Eyeball Movement Based Wheel Chair Control System

M. VASANTHA LAKSHMI[1], N.V.SRINIVAS[2], M.LAKSHMINADH[3], N. SATHISH KUMAR[4], M. HAREESH TEJA[5]

[1, 2, 3, 4, 5] *Department of Electronics and Communication Engineering, Vasireddy Venkatadri Institute of Technology, Nambur(V), Guntur(Dt), Andhra Pradesh , India*

Abstract- ***Many people are suffering from the disease called Quadriplegia which means the forelimbs of those people do not work. Some People cannot walk, and they can't even move because of major accidents. The number of persons suffering from Quadriplegia is increasing with increase in the population of the world. For such people, the main source for movement is the Wheelchair. It is very helpful for the people if those wheel chairs are automated. Some systems have already come into existence such as voice controlled wheel chair, gesture controlled wheel chair. But these systems have some drawbacks as they cannot be used by the persons who cannot move their hands, and voice controlled systems are vulnerable to noise. Therefore, to overcome those, we propose Eye ball movement Based Wheel chair control system which moves in the desired direction that the person wants to move. Here we are counting the eye blinks. Based on the blinks count we are going to monitor the eye ball movement. We use eye detection, processing of the captured images and interfacing the raspberry pi with motor drivers to control the wheelchair. We also include IR sensors for obstacle detection in left, right, forward direction.***

Indexed Terms- ***Eye blink, Eye ball movement, IR (infrared) sensor, Quadriplegia, Raspberry pi***

I. INTRODUCTION

Quadriplegia is a disease where a person cannot move his limbs. It is a situation where a person can move only his eyes freely. Some major accidents can also cause the people to get paralyzed. Several wheel chairs have come up to help the people suffering from paralysis or physical disorders. Manual wheelchairs move with the movement from the hands which take more energy. In addition to this some automated voice controlled wheel chairs, gesture controlled wheel chairs have been proposed already, but these systems are less accurate which may give faulty movements when they are used by the user. So, Eye ball movement based wheel chair control systems have come into existence. This system improves the portability of the user. It can be used freely and independently by the person suffering from extreme paralysis. Iris movement of a person is used to control the wheel chair. Obstacle detection is also provided for the proposed system. The main thing in the proposed system is to avoid the false detection of eye movement i.e. if the user looks at left side normally, the system is going to move to the left side even if he doesn't want to move. The controlling can be done based on certain algorithms which use raspberry pi, open CV with python software for easy execution of commands.

II. LITERATURE SURVEY

There are many previous works that are carried out to help the persons suffering from paralysis. Some of those systems helped us to get ideas for eyeball based wheel chair. Some of the works which were carried out previously are:

A. Voice controlled wheel chair – The wheel chair is controlled based on user's voice it moves in the direction the user wants to move. It has certain drawbacks such as vulnerability of noise, speech variability, speaking style and accuracy is less in these systems. [3]

B. Gesture controlled wheel chair - The wheel chairs move based on hand gestures. The limitation of this device is that it requires a lot of effort and also the people suffering from deformities in their hands finds it difficult. [4]

C. Bio potential based method – Bio potential method uses voltage from the surface of the human body using special instruments. It is very uncomfortable as it uses the sensors that are directly attached to the human body [2]

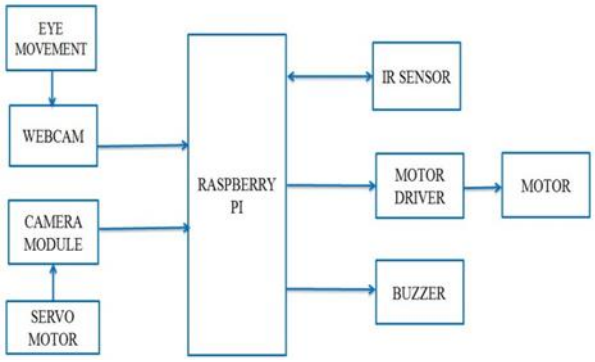
D. Eye controlled wheel chair- These are proposed without any obstacle detection in the path of the user using Eye tracking techniques based on the

user's gaze location. [1]

All these works led us to work on Eye ball base Wheel chair control system with IR sensors fixed in different directions at the base of wheel chair for easy detection of obstacles and also backward tracking is done with the help of camera module to see the objects behind him.

III. SYSTEM OVERVIEW

A. Block Diagram



B. Hardware Description

1. Raspberry Pi:

Raspberry pi is the heart of the project. It is a mini credit card sized computer which has Linux based operating system called Raspbian. The instructions are written in python programming language in this. Raspberry pi consists of set of GPIO pins that are used to send the signals to the motor driver based on which the motors move in direction that is desired by the user.

