EYE CONTROLLED CAMERA BASED WHEELCHAIR USING RASPBERRY-PI

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ABSTRACT

This project is implemented for the eye controlled based independent and cost effective system. The purpose of this project is to eliminate the necessity of the assistance required by the disabled person and also it provides great opportunity for the disabled to feel an independent accessible life. This implemented wheelchair is controlled by iris movement. Therefore, it allows the disabled person to control it without the assistance from another person. The camera captures the image of any one of the user eye. Based on the position of the eye, the wheelchair motor will be directed to move in the required direction.

Keywords: *Image Processing, Open Computer Vision Library, Python, Raspberry Pi, Arduino, Wheelchair.*

1. INTRODUCTION

The Wheelchair is dependent system used by physical disable and elderly persons. We are introducing the design implementation models of independent Eye control electric wheelchair. As per disabilities requirement different kind of automatic systems are available in market like joystick control, voice control system. For totally paralysis person it is very difficult to use those types of systems. The Eye control system will make their life easy, independent and more convenient [1]. They also save huge amount of energy, external man power. The image is captured in real time by camera and analysis the image as input, these input is sent as commands to raspberry pi for interfacing the motor driver IC. The motor driver circuit will perform different operations such as left, right, forward and stop. The advance level of Image Processing open computer vision (OpenCV) library is used for Eye detection [2].

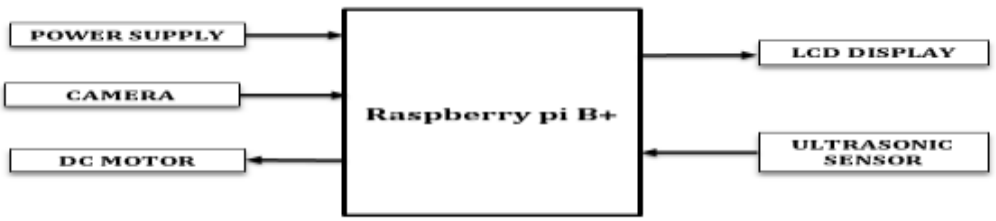

Fig-1:System architecture diagram

The ultimate goal of this system is to detect the Eye pupil and to locate its center point. For detecting Eye pupil and tracking eye pupil automatically many computer vision library of Image processing are used like object detection, motion detection, Image colour conversion, edge detection, pattern matching etc. For eye pupil tracking there are several number of other techniques available [4] [5]. One of which is ECG, EEG and EOG sensor based eye pupil detection technique is available [6] [7], where the location of pupil is decided based on voltage variation [8]. The head movement based system limitation is user can not access the system physically [9] [10]. The voice activated power wheelchair will work properly, only when user speak the command properly then system works according to it like left, right, forward, back, stop. In case of noisy environment system gets distracted and cannot respond accurately. The infrared reflection based eye pupil detection system provides an accurate detection of the eye pupil center location, also can track the eye movement. The problem is infrared radiations affect the eye and user may loss the eye visibility. Therefore, an effective camera based eye pupil detection and tracking system is used.. The output signal which is based on Digital Image processing, sent to the Raspberry pi board. The Raspberry pi receives the data and analyzes it. Raspberry pi will send the control signal to arduino based on the location of eye pupil. Arduino directs the motor driver to run the motor either in clock voice direction, anti-clock voice direction or to stop the motor based on eye pupil location. Two individual motors are embedded on each wheel of the wheelchair. The Ultrasonic sensor is also mounted on the wheelchair for detection of any static or mobile obstacle. If sensor gets the obstacle very close to the wheelchair, it will indicate to the arduino and arduino sends the signal to motor driving circuit to stop the motor.

2. SYSTEM DESIGN MODEL

This system is totally automatic system. Power supply is basic requirement of any electronic system .The figure represents the overall functionality of the implemented system.

