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Implementation of Wheelchair Controller using Eyeball Movement for Paralytic People

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Abstract

This paper delivers a new method to guide and control the wheelchair for disabled people based on their eyeball movement. In this method we use sensor based eyeball tracking system to control powered wheelchair. Eyeball sensor will generate distinct range of values for each position of eyeball (i.e. left, right, straight). This concept can be used for multiple applications, but this paper focuses the application to mobile and communication aid for paralytic people. The proposed system involves two stages; first eyeball tracking and second sending of control signals to the arduino controlled wheelchair.

Keywords: wheelchair, paralysis, input by eye-only, hand-free controller.

Introduction

Transportation is of vital importance in this advanced world. The world is changing towards automation. The aim of this project is to introduce automation in transportation for the paralytic people. This project proposes advanced model of existing system .This existing system can operate using joysticks in hand or using head movement detection sensor. But this proposed system operates in eyeball movement detection.

Inside house paralytic people reaching a desired destination is little bit difficult. So, paralytic people can't move freely inside their house they depend on others for their motion. Here with the help of eyeball movement detection system, the new idea of providing a cost effective, less hardware complex embedded system that helps the paralytic people to move freely inside their house.

Different Eye Tracking Mechanisms

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

Electro-Oculogram (EOG) Method:

The Electro-Oculogram method obtains the gaze direction by sensing the electrooculographic potential. This is done by measuring the potential using electrodes placed on face where human eye is an electric dipole with a negative pole at the fundus and positive pole at the cornea. One electrode is placed to the side of the left eye and another to the side of the right eye. This pair shall detect horizontal eye movements. One electrode is placed above the left eye and another below the left eye. This pair shall detect vertical eye movements. A fifth 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.

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; alternatively, the integrated coil in the contact lens allows detecting the coil's orientation in magnetic field. 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-gaze interaction is using video camera.

Head Mounted Camera System

The most common mechanical setup involves use of desktop computer with integrated eye tracker camera. The desktop computer is loaded with software package for analyzing the eye gaze data. This setup require head fixation and hence restricts the head movements. An alternative method uses a head mounted eye tracking

Proposed System

Our proposals importance is to serve all types of paralytic people to move freely to smaller distances inside their residence. This system uses only eyeball detection using eyeball IR sensor. The sensor consists of two parts infrared transmitter and receiver.

Infrared transmitters and receivers are housed into a single unit and fixed in front of the goggles. Necessary wirings are takes through the goggles to the sensor processing. The person should wear the goggles for the sensor to work. Since the sensor is shielded it can be isolated from the external light, thus external light illumination will not affect the sensor output values.

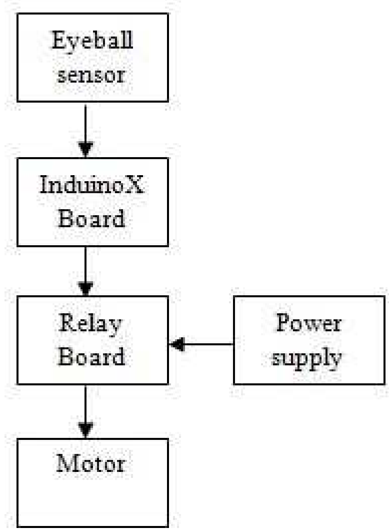

Fig 1.0: Flow of the proposed system.

The flow of our proposed system starts with the detection of the eyeball position. In order to detect the position of the eyeball we use the eyeball IR sensor. The values generated by the sensor depending on the position of the eyeball are routed to the arduino kit. Next the values in the arduino kit are processed and sent to the relay as the enable signals to switch on the relays and as the final step when the relays 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.

Eye Ball Sensor Working

The eyeball sensor is based on the concept that “white color region of the eye will scatter the light and black color region of the eye will absorb the light”. The sensor consists of IR transmitter and receiver circuitry (LDR). The IR transmitter will transmit the light. The iris of the eye which is in black color will absorb all the light and it won’t reflect where as the white part will reflect the light. At the receiver side there will be LDR or Light Dependent Resistor these LDRs are used at the dark/light sensing area. Thus when the eyeball of the patient is illuminated by the light in the transmitter side, partial of the illuminated light will be absorbed by the black region of the eye and part of the light will be reflected by the white region of the eye as mentioned above. Thus by receiving the analog light pulses the Light Dependent Resistors at the receiver side which has ohmic resistance about 100000 will absorb the light, on absorbing the light pulses the ohmic values of the sensor will decrease or increase depending on the intensity of the light which in turn sends digital values as the output to the arduino kit.

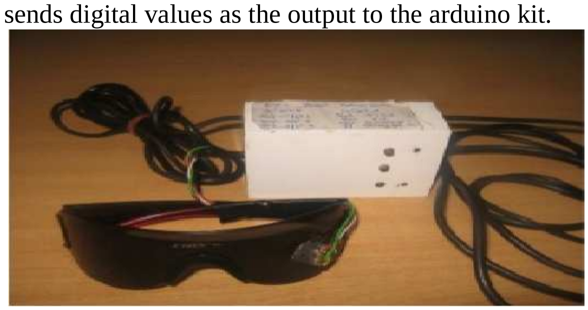

Fig 1.1: Eyeball sensor.

