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Driver Drowsiness Alert System With Computer Vision Using Machine Learning And Engine Stopping With Raspberry Pi 4

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Abstract- This project presents a real-time driver drowsiness detection system for driving safely and if the drowsiness further continues then the vehicle will be stopped slowly using raspberry pi 4. Based on computer vision techniques using machine learning, the driver's face is located from a camera infront of him. Then, face detection is employed to locate the regions of the driver's eyes, which are used as the templates for eye tracking in subsequent frames. Finally, the tracked eye's images are used for drowsiness detection in order to generate warning alarms. The proposed approach has three phases: Face, Eye detection and drowsiness detection. The role of image processing is to recognize the face of the driver and then extracts the image of the eyes of the driver for detection of drowsiness. The Haar face detection algorithm takes captured frames of image as input and then the detected face as output. If the eyes are closed for a predefined period of time the eyes of the driver will be considered closed and hence an alarm will be started to alert the driver. If the alarm sounds 3 times for about a time period of 10 minutes then the vehicle speed will reduced slowly and finally it will be stopped and parking lights will get ON. The proposed system was tested on a Raspberry pi 4 with 4GB RAM. The experimental results appears quite encouraging and promising. The system could reach more than 15 frames per second for face and eye tracking, and the average correct rate for eye location and tracking could achieve 99.0% on some test videos. Thus, it can be concluded that the proposed approach is a low cost and effective solution method for a real-time of driver drowsiness detection and engine stopping.

I. INTRODUCTION

The **NTSB** in the United States have indicated the significant danger of fatigue drivers operating heavy vehicles. **52%** of heavy truck single vehicle accidents were fatigue related. Annually, it is estimated that there are **40,000** injuries and **1,500** fatalities caused from fatigued persons at the wheel. Also, driver drowsiness involves a high percentage (30%) of traffic accidents. Also, a research suggests that up to 25% of accidents on monotonous roads in India are fatigue related.

II. PROPOSED ALGORITHM

The main objective is to overcome the problem related to the accidents related to the drivers experiencing fatigue.Where this fatigue leads to a need of arising to design a system that keeps the driver focused on the road. It involves controlling vehicle accident and saving driver's life by alerting him and vehicle owner on real time. Whenever driver's eye is blinking period is more than 3 seconds, we consider this condition under drowsiness. Immediate action will be taken and buzzer will immediately blow up &alerts and wake up the driver. This drowsiness condition is reported to the remote person through Raspberry Pi in real time. Coding is done in Python Programming Language.

III.HARDWARE AND SOFTWARE COMPONENTS

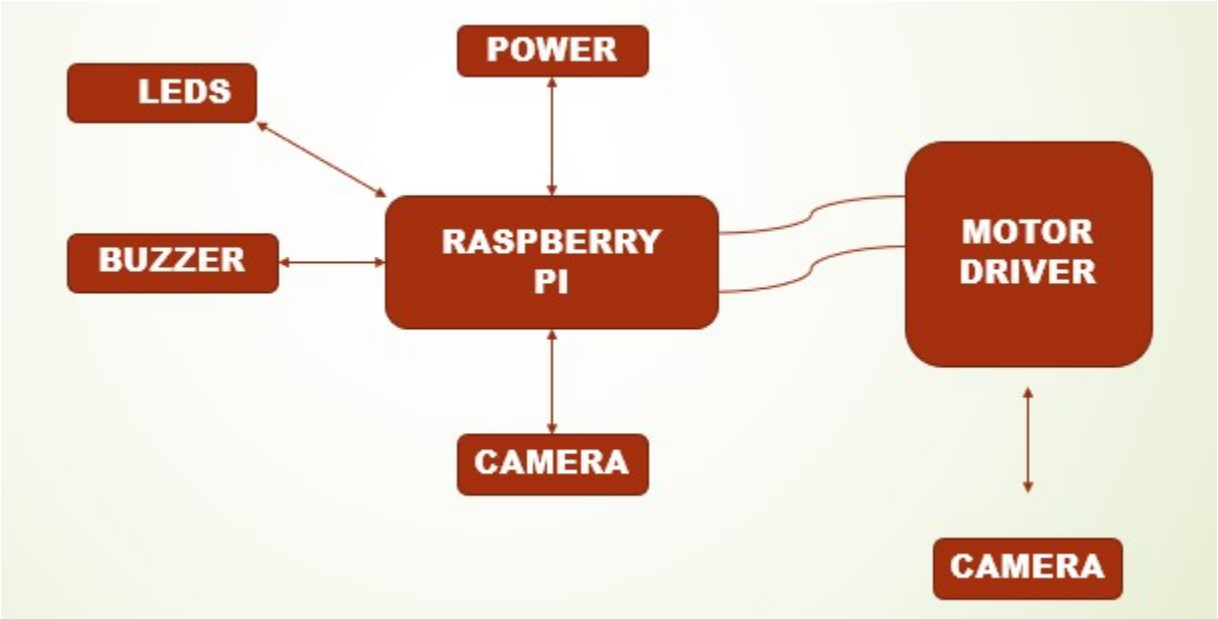
Hardware Components

1)Raspberry Pi
2)Pi Camera
3)Motors 10 Rpm
4)Motor Driver
5)Alcohol Sensor
6)Buzzer
7)IR LED Light
8)Battery(12V)

9)Robot Base

Software Requirements

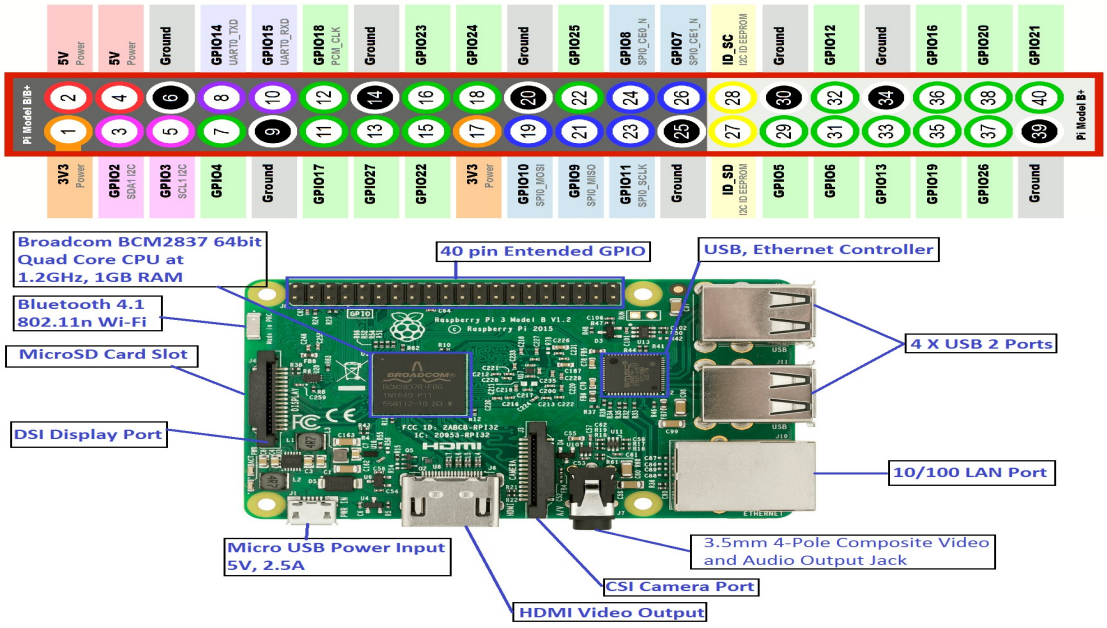
1)Raspbean OS.
2)Python 2.7
3)Open CV 3.2



i)Block Diagram

Raspberry pi board

The **Raspberry Pi** is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python.



