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Paper Authors

BATHULA BHAVANI

Eswar College Of Engg, Narasaraopet, Guntur Dt.

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ARM – 11 BASED ADVANCED EYE CONTROLLED WHEEL CHAIR

BATHULA BHAVANI
Assistant Professor,Department of ECE Eswar College of Engineering,Kesanupalli Narasarao Pet, Guntur, Andhra Pradesh

Abstract
A novel technique is implemented for the eye controlled based independent and cost effective system. The purpose of Eye movement based control electronic wheelchair is to eliminate the necessity of the assistance required for the disabled person. And it provides great opportunity of the disabled to feel of independent accessible life. The implemented system will allow the disabled person to control the wheelchair without the assistance from other persons. In this system controlling of wheelchair carried out based on Eye movements. The camera is mounted in front of the user, to capture the image of any one of the Eye (either left or right) and tracks the position of eye pupil with the use of Image processing techniques. According to the position of the eye, wheelchair motor will be directed to move left, right and forward. In addition to this, for the safety purpose infrared obstacle sensor is mounted in front of wheelchair to detect the obstacles and automatically stop the wheelchair movement. An APR module is mounted in wheel chair which gives information about the obstacle through speaker. To make system cost effective for monitoring, a Raspberry pi board allowed to access the system without displaying unit.

Keywords: Raspberry-Pi-B+, Embedded C, USB Camera, IR Obstacle Sensor, APR Module, Motor driver IC, Motors, Open Computer vision Library, Wheelchair.

I.INTRODUCTION
The Wheelchair is dependent system used by elderly and physical disable persons. Here introducing the design implementation models of totally independent Eye control electronic wheelchair. As per requirement of the disabilities different kind of automatic systems are available in market such as voice control or joystick control system.

Sometime for totally paralysis person may be have very difficult to use that type of systems. Here the Eye control system provides the independence to make their life easy and more convenient [1].And also they save the huge amount of energy or external manpower. Camera captured the image in real time and analysis the image as input to set the commands for interface the motor driver IC through sending the commands to GPIO pins. The motor driver circuit is used to perform the different operation such as left, right, forward and stop operations respectively.

2.LITERATURE OF SURVEY
The existing computer input devices such as keyboard, mouse, and the other input devices have been used to interact with digital instruments. These computer input devices cannot be operated by handicap persons. In this paper, a computer input device by human eyes only is proposed for

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handicap person and also for wearable computing. The existing computer input devices can be divided into five categories:

(1) Bio-potential based method which utilizes potential from user's body actions acquired by using special instrument. Instrument such as Electrooculargraphy (EOG) [2], Electromyography (EMG), and Electroencephalograph (EEG) [3], Search coil can be used for measuring biopotential. The search coil output can be used as sources of computer input for handicap person. EOG method uses voltage differences between fore and aft surface of eyes.

METHOD	DRAWBACKS
Bio-potentialbased method.[1]	Poor gaze direction accuracy compared to video tracker, relatively costly
Voice Based Methods[2]	Less accurate on: • Back ground noise • Speed of the speech • Sex of the speaker
MotionBased Methods[3]	Uses human effort to navigate like joystick, etc., for a handicapped with any of the organs failed is not useful.
Search Coil[4]	Burden to user, here measuring time is limited to approximately 30 to 60 .They have limited Lifetime.

(2) Voice Based method [4], which use user's voice as source input. Voice analysis is used to analyze user's voice and convert into digital data. The weakness of this system is vulnerable against noise. Other voices which come from surrounding user may affect the system.

(3) Motion based method [5], utilizes other normal movement organs to operate computer input. Head, foot, and etc. can be used to control computer input.

(4) Image Analysis method [6], utilizes camera to analyze user's desire and convert into digital data. Several image processing methods are used to analyze user's desire. The user's desire itself can be done by Gaze based [7] analyze user's desire from users gaze, Face based analyze user's desire from face expression, and the others.

(5) Search coil method [7] uses induced voltage with coil including in contact lenses attached to user's eyes.