Micro- Controller

The signals from the eyeball sensor are sent to the micro-controller. Based on the signals received by the micro-controller, it sends the control signal to enable the relay circuit. The relay circuit in turn supplies power to the motors, thus the motors start to rotate and the wheelchair is locomoted.

Sprocket System

A **s**procket is a profiled wheel with teeth, cogs, or even sprockets that mesh with a chain, track, or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which are radial projections that engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth.

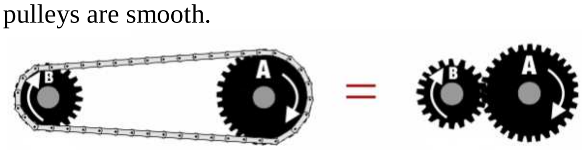

Fig 1.2: Sprocket wheel arrangement.

Sprockets are used in bicycles, motorcycles, cars, tracked vehicles and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc. Perhaps the commonest form of sprocket is found in the bicycle, in which the pedal shaft carries a large sprocket-wheel (driver) which drives a chain which in turn drives a small sprocket (driven) on the axle of the rear wheel. Early automobiles were also largely driven by sprocket and chain mechanism, a practice largely copied from bicycles. In order to reduce the speed of the powered wheel chair sprocket arrangement is used but in a reverse arrangement that is the small sprocket (13 teeth) is used as a driver i.e. it is connected to the motor shaft and the larger sprocket (26 teeth) is connected to the wheel shaft and it is driven. Thus as a result we obtained speed reduction of the powered wheelchair.

Working Process

The eyeball sensor which is focused to the eyeball of the patient generates three different ranges of values depending upon the position of the eyeball.

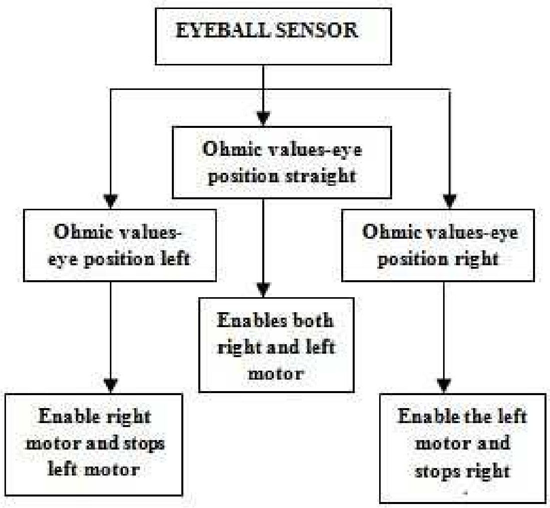

Fig 1.2: Flow of controls from sensor.

As shown in the above flowchart, values generated by the sensor is fed into the arduino kit. Now the arduino kit matches it with the values that is written in the coding.

Left Motion

If the values generated by the sensor matches with the values of left in the coding, then the arduino will automate the relay 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.

Right Motion

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

Straight Motion

If the values generated by the sensor matches with the values of straight in the coding, then the arduino will automate the relay connected to the right motor and also the left motor. Thus the right and left motors will start to rotate in the forward direction. As a result the wheelchair will move straight.

Braking System

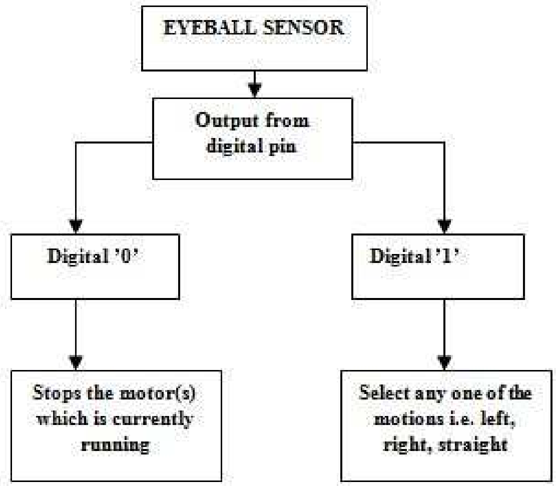

Fig 1.3: Flow of controls from sensor for braking the system.

The system doesn't have any manual braking**.** Eyeball sensor will also produce two binary values '1' and '0'. The value '1' is produced when the patients eye is opened and one of the above three motions will be selected and the wheel chair will be moved accordingly. The value '0' is produced when the patient eye is closed and this value is passed into the arduino kit, which in turn will switch off the relay(s) which are enabled at that time.

Advantages

The existing eye tracking methods for locomating the powered wheel chair are based on image processing techniques thus it is tedious to work with images. But our system uses only eyeball sensor which tracks the position of the eye by using a simple components light dependent resistor, comparator, IR led.

Calculating the threshold values of position of the in image processing techniques are complex but using the eyeball sensor we can easily calculate the threshold values.

Using the eyeball sensors instead of the CCD camera will also reduce the cost of the total system dramatically.

Fig 1.3: Modelled wheelchair.

Conclusion

This system consists of eyeball sensor, micro- controller and wheelchair. The above mentioