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Eye Tracking Based Wheel Chair with Embedded System

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ABSTRACT

In today's world there are so many who are paralysed due to health problems, wars, accidents and age. Due to which perhaps lead to be dependent on someone who can help them to move from one place to another. To overcome from such a scenario, here comes the most helpful equipment which helps the people who are paralysed to move in their surroundings without taking help of anyone by without losing their self confidence. The only way which helps the paralysed to move them around and achieve is a head and their eyes. This project implements the movement of eye by which the wheel chair is automatically controlled to move in all the directions. A vision based system is utilized by which web camera is connected to the laptop which captures the eye images of the patient.

Keywords: Wheel chair, Camera, Eye image.

I. INTRODUCTION

The number of persons who are paralysed and growing with the population day by day which lead them to be dependent on others by which loosing the self confidence on themselves. This occurrence could be due to loss of limbs, accidents or any health problems. The developments of wheel chair in these days are implemented by advanced powered wheelchairs which are electrically moved.

Conventional wheel chair are which manually used by their hands which is making the person to be helped them through their hands, where this would not be possible with the people who are unmovable with any of their body parts like legs or hands. Paralysis can also be caused through genetic diseases which are called as a periodic paralysis.

Figure 1: Modern wheel chair

Scientist Sir Leslie Stephen W. hawking is that the most well-known one who severely paralysed with Amyotrophic Lateral Sclerosis (ALS) within the year 1962 by that started exploitation wheel chair. Likewise, several of those who are suffering like somebody had a hope to regulate the wheel chair by an electrically controlled wheel chair. By this numerous scientists came forward to boost the methodology of wheel chair in numerous ways in which this idea of implementing the various methodology of wheel chair galvanized numerous individuals that created paralysed feel happy.

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II. LITERATURE SURVEY

Table 2.1: Comparision of Eye tracking methodology

S no	Author name	Year	Methodology	Remarks
1.	Luca maule. e*t .al* [1]	2017	Autonomous navigation	As per the navigation technique, sometimes aruco markers may not be available and create any disturbance while moving a wheel chair by the user.
2.	Neha paul M. *et.al.*[2]	2016	IR camera, Lab VIEW, DC motor	The person cannot stop his wheelchair when they wish to stop.
3.	Nutthanan Wanluk *.et.al* . [3]	2016	Raspberry-Pi,	The remote control cannot be worked for a long distance which is used to move the wheelchair.
4.	Ujjwala T. Jarad. *et.al.* [4]	2016	MATLAB script, PIC controller	In this, the PIC controller which have used cannot store much information.
5.	Dulari Sahu . *et.al.* [5]	2016	HAAR cascade algorithm, Hough circle transform	Wi-Fi adapter is used in which the person cannot operate his wheelchair when there is no power supply.
6.	Mrs.B.Buvaneswari. *et.al.*[6]	2015	MATLAB, AT Mega 1284P	Could have a better microcontroller used in the operation of the system
7.	Shyam Narayan Patel . *et al* [7]	2015	Image processing, Raspberry-Pi	It can have a better contrast in using a clear camera for the visual base.
8.	Prateek Arora. *et.al.* [8]	2015	Viola-Jones algorithm	By using this algorithm it cannot be detected tilted or turned faces.
9.	A. Nanditha sree. et.al [9]	2011	Optical sensor based systems	In the low resolutions Photo Oculo Graphy (POG) cannot be captured.
10.	Gunda Gautam *et al.* [10]	2014	Bio-potential based method	When the person is dumb who cannot talk, cannot operate the system as they have used the voice-based method in the indicating the direction of the wheelchair.
11.	Shawn plesnick *et al.* [11]	2014	The C++ script, Data Acquisition Unit, Control Module.	where the module cannot be placed conveniently in the wheelchair.

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12.	Sandesh Pai *et al.* [12]	2012	pupil tracking, Microlens Camera	Microlens camera cannot be detected when the person wishes to look down and move forward.
13.	K.S.Sabarish *et al.* [13]	2012	Fuzzy logic	By this logic there is chance of not moving the wheel chair in the proper direction like backward detection can be less
14.	Ms.Humera Mujawar. *et .al.* [14]	2015	ATMEL 8051 MATLAB 2013A	Due to which there could be a better controller used in the system.
15.	D. U. Dalavi. *et .al* [15]	2015	infrared(IR)	Based on 3 IR sensors the system is tracked and moved due to which there is no accuracy in the system
16.	Rafael Barea *et.al* [16]	2002	Electrooculography (EOG)	The complete project has made as a wired module.
17.	PoonamS. Gajwani *et.al* [17]	2010	Coherence algorithm and obstacle detection.	Camera used is not detected in the dark areas.
18.	Bharat Thaku *et.al* [18]	2014	Machine vision, Data acquisition	Behind voice coherences are held
19.	Kohei Arai *et.al* [19]	2011	Gaze estimation	Proper gazr estimation techniques are not used with which it may cause less detection.
20.	Neha Paul M *et.al* [20]	2016	IR camera, Lab VIEW	IR camera can be only made for few days or months due to less capacity.

Luca maule. e*t .al* [1] used an Autonomous navigation system methodology in which ArUco marker has been used as the according to the marker points the wheel chair is moved by the person.

Neha paul M. *et.al.*[2] , by using the joystick, IR camera along with the DC motors the paralysed person access the wheel chair.

Nutthanan Wanluk .*et.al* . [3], proposed a methodology by using Image Processing, Raspberry-Pi, Wireless Receiver. The remark found in the methodology wash, the remote control cannot be worked for a long distance which is used to move the wheelchair accessability.

Ujjwala T. Jarad. *et.al.* [4], proposed a methodology by using circular hough transform in which the pupil is detection and then according to the direction given by the user.

Dulari Sahu . *et.al.* [5], proposed a methodology using the image processing and the raspberry pi along with which the wheel chair is moved by the person who access the chair.

Mrs.B.Buvaneswari. *et.al.*[6], proposed a methodology by using the MATLAB script along with which the camera is mounted towards the eye by which the eye points on to the directions as per the directions given by the user.

Shyam Narayan Patel . *et al* [7], proposed a methodology by using Image processing techniques and ultra sonic sensors. These sensors help the camera captured images to move the wheel chair in the required direction.

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Prateek Arora. *et.al*. [8], used a Voila-Jones algorithm in which this algorithm helps the user to track the movement of the wheel chair.

A. Nanditha sree. et.al [9], used an optical based sensor in which this helps the wheel chair to move the wheel chair in the required direction.

Gunda Gautam *et al*. [10], author proposed a methodology by using the Bio potential based method , Voice based method, Motion based method and Search coil.

Shawn plesnick *et al*. [11], proposed a methodology Data Acquisition unit by using the C++ script. The remark found in the project was, as the module was heavy so couldn't be able to set on the wheel chair.

Sandesh Pai *et al*. [12] , proposed a methodology with which the microlens camera has be used and then helped in the pupil tracking ,methodology.

K.S.Sabarish *et al*. [13] , proposed a methodology by using the fuzzy logic and the other components with which helped the entire module run successfully.

Ms.Humera Mujawar. *et .al*. [14] , proposed a methodology using the ATMEL 8051 and MATLAB with the version 2013A helped the module to work but the better version of the coding process could have been done.

D. U. Dalavi. *et .al* [15], proposed a methodology by using 3 infrared sensors in which the there is a chance of making the detection may occur.

Rafael Barea *et.al* [16], proposed a methodology by using the Electrooculography(EOG) in which the cost of the module is highly expensive with many feature but instead it can be different camera which can be used so that any person can afford to buy.

PoonamS. Gajwani *et.al* [17], proposed a methodology in which the coherence alogorithm and obstacle detection methodology is used.

III. PROPOSED SYSTEM

TRANSMITTER

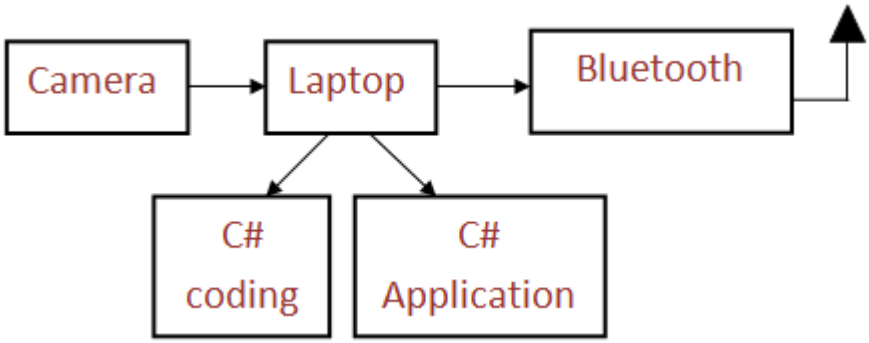

Figure 3.1 Transmitter block diagram

RECEIVER :

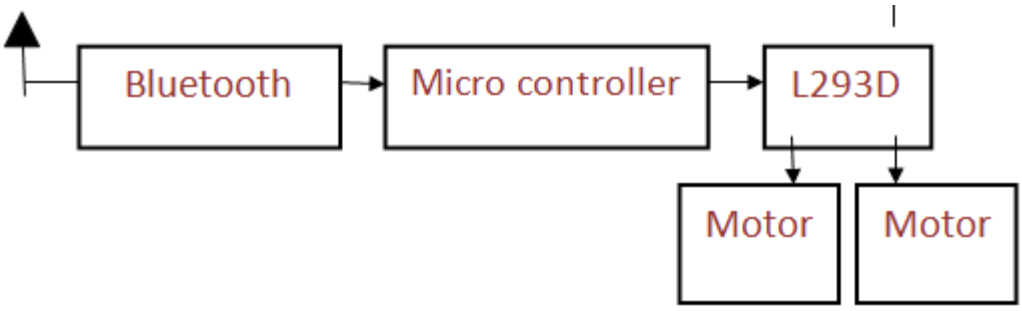

Figure 3.2 Receiver block diagram

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IV. ALGORITHM

FACE AND EYE DETECTION:

In the face and eye detection, face is detected as well as eye is detection. Detection is major role which plays in the project. Face and eye detection helps the user's eye pupil to detect, which means the pupil point is detected. One of the method used is Haar-like method which helps to detect the face to execute faster. By using the kalman filter based tracking we can remove the false detection. It not only helps in removing the false detection but also helps to remove back location of the face. The angles of the face are detected in such a way that it can be detected up to 15 degrees. By using this it can be taken up to 200 frames in a second.

IRIS DETECTION :

Iris detection is mostly formulated as circular detection in which the width of the face and the iris the average ratio is taken and computed. Novel convolution operator is used to detect the centre of the circle CHT filter is used in this algorithm as the 3D accumulator is reduced to the 2D surface by selecting the particular range of the radii.CHT filter is mostly focused on the particular image rather than detecting the edge of the image. According to the Atherton the equation of convolution kernel is given as

$$OCOA(a,b) = \begin{cases} \sqrt{1}\ a^2+b^2\,(\cos\theta ab + i\sin\theta ab), \\ \text{iff, } R_{min}{}^2 < a^2 + b^2 < R_{max2} \\ 0, \text{ otherwise} \end{cases} \longrightarrow 1$$

where, $\theta_{ab} = \left[\tan^{-1} a/b\right]$

Where a and b represents the coordination of kernel matrix . by this equal circles are made with the expected range of radius . For finding the dark region values weighting kernel is used.

$$WA(a,b) = \begin{cases} \dfrac{1}{\sqrt{m^2+n^2}\quad m^2+n^2} \text{ , iff , } m^2+n^2 < R^2 max \\ 0, \text{ otherwise} \end{cases} \longrightarrow 2$$

$$C_{GCOx} = R_e\,(O_{COx}) \otimes S_a + i\,Lm\,(O_{COA}) \otimes S_b \longrightarrow 3$$

- Where $\otimes$ represents convolution operator.
- S_a and S_b represents 3x3 schaar kernel in a and b directions.

Weighing factor β which helps to increase the gradients horizontally. Equation for real valued

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kernel is

$$C_{RCC} = \beta Re\,(O_{COX}) \otimes S_a + 1\,\beta\, Im\,(O_{COX}) \otimes S_y \longrightarrow 4$$

The final correlation output obtained is

$$CO = \lambda\,(I \otimes CR_{CC}) + (1 - \lambda)\,W \longrightarrow 5$$

Where

$$W = (255 - I) \otimes Wc \longrightarrow 6$$

The correlation of peak output which leads to the wrong detections of the image. Where, peat to side lobe ratio(PSR) is used to find the location of the iris. Finally PSR is generated as

$$PSR = \left(CO_{max} - \mu \,/\, \sigma \right) \longrightarrow 7$$

TRACKING OF IRIS

Kalman filter is used to detect the IC in videos for capturing of the particular image area. Coordinates of the image is equated as

$X_{t+1} = F_t X_t + W_t$

X_t contains a,b, V_a,V_b coordinates and its velocity in a and b directions at the t th instantaneously

DETECTION AND TRACKING METHODOLOGY OF EYE CORNER:

Detecting and tracking the eye corners are the major aspect for the images to capture. Vectors which are connected to the corners of the eye and the eye centre will be calculated by the gaze position. The corners of an eye are easily located in eye ROI .Several images are captured in such a way that the cameras helps the module to move in the respective directions.

ESTIMATION OF GAZE

For the gaze estimation Ic location and reference point are noted.

If (a1, b1) and (a2, b2) represents the co ordinations of eye corners and the iris centre.

(a, b) = ($a_2 - b_1$, $a_2 - b_1$) . The eye corners and the iris centre vector (EC-IC) I equated separately for the left and right eye.

Screen $a_i = x_0a_i + x_1b_i + x_2a_ib_i + x_3a_{\,2}\,i + x_4b_{\,2}\,i + x_5$ ⟶ 8

Screen $b_i = y_0x_i + y_1b_i + y_2a_ib_i + y_3a_{\,2}\,i + y_4b_{\,2}\,i + y_5$ ⟶ 9

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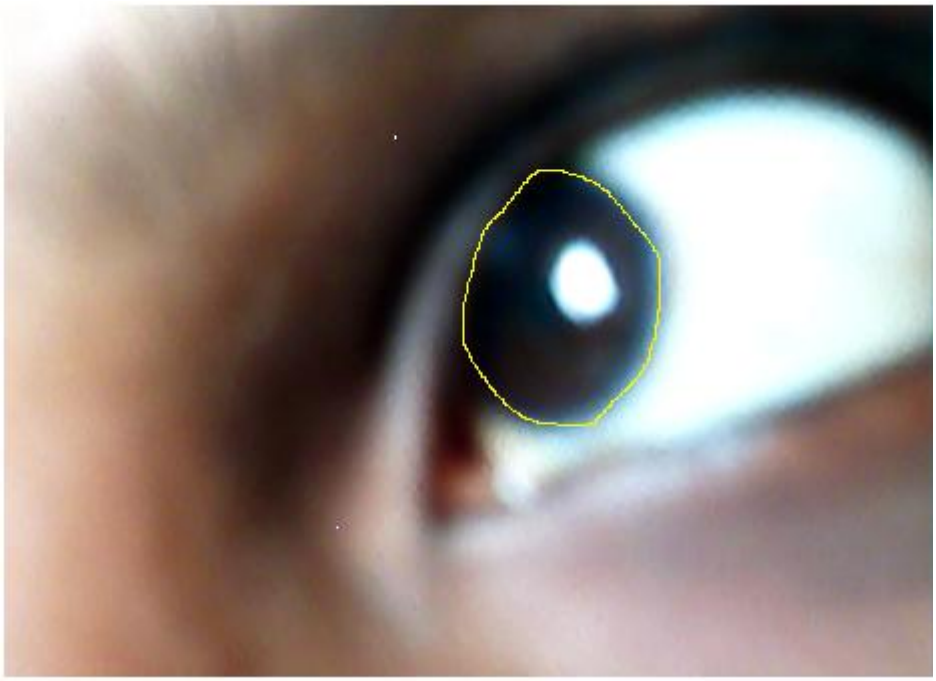

Figure 4.1: Selected users eye corner points

From the above figure it shows the eye corner detection in which the camera is detected.

Through this eye corners the image is converted according to the gray colour conversion technique in which the colour portion of the eye is converted in to the light color and the dark colour portion is converted in tyo the light colour of an eye in which this helps the wheel chair to move in either directions given by the user like forward, backward, left hand side and the right hand side.

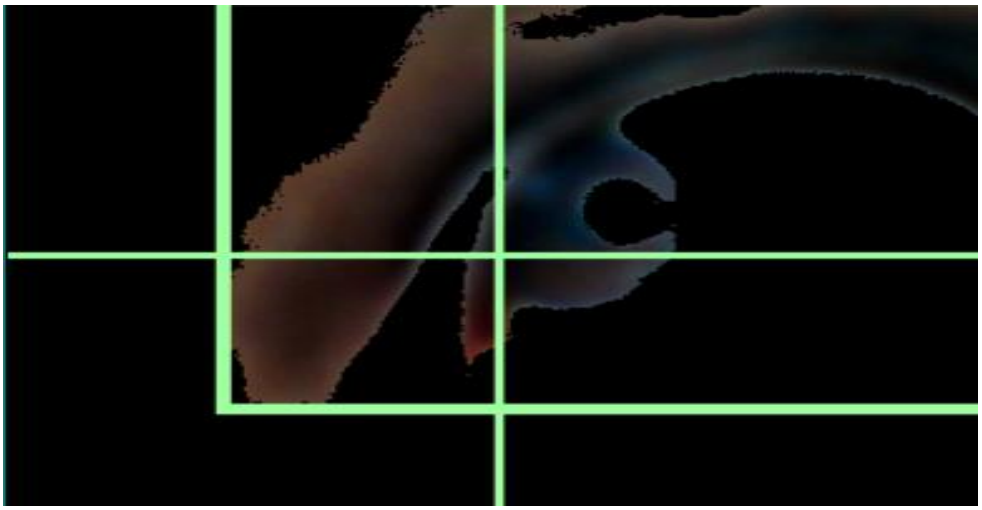

Figure 4.2: Cropped region of an Eye

From the above figure it shows the conversion of eye colour is changed by using the gray colour conversion technique.

SOFTWARE

Software used in the project is a C# coding in which the whole debugging is done by using the Microsoft Visual Studio. First the arduino coding is done in the arduino applcation in which the program is sampled to check whether the directions of the module is moved in the following directions or not.

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In the below figure 4.14 it shows the path of the coding area in which the code is generated in such a way that coding is running with the right operations or not. Arduino applications helps in writing the code to check the sample one. This application not only helps in writing the code or to check but also make the users to use this application easily.

The coding which has generated in the arduino is of embedded C in which proper command functions are used in the design. The coding is generated in such a way that the directions of the eye ball or pupil is used and made the directions. The coding is generated in such a way gthat the four directions like forward, backward, left hand side and the right hand side of an eye should be moved so that according to it the directions of the wheel chair are made.

This coding is generated according to the logic 0 and logic 1 so that when the wheel chair is wished to move in the forward direction then the i is given as 1 and the other movement of the motor wheel chair is given as 0. Like wise, the other directions are also made. It is very easy to generate the code for the directions of the wheel chair but we have to make sure that the

The version used in writing the code is an arduino 1.8.9 in which helps the coding path to write a code and generate it easily in such a way that the exact debugging can be held and the direction marks given are also generated in such a way that the user cvan be easily move an eye for the required directions.

V. RESULT

By the end of the project the final results are made in such a way that, when the connections are made with the help of bluetooth to the laptop in which perfect connections are made. Later, the camera which is worn like a headset helps to capture the eye pupil of the use. Then the coding which has been executed to run the entire system is opened and debugged with which the particular port of the bluetooth which is connected to the laptop before is needed to be indicated.

The port mostly used in the project is COM7. After the debugging process is started the application of Advanced Eye Ball Movement Tracker is opened in which the entire process runs. The main advantage of the applicationis as every person has the different eye ball colour. That can be changed to the particular eye ball in this application.according to the direction of the eye ball is made likewise the wheel chair is moved.by this the perfect outputs are made with the following methodology used.

