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Eye Controlled Electric Wheel Chair

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ABSTRACT: This paper delivers a method to guide and control the wheelchair for disabled people based on movement of eye. This concept can be used for people with loco-motor disabilities. The proposed system involves three stages: image detection, image processing and sending of control signals wheelchair. The eye movement is detected using a head mounted camera. The images of the eye will be sent to the laptop where the images will be processed using Python software. The corresponding output signals are then send to the motor driving circuit which control the motors.

KEYWORDS: Head mounted camera, RF module and image processing unit.

I. INTRODUCTION

A wheelchair is a chair with wheels, invented in the early 5th century. The device comes in variations where it is propelled by motors or by the seated occupant turning the rear wheels by hand. Often there are handles behind the seat for someone else to do the pushing. Wheelchairs are used by people for whom walking is difficult or impossible due to illness, injury, or disability. People who have difficulty sitting and walking often need to use a wheel bench. A basic manual wheelchair incorporates a seat, foot rests and four wheels: two, caster wheels at the front and two large wheels at the back. Other varieties of wheelchair are often variations on this basic design, but can be highly customised for the user's needs. Such customisations may encompass the seat dimensions, height, seat angle (also called seat dump or squeeze), footrests, leg rests, front caster outriggers, adjustable backrests and controls. An electric-powered wheelchair is a wheelchair that is moved via the means of an electric motor and navigational controls, usually a small joystick mounted on the armrest, rather than manual power. For users who cannot manage a manual joystick, head switches, chin-operated joysticks, sip-and-puff or other specialist controls may allow independent operation of the wheelchair.

II. LITERATURE SURVEY

There were many previous works carried out on electric wheelchairs. A few of them helped us get ideas for our current prototype. In [1], Karthikeyan K C et.al, proposes an optical-type eye tracking system to control powered wheel chair. Users eye movement are translated to screen position using the optical type eye tracking system movement. In [2], a method is proposed to control the motorized wheelchair using EOG signals. The method allows the user to look around freely while the wheelchair navigates automatically to the desired goal point. Another control method of a robot is by means of an electric wheelchair, dedicated to severely disabled persons, equipped with a low-cost web camera, using only eye movements and gaze direction. In [5], iris recognition is by characterizing key local variations. The basic idea is that local sharp variation points, denoting the appearing or vanishing of an important image structure, are utilized to represent the characteristics of the iris. Using the ideas listed in the survey we developed a wheel chair for paralysed persons based on eye recognition technology.

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III. SYSTEM MODEL

The purpose of this project is to develop a wheelchair that will be controlled by the eyes of the person seated in the wheelchair. This will allow people without full use of their limbs the freedom to move about and provide a level of autonomy. The project will consist of three main parts. The eye tracking module consists of a camera that captures the image of eye ball. The setup is designed so as to cause minimum stress to the user. A webcam is fixed on to a spectacle like set up to capture the image. The camera is placed so as to capture the movement of one eye allowing clear vision to the other eye. The camera will take an image of the eyes that will be sent to the laptop where the images are being processed. Once the image has been processed it moves onto the second part, the microcontroller.

A functional block diagram of the system is given in fig. 1. The microcontroller is used to produce the logic signals to the H-bridge.The burner circuit of the microcontroller can be used if any editing of the microcontroller program is required. A microcontroller with the required number of input and output pins and asynchronous serial communication is selected (ATMega8). The RF receiver is connected to the microcontroller. The microcontroller receives the serial data through the RF receiver. The input ports of the microcontroller are connected to the RF receiver and its output ports are connected to the logic input of the H-bridge to control the direction of rotation of the motor. 4 output ports are used to control two motors using their respective H-bridges. The ATMega8 microcontroller converts the serial data received from the RF receiver to logic signals and these signals are given to the input port of the H-bridge. Ports RB4-RB7 are used to control the H-bridge.

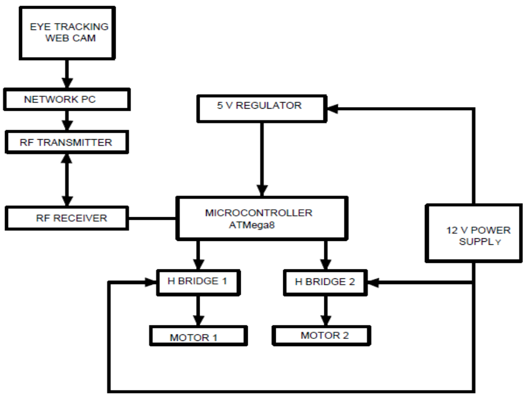

Fig. 2. 1: Functional block diagram

The final part of the project is the motor drivers to interface with the wheelchair itself. There will be two motor drivers for each motor on the wheelchair both left and right. Each motor driver will consist of an H-bridge that will power the motor depending on the output of the microcontroller. The motor drivers will control direction, to enable the wheelchair to move forward, reverse, left, or right. The H-bridge uses switching device to control the polarity of the voltage at the input of the dc motor. The direction of rotation of the motor can be reversed by reversing the polarity of the supply voltage at the input of the dc motor. The H bridge accepts logic supply from the microcontroller. Depending on the logic supply, the motor rotates in forward direction or reverse direction.

IV. IMAGE PROCESSING

Image processing is done using Python software. Python is a high-level programming language designed to be easy to read and simple to implement. Python is considered a scripting language, like Ruby or Perl and is often used for creating Web applications and dynamic Web content. It is also supported by a number of 2D and 3D imaging programs, enabling users to create custom plug-ins and extensions with Python. Examples of applications that support a Python API include GIMP, Inkscape, Blender, and Autodesk Maya. Scripts written in Python (.PY _les) can be parsed

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and run immediately. They can also be saved as a compiled programs (.PYC les), which are often used as programming modules that can be referenced by other Python programs.

Certain functions are used to get the images of the eye. The image is captured using head mounted camera. A night vision HD webcam is used for this. The image is then converted to grey scale. A rectangular region around the eye is considered. A series of functions are used to process the image. They are:

1. Gaussian Filtering: In this approach, instead of a box filter consisting of equal filter coefficients, a Gaussian kernel is used. It is done with the function, cv2.GaussianBlur(). We should specify the width and height of the kernel which should be positive and odd. We also should specify the standard deviation in the X and Y directions, sigmaX and sigmaY respectively. Gaussian filtering is highly effective in removing Gaussian noise from the image.

2. Threshold: If pixel value is greater than a threshold value, it is assigned one value (may be white), else it is assigned another value (may be black). The function used is cv2.threshold. First argument is the source image, which should be a greyscale image. Second argument is the threshold value which is used to classify the pixel values. Third argument is the max Val which represents the value to be given if pixel value is more than (sometimes less than) the threshold value. OpenCV provides different styles of thresholding and it is decided by the fourth parameter of the function

3. Erosion: The basic idea of erosion is just like soil erosion only; it erodes away the boundaries of foreground object. The kernel slides through the image (as in 2D convolution). A pixel in the original image (either 1 or 0) will be considered 1 only if all the pixels under the kernel are 1, otherwise it is eroded (made to zero). So what happens is that, all the pixels near boundary will be discarded depending upon the size of kernel. So the thickness or size of the foreground object decreases or simply white region decreases in the image. It is useful for removing small white noises, detach two connected objects etc.

4. Dilation: It is just opposite of erosion. Here, a pixel element is '1' if at least one pixel under the kernel is '1'. So it increases the white region in the image or size of foreground object increases. Normally, in cases like noise removal, erosion is followed by dilation, because erosion removes white noises, but it also shrinks the object. So we dilate it. Since noise is gone, they won't come back, but the object area increases. It is also useful in joining broken parts of an object.

After performing these, corresponding signals are send to the microprocessor, according to the area of the pupil.

V. RESULT AND DISCUSSION

The following figure shows the output of the image processing software. Eye tracking is initiated when a small rectangle is drawn around the eye as shown. The area of pupil inside the small circle is considered in determining the motion of eye. The wheel chair moves in three directions; left, right, and forward. The starting and stopping is done by blinking the eyes for 2 seconds.

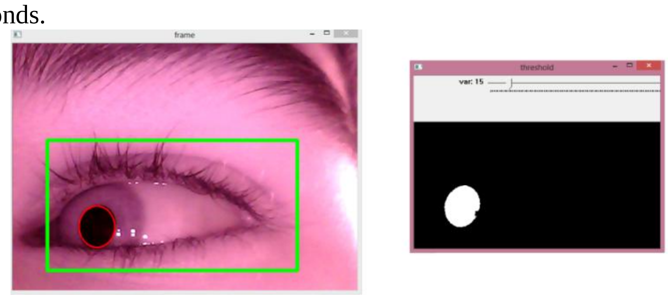

Fig 2. : Right motion

Fig. 2 shows the movement of eye which results in the motion of wheel chair towards right. The relative position of iris shows the direction of movement of wheel chair.

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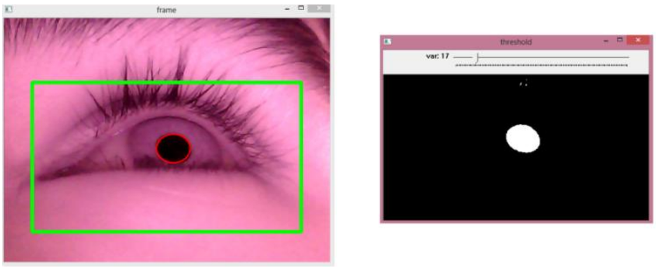

Fig 3. : Forward motion

In Fig. 3, the iris is at centre. The position of iris and pupil detected will be highlighted with the help of a circle as shown. As the iris is at centre, the wheel chair moves in forward direction.

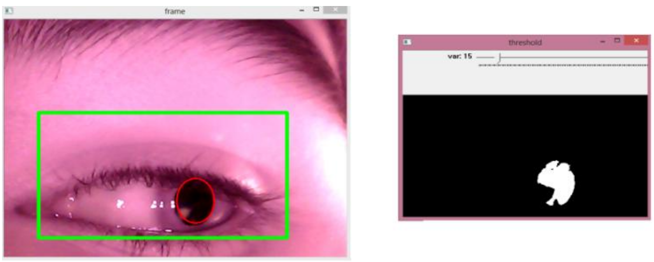

Fig 4. : Left motion

From Fig. 3, we can see that the position of iris is at left. The signals corresponding to the left side movement will be send to the microcontroller. Accordingly the wheel chair moves towards left.

VI. CONCLUSION

The system consists of eye tracking webcam, microcontroller, motor, chair image processing unit and associated circuits. The system works by tracking the motion of eyeball using a webcam. The image is processed with the help of Python software and corresponding movement is obtained. This set up is meant for paralyzed people and person having loco-motor disabilities. The hardware along with the software is great tool which makes the life of paralytic people independent. A wheelchair prototype incorporating the above mentioned specifications was designed and found to be working successfully.

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