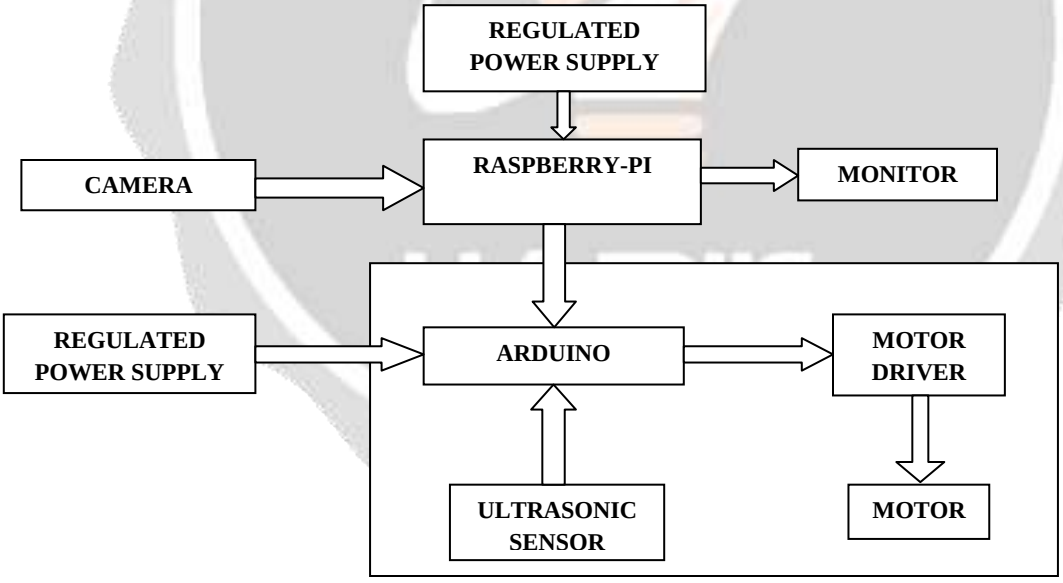

Fig-2: proposed system design model

Proper power supply is supplied to individual components, and the standard power supply is used for Raspberry pi, camera, sensor, and motors. The Raspberry pi board is brain of wheelchair. In proposed system the module like monitor, camera, power circuit and arduino is directly connected to the Raspberry pi board. In this system the controllers like Raspberry pi and arduino is playing a main role of hardware part. The major process performed in this system is real time data acquisition and analyzing the signal. For analyses multiple images are used frame by frame. Normal web camera captures the image. The High resolution HD web camera can also be used but it increases the image memory size in MB. Hence the system cannot read the image and process efficiently as per requirements, and also increases the processing

time. The Raspberry pi sends signal to arduino based on eye movement and the arduino sends the commands to the motor driver circuit, which enables the GPIO pin to perform operation. Such as forward, left, right and stop operation performed based on eye movements. Ultrasonic sensor is used for detecting the obstacle or any moving object in front of wheelchair. This system comes under real time data acquisition, data processing and controlling system. There is real time video capturing and advance image processing used on it. The Raspberry pi board used, have its own operating system known as "Raspbian", which is Linux based operation system and also compatible with raspberry pi board. To detect the eye pupil location accurately is very challenging. A new image processing technique used for eye pupil center detection and tracking, which works based on open computer vision (OpenCV) library. Most of coding part done with the help of OpenCV library. To connect the raspberry pi board to desktop Jessie file is used. Python language and C++ is used for coding, which is user friendly and is helpful to resolve the error efficiently. OpenCV 3.0.0 library with python is used in this system.

3. METHODOLGY

The principle of this system is eye pupil detection and eye tracking based on computer vision technology. A new algorithm is introduced for detecting the eye pupil location by Image processing. In this technique several stages performed to find out the movement of eye, such as Eye detection, color conversion, Edge detection and eye tracking. During initial stage the system acquires the captured images by USB Web camera. The system detects and represents the eye of user in a specific area of image. After that, system performs the several operation of image processing to track the Eye pupil.