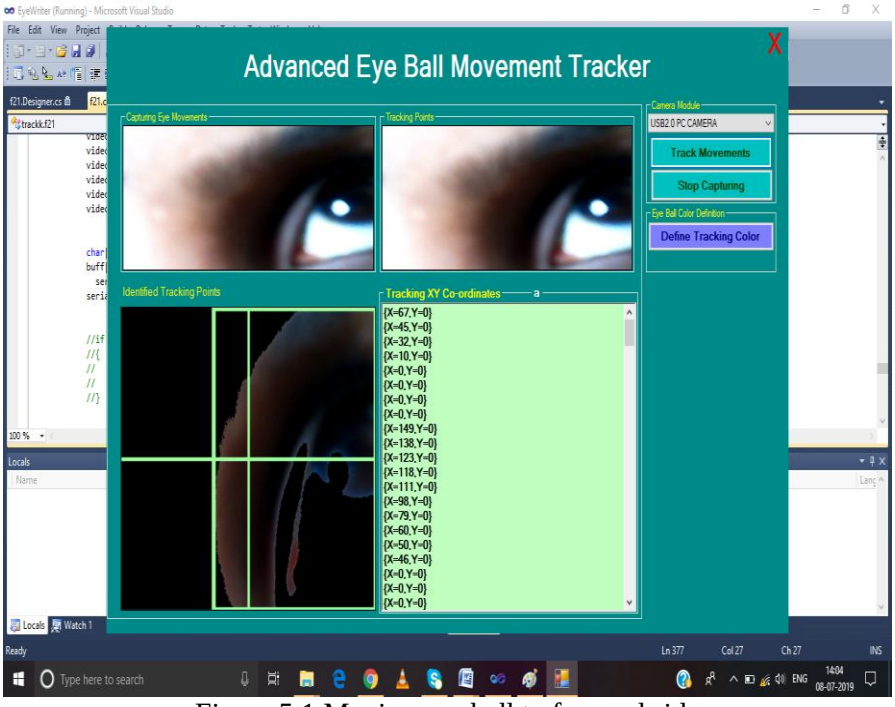

Figure 5.1 Moving eye ball to forward side

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From the above figure 5.1 it descibes that by moving the eye lid towards the forward side which is indicated as ‘a’ and by this the wheelchair moves forward.

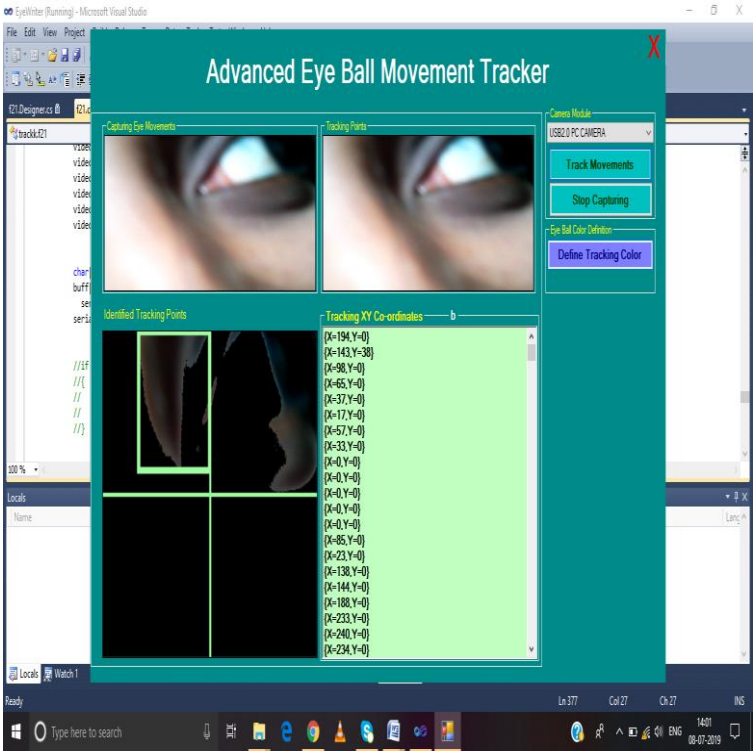

Figure 5.2 Moving eye ball to left side

From the above figure 5.2 it descibes that by moving the eye lid towards the left side which indicated as ‘b’ and by this the wheelchair moves towards left.

This not only helps the user to move in the partucular directions but also helps to perform the tasks easily.

