially to implement a simple approach to matrix software developed by the “LINPACK” (Linear system package) and “EISPACK” (Eigen system package) projects.

Figure.3.3 MATLAB Various Disciples



It is a modern programming language environment, Multi-paradigm and has refined data structures, includes built-in editing and debugging tools, and supports object-oriented programming. It can work with multiple types of programming approaches, such as Functional, Object-Oriented, and Visual. Besides an environment, it is also a programming language.

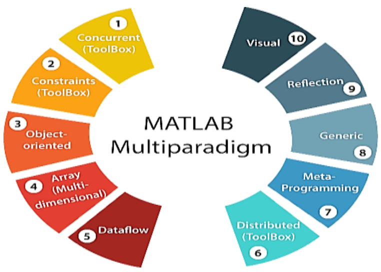


Figure 3.4 MATLAB Multiparadigm

As its name contains the word Matrix, MATLAB does its' all computing based on mathematical matrices and arrays. MATLAB's all types of variables hold data in the form of the array only, let it be an integer type, character type or String type variable.

state-of-the-art algorithms. These are numerous functions for 2-D and 3-D graphics, as well as for animations.

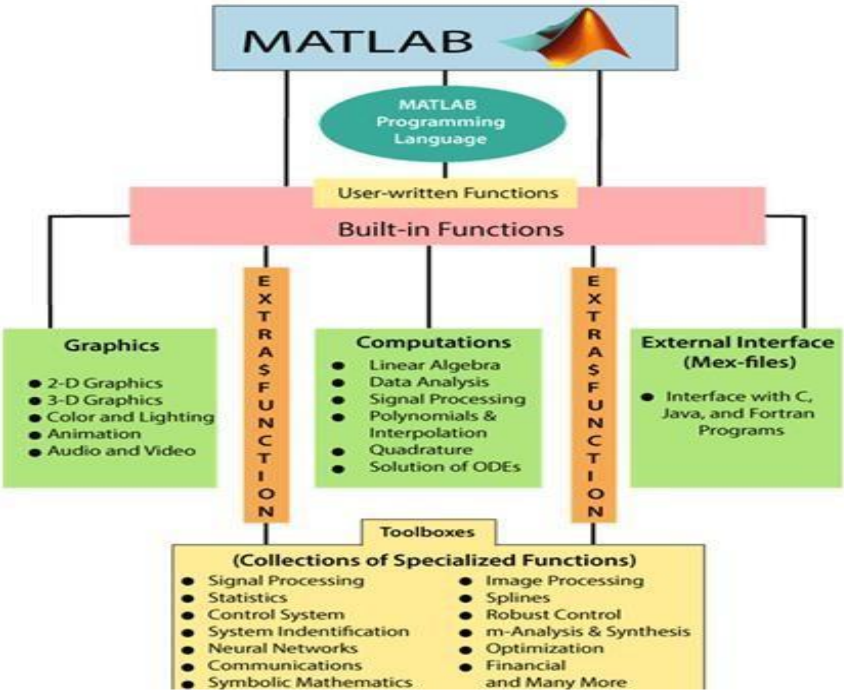


Figure 3.5 Schematic Diagram of Matlab Main Features

MATLAB supports an external interface to run those programs from within MATLAB. The user is not limited to the built-in functions; he can write his functions in the MATLAB language. There are also various optional "Toolboxes" available from the developers of MATLAB. These toolboxes are a collection of functions written for primary applications such as symbolic computations, image processing, statistics, control system design, and neural networks.

The necessary building components of MATLAB are the matrix. The fundamental data type is the array. Vectors, scalars, real matrices, and complex matrices are all automatically handled as special cases of the primary data type. MATLAB loves matrices and matrix functions.

The built-in functions are optimized for vector functions.

3.4 MATLAB System:

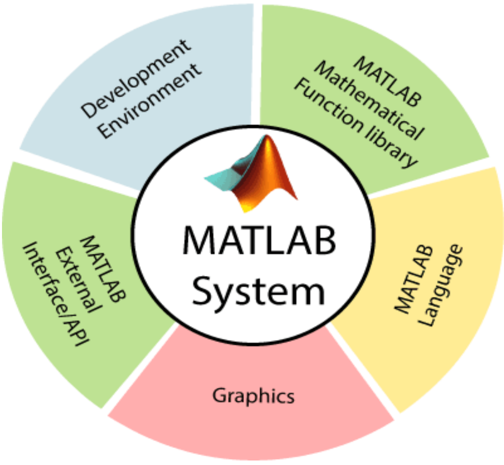


Figure 3.6 Elements of MATLAB system

CHAPTER 4

APPLICATIONS OF DROWSINESS DETECTION

The applications of a drowsiness detection and auto alerting system using image processing is to detect when a driver is becoming drowsy and alert them to prevent an accident. The drowsiness detection and auto alerting system using image processing can be useful in any situation where the safety of people is a concern. This technology can be used in various settings, such as:

1. Transportation:

This technology can be implemented in cars, buses, and trucks to ensure that the driver is alert while driving. If the system detects drowsiness, it can alert the driver to take a break or pull over to rest.

