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Eyeball Controlled Wheelchair

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Abstract: *A basic wheelchair is a gadget for people influenced by moderate, extreme physical incapacities and interminable disease. It is also meant for the elderly people. Many people with disabilities cannot manage the energized wheelchair operating joystick, sound, furthermore, hand developments as it is harder for the individual to do such specific tasks also it is programming focused. This strategy comprises of equipment which reduces the person's work utilizing the image processing method. This model comprised of a camera that tracks the eyeball movement and hence the position of the pupil by the image processing technique. And thereby the wheelchair is constrained by a user's eye gesture in an indoor space. When the development has been initiated and it is given to the Raspberry pi for processing. The procedure relies on the feed coding and an output is given into the driver circuit. Likewise, the hindrance location sensors will be associated as an Emergency Brake that gives necessary conditions for the conventional activity of the wheelchair framework. Every one of the four wheels are associated with a driving circuit that moves the wheelchair*

Keywords*: Eyeball tracking technology, Wheelchair, Sensors, Raspberry pi, python, image processing.*

I. Introduction

A Wheelchair is basically designed and is mainly used when walking is troublesome or outlandish. Wheelchairs arrive in an assortment of arrangements to meet the particular needs. The needs may comprise specific seating alterations, individualized controls, and might be explicit to specific exercises.

A report uncovers that according to 2011 populace census, 20% of people with handicaps in India have incapacity in development, 19% have an inability in observing, 19% have incapacity in hearing and 8% have numerous handicaps. In this proposed model of Eyeball Controlled Wheelchair using Raspberry pi, the movement of a wheelchair depends only on the eye movement. The helmet has a camera mounted on it to capture the user's pupil position and hence moving the wheelchair in that respective direction. Ultrasonic sensors are used for the emergency brake. When the wheelchair detects an obstacle/barrier then as a result of the emergency brake the wheelchair automatically stops. Through the operation of an image processing, an input is conveyed to the Raspberry pi. The Raspberry pi then operates the image with the help of Python coding language and as an output, the wheelchair moves in the directed direction. Figure.1 shows the framework of the Eyeball Controlled Wheelchair. Since digital image processing involves the utilization of computers to process digital images through certain algorithms. Image processing is a faster as well as an easy process. This camera captures the picture progressively and a picture is investigated as contribution to set the orders for the motor driver. Gear motors perform various tasks like left, right, forward, in reverse in the result.

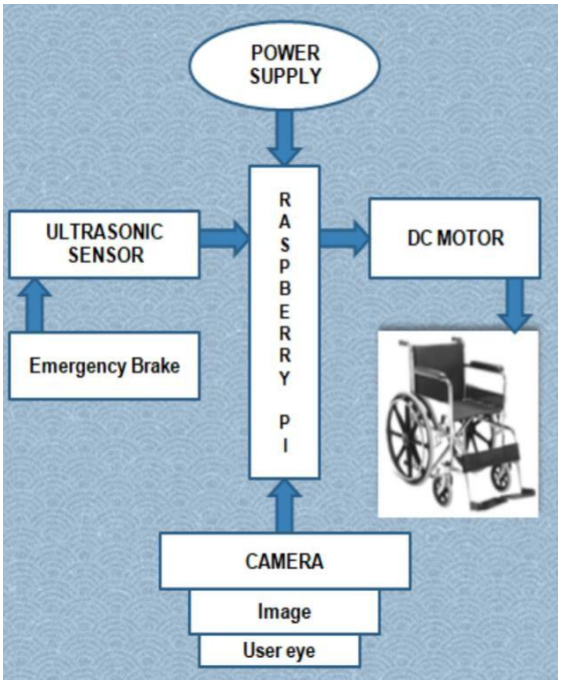


Fig. 1. Block Diagram

II. Literature Review

Eye-tracking includes the design and implementation of the rotational of the eye in all the directions according to the eye angle tracking in all the directions through the eye- tracking system at a very low cost through the EOG circuit. And the measurements of horizontal angles are more accurate than vertical measurements.[1]

Contains information regarding the structure and execution of an eyeball controlled utilizing the electro-oculography technology designed as a savvy mobility adds the incapacitate obstacle sensing and so many technical designed microcontroller is casted instead of a PC, consisting of the various safety features are also introduced to get a proper coordinated utilizing control module to vigorous and streamlined [2] system includes the SIAMO. And it is developed to each individual's specific need, according to the sort and incapacity.