Technical features of Raspberry pi

- SoC: Broadcom BCM2837 (roughly 50% faster than the Pi 2)
- CPU: 1.2 GHZ quad-core ARM Cortex A53 (ARMv8 Instruction Set)
- GPU: Broadcom VideoCore IV @ 400 MHz
- Memory: 1 GB LPDDR2-900 SDRAM
- USB ports: 4
- Network: 10/100 MBPS Ethernet, 802.11n Wireless LAN, Bluetooth 4.0

The **Raspberry Pi** is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundationto promote teaching of basic computer science in schools and in developing countries.[5][6][7] The original model became far more popular than anticipated,[8] selling outside its target market for uses such as robotics. It does not include peripherals (such as keyboards and mice) and cases. However, some accessories have been included in several official and unofficial bundles.[8]

The organisation behind the Raspberry Pi consists of two arms. The first two models were developed by the Raspberry Pi Foundation. After the Pi Model B was released, the Foundation set up Raspberry Pi Trading, with Eben Upton as CEO, to develop the third model, the B+. Raspberry Pi Trading is responsible for developing the technology while the Foundation is an educational charity to promote the teaching of basic computer science in schools and in developing countries.

The Raspberry Pi, at the time I am creating this project, is available in several different models. Model A, Model A+, Model B and Model B+. In this project I am using the Model B. Some of the available Raspberry Pi models All Raspberry Pi's share some common features. Looking at the circuit board, you can
see:
1. The Processor and RAM chip
2. The LAN controller chip
3. A HDMI video output connector
4. A composite analog video connector (on models A and B)
5. An SD card connector
6. A micro-USB power connector
7. A USB port
8. An Ethernet port (on model Bs)
9. A camera connector
10. And the very important GPIO headers

The Raspberry Pi, common components

The Raspberry Pi comes as a single PCB. No keyboard and mouse, no screen, not even a power supply. You have to provide all that. In this project, we will be using the Raspberry Pi in so called "headless" mode. This means that we will not be connecting it to a keyboard or mouse. Instead, we will work with the Raspberry Pi via an SSH network connection. Don't worry if you don't quite understand what this means, I will show you everything you need to know, step by step.

As a computer, and unlike micro-controllers like the Arduino, the Raspberry Pi needs an operating system. There are several options to choose from:

Rasbian, the Raspberry Pi Foundation's preferred operating system distribution

Ubuntu,Openelec OSMC Pidora RISC OS And Minibian, my preferred distribution.

All of them except for RISC OS are flavours of Linux.

Minibian is a minimalist version of Raspbian. It keeps everything that is important and throws away the graphical user interface and a few other things that are not really needed for our purposes. In return, we get a small disk footprint so we can use even small 4GByte SD Cards.

Although there is an distribution designed for absolute beginners, NOOBS, I will show you how to install Minibian in the next section.

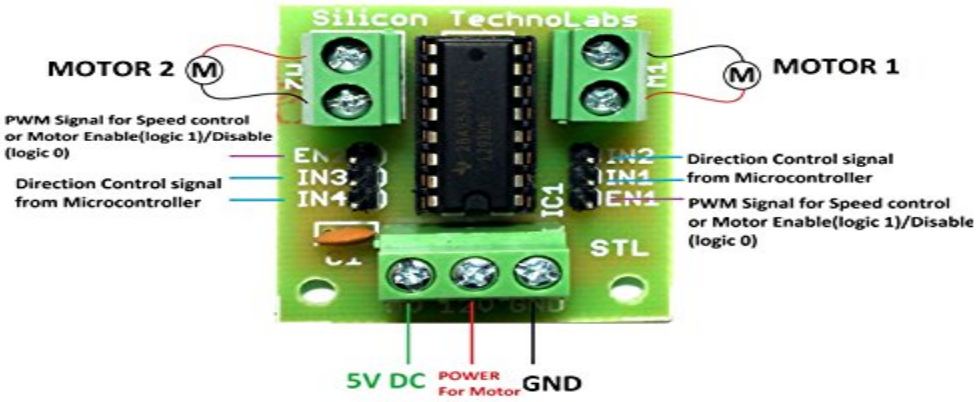
The Raspberry Pi comes with 512 MBytes or 1GByte of RAM, depending on the model.