2. Webcam:

Webcam is a digital camera that is used to capture still pictures or videos of the user. It is connected directly to the computer. The webcam is interfaced with raspberry pi to capture the images from eye or movement of eyes based on which the wheel chair will be controlled.

3. IR Sensor:

Infrared sensor is used for detecting obstacle. The IR sensor is attached to the wheel chair in left, right, forward direction. It is connected to the raspberry pi. If any obstacle is detected in the path of the user, the sensor sends the signals to the raspberry pi which controls the motors to stop. It can be used to sense the objects up to a few centimetres.

4. DC Motors:

Two dc motors of 12v, 60 rpm are used in our project. It is used to move the wheel chair in desired direction by the user. The motors are driven by motor driver L293D which is a 16 pin IC. Motor driver is to control the motors to move in left right, forward direction.

5. Buzzer:

Buzzer is an electric device which is used to alert the user. We used buzzer to indicate the user about obstacles in the path and to stop the Wheel chair.

6. Camera Module:

Camera module is used in our project to observe the objects behind the user. It is connected to a servomotor which is used to rotate in 180 degrees and sends the signals to the raspberry pi about the objects behind the person.

C. Software Description

1. Open CV:

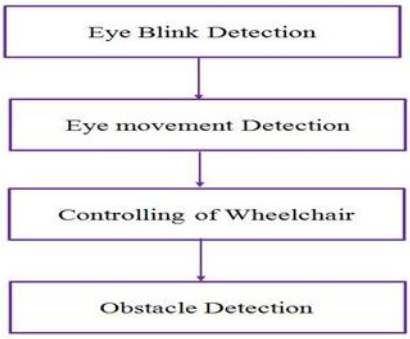
Open CV is an open source computer vision and machine learning software library. It is mainly used to do all operations related to images. Open CV was designed for computational efficiency to focus on real time applications and to accelerate the use of machine perception in commercial products.

2. Python Software:

Python is a high level programming language for general purpose programming. It can be used for many operating systems. The code written in python is easily understood by the user. It can be used for building various projects with the help of raspberry pi such as sending or receiving sensor data, monitoring, controlling applications.

IV. DESIGN METHODOLOGY

The design methodology includes four stages such as eye blink detection, eye movement detection, controlling of wheel chair, obstacle detection.



A. Eye Blink Detection :

The camera is continuously focused on the eye to capture live video. From this video frames are taken and algorithms are applied on those images. Viola-jones algorithm is used to detect the face and eye in the shape of rectangles. However in our project we have used an efficient method called eye aspect ratio to determine whether the person is blinking or not. When the eye is open the eye aspect ratio is almost constant. But when a person closes the eye the eye aspect ratio almost falls suddenly near to zero and whenever the EAR is maximum then that is counted as a blink. The entire process is dependent on eye blinks of a person whether to control the wheel chair or camera module. While we are focusing on the blinks count sometimes we may get false blinks. So, to avoid this we have set a timer such that for every 30 seconds automatically it restarts the count of blinks. For detecting the eyes of a person directly we have used the ---*haarcascade_ eye_tree_eyeglasses*.xml library in Open CV. [8]

B. Eye Movement Detection:

Based on the count of blinks the camera starts to capture the video of the eye. Here, we focus on the iris of the person. When the person opens the eye then the corresponding eyeball image of the instance is converted into gray scale and then by using the centroid algorithm the centre of the eye is detected i.e. iris of the eye. Coming to the second phase of movement detection, here we are going to use a threshold algorithm to detect eye movement based on some threshold values which can be obtained from the position of the eye. The minimum movement of the eye is considered as a valid attempt according to threshold values compared with actual position and flags are set accordingly. If any faulty detection is found the preference is given to the stop command. Based on these algorithms the controlling of the wheelchair is done with eye movement [3]

