Driver Drowsiness and Safety Enhancement Technique in Vehicles Using Machine Learning

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***Abstract*- Safety of life is the main priority while driving and travelling. There are many reasons for road accidents, but accidents due to driver fault and lack of safety in the vehicle comprises the maximum percentage. Driver drowsiness and safety enhancement system is one of the important domain in the road safety which involves continuous monitoring of fatigue condition and health parameters of the driver. However, the development of such system has many difficulties related to fast and proper recognition of a driver's fatigue symptoms. One way to implement driver drowsiness detection systems is to use the vision-based approach. The proposed method uses Machine learning for monitoring the drowsiness of the driver by video processing and IOT enabled system for enhancing the safety in vehicles by detecting Heart beat rate, Temperature rate and oxygen level of the person inside the vehicle. If these parameters exceed from the threshold level an alert will be sent to the driver and also to their relatives via SMS. The fatigue detection system runs on MATLAB and is capable of detecting drowsiness of drivers and based on the current situations an alert will be given to the driver using buzzer.**

***Index terms*- Driver drowsiness, Safety, SVM, Sensor, Blinking, Sensor**

1. INTRODUCTION

DROWSINESS is outlined as a transformation state between attentiveness and slumber that is additionally connected with an inclination towards sleep. As per the National main road Traffic Safety Administration, once a year regarding 100,000 police-reported crashes involve drowsy driving. These crashes lead to quite 1,550 fatalities and 71,000 injuries. the real range is also a lot of higher, however, because it is troublesome to work out whether or not the driving force was drowsy at the time of the crash. it's one in every of the dominant reasons for accidents in driving, industrial activities, and mining, wherever a continuing level of attention is needed to avoid unwanted events. These accidental things may end up in high economic loss and cause personal risks. A report discharged by the Indian ministry of road transport says: 146,133 individuals were killed in road accidents in the Republic of India in 2015, up from 139,671 in 2014. four hundred road deaths present itself. Intelligent vehicles are advanced and integrated systems consisting of assorted sensors and process modules to mechanically cut back risks. Among them, vision-based motion chase may be an important technique, the contribution of pc vision increased cameras and therefore the low-priced advantage. Actually, visual target chase may be an ancient and elementary topic and has wide-ranging applications in coming up with varied systems like police investigation, increased reality, artificial intelligence and human-computer interaction. The proposed system permits live observation of driver sleepiness by video process and provide medical support to the driving force over IoT that improves the standard of knowledge to the driving force.

2. PROPOSED SYSTEM

In the proposed system, video process technique is employed to sight the somnolence of the driver whereas driving. The detection is achieved with three main steps, it begins with face detection, facial feature detection using Viola Jones algorithm followed by eye tracking. By the utilization of correlation template matching the eyes are tracked. The driver is awake or asleep is known by matching

the extracted eye image with the outwardly fed template (open eyes and closed eyes) supported eyes opening and eyes closing, blinking is recognized. If the driver is falling asleep state remains higher than a particular time (the threshold time) the vehicles stops and an alarm is activated by the utilization of a particular microcontroller. Gas sensor is employed to sight the venturous gas within the vehicle. If any presence of person within the vehicle is detected, at an equivalent time any venturous gas is detected, directly the window doors of the vehicle are going to be opened directly and therefore the data is sent to the server through Wi-Fi. From the server the driver will receive SMS regarding escape of gases. An inbuilt medical box system is developed within the vehicle. The heart beat rate and temperature rate of the driver who is traveling long distance is detected using temperature and heart beat sensors. If any abnormal amendment happens in any of the one parameters, the medical box unit will indicate the corresponding LED and driver will take the exact tabulate from the medical box and therefore the data is sent to server via Wi-Fi (IOT) technology. Once key is pressed, IR sensor detects whether the door is opened or closed. If the door is opened the Engine will not on.