3. PROPOSED MODEL DESIGN

This system is totally autonomous system, and all the module will work independent each other. For the basic requirement of the any electronic system is Power supply. In this system there is mandatory to gives the proper power supply to individual components, and the standard power supply should be used for Raspberry pi[8], camera[9], sensor[10], and motors[11]. In this system the Raspberry pi is playing a main role of hardware part. A real time data acquisition and analyzing the signal Raspberry pi B+ model board is very efficiently process the multiple image frames by frame. For capturing the image

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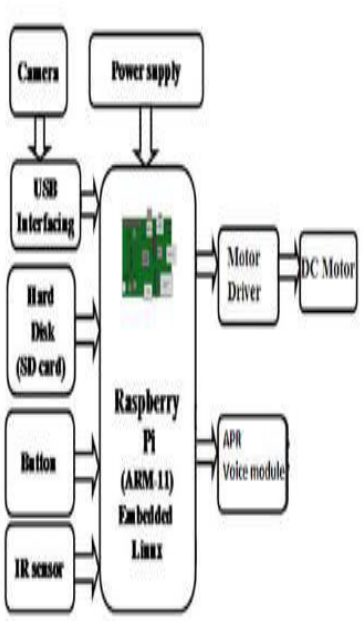

Figure 1. Block diagram of eye controlled wheel chair

normal web camera is used in our system. Moreover, High resolution HD web camera can be used but it increase the image memory size in MB. So that system cannot read the image and process efficiently as per requirements, and it will also increase the processing time. The Raspberry gives the commands to the motor driver circuit, which is enable the GPIO pin to perform operation. Such as forward, left, right and stop operation performed based on eye movements. Sensors are also mounted on the head of wheelchair for detecting the obstacles and controlling the wheelchair. Infrared sensor is used for detecting the obstacle or any moving object in front of wheelchair. The sensor is directly connected to the Raspberry pi board, it acquired the data and measuring the distance between wheelchair and obstacle. This system is comes under real time data acquisition, data processing and controllingsystem. There is real time video capturing and advance image processing used on it. For using Raspberry pi board, they have its own operating system is known as "Raspbian",[12] which is Linux based operation system and also compatible with raspberry pi board.

4. METHODOLOGY

The principle of this system is eye pupil detection and eye tracking based on computer vision technology. A new algorithm introduced for detecting the eye pupil location by Image processing. In this technique several stages used to find out the movement of eye, such as Face detection and Eye detection, color conversion, Edge detection, Hough Transformed, motion detection and object tracking. During initial stage the system acquired the captured Images by USB Web camera. The first direction is to detect the user Face accurately. If there is multiple faces are presented it will display the individuals and also showing the run time error. A system indicates and represents the face of user in a specific area of image. After that system will performed the several operation of image processing to track the Eye pupil. The figure 2 represents the complete methodology of proposed implementation. Here it will give the step by step information of the system working. A system started with capturing images continuously by camera. And captured images processed in Raspbian system.USB camera is used to capture the image at high pixel rates. In idle condition the eye will be

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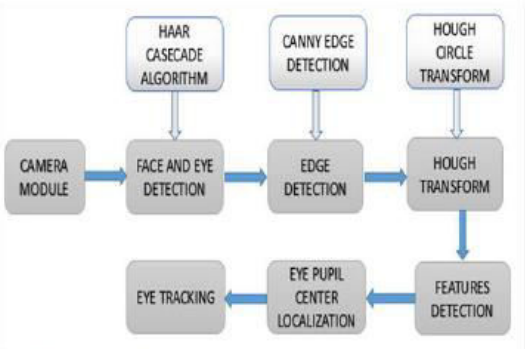

Figure 2. System process diagram

consider open. Once the power supplied is on, the system will start working, and according to the command values system will worked.

1) Face detection and Eye detection: For the face detection and eye detection the Open CV library can be used directly. Avery first Haar cascade algorithm is used for both Face detection and Eye detection individually. A system camera detects the face of user. Once it will detected, system found the eye location and marked the eye region using Haar cascade algorithm. And system accurately detect both the eyes based on the proper distance of the each other.

2) BGR to Gray conversion:

A very next operation of the image color convention to reduce the system delay time. The Image frame size should be low, because the processor cannot processing the image frames in run time condition. So, by using the BGR to GRAY conversion a colored image converted into gray image.

3) Features detection and Blurring image:

The Gaussian blur filter is used for blurring the image. Which helps to detect the exact edges of specific area of the cropped image. Features is nothing but it found some special pattern on image which is unique, based on it will make a pattern. The next operation of Hough circle transform algorithm is worked based on it. In canny edge detection algorithm system used a blurred image.

