WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Wheelchair Movement through Eyeball Recognition using Raspberry Pi

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DOI: https://doi.org/10.55248/gengpi.2022.3.4.13

A B S T R A C T

We all consider how we might help people who are in needy, whether economically or substantially. As a graduate, on the other hand, allows us to create a new instrument or machine that benefits the less fortunate. This project is an example of how we can make a difference in society. Many people have become paralyzed in recent years. Paralysis is nothing but a complete loss of power in muscle group. In the bad scenario, the disable could only operate his eyes. To assist these disabled people, we are implementing the project eyeball movement-based wheelchair would benefit them the most. In comparison to previous automated wheelchairs, this would be more accurate because noise from the outside environment causes inaccuracy in voice-controlled wheelchairs, and human effort is necessary for a head movement-based wheelchair. Here we are putting in place a device that allows people sitting in wheelchairs and look straight into the camera to direct the wheelchair in the desired path easily by looking in that specific path. We designed this system using Raspberry Pi (with image processing, camera, OpenCV python). It involves certain set of algorithms that allows you to run the wheelchair. To control the wheelchair movement a method is proposed that is called Eyeball Localization. To reduce the cost and computational complexity, there is an algorithm designed with efficient system and different executional steps. An Open CV application monitors the camera signals and directs the motor connected to the Raspberry Pi microprocessor via the serial interface to move in a specific path. Because the system is economically handy, it can be used by patients from a wide range of socioeconomic backgrounds. When compared to other automated wheelchairs, this would be more accurate.

Keywords:OpenCV, Automated wheelchair, Eyeball Monitored System, Python, Raspberry Pi, Image Processing, Quadriplegia.

1. Introduction

The goal of this study is to suggest a method for controlling a wheelchair using ocular localization. By reducing both costs and complexity, an algorithm provides an efficient method of processing data. During this project physical features of the pupil and eye were taken into account, as well as pixel values from nearby areas, since the purpose was to track and detect eyeballs in real time. Localization of the eyeball is used in a variety of applications, and many algorithms have been developed to easily achieve the results that are desired.We had to develop an algorithm specifically designed for this application, since none of these algorithms could be implemented on controllers with limited RAM speed. Another objective of this project is to build a hardware assembly to remotely control an eyeball by observing its position. A wheelchair with a completely automated gear box, motor, and power supply is created, allowing people with disabilities to move around independently. Additionally, the wheelchair's incorporation of multiple modules and other optional features made it more affordable and more practical for individuals. Keeping in mind of the larger welfare of human society this project conception and execution were designed. Harr Cascade classifier is used by us in this system. In this system, using the place on the face where the eyeball is located is detected, and accurate location of the eyeball is located using statistical analysis and geometricaltechnique,

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by using these techniques the detection of unwanted region of face that are close to the eyeball from being recognized and from being detected.

2. Literature Review

2.1 Advanced Intelligent Eye Controlled Wheelchair for Disabled Person:

Author built the system is built with a web camera, an ultrasonic sensor, an Arduino, and a motor driver IC. Here the web cam detects the patient's pupil, which is then processed with the MATLAB software. For eye pupil detection, the image acquisition toolbox is used. The Arduino serial interface sends commands to the Motor driver IC L293D based on the movement of the eye pupil. With Arduino connected to the wheelchair, the wheelchair can travel forward, backward, left, or right, depending on the signal received from the Arduino. If an obstacle is detected in the path of the wheelchair, the ultrasonic sensor detects it and the wheelchair stops immediately.

2.2 An Automated Eyeball Controlled Wheelchair for Patients who are paralyzed using Arduino:

Here the system the main input is head movement of the user, which will be taken as input signal to move the wheelchair in particular direction that user needed. In this system voice control is also used. For the head movement a head cap is used that is attached with a robotic limb individually. The microcontroller accelerates the vehicle based on the user's head movement, which is detected by the head cap.If the eye movement was not recognized for a particular period of time, the system will be turned off using an eye blink sensor.The eye control system allays the concerns mentioned above by simplifying and improving users' lives. A set of image processing commands enabled by MATLAB is used to drive the wheelchair based on eye pupil movement.In order to move in a specific direction, microcontroller signals control the driving circuit. Wheel chairs are equipped with ultrasonic sensors that keep them from colliding with objects along their route. If someone suffering from paralysis closes their eyes while on a wheelchair, the wheelchair will come to a halt.

2.3 Eye Gaze Controlled Wheelchair:

This research addressed the aforementioned issues; the eye control system allows them to simplify and improve their lives.This system detects eye pupil movement by using MATLAB, a set of image processing instructions, to control the wheelchair. The microcontroller unit sends signals to the driver circuit to cause it to move in a specific direction. Ultrasonic sensors are used to avoid collisions between wheelchairs and objects in their path. In an emergency, if a paralyzed patient closes their eyes, the wheelchair comes to a halt. This chair moves to the left, right, forward, and back in response to the patient's eyeball movement. This enables the paralyzed individual to live independently.