2.1 BLOCK DIAGRAM OF PROPOSED SYSTEM:

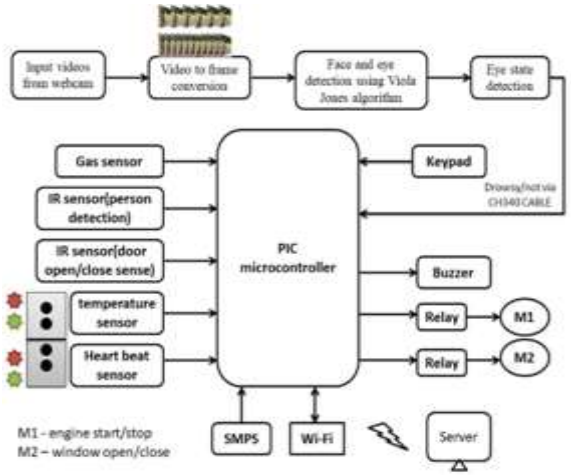


FIG.2.1

2.2 PIC MICROCONTROLLER PIC16F887:

A. ANALOG TO DIGITAL CONVERSION MODULE:

When configuring the ADC the following functions must be considered.

- Channel selection
- ADC voltage reference selection
- ADC conversion clock source
- Interrupt control
- Results formatting

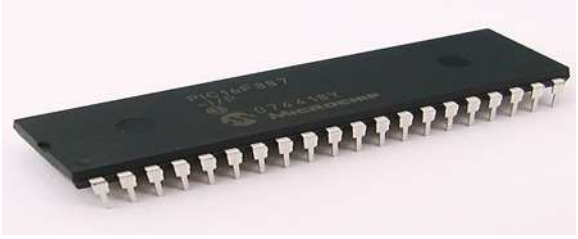


FIG.2.2PIC16F887

The ADC may be accustomed convert each analog and digital signals. Once changing analog signals, the I/O pin ought to be configured for analog by setting the associated TRIS and ANSEL bits.

2.3 TEMPERATURE SENSOR MODULE:

The body temperature of the driver should be maintained at normal condition while travelling long distance. This parameter can be sensed by using LM35 sensor.

FIG.2.3LM35

2.4 HEART BEAT SENSOR MODULE:

Heart beat sensing element is intended to supply digital output of heart beat once the finger is placed on that. Once the heart beat detector is functioning, the LED flash is unison with each heartbeat. This digital output is connected to microcontroller on to measure the Beats per Minute (BPM) rate. It works on the principle of photo modulation by blood flow through finger at every pulse.

2.5 MQ2 GAS SENSOR:

MQ2 gas sensing element is associate electronic sensing element used for sensing the concentration of gases within the air. MQ2 gas sensing element is additionally referred to as chemi-resistor. It contains a sensing material whose resistance changes once it comes in contact with the gas. this transformation within the value of resistance is employed for the

detection of gas. MQ2 is a metal oxide semiconductor kind gas sensing element. Concentration of gas is measured using a potential divider network present within the sensing element. This sensing element works on 5V DC voltage. It will detect gases within the concentration of range 200 to 10000ppm.

FIG.2.5 MQ2 GAS SENSOR

2.6 IR SENSOR:

The sensing element works by detection reflected light returning from its own infrared LED. By recording the quantity of mirrored infrared, it will sight objects directly ahead of it. an onboard RED LED is employed to point the presence of an object or detect line. Sensing range is changed with inherent resistance. The sensing element features a 3-pin header that connects to the microcontroller board via female to female or female to male jumper wires. A mounting hole connects one or more sensor to the front or back of robot chassis.

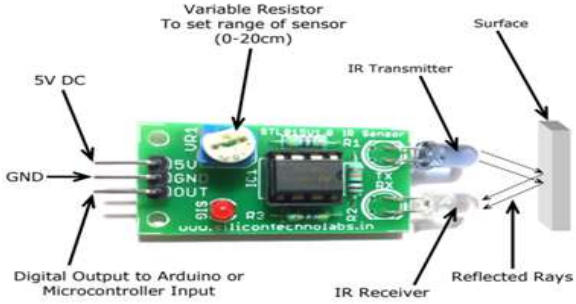


FIG.2.6IR SENSOR

2.7 BUZZER:

A buzzer or beeper is anaudio signaling device which is mechanical, electro-mechanical or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or roke.

Fig.2.7 BUZZER

A piezoelectric component may be driven by an oscillatory electronic circuit or different audio signal supply, driven with a piezoelectric amplifier. Sounds normally used to indicate that a button has been ironed are a click, a ring or a beep.