4) Edge detection:

A canny Edge detection and corner edge detection algorithm is applied for determine the soft edges of the image. To set the proper threshold value it will allowed easy to recognize rectangles or circle presented in Image.

5) Hough Transform:

Over the edge detection resulting image we use Hough circle transform method to draw a circle on eye pupil. Camera capture the images continuously and according to eye movement, a Hough circle transform detects the movements of eye pupil and drawing the circles.

6) Eye Tracking:

To track the Eye movements we use projection function algorithm was used, where the coordinates system points the eye center point location The horizontal and vertical axis based two directional graph represents the eye

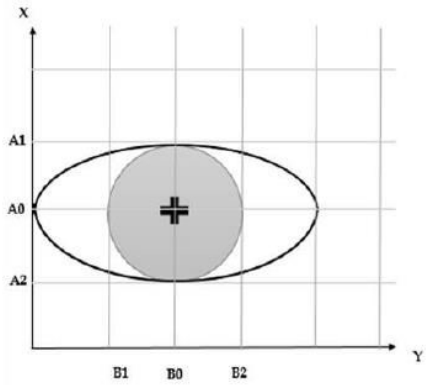

Figure 3. Co-ordinate systems with respective eye position

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movements in left or right direction. And detects average point of eye pupil location. A captured Projection function graph shows relation between the eye center and respective projection points. The X and Y scale points indicates the directions of the eye movements The eyeball position at the (A0, B0) point is:

$$A0 = (A1 + A2)/2 \; ; \; B0 = (B1 + B2)/2 \quad (1)$$

The camera module is mounted in front of user Eye. And important part is a distance between eye and camera device is fixed. It may me 10cm to 14cm. Camera will capturing the images of user face, and find out the exact pupil location[14]. After detecting pupil location, system algorithm measure the center average value from the corner of the Eye. Which gives the correct information of Eye movements. For controlling the motors driving IC, 2-channel relay board and battery for power supply of motors is used. The motor driving circuit is connected with Raspberry pi, which is operates the entire system. Camera module is directly connected with raspberry pi, and continuously capturing the Images. Than system generates the command signal to enable the GPIO pins and perform the Left, Right, forward and stop operation.

5. EXPERIMENTAL RESULTS

The system acquired the resulted data of image processing, and based on the Eye pupil center value signals end to the motor driving circuit for movement of Wheelchair. There the system used the infrared obstacle sensor for obstacle detection. And successfully measure the distances between the wheelchair and obstacles. When the object is detected very close to in front of Wheelchair and cross the minimum distance threshold value, emergency brake will be applied to stop the Wheelchair.

