EYE CONTROLLED WHEELCHAIR MOVEMENT

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Abstract—This paper includes eye-controlled wheelchair implemented for the disabled persons. The purpose of this eye-controlled wheelchair is to make the life of the disabled people easier and boost their confidence in leading an independent life by eliminating the necessity of the assistance required. In this system, the movement of the eyes determines the direction in which the wheelchair has to move. Here a camera is used in order to capture the eyes. Theeye and the pupil movementare continuously monitored. Based on the direction of the movement of the eye, wheels are made to move in the corresponding direction. Raspberry pi board is used to control the whole system.

Index Terms—Gaussian blur, Haar cascade algorithm, motordrivers, Raspberry pi, USB camera.

I. INTRODUCTION

The capability to move freely is incredibly valued by all the people, but it is sometimes difficult for a person with physical disabilities. With the increasing number of populations,the ratio of people with disabilities has been increasing About 9 million people in India suffer from limb and torso paralysis with othermillion-people suffering from paraplegia (paralysis of legs) [1].

Many disabled people use wheelchair as a medium to move. The person who cannot walk will put his entire energy in moving the wheelchair, but for the disabled and old people this is difficult. Hence some effective method is needed to improve their life. Different types of wheelchairs are available in the market such as voice-controlledwheelchair, joystick-controlled wheelchair and many more. Sometimes it may be difficult for totally paralyzed persons to utilize these systems and at times it is difficult to afford these systems. Hence there is a need for cost effective and easily accessible method. We know that in 99% of paralysis cases the person can still move their eyes. Hence this paper helps in making the life of people suffering from such difficulties simple and independent. It also concentrates on developing easily accessible and cost-efficient system which can be utilized by many.

II. HARDWARE AND SOFTWARE REQUIREMENTS

A. HAAR CASCADE

Haar cascade is one of the image processing technique used for object recognition that basically works on the image intensity. Haar feature is used for uniformity matching things since human face share some similar properties. Basically, Haar cascade applies Haar like features computed by haar wavelet which is a single rectangle shape 2D square [2]. These Haar features are compared in the input images and this process is repeated continuously until hundreds of Haar features are checked on that image. This is done by a classifier which classifies images based on the criteria of them matching with the haar like features in those images. If the features are not matched, then images are rejected. Images that passes through all the classifier will lead to the detection of the eye in our case.

Eye_cascader=cv2.CascadeClassifier('haarcascade_eye.xml')

B. GAUSSIAN FILTER

Gaussian Blur it is a process of applying Gaussian function on an image to remove and reduce the clarity of an image. Here we are

basically using it to reduce the presence of black color tiny object which are unwanted. This operation is performed on each pixel leading to smoothing of an image. Mathematically it is convoluting the image with the Gaussian function [3]. Each pixel is multiplied with a Gaussian kernel which is a matrix, based on the resulted multiplied value the destination pixel value is changed. Resulting in removing the noise.

The Gaussian function equation is given by

$$G(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}} \quad (1)$$

σ is standard deviation wherex and y are corresponding coordinate values

C. RASPBERRY PI

It is a low-cost computer which is of square shaped basically used for running the codes using its software and sends command to communicate with the devices aiming to work as a single product. It is used to learn programming skills and build hardware projects. It also aims at providing access to computing and digital marketing.

Figure 1:Image of raspberry pi.

D. ARDUINO

Arduino provides a platform to create interesting electronic projects. It blends the combination of hardware and software. The board is equipped with set of digital and analog pins. Arduino is also very Low-cost device with equally effective quality and application which makes it demandable in the field of technology

E. MOTOR DRIVER

These are used to control the motors and instruct them to move in a specified and required directions. They are also used to establish the access over speed of the Motors. L293d is a motor which we have used which is 16 pin IC. It works on H Bridge in which the voltage will be followed in both directions that is both in left and right direction. This is brought into action with the help of two pins which are pin 1 and pin 9

Pin1	Pin9	Direction
1	0	left
0	1	Right

Fig 2:logic values used for right and left.

Moto drive can also control the motion in the clockwise and anticlockwise direction that is established with the help of another two pins which are pin 2 and pin7

Pin2	Pin7	Direction
1	0	clockwise
0	1	anticlockwise

Fig 3:logic values for clockwise and anticlockwise

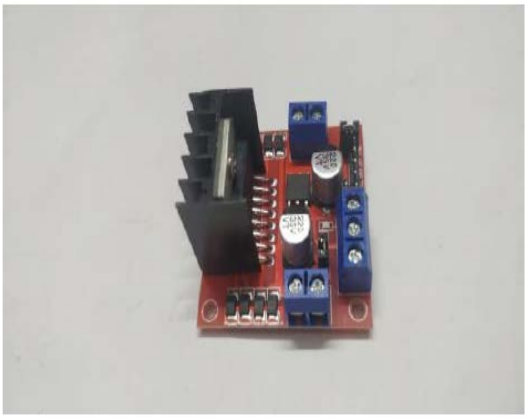

Fig 4:Image of L293D motor driver

F. USB CAMERA

camera is used for capturing the video in a continuous manner. As it is a real time-based project camera plays a very important role. it is fixed on a cap which is focused near to the eye region of human body. Fixing the cap in this manner not only provides flexibility and strength to the camera but also efficiently serves for the purpose that is used.

Fig 5:image of a USB camera

III. PROPOSED METHODOLOGY

The project consists of three main stages:

A. Eyeball detection

Face detection or eye detection could be done in many ways. We used Haar Cascade algorithm. Initially the USB camera placed in front of the user, will continuously captures video 640*480. The process of Haar Cascade in detecting eyes is using the method of the sliding window on the entire video and checks if there is any part of the video is like the shape of an eye. Once Before detecting the eye some image processing will be done. The video will be in the form of RGB channel. When OpenCV reads the video, it stores the video in BGR form. For the purpose of image recognition, we need to convert it into gray channel. Then we need to extract the features from these images using Haar feature. By using the concept of integral image, value of rectangular features can be calculated by quickly changing each pixel value of grey image. This method is relatively faster in computing because it depends upon the number of pixels in a square rather than each pixel value of an image. Even after applying Haar Cascade there are chances that along with the eye, eyelashes might get detected. To avoid that we apply Gaussian blur filter. To detect the pupil, which is the mid-point of an eye, Consider a certain threshold value less than the mid value of 0-255. The grayscale image is masked based on the intensity level in the order 0-255. The pixel intensity lower than the threshold are considered and rest of them are ignored. After sorted, only the darkest image whose value is 0 will be obtained which is nothing but a pupil. To track the movement of an eye x and y co-ordinates are considered at the mid-point of a pupil, where the intersection of these horizontal and vertical axis represents the eye movements in left or right direction. Two threshold lines are drawn in the right and left side of the pupil. If the intersected lines cross the threshold line present at the right side then, it indicates that eye is directed towards right. If the intersected lines cross the threshold line present at the left side then, it indicates that eye is directed towards left and if the intersected lines are between the two threshold lines it means that eye is directed towards front.

B. Establishing Communication via Bluetooth

Raspberry pi has an operating system known as Raspbian. The data is processed in a Raspbian system. Once it is processed the information of the eyeball movement is transmitted wirelessly via Bluetooth to the Arduino mounted on the prototype wheelchair. Bluetooth used Serial Communication to transfer the data.

C. Interfacing the result with prototype wheelchair

Arduino receives the data through the Bluetooth and gets processed. A specified action for each set of code is performed by the Arduino. Two L293D motor drivers are used for the right wheels as well as for the left wheels. Motor inputs are connected to the Arduino. This motor driver allows DC motor to drive on either clockwise or anti clockwise direction. Based on the command received it performs the specified action. The below truth table shows how motor works when different commands are given.

IC1	IC2	Output
10	10	Front
01	01	Back
10	01	Left
01	10	Right

Fig 6: Logic values for different directions

When Arduino receives direction of the eye as right, it will command motor driver to move in the right direction by sending 01 and 10 to the respective IC. When Arduino receives direction as left, it will command motor driver to move in the left direction by sending 10 and 01 to the respective IC. When Arduino receives direction as front, it will command motor driver to move in the forward direction by sending 10 and 10 to the respective IC. When Arduino receives direction as back, it will command motor driver to move in the backward direction by sending 01 and 01 to the respective IC. Emergency switch is used to stop the wheelchair.