2.8 RELAY:

Relays are electromagnetic switches used as protecting devices, indicating devices and as transmission devices. Transmission relays are employed in communication systems. This relay is also used to determine a component that has failed.

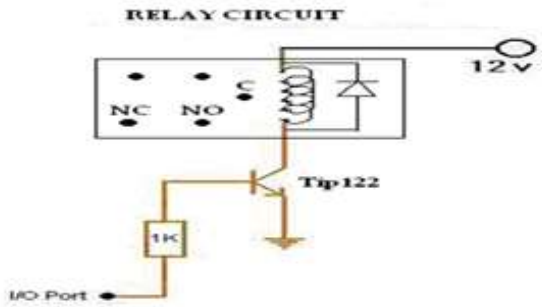
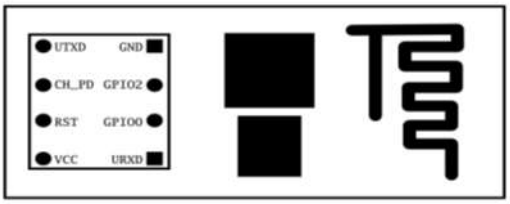


FIG.2.8.RELAY

2.9ESP8266 WIFI MODULE:

ESP8266 is a powerful, low price LAN module appropriate for adding LAN functionality to an existing microcontroller project via a UART serial association. The module will even be reprogrammed to act as a standalone Wifi connected device–just add power! The feature list is spectacular and includes:

802.11 b/g/n protocol Wi-Fi Direct (P2P), soft-AP Integrated TCP/IP protocol stack. The hardware connections needed to attach to the ESP8266 module are fairly straight-forward however there are a couple of necessary things to notice associated with power: The ESP8266 needs three.3V power–do not power it with 5 volts. The ESP8266 must communicate via serial at three.3V and doesn't have 5V tolerant inputs. ESP8266 on-board process and storage capabilities permit it to be integrated with the sensors and alternative application specific devices through its GPIOs with minimal development up-front and minimal loading throughout runtime. With its high degree of on-chip integration, which incorporates the antenna switch balun, power management converters, it needs minimal external electronic equipment, and also the entire solution, including front-end module, is designed to occupy minimal PCB space.



ESP8266 WiFi Pinout
Top View (Not to scale)

3. SOFTWARE PROFILE

3.1VIDEO PROCESSING:

Video will be used for detecting the state of driver. So we are going to process images after converting those videos into frames.

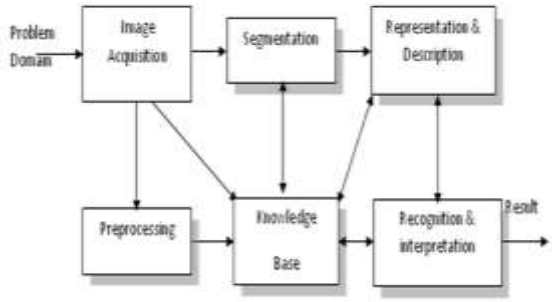


FIG 1.2 BLOCK DIAGRAM OF FUNDAMENTAL SEQUENCE INVOLVED IN AN IMAGE PROCESSING SYSTEM

FIG.3.1 VIDEO PROCESSING

4. IMPLEMENTATION STEPS

4.1 VIDEO ACQUISITION:

MATLAB permits you to acquire image and video data from hardware and import it directly into MATLAB for visual image and process. Image Acquisition toolbox provides functions and blocks to attach industrial and scientific cameras to MATLAB and Simulink. This stage of the progress is simplified by the subsequent features:

- Support for an intensive range of cameras, including all major standards and hardware vendors
- Extensible hardware support using third-party drivers
- An App for interactively detecting and configuring hardware properties

The ability to use multiple acquisition models, like process in-the-loop, hardware triggering, background acquisition and synchronizing acquisition across multiple devices

4.2 FRAME CONVERSION:

Video will be converted into serious of frames after reading video file using video reader function in Matlab. Frames are nothing but images.