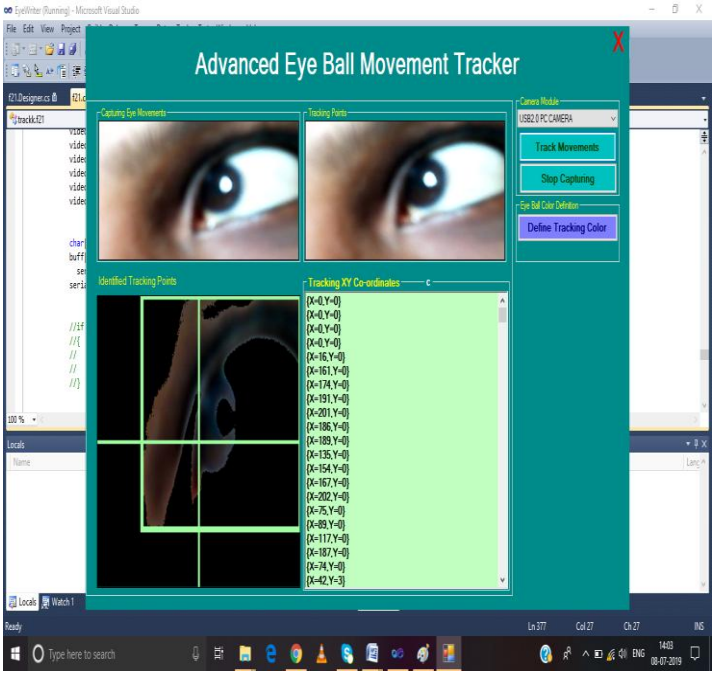

Figure 5.3 Moving eye ball to right side

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From the above figure 5.3 it descibes that by moving the eye lid towards the right side which indicated as ‘c’ and by this the wheelchair moves towards right. According to the right axis the movement of an eye ball is made

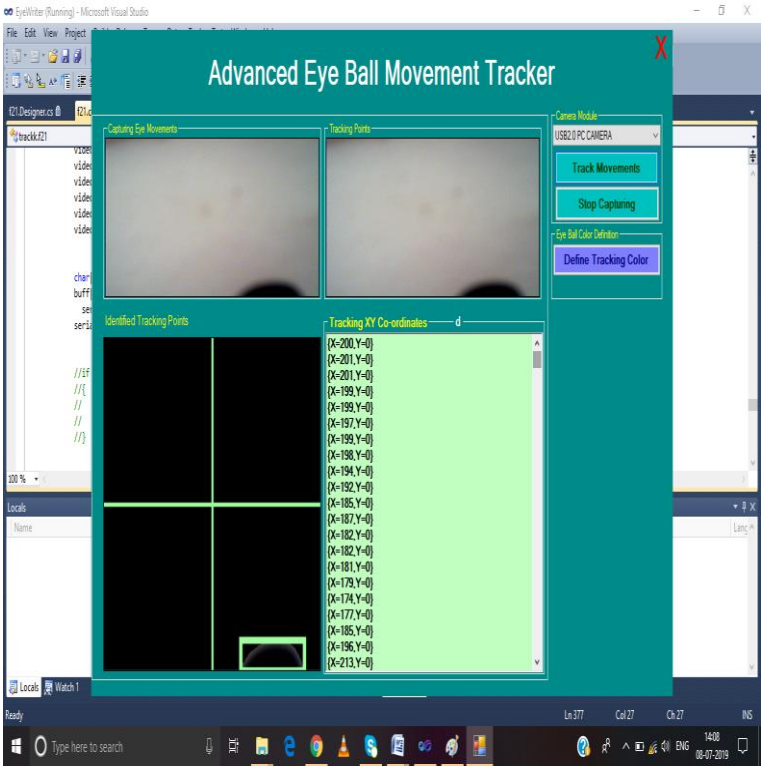

Figure 5.4 Moving eye ball towards backwards

From the above figure 5.3 it descibes that by moving the eye lid towards the backwards which indicated as ‘d’ and by this the wheelchair moves towards backwards.

The above outputs are the perfectly generated with which this module helps the people who are paralysed and who are dependent on others to move them one place to the other.

VI. CONCLUSION

The proposed wheelchair is easy to operate by the user. The headset worn by the user is light weighted carrying only a small camera with LEDs. The user has to only look left, right, forward and backward to move the wheelchair towards the desired direction. The diagonal motion is achieved when user looks left or right for only small duration of time. The experimental results are satisfactory.

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