Video memory is shared with general purpose memory. In our project, we will not be using any video output, so we will configure our Pi to not use any video memory. Although this amount of RAM may seem too little at a time when computers come with multiple of gigabytes, for an embedded computer it is more than enough. People run multiplayer game servers like Minecraft on it, and small production web servers and database server. Others have even used the RPi as a node for small supercomputers. With a bit of planning, the Raspberry Pi can do amazing things. Raspberry Pi running a Minecraft server

To make something useful with the Raspberry Pi, just like with any computer, you need application software. You can either download ready made software, or write your own. In this project, I will show you both. You will download, install and configure various types of servers, and you will write your own application in Python. You will not become an expert Python programmer, but you will become familiar with it enough to be both useful and dangerous. That's a great start!
Finally, the Raspberry Pi rarely works in isolation. It has a fast Ethernet communications socket through which you can connect it to the Internet. You can also attached a Wifi USB module and go wireless. We will take advantage of this capability and make it possible for our application to interact with Internet based web services. You will also be able to access your application via a web browser, potentially making it possible to access your Raspberry Pi from anywhere in the world. Ok, enough with this general introduction to the Raspberry Pi. In the next lecture, I will talk about the components that you will need for this project.

L293D Motor Driver

A motor driver is an integrated circuit chip which is usually used to control motors in autonomous robots. Motor driver act as an interface between Arduino and the motors . The most commonly used motor driver IC's are from the L293 series such as L293D, L293NE, etc. These ICs are designed to control 2 DC motors simultaneously. L293D consist of two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor. We will be referring the motor driver IC as L293D only.



(1) IN1,2 & IN3,4 are controll signals from controller use for Direction control of Motor.
(2) If IN1,2 signal is logic(1,0) then Motor 1 Rotates in One Direction.
If IN1,2 signal is logic(0,1) then Motor 1 Rotates in Opposite Direction.
(3) EN1 & EN2 are Enable pins. Connect 5V DC to EN1 & EN2 pin to operates Motor its normal rated Speed .
if Speed Control needed. then give PWM on EN1 and EN2 from Microcontroller
(4) Power for Motor.if 12V DC Gear Motor is Used Then apply 12V.
(5) Make sure to make GND common for all Circuit

Raspberry pi camera
Introduction

Pi Camera module is a camera which can be used to take pictures and high definition video.

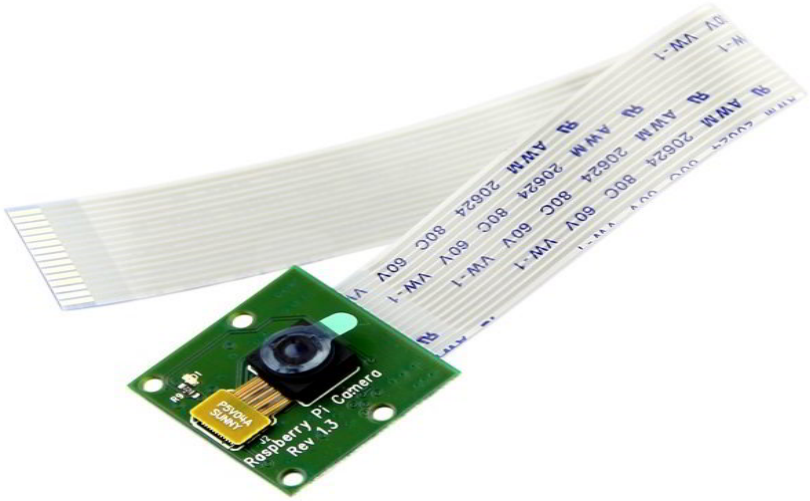
Raspberry Pi Board has CSI (Camera Serial Interface) interface to which we can attach PiCamera module directly.