4.3 RGB COLOR MODEL:

An RGB image, generally referred to as a real color image, is stored in MATLAB as an m-by-n-by-3 information array that defines red, green, and blue color components for every individual pixel. RGB pictures don't use a palette. The color of every pixel is decided by the mixture of the red, green, and blue intensities stored in every color plane
at the pixel's location. Graphic file formats store RGB images as 24-bit images, wherever the red, green, and blue elements are 8 bits each. This yields a possible of sixteen million colors. The RGB color model is an additive color model within which red, green and blue light are added along in numerous ways that to breed a broad array of colors. The main purpose of the RGB color model is for the sensing, illustration and show of display in electronic systems, like televisions and computers, although it has conjointly been utilized in conventional photography. RGB color value doesn't offer specifically same color till there's some reasonably color management.

4.4 GRAY CONVERSION:

The input color image is converted to gray image using grey conversion. Gray image carries solely intensity information. The black and white, are composed solely of gray shades, varied from weakest intensity (black)to the strongest intensity(white).

The converted grayscale image might lose contrasts, sharpness, shadow, and structure of the color image. To convert the color image into grayscale, the new algorithmic rule performs RGB approximation, reduction, and addition of chrominance and luminance. The grayscale images generated using the algorithmic rule within the experiment confirms that the algorithmic rule has preserved the salient features of the color image like contrasts, sharpness, shadow, and image structure.

The grayscale image is represented by luminance using 8-bit value. The luminance of a pixel value of a grayscale image lies between 0 to 255. The conversion of a color image into a grayscale image is changing the RGB values (24 bit) into grayscale value (8 bit).

Grayscale image = ((0.3 * R) + (0.59 * G) + (0.11 * B))

R, G and B are red, green and blue pixels respectively

4.5 MEDIAN FILTER:

The median filter is a nonlinear digital filtering technique, usually accustomed to remove noise from an image or signal. The median filter, when applied to grayscale images, the neighbourhood brightness-ranking algorithm that works by first placing the brightness values of the pixels from each neighbourhood in ascending order. The median or middle value of this ordered sequence is then selected as the representative brightness value for that neighbourhood. Median filter is used to remove the speckle noise and salt-and-pepper noise (impulsive noise). It preserves the edges of an image than other filters.

To soften and remove noise in the captured image eye image can be done by using a median filter. This filter works with nonlinear operation, in which a pixel value is taken from the value of the surrounding pixels.The calculation is done by sorting the group of pixel intensity values and then replace the pixel values are processed by the mean value of the results of the sequence.

4.6 IMAGE ENHANCEMENT:

Image Enhancement is the technique to improve the perception of information in images for human viewers. It improves the image quality so that the resultant image is better than the original image for a specific application. The main function of image enhancement is to increase contrast in a low contrast image. HE, AHE is used to make the medium brightness towards the middle gray level ofan image disregarding of the input image, and introduce objectionable artifacts and affected contrast effects. This makes the visual quality of processed imagery inadequate image histograms resembles each other as much as possible. In result we have an image that does not give the true intensity of the image pixels. Firstly, image captured by the webcam goes under different types of smoothing filters after that we have the resultant image. A picture is a set of pixels; each contains an average value of light caught in time of exposure - the time frame. When the subject does not move during the time frame (and is in focus), it will appear as frozen in the image and we will get sharper edges. Detecting blur in images and then reconstructing the blurred areas may restore some of the information.

Contrast Limited Adaptive Histogram Equalization (CLAHE) is a technique to improve the visibility of local details of an image by enhancing the contrast of local regions. It is based on AHE, where the histogram is calculated for the contextual region of a pixel. The pixel's intensity is thus converted to a value within the display range equivalent to the pixel intensity's rank in the local intensity histogram.

4.7FEATURE EXTRACTION:

Feature extraction techniques are applied to induce features which will be helpful in classifying and recognition of images. Feature extraction techniques are useful in numerous image processing applications e.g. character recognition. As features outline the behavior of an image, they show its place in terms of storage taken, efficiency in classification and clearly in time consumption conjointly.

The coefficient of correlation may be a statistical measure of the strength of the connection between the relative movements of two variables. The values vary between -1.0 and 1.0.If calculated range is greater than 1.0 or less than -1.0 implies that there's a mistake within the correlation measuring. A

correlation of -1.0 shows a perfect negative correlation, whereas a correlation of 1.0 shows an ideal correlational statistics. A correlation of 0.0 shows no linear relationship between the two variables. Features like coefficient of correlation, variance and variance are going to be extracted.