2. Workplace Safety:

Workers who operate machinery or perform safety critical tasks can benefit from a drowsiness detection system. This system can detect when the worker is getting drowsy and alert them or their supervisor to take a break or switch to a less safety critical task.

3. Medical Applications:

Drowsiness can be a symptom of many medical conditions, including sleep apnea, narcolepsy and other sleep disorders. A drowsiness detection system can help doctors monitor patients with these conditions and adjust their treatment accordingly.

4. Gaming Industry:

A drowsiness detection system can also be used in the gaming industry to alert players who are getting too tired and may need to take a break to avoid eye strain or other health problems associated with excessive screen time.

5. Educational Institutions:

Students who are studying or attending online classes for extended periods can benefit from this system. It can detect when they are getting drowsy and suggest them to take a break or switch to a different task.

CHAPTER 5

RESULTS

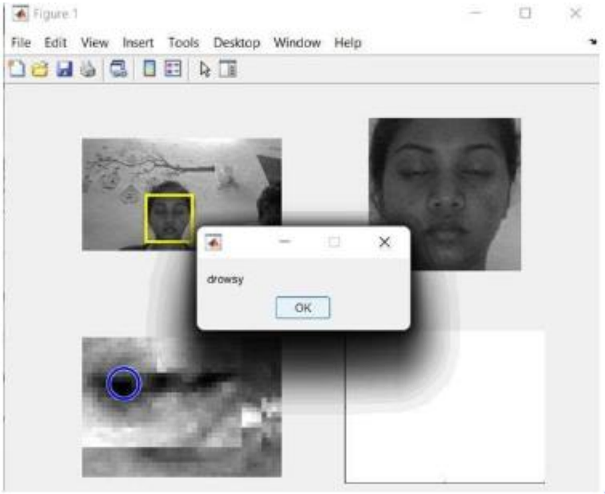


Figure 5.1 Drowsy

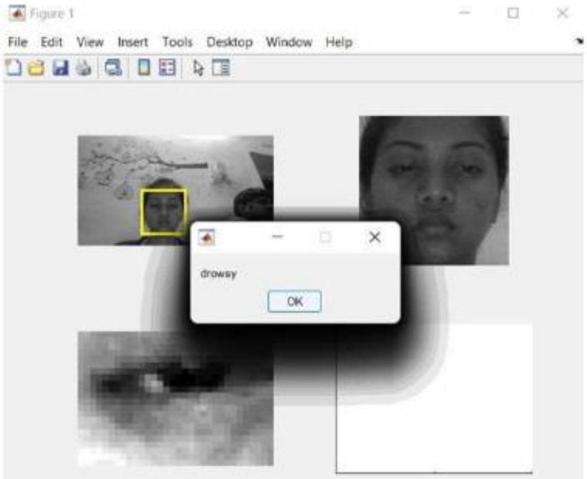


Figure 5.2 Drowsy

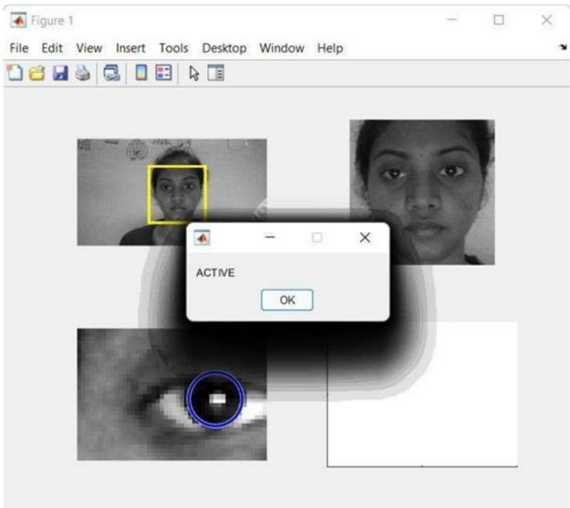


Figure 5.3 Active

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

CONCLUSION:

Using the MATLAB platform along with the Viola Jones Algorithm, we have effectively implemented drowsiness detection. Subsequently, the system we created underwent successful testing, during which we identified its limitations.

FUTURE SCOPE:

It is required to make the speed of vehicle slow or slow down the speed of vehicle in real time drowsiness detection. In order to create continuous monitoring, threshold drowsiness detection should be kept aside. While monitoring the drowsiness continuously, when the level exceeds certain value a signal is generated which directly controls the braking of vehicle.

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