C. Controlling of Wheel Chair:

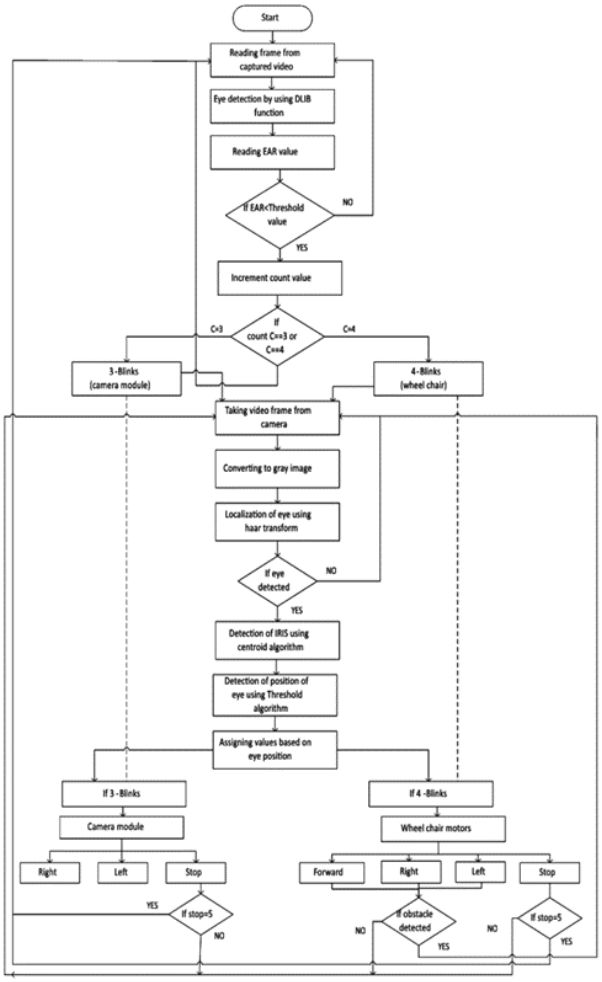
The controlling of wheel chair is done based on the eyeball movement. Here certain blinks are given to command the camera to check the eye ball movement. Based on the movement of eye the position of the eye is detected and the wheel chair moves in the given direction. From the raspberry pi the signals are given to a driver circuit which is used to control the wheels of the chair. As we cannot control motors by using supply from raspberry board we are going to use an extra driver circuit. The main purpose of driver circuit is to change the polarities given to motor.

D. Obstacle Detection:

The infrared sensors are attached to the wheelchair at the base of the left, right, front portion of the wheels. When an obstacle is detected then buzzer will alert the user about the obstacle and corresponding commands are given from the raspberry pi to stop the wheelchair based on the eyeball movement.

V. FLOW CHART

In the following flow chart when an obstacle is detected the wheel chair stops following with the buzzer sound. So the process of taking video frame starts again according to the choice of the user.



VI. RESULTS

The wheel chair is moved according to the position of iris in left, right, front and also to stop corresponding to the commands given in raspberry pi. Here counting of blinks initiates the start of this process. So initially blinks are counted.

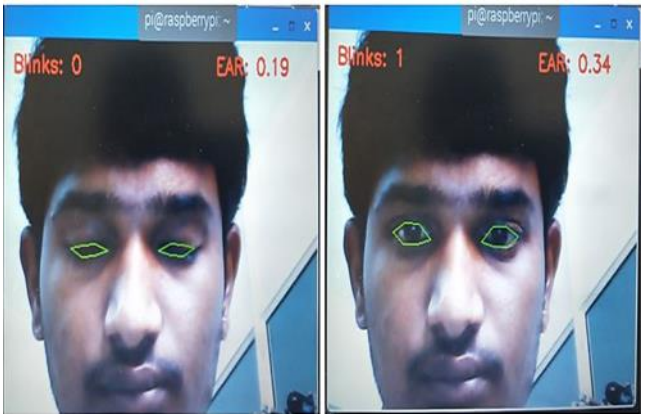


Figure a. Blinks counting using haar-cascade library

Figure b . Movement towards left and right

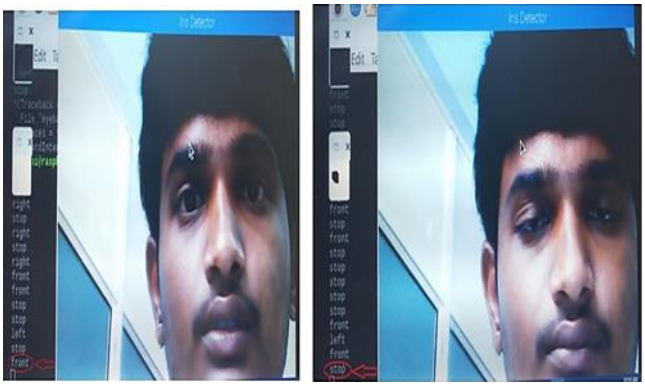


Figure c. Movement towards front and to stop the wheelchair

VII. FUTURE WORK

1. Replacing ultrasonic sensors in place of IR sensors makes the wheel chair to detect the range of obstacles (how far).

2. Wireless implementation of system is more flexible to use than a wired one. Using wireless communication techniques one can improve the system.

CONCLUSION

Eyeball movement based wheel chair control system is designed for paralysed people. This system makes the lives of the people independent. Raspberry pi technology is used to improve the accuracy compared to other systems. Obstacle detection using IR sensors which are fixed at the base of wheel chair allows the user to know the obstacles in his path. Camera module is fixed for backward tracking. The system is efficient with minimum cost compared to other systems. The idea of this system could better the lives of many people across the globe.

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