Sensor Based Eye Controlled Automated Wheelchair

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ABSTRACT

The paper discuss about a wheel chair based on eye gesture. This project is made to help the people with motor nerve problem. Though paralyzed, this project will help them to maneuver an electric wheel chair with just their eyes. They can move the wheel chair left or right by just looking to the required direction, they can also start and stop the wheel chair, with other eye gestures.

Keywords/ Index Term— Wheelchair, Ir Sensor, Ultrasonic Sensor, Accelerometer

1. INTRODUCTION

Intelligent wheelchairs have been being developed for a long time to support paralysed people with several disability levels. In many cases, the eye muscles of paralysed people are one of the few controllable muscles that still function well. Therefore, using the eye-gaze as an interface for paralysed or physically disabled people has been of interest [1]. The particular project is useful for the patients where they can move their wheelchair in their own directions, without any third party's help or support .In this project, there will be a wheel chair model as a ROBOT model, which will contain an in-built MICRO CONTROLLER and EYE BALL SENSING system, which will do the functions like right, left, forward and reverse operations. The wheel chair is designed in such a way that it can move freely without external support or dependency. Through this feature the patients can enable movements of their wheelchair as per their desire.

Model: A prototype model which symbolizes the wheel chair is constructed.

Master Controller: A PIC Microcontroller will act as a master controller for the movement of the automated wheelchair. It is responsible for all the decisions taken by the auto mated wheelchair.

Eye ball Movement Sensor: This is used to sense the movement of the eye ball's direction and converts it into digital data and transfers it to the Master controller. (Straight Command, Left/Right Command, Stop Command).

2. DIFFERENT EYE TRACKING MECHANISM

There are there eye tracking mechanisms to compute the position of pupil.

2.1 Electro-Oculogram (EOG) Method

The Electro-Oculogram method obtains the gaze direction by sensing the electro-oculographic potential [2]. The cornea-retinal potential resulting from a dipole (eye ball), generated between the cornea and the retina is called Electro-oculogram (EOG). The potential is produced due to the movement of the eye ball and can be acquired noninvasively by placing electrodes in the surrounding region of the eye [1]. An electrode is attached by the ear to provide reference voltage. These electrodes send the electrical signals to two EOG circuits of similar design to detect the horizontal and vertical movement of the pupil. This information is sent for computation. The big advantage of this method is the ability to detect eye movements even when they are closed.

2.2 Lens Tracking Systems

In this method a non slipping contact lens fits over corneal bulge. The tracking of the pupil is recorded by affixing a magnetic coil or mirror to the lens. The integrated mirror in the contact lens allows measuring reflected light. The big advantage of this method is high accuracy and nearly unlimited resolution in time. Both methods explained so far are obtrusive and are not suited well for interaction by gaze. The third and preferred method for eye interaction is using video camera.

2.3 Head Mounted Camera System

A camera is set up in front of the wheelchair user to capture image information. The camera direction is focused onto the face area of the wheelchair user. The camera is connected to a computer with vision processing and electric wheelchair motion control capabilities. With vision processing, the sequential captured image is interpreted to obtain the gaze direction and eye blinking properties [3].

3. HARDWARE DESIGN OF AUTOMATED WHEELCHAIR

3.1. The Hardware Architecture

In this automated wheelchair mainly consisting of 3 types of modules: first one is the sensor module, second one is control module and third one is the motor driver. The sensors will sense the eyeball rotation send the values to control module. Control module is given the directions to wheelchair. Another two sensors take the position of the wheelchair and send it to control module. Control module converts analog data into digital and send the values to pc motor driver.

In this proposed model master controller is PIC16887A. It is high-performance enhanced flash microcontroller with 10-bit analog to digital converter and microcontrollers with 10-bit analog to digital converter and microcontroller with 10-bit analog to digital converter and also 32k of flash memory. It is belongs to PIC16f series.

Our proposed system starts with the detection of the eyeball position. In order to detect the position of the eyeball we use the eyeball infrared sensor (IR sensor). The values generated by the sensor depending on the position of the eyeball are routed to the microcontroller. We have to store the value of every eye location by pressing a switch. Next the values in the microcontroller are processed and sent to the motor drivers which are made to switch on the motors fitted to the wheels of the wheelchair will start to rotate and thus the wheelchair will be locomoted.

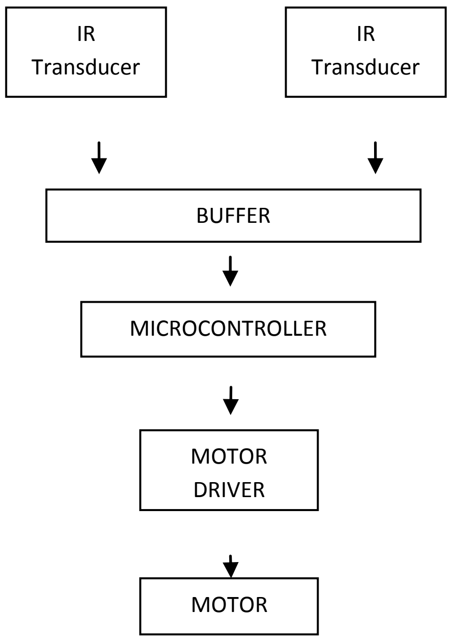

Fig-1: Block Diagram.