To wheelchair clients who can only with significant effort work customary fuelled units. The ultrasonic framework to configuration considering fast and simple discovery of obstacles [3] contains data as indicated by the populace numerous people with different handicaps are fulfilled by the controlled wheelchairs, and examination is done on versatile mechanical autonomy to make savvy wheelchairs. This aides in a synopsis of the current cutting edge and bearings for future different models of wheelchairs.[4]

This helps disable individual who find themselves challenging to go out without the help of any other wheelchair is introduced for their solution, A new technology is introduced to control the wheelchairs using infrared. An infrared depends on the eyelid movement. The primary target of this wheelchair is to reduce human effort to operate the wheelchair. [5]

This helps disable individual who find themselves challenging to go out without the help of any other wheelchair is introduced for their solution, A new technology is introduced to control the wheelchairs using infrared. An infrared depends on the eyelid movement. The primary target of this wheelchair is to reduce human effort to operate the wheelchair. Paper consists of an eye recognition approach utilizing annular though trans-method is about form. This process includes face detection methods and eye detection methods. Eyes tracking method includes pre-processing that separated and edited the face pictures and annular however change. [6] [7]

Pupil positioning has been discussed in this paper. This calculation is worthy aside from that the meaning of the understudy edge includes an incredible effect on its productivity and oval fitting is a tedious technique. [8]

Understudy situating has been talked about in this paper. We propose a non-IR based calculation and use RGB shading space dependent on a quick student situating calculation for realtime eye-following frameworks. This calculation is worthy with the exception of that the meaning of the understudy edge impacts its effectiveness and oval fitting on a tedious strategy. [9]

A non-meddling eye tracker can distinguish and follow an individual's eyes in realtime. The face shows up in the perspective on the camera without lighting of gaze monitoring employs neural networks. It is required to screen the individual's eye gaze to find the individual's focal point of consideration.[10]

III. The Proposed System

Eyeball controlling system includes the following of eye motion. A system in which power supply to each and very component is mandatory and a standard power must be supplied to Raspberry Pi, camera, and motors.

In the proposed model camera and motor driver is connected directly to the Raspberry Pi board.

Figure 2 shows the working model of the framework.

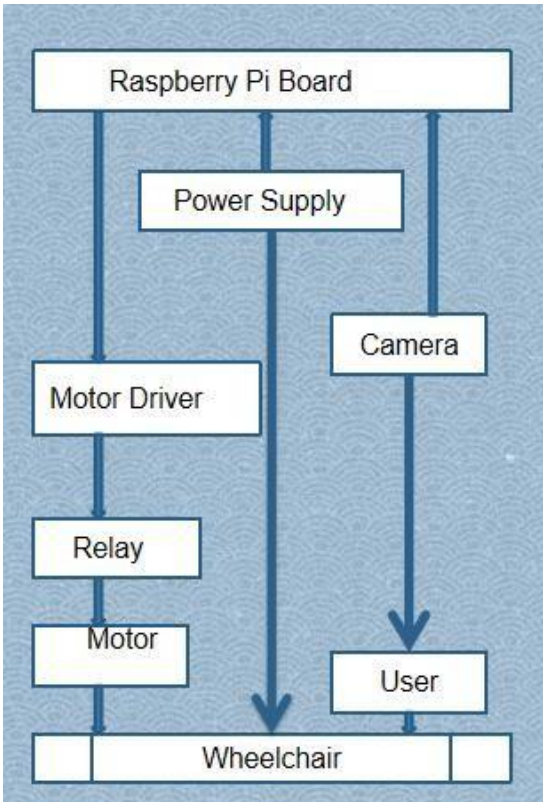


Fig. 2. Working of the proposed model

1. Hardware Description

A.Raspberry pi

It has its own operating system RASPIAN that is based on the Linux working framework and is very compatible with the Raspberry Pi board. The motor driver receives the commands sent by Raspberry pi that results in the movement of the wheelchair in the directed direction. Raspberry Pi is called the Brain cell of the framework.

1.4GHz 64-bit quad-core processor along with 802.11n Wi- Fi. With 4.2/BIE Bluetooth & USB boot capability and has 3 times faster gigabit Ethernet.

Raspberry Pi: Raspberry Pi three Model B+ has quick Ethernet & power Ethernet. These are ease and credit estimated gadgets that utilize standard console and mouse.

B. DC Motor(Gear Motor)

2 Gear motors of each 12V have been used for moving the wheelchair ahead, backward, left and right direction.L293D is a motor driver that is utilized to interface with Raspberry Pi which is TTL(Transistor-Transistor Logic which is a rationale family worked from bipolar junction transistor). To increase the current capacity to 2Amp 2 H Bridges of L293D can be connected in parallel.

Voltage: 12Volt DC, Torque: 1200 m Nm, Speed: 24RPM

Current: 0.9A, Gear Ratio: 264:1, Encoder yield: 1848 heartbeats for every turn, single channel yield.

a

b

Fig. 3 (a) & (b) Actual Photograph of Proposed Model

C. Ultrasonic Sensors

Ultrasonic sensors in this system have been used for the Emergency brake, which detects a minimum separation between the wheelchair and the hindrance, and thus, engines will stop to run the wheels.