2.4 Auto Controlled Wheelchair for Quadriplegics:

Balamurugan proposed the system considering two components they are Motion tracking and eye detection using a microprocessor for wheelchair assembly.

- In the first component there is a web camera, that will be wired to the user's laptop runs an OpenCV application.This will be accomplished through the use of a series of snapshots, after which wheelchair's path will be determined by the user's eye movements, and the wheelchair will move in a specific direction depending on what direction the user chooses.
- In the next component, Microcontrollers communicate with OpenCV applications and receive a decision based on the processing they perform.As soon as it receives the wheelchair, the controller lifts the port pin to which it is connected to, causing the wheelchair to move as desired.

2.5Eye Recognition-based Electric Wheelchair:

Abhishek explained a system that will track the eye of the person who is wearing the camera using laptop system and spectacle mounted camera. As the USB output passes through the laptop's microprocessor, it will be taken to the laptop's display and to move the wheels it takes the electrical signals which are produced from digital output signals. In this system there are two modules namely Capture and analysis of images modules. In the first module the image will be captured using MATLAB and in the second module the capture image will go through segmentation and processed to find the pupil and get the direction of the pupil. Using a camera on the headgear, the patient can look straight at the camera and move in a certain direction by simply staring in that direction.With the help of an OpenCV programme, the Microcontroller controls the motors connected to the Serial Interface by monitoring the camera signals.Patient from a variety of economic backgrounds can benefit from the device, as it is inexpensive.

The Machine Learning field lot of applications we are having. Some of the applications are Regression [9], Plant Disease Prediction [6], Cancer prediction [7], Security [8] [9], Forgery Detection [10], and so on.

3. Proposed Work

This section gives the information about implementation of our work. This section consists of three stages. First stage is about detection and conversion of image, second stage is about partition of the image and third stage is about sending logic from the raspberry pi to dc motor using motor driver.

3.1.Stage one - Detection of the Eyeball and Conversion of the image:

The colour of the eyeball is essentially black. In order to find the direction of the eye we have to count the number of black pixels in the eye. To accomplish the above process, we have to give the persons eyes image as the input to the code that we have to be executed. As a result, the person's image is captured and then eye image will be send to the raspberry pi using raspberry pi compatible camera. The image that was captures is coloured picture. Because there are more pixels in a colour image, computing it is a more difficult task. For this purpose, the binary image (black and white) will be converted from the captured colour image. Next the coloured image will convert to grayscale image using colour spaces using thresholding. As the darkest region in any human eye is eyeball, when it is converted to grayscale image this will be in the brightest shades of gray. Because the black pixel value is zero, we have to fix the threshold value near to zero. White pixels will be produced for all pixels equal to or greater than the threshold value. Black pixels will be generated if the threshold value is equal to or less than the threshold value.

Figure.1--5MP Pi CameraFigure. 2-- Pi camera with Raspberry pi

3.2. Stage two – Division of the image:

In this stage we have to break the image int three vertical parts. By writing the Python code we will count how many pixels in the picture are black. It must go right if there are more black pixels in the right portion, and it must go left if there are more black pixels in the left portion. In the other case we have to divide the image into three horizontal parts. In the middle of the image, there are a greater number of black pixels

With our Python function, we'll determine how many black pixels are in each region. We must proceed if the number of dark pixels in the top area increases. In the same way we move backward when the black pixels on the bottom section are higher. In the central part of the chair, when the number of black pixels reaches a certain point, it halts.