3.2. Eye Tracking Sensor

Based on the position of eye wheelchair will move left, right and forward. By using eye tracking sensor detect the position of eye. Eye tracking sensor will recognize colour differences. the eye focus on three parts of the eye that will respond to incoming light rays in a different manner: 1) the sclera (the white portion of the eye), 2) the iris (the region bearing one's eye colour), and 3) the pupil (the black entrance hole that serves as a light receptacle based on these white and black portions eye tracking sensor will give the signals to microcontroller. It decides movement of wheelchair.

Note that IR light is not visible light, but it resides after red light and opposite blue/ultraviolet light. It is known that a large percentage of IR light is transmitted through the skin (another type of soft tissue). The same result is expected for IR emission towards the eye. With ultraviolet light, however, the complete opposite is true. Blue light is absorbed by soft tissues and is known to cause damage to cells (specifically, damage to DNA). This is why the general populous is asked to be careful when exposed to sunlight for a long duration of time. Freasier and Sliney have acknowledged that 0.3mW/cm2 is the maximum allowable intensity that the retina can be exposed to IR without damage.

3.3 Ultrasonic Sensor

In this proposed project ultrasonic is used to detect obstacles in the path of wheelchair. Any obstacle is detected microcontroller is zero and buzzer is activated. Calculate the range through the time interval between sending trigger signal and receiving echo signal. The HC-SR04 Ultrasonic Sensor is a very affordable proximity/distance sensor that has been used mainly for object avoidance in various robotics projects.

3.4. Accelerometer

In the proposed project accelerometer will give the position of the wheelchair like as bend left or right or front or back. It send analogue values to microcontroller, microcontroller have inbuilt A to D converter it converts analogue values into digital. It measures static acceleration of tilt sensing and dynamic acceleration resulting from motion, shack or vibration. An accelerometer is a sensor that measures the physical acceleration experienced by an object due to inertial forces or due to mechanical excitation. Acceleration is defined as rate of change of velocity with respect to time. It is a measure of how fast speed changes. It is a vector quantity having both magnitude and direction. As a speedometer is a meter to measures speed, an accelerometer is a meter to measure acceleration.

4. WORKING PROCESS

The IR transducers which are focused to the eyeball of the patient generate three different ranges of values depending upon the position of the eyeball.

In the kit there are four switches for store the value of every eye position i.e. left, right, straight and eye closed. Before starting the wheelchair the patient have to press the switches while looking at left, right and straight and while closing the eyes. The values for all directions are stored into the buffer.

Now values generated by the sensor are fed into the microcontroller. Now the microcontroller matches it with the values that are stored in the buffer.

If the values generated by the sensor matches with the values of left in the buffer, then the microcontroller will automate the driver connected to the right motor. Thus the right motor will start to rotate in the forward direction. As a result the wheelchair will turn left. During this time the left wheel is stopped.viceversa is for right direction.

If the values generated by the sensor matches with the values of straight stored in the buffer, then the microcontroller will automate the driver connected to the right motor and also the left motor. Thus the right and left motors will start to rotate in the forward direction. Using the switch we can get the exact value of every eye position for every size of eye correctly.

5. ADVANTAGE

The existing eye tracking methods for wheelchairs are based on image processing techniques thus it is not only tedious to work with images but also it is very costly. The main disadvantage of using head mounted camera is it will not work in night. But our system uses only eyeball sensor which tracks the position of the eye by using a simple component IR LED.

Another advantage of the system is using ultrasonic sensor and accelerometer which make the wheelchair safer for the patient.

6. CONCLUSION

Today, Robots play a vey major role in industrial applications. In future these may come in every field, they could change the way the people live. Even though robots are the creation of human, they are more efficient and accurate.

However, the only drawback with this project is as the wheel chair requires eye-ball movement as input to the controller for its working, a lot of strain is created to the eyes.

In the real time application we can use long range ultrasonic for the sensing of obstacles in a little far distance and always monitor the position of wheelchair like as it bend front or back or right or left. Thus this project enables to help the physically challenged persons to move freely with their own control of the wheel chair and that is the sensor based automated wheelchair.

7. FUTURE SCOPE

To make the system more interact with patient we have to add some additional sensors. Based on the results obtained we conclude that the eyeball response towards normal subjects and hemiplegic patients is very prominent and gives a wide range of movements. Thus the wheel chair moves in all required directions with good response.

There is very slight variation in the responses of eyeball sensor in the case of normal subject to hemiplegic patient i.e., in the order of 0.5 mv.

There is no big difference in the IR sensor response when tested on normal subjects and patients i.e., the activity of the sensor depends on the eye movement of the subject so the range can be narrowed according to the subject using the wheel chair.

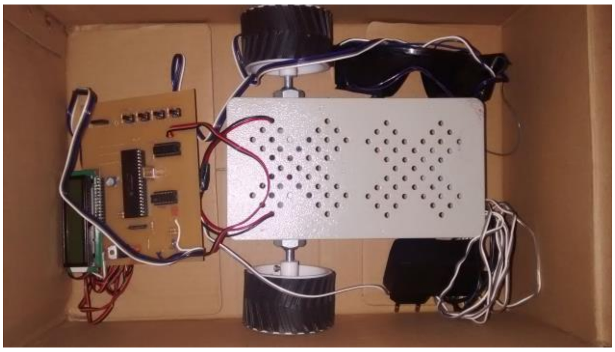

Fig-2: Prototype model.

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