Ultrasonic sensors are of 4 types:- Ultrasonic proximity sensor(used for alternate transmission as well as the reception of sound waves), Ultrasonic 2-point proximity switches(have 2 points for switching), Ultrasonic retro-reflective sensor(operation is similar as of the Ultrasonic proximity sensor and the only difference is that by measuring the propagation time gives the distance between the sensor and the reflector) and Ultrasonic through-beam sensor(comprised of two separate components, emitter and receiver which are mounted directly opposite to one another).

In our system, we have used the Ultrasonic Proximity sensor for sensing the distance for the Emergency Brake.

Measurable distance: 2cm-300cm Measurement resolution: 3mm

Minimum time between the measurements: 50us

D. Camera

To interface the camera with Raspberry Pi board UV4L Driver has been used. While the camera captures the image that is used further in the image processing process.

E. Relay

For changing the direction of the motors at a very fast instance relay is used. It's an electromechanical gadget that comprises of an electromagnet and various contact sets.

2.Software Description

A. Python language

Python language syntax is easy what's more, hence decreases the expense of program support.

It is very effective because of its fast edit-test-debug cycle. Moreover, Matlab could also be used for code but because of its expensiveness and proprietary algorithms, there's a restriction on code portability.

B. Open CV Image Library

It's a cross-stage and free for use under the open-source BSD permit. It brace Linux, Windows, iOS, and Android and it also has C++, C, Python, and Java interfaces.

Fig. 4 Actual Photograph of Raspberry pi

C. Putty Software

It is a free and open-source terminal emulator sequential comfort, and system document move application Used for connecting the desktop to the Raspberry pi board. It can be utilized to interface with a Telnet meeting which makes it risky. If interfacing with a SSH server utilizing SSH2 with Putty, at that point you are most likely fine

IV. Design And The Implementation

Different Algorithms have been utilized for following the eye student area by the technique for Image handling. The underlying procedure of the .framework includes the catching of the picture by the introduced camera and the thought process of the task is to recognize the client's eye student precisely. While recognition of different eyes will bring about blunder and after this lone further activity will be performed.

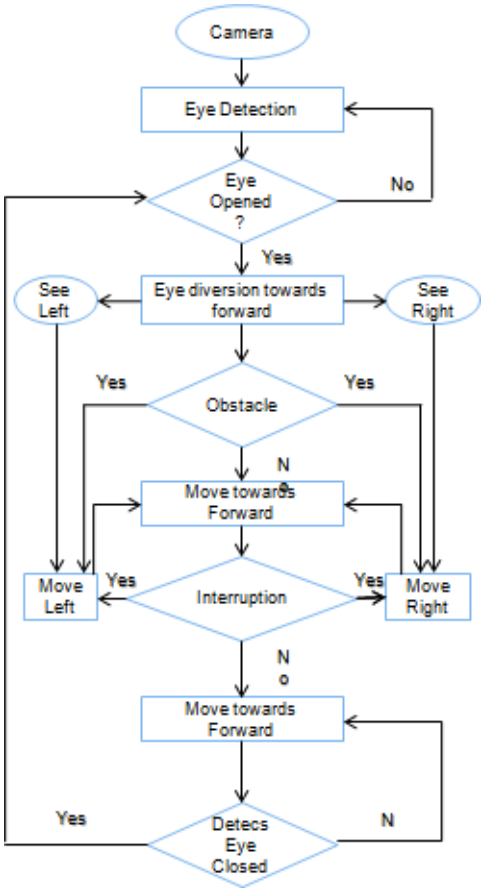


Fig. 4 Flow Diagram

V. Experimental Analysis

We use student size, shape, and shading in view of the primary information. Initially, the versatile limit technique is applied for student location. The typical pixel value of eye image decides the threshold value T. We set the limit estimation of 27% underneath the normal worth. We set the threshold value of 27% below the average value.

$$\mu = \frac{1}{N}\sum_{I=0}^{N-1} I \quad (1)$$

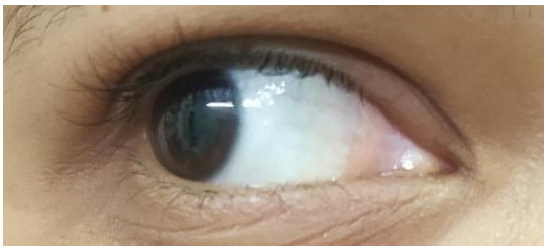
$$T = 0.270\mu \quad (2)$$

Understudy is marked together hover inside the procured eye picture. In the main stage, the student is recognized by a versatile edge strategy when the understudy plainly shows up inside the obtained eye picture. By utilizing associated named segments, we will handily gauge the student community area.