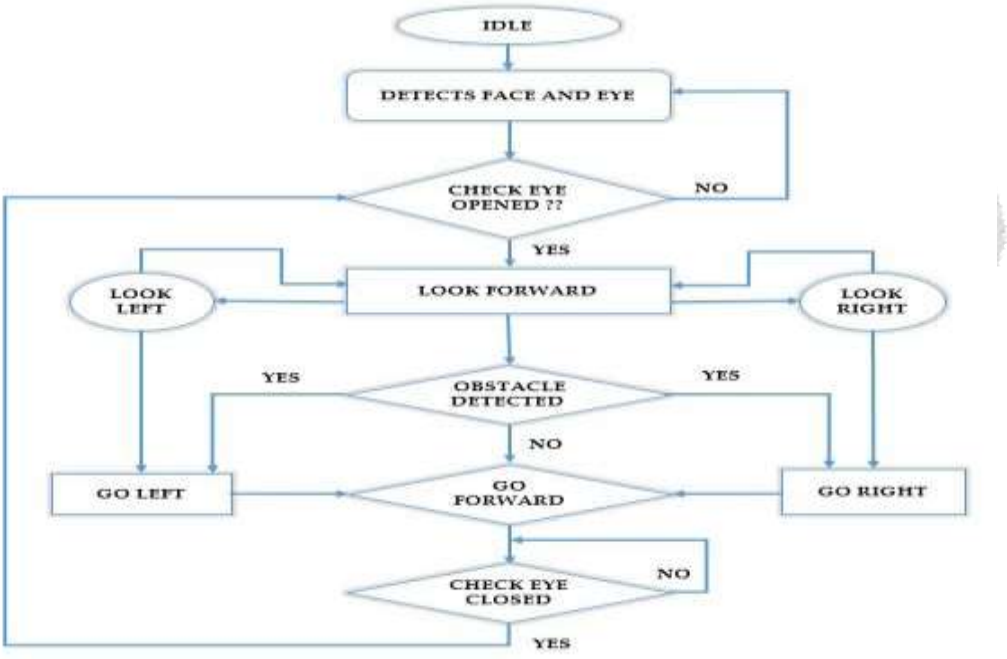

Fig-3: flowchart of system working

Firstly camera module will start to capture the images. Next by using edge detection technique the detection of eye region of interest is extracted. It will draw the rectangular box over the Eye. This rectangular box is called as frame. The main target of the system is to detect the eye pupil and to locate its center points. Several image processing operations are performed such as blur Image, color conversion, thresholding, filtering, edge detection, Hough transform. Image Processing based OpenCV library are installed in raspberry pi memory. Now corner and edge detection method are applied on the extracted area. Based on location of eye in the frame, the wheelchair would move. When eye location is in left of frame, then wheelchair will turn left side. And when the eye moved is right then wheelchair will move right. If eye location is up then wheelchair moves forward, if eye location is traced down then wheelchair will move in backward direction.. USB camera is used to capture the image at high pixel rates. In idle condition the eye

will be consider open. Once the power supply is on, the system will start functioning, and according to the command values system will work.

4. SYSTEM DESCRIPTION

The system is operating based on real time data acquisition. Raspberry pi B+ which consumes less power and is controlled based on ARM architecture is used in the system. The raspberry pi computer board provides in/out pins, USB ports, UART, PWM, HDMI port and Ethernet adapter port for connecting it to internet via wired or wireless connection. Camera will capture the images of user eye. The motor driving circuit is connected to Arduino, which controls operations of motor driver. Camera module is directly connected with raspberry pi for continuous capturing of the Images. Then Raspberry-pi will generate the command signal to enable the Arduino GPIO pins which in turn controls dc motor driver to move either left, right, forward, backward or to stop the motor.

5. SYSTEM ALGORITHMS

In our system open computer vision (OpenCV) free access library algorithm used for Image processing. A novel algorithm used for system execution. Following steps are performed to get exact eye pupil center point location:

5.1 BGR to Gray conversion

The very first step performed is colour conversion. This operation of image color convention is done to reduce the system delay time. The colored image is converted into gray image by BGR to GRAY conversion technique. Fig-4a) indicates the cropped colour image of eye, Fig-4b) indicates the colored image to gray converted image and Fig-4c) shows the threshold image.

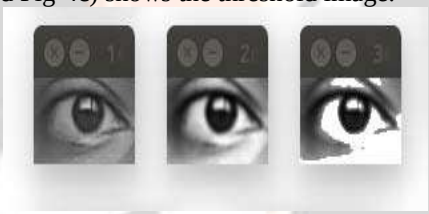

Fig-4:(a) Color image, (b) BGR to Gray conversion image, (c) Thresholding on image.

5.2 Features detection and Blurring image

Feature detection is nothing but to extract special pattern or region of interest on image which is unique. The next operation of Hough circle transform algorithm is feature detection method. For blurring the image and to detect the exact edges of specific area of the cropped image Gaussian blur filter is used. Canny edge detection algorithm system uses a blurred image for its operation. Fig-5(a) indicates the blurred image and Fig-5(b) indicates the featured detected image.

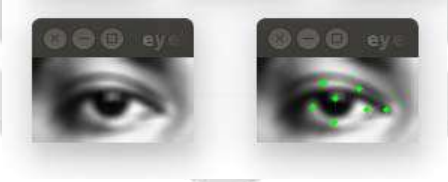

Fig-5:(a) Gaussian blur filtered image and (b) featured detection on image.

5.3 Edge detection

A corner edge detection and canny edge detection algorithm is applied to determine the soft edges of the image. To set a proper threshold value and for easy recognization of rectangles or circle presented in Image this method is very efficient. Fig-6 indicates the edges of pupil.

Fig-6:Canny edge detection

5.4 Hough Transform

The resulting image of edge detection is used as input for the Hough circle transform method, to draw a circle on eye pupil. Hough circle transform will detect the movements of eye pupil and draws the circle as shown. Fig-7a) indicates the features detection on image, fig-7 (b) indicates circle drawn on image.

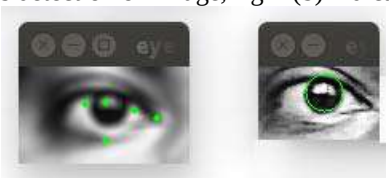

Fig-7: (a) Features detection and (b) Hough circle detection

6. RESULTS

The system obtains the resulted data of image processing, and based on the Eye pupil center value signal is sent to the motor driving circuit for movement of Wheelchair.. The system uses the ultrasonic sensor for obstacle detection and successfully measure the distances between the wheelchair and obstacles.

7. CONCLUSION

The concept of the eye controlled wheelchair not only represents the alternative resources but more important to help physically disabled persons to make their life independent. The aim of implementing this system 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.

8. REFERENCES

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