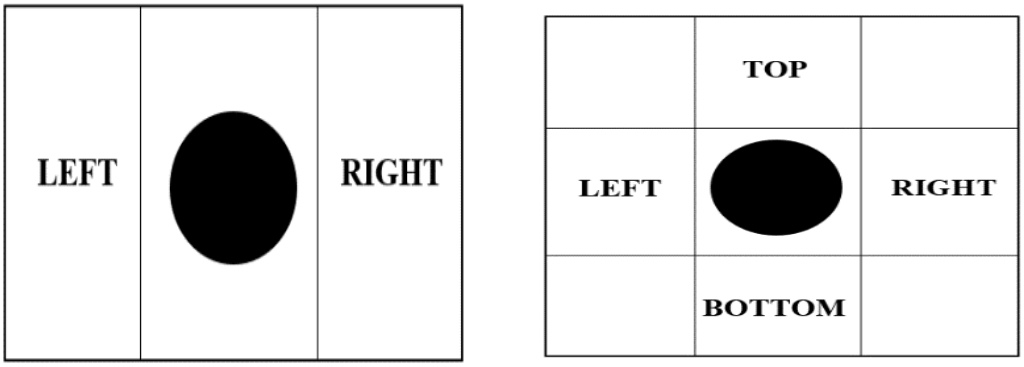


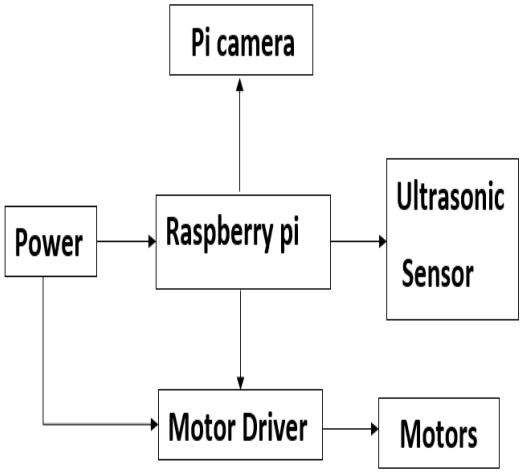
Fig. 3. Diagrammatic representation of image division

3.3. Stage three – Transmitting the logic of DC motor from Raspberry pi using driver motor IC:

Here the motor driver IC is L293D. The motor driver IC that operates on the principle of H-bridge circuit. In H-bridge circuit to make power supply there are four switches connected in parallel. We have a motor between the parallel connections. If S4 and S1 are both turned on, the motor will rotate front; if S3 and S2 are both turned on, the motor will rotate back. H-bridge circuit is an electronic circuit that switches the polarity of a voltage applied to a load. These circuits are frequently used in robotics and other applications to allow DC motors to move forward or backward. This H-primary bridge's application is motor control. It is dangerous to drive and change directions at the same time because the H-bridge may burn.

L293D driver motor IC is connected to the dc motors then that L293D driver motor will be connected to GPIO pins of Raspberry Pi. Now the motors move forward when the input given as HIGH-LOW, in the same way motors move in backward direction when the input is given as LOW-HIGH. We use two dc-motors because we need turning movement. The L293D IC works like, receives signals from the microprocessor and then it transits those signals to the respective motors. This IC has 2 voltage pins, in those pins one is used to draw current for the working of the L293D and the another one is used to apply voltage to the respective motors.

In the pin diagram of motor driver, it contains total of 16 pins where there are four input pins, four output pins, pins of enable 1,2,3,4 are connected to two pins. In every motor driver there must be ground connected to it, at pins 4,5,12,13 ground is connected, and the vcc's are connected to two pins, where vcc denotes the voltage at the common collector. On a circuit, the letter V represents the supply voltage. The supply voltage is indicated by letter CC that is either positive or negative. Enable A pin is used to control the speed of motor A. Similarly, Enable B pin is used to control the speed of motor B.



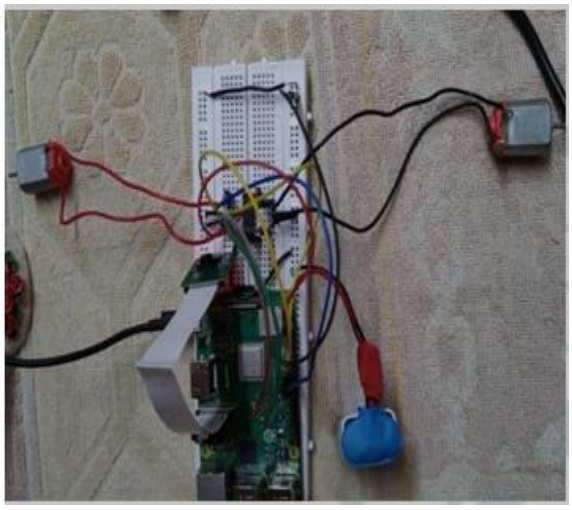


Figure. 6-- Block Diagram of the SystemFigure. 7-- Prototype of our System

There are two types of DC motors one is self-excited another one is separately excited based on the construction. This DC motor is different from other motors, it will convert the electrical energy into mechanical energy. This operation mainly depends on electromagnetic principle. The main components of this motor are rotor, stator, commutator, field windings, axel and brushes. Those motors and motor driver are connected with the help of the male to male, female to male and female to female. The output from the raspberry pi code will be passed to the L293D IC. Then this motor driver converts it into the signal and it passes the signals to the DC motors. With that signals the motors will move in the specific direction according to the specific movement of the eyeball. Those motors are connected to the wheelchair then the wheelchair also will be move in that direction. And the final output or result will be used by the people who are suffering from the quadriplegia people.

Move Left

Move Back

Move Front Move Right

Figure. 8-- Binary and Grayscale image along with direction

4.Conclusion

The main aim of this project is to develop an automated wheelchair for the people who are physically handicapped by using eyeball detection technique. The obtained result is suitable for physically challenged people to move the wheelchair easily irrespective of their ages. This can be successfully done by moving the ones eye in a particular direction, which will move the wheelchair in that direction. The result is more accurate when every frame is captured from the eyeball and the number of pixels from each frame is taken into consideration.

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