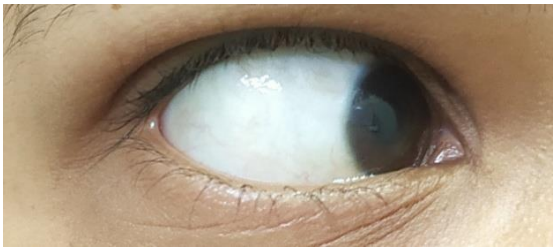
The shape and size of the eye are changed when the client looks to one side and left bearings. In this circumstance, understudy discovery is difficult to search out. Clamor and impedance because of eyelid must be disposed of. In this circumstance, information on size and shape can be utilized. Additionally recently recognized student place is regularly utilized when clients close the eye. The student place area is chosen utilizing the resulting condition.

$$P(t-1)-C<P(t)<P(t-1)+C \qquad (3)$$

The sensible pupil location P(t) is for the most part in encompassing prior area P(t-1) with world C. Fig.5 shows such this circumstance.



a



b

c

d

e

Fig. 5 (a) Left, (b) Right, (c) Centre, (d) Down & (e) Up

When the whole above method neglects to distinguish understudy focus area, at that point we gauge student focus area by utilizing eye developments. This circumstance happens when the dark pixels are blended in with others or no dark pixels at all in the procured picture. We utilize this information as a last need to keep away from a questionable movement that makes misidentification of the student the contrary eye segments. We followed a student area utilizing its past area upheld the notable Kalman channel. Kalman Filter revises the assessed student area and speed. In every pixel as recognized as a student, we assume the area of the understudy is (IT, JT) and velocity is (UT, YT). Because of the previous location is (IT, JT), the current location should be(*it*+ *UT, JT*+ V*T*).We can display the condition of understudy area is as per the following,

$$x_t\,(I, \mathrm{J}) = Ax_{t-1}\,(I, \mathrm{J}) + \Omega_{k-1}\,(I, j) \qquad (4)$$

where XT is a genuine state and An is state progress while Wk. signifies added substance clamor. Next, we expect that the assessed area is (Iˆ, J). The estimation procedu*t*re can be displayed as follows,

$$z_k\,(I, \mathrm{J}) = Xx_k\,(I,\mathrm{J}) + v_k\,(I, \mathrm{J}) \qquad (5)$$

where VK represents noises within the measurement, H represents the observation matrix. This method works when the estimated pupil location becomes entrusted. Such a condition may happen when the opposite components disturb the pupil location estimation. By using time updating algorithm and measurement update process, a far better-estimated pupil location is going to be obtained.

S. No.	P1	P2	P3	P4	P5
Total Detections No.	30	30	30	30	30
Total no. of max left Detection (S1)	8/10	10/10	9/10	8/10	9/10
Total no. of max center Detection (S2)	9/10	8/10	9/10	10/10	10/10
Total no. of max right Detection (S3)	8/10	8/10	10/10	9/10	10/10
Total no. of max Detection	25	26	28	27	29
Accuracy	83.33%	86.66%	93.33 %	90%	96.66%
Error	16.67%	13.34%	6.67%	10%	3.34%

Table 1. Anthology of tests and errors

Measuring accuracy: Gaze estimation accuracy is measured at the middle center to horizontally aligned five different locations with different angles as shown in Fig.7.

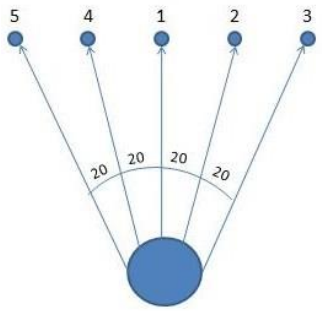


Fig. 7 Different locations of eye pupil (accuracy)

Raspberry pi 3b+ and Microcontroller AtMega32-8 bit has been successfully used to design and test the eyeball controlled wheelchair-using a camera. The outcomes of the variously conducted trials on different persons have been observed and logged to be used in case of future studies. The circuits and control algorithms have been successfully tested. The proposed design is complete and successfully tested

VII. Conclusion & Future Scope

Image Processing using Raspberry pi has been effectively used to plan and test the eyeball controlled wheelchair.

The Image Processing based controlled wheelchair can be utilized as a fundamental framework in future advances, for example, home computerization. The helmet provides additional safety to the user. The framework can be utilized for remote mechanization as an indoor gadget. The emergency brakes play a vital role in providing the person accident-free. With various required modifications, this Eyeball Controlled Wheelchair can also be implemented in vehicle automation as well as for individual home automation.

The steering can be constrained by the movement of an individual's eyeball. In this manner, we have effectively made a gadget for exhibiting and testing eye-based interfaces at an exceptionally minimal effort and high proficiency which can be utilized for a huge scope in different fields.

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