This Pi Camera module can attach to the Raspberry Pi's CSI port using 15-pin ribbon cable.

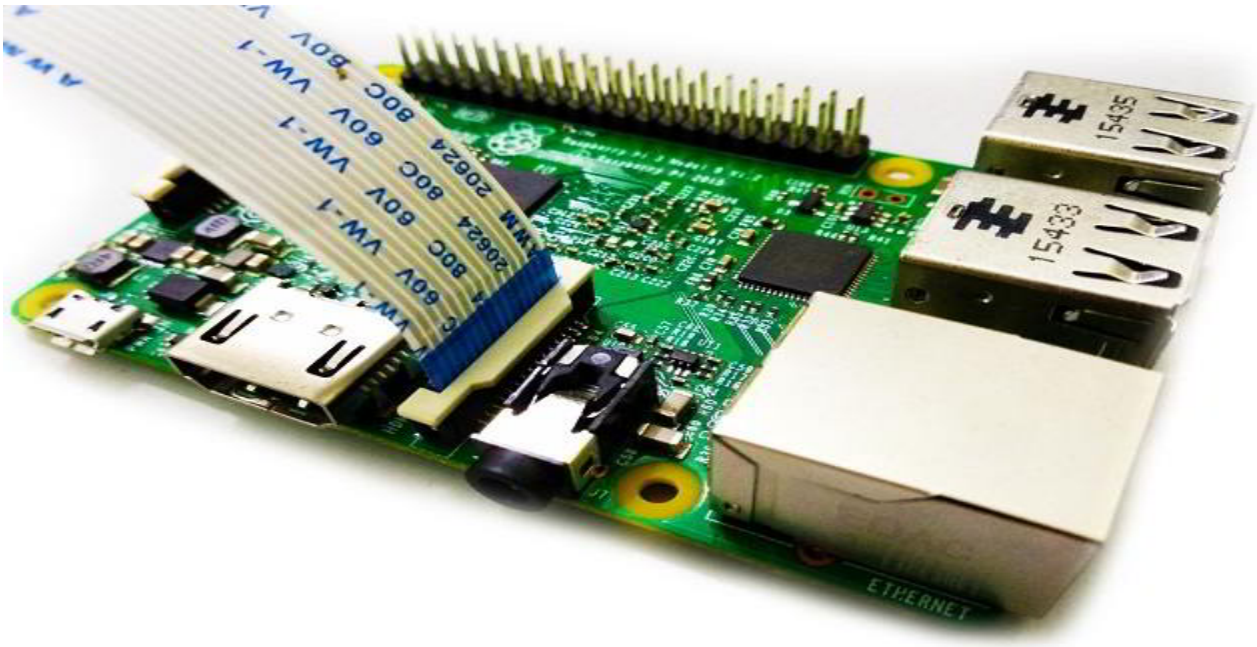
IV. FEATURES OF PI CAMERA

Here, we have used Pi camera v1.3. Its features are listed below,

- Resolution – 5 MP
- HD Video recording – 1080p @30fps, 720p @60fps, 960p @45fps and so on.
- It Can capture wide, still (motionless) images of resolution 2592x1944 pixels
- CSI Interface enabled.