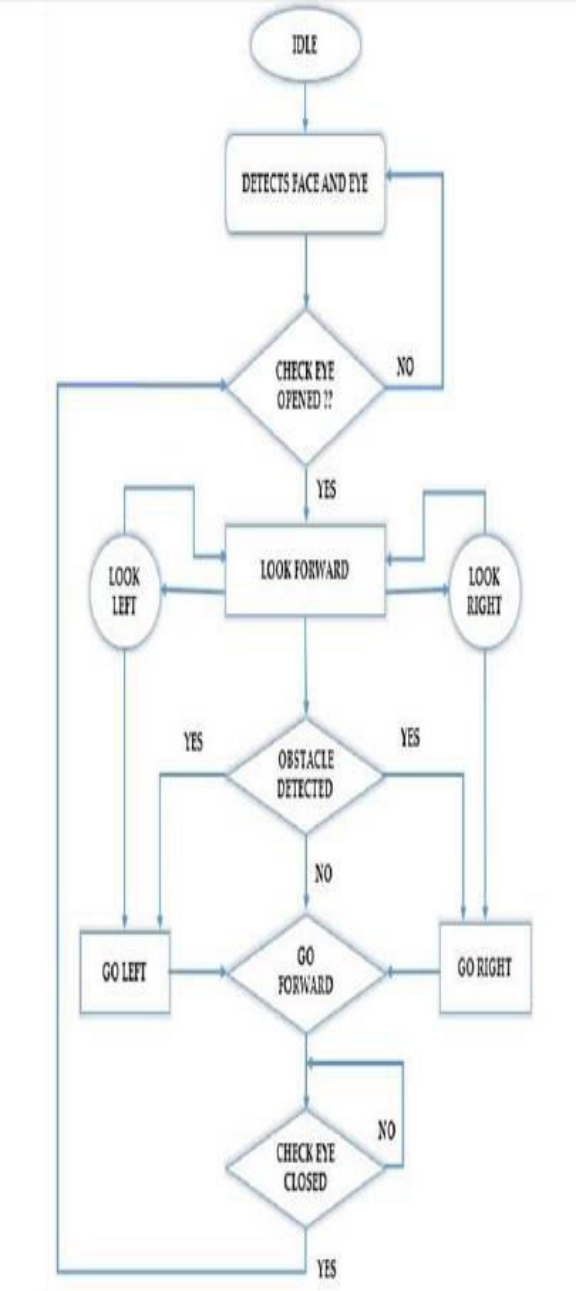

Figure 4. Flowchart of the system working

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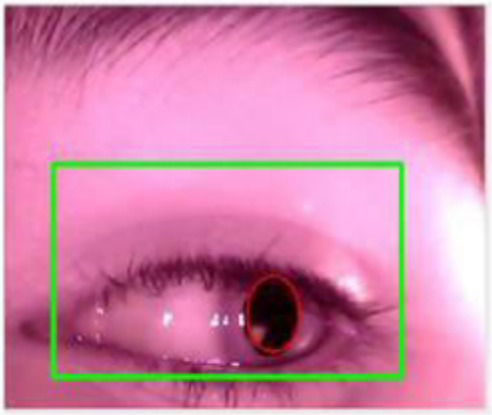

Figure 5. Eye pupil in left motion

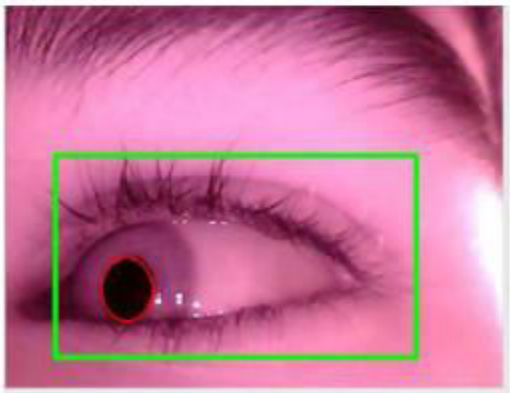

Figure 6. Eye pupil in right motion

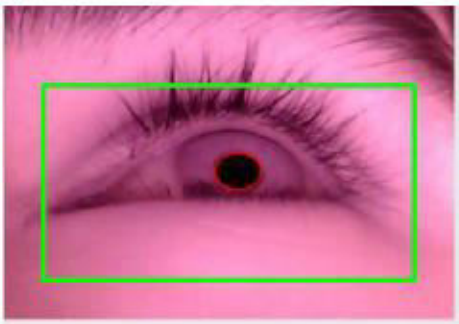

Figure 7. Eye pupil in forward motion

6. ADVANTAGES AND LIMITATIONS

The eye controlled wheel chair has highly reliable with IR obstacle sensors & USB camera to detect obstacles & gives enhanced image for tracking the eye pupil of user. The system consists of APR module to alert the user when obstacle detected. This system consists of Raspberry pi- B+ ARMv8 embedded LINUX processor, a innovative & advanced technology computer board ,works as interface between the all building blocks. The only limitation is It's very hard to track the Eye pupil in dark light places, so the system works perfect on environmental light and in a room light with fluorescent mercury vapour lights, which is low in infrared.

7. CONCLUSION

The concept of the eye controlled wheelchair is not only represents the alternative resources but more important to help physically disabled persons to make their life independent. The aim of implementing an autonomous eye controlled wheel chair is to highlight the features of digital Image processing. There are some real time design constants measured like a system takes some time (4second) to execute the system for processing the video in Real time Environment. Therefore the system performs the Wheelchair movement operation with some delay time. It's very hard to track the Eye pupil in dark light places, so the system works perfect on environmental light and in a room light with fluorescent mercury vapour lights, which is low in infrared.

8. FUTURE SCOPE

Using this system as framework, the system can be expanded to track the eye pupil in dark light places using the eye protected advanced flash web cameras to work efficiently at night times also, Use GSM service to send messages for caretaker of

disabled person whenever obstacle is detected .Use more web cameras gave resources possible that allow the user to look at user "backward control" to see behind them as they go forward.

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Bathula Bhavani Assistant Professor Department of ECE Eswar College of Engineering Kesanupalli Narasarao Pet, Guntur, Andhra Pradesh