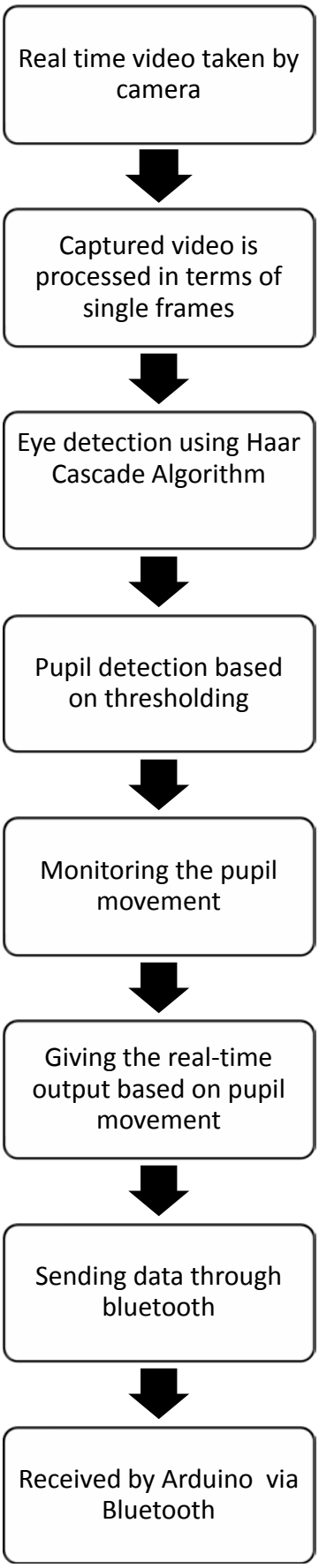

Fig 6:Working of block diagram

D. Eye detection Results

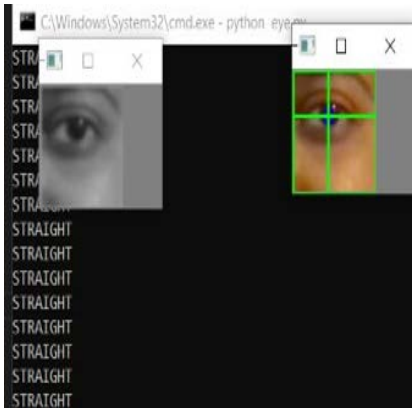

Figure 7Direction of pupil: -Straight

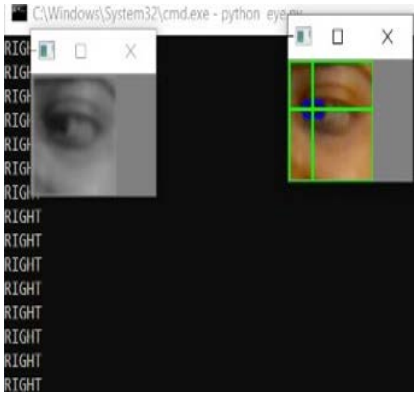

Figure 8:Direction of pupil: -Right

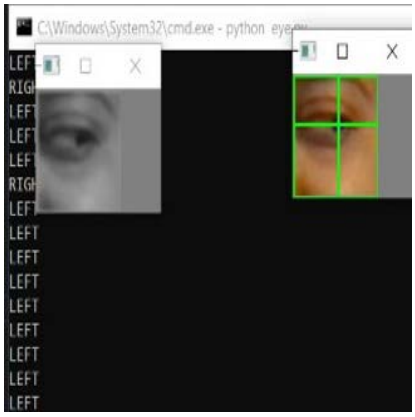

Figure 9:Direction of pupil: -Left

IV. CONCLUSION

In this project we have developed a prototype wheelchair system which enables the disabled person to move their wheelchair independently in their own direction. It is cost effective because an ordinary wheelchair can be used by including motor type mechanism to it and the only part required to control the system is eyes. The predicted position of the eyeball is fed to the microcontroller which commands the motor driver to move the wheelchair in the required direction. The main motive of this project is to

help the disabled people lead the independent life.

V. DRAWBACKS

- ✓ Difficult to track the position of the pupil, if light changes continuously.
- ✓ The project requires eyeball movement as an input, a lot of stress is created to the eyes.

VI. FUTURE WORK

- ✓ Performance of the system can be improved by adjusting the lightening condition during the eyeball movement detection.
- ✓ By using Artificial Intelligence person can control the household appliances while sitting on the wheelchair.

VII. REFFERENCE

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