4.8SVM CLASSIFIER:

Support Vector Machine (SVM) is the most commonly used classification algorithm for disease prediction. It is a supervised learning technique that is used for discovering patterns for classification of data. The two elements used for the implementation are the mathematical programming and the kernel functions. The kernel function allows it to search for a variety of the hypothesis spaces. In SVM, classification is performed by drawing hyperplanes. This hyperplane is equidistant from both the classes. The data instances which are used to define this hyperplane are known as support vector. A margin is defined in SVM which is the distance between hyperplane and the nearest support vector. For good separation by this hyperplane, the distance of margin should be as large as possible because large distance gives less error. If the margin is close, then it is more sensitive to noise.

The equation to define the hyperplane and the margin are = 0 and = ±1 respectively. Here, it is defined as a weight vector and as bias. For better results of SVM, the features that are given as an input to SVM are needed to be reduced. The reduced feature set helps to improve the efficiency of the results produced by the algorithm.

In feature selection, there is a set of features and a method is used to select a subset of features that can perform best under the classification system. The term 'feature selection' refers to the algorithms that gives a subset of feature set which are given as an input to the algorithm.

5. RESULT

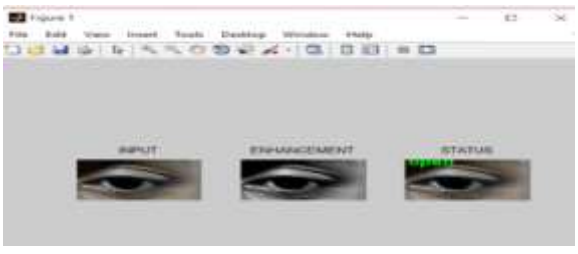


FIG.DROWSY DETECTION EYE OPEN

FIG.DROWSY DETECTION AFTER CLOSURE OF EYE

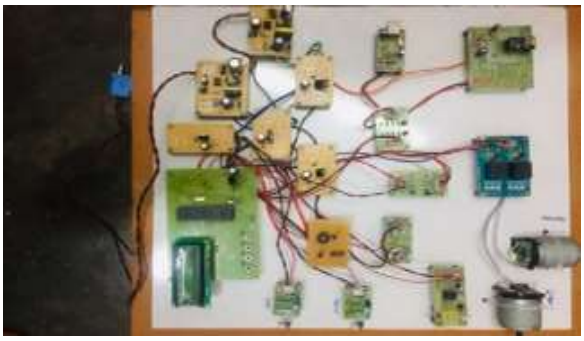


FIG .OVERALL HARDWARE

FIG. DATA TRANSMITTED IN INTERNET

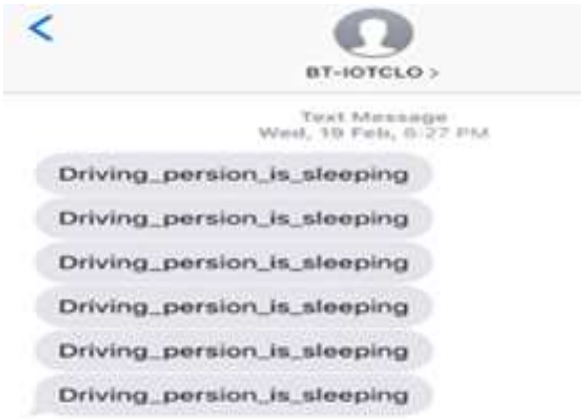


FIG .SMS SENT TO MOBILE PHONE

6. CONCLUSION

The main objective of this approach is to alert the driver that his/her detection capabilities are getting degraded and is not safe to drive the vehicle. If the driver is aware of fatigue and its related consequences then providing warning may be helpful but drivers who are not aware, the increasing fatigue may impact their driving skills. The devices developed for the benefits of drivers may issue warning in the early stage with sufficient inputs to avoid collision. Driver drowsiness detection system using Machine learning was developed to take one consideration that, if driver is not stopping the vehicle after the warning then an SMS will be sent to the authorized person such that an action will be taken before accident occurs. The further improvement to the existing approach can be provided in terms of stopping the vehicle or locking the engine if the driver is not responding to the warning alerts for certain period of time.

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