- ii)Pi Camera



- iii) How to attach Pi Camera to Raspberry Pi

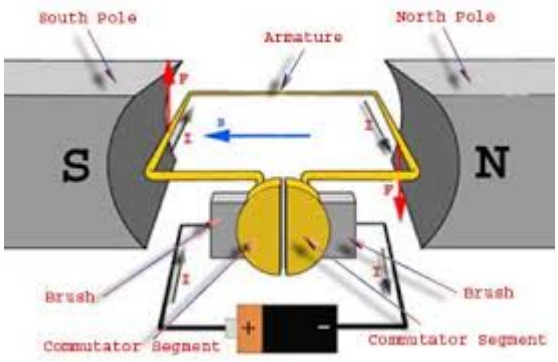
V. DC Motor

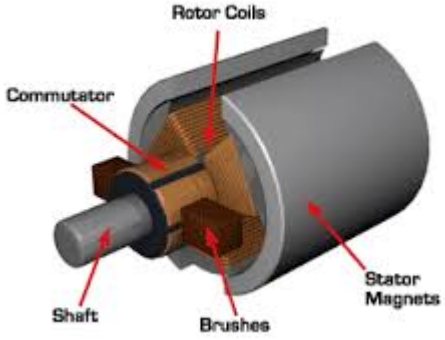
An **electric motor** is an electrical machine that converts electrical energy into mechanical energy. The reverse of this is the conversion of mechanical energy into electrical energy and is done by an electric generator, which has much in common with a motor.

Most electric motors operate through the interaction between an electric motor's magnetic field and winding currents to generate force. In certain applications, such as in regenerative braking with traction motors in the transportation industry, electric motors can also be used in reverse as generators to convert mechanical energy into electric power.

Found in applications as diverse as industrial fans, blowers and pumps, machine tools, household appliances, power tools, and disk drives, electric motors can be powered by direct current (DC) sources, such as from batteries, motor vehicles or rectifiers, or by alternating current(AC) sources, such as from the power grid, inverters or generators. Small motors may be found in electric watches. General-purpose motors with highly standardized dimensions and characteristics provide convenient mechanical power for industrial use. The largest of electric motors are used for ship propulsion, pipeline compression and pumped-storage applications with ratings reaching 100 megawatts. Electric motors may be classified by electric power source type, internal construction, application, type of motion output, and so on.

Electric motors are used to produce linear or rotary force (torque), and should be distinguished from devices such as magnetic solenoids and loudspeakers that convert electricity into motion but do not generate usable mechanical powers, which are respectively referred to as actuators and transducers.





VI. WORKING PRINCIPLE OF DC MOTOR

A motor is an electrical machine which converts electrical energy into mechanical energy. The **principle of working of a DC motor** is that "*whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force".* The direction of this force is given by Fleming's left hand rule and it's magnitude is given by F = BIL. Where, B = magnetic flux density, I = current and L = length of the conductor within the magnetic field.

Fleming's left hand rule: If we stretch the first finger, second finger and thumb of our left hand to be perpendicular to each other AND direction of magnetic field is represented by the first finger, direction of the current is represented by second finger then the thumb represents the direction of the force experienced by the current carrying conductor.

Above animation helps in understanding the **working principle of a DC motor**. When armature windingsare connected to a DC supply, current sets up in the winding. Magnetic field may be provided by field winding (electromagnetism) or by using permanent magnets. In this case, current carrying armature conductors experience force due to the magnetic field, according to the principle stated above.

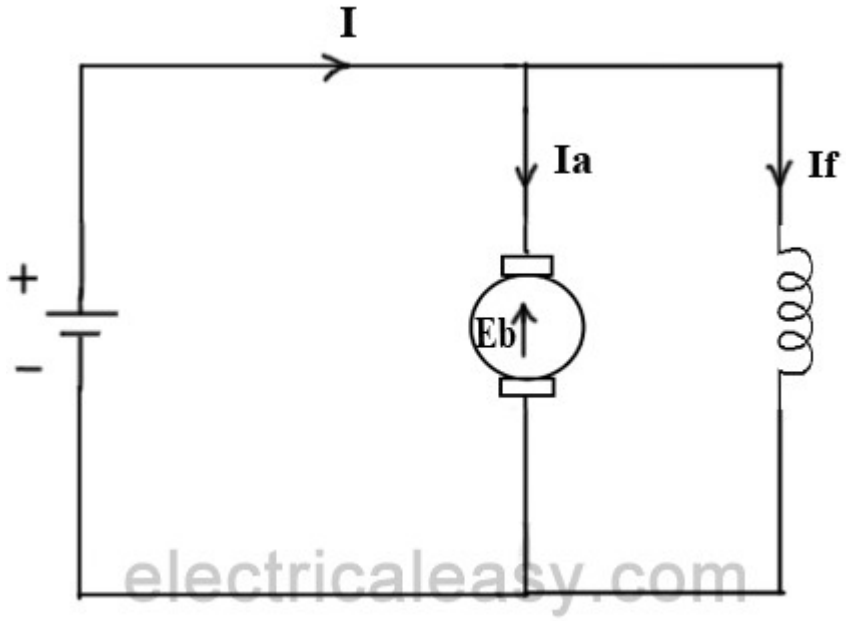
Commutator is made segmented to achieve unidirectional torque. Otherwise, the direction of force would have reversed every time when the direction of movement of conductor is reversed the magnetic field.

This is how a DC motor works!

Back EMF

According to fundamental laws of nature, no energy conversion is possible until there is something to oppose the conversion. In case of generators this opposition is provided by magnetic drag, but in case of dc motors there is back emf. When the armature of the motor is rotating, the conductors are also cutting the magnetic flux lines and hence according to the Faraday's law of electromagnetic induction, an emf induces in the armature conductors. The direction of this induced emf is such that it opposes the armature current (I_a) . The circuit diagram below illustrates

the **direction of the back** emf and armature current. Magnitude of **Back emf** can be given by the emf equation of DC generator.



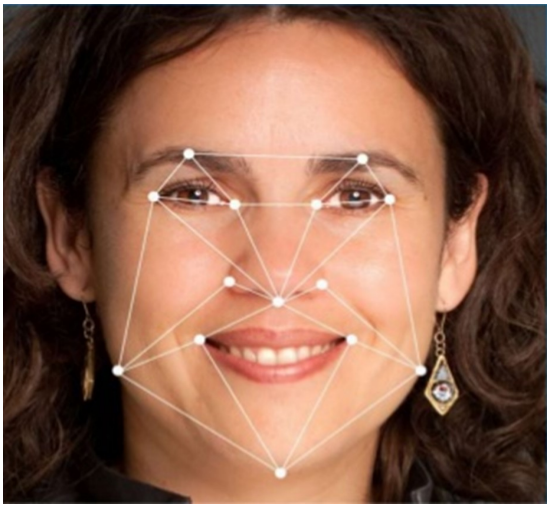
1) Significance Of Back EMF:

Magnitude of back emf is directly proportional to speed of the motor. Consider the load on a dc motor is suddenly reduced. In this case, required torque will be small as compared to the current torque. Speed of the motor will start increasing due to the excess torque. Hence, being proportional to the speed, magnitude of the back emf will also increase. With increasing back emf armature current will start decreasing. Torque being proportional to the armature current, it will also decrease until it becomes sufficient for the load. Thus, speed of the motor will regulate.
On the other hand, if a dc motor is suddenly loaded, the load will cause decrease in the speed. Due to decrease in speed, back emf will also decrease allowing more armature current. Increased armature current will increase the torque to satisfy the load requirement. Hence, presence of the **back emf makes a dc motor 'self-regulating'**.

VII. TECHNIQUES FOR DETECTING DROWSINESS STATE

The proposed method is built in four stages and it is applied to the coloured images with any background:

1. Localization of Face.
2. Localization of the Eyes.
3. Tracking the eyes in the subsequent frames.
4. Detection of Drowsiness.



iv)Localization Of Face

v) localization Of eyes

VIII. DETECTION OF DROWSINESS

As the driver becomes more fatigued, he/she is expected to blink the eyes. This lead to generation of consecutive frames. These frames depicts that the eyes are closed. These frames are counted in order to decide the condition of the driver. To determine whether the eyes are closed or open, a method is implemented that looks at the horizontal histogram across the pupil.

IX.CONCLUSION

This projects is very useful for road safety, to avoid the accidents this project is enabled with image processing algorithm, which uses haaracascade to detect the face sign for detecting the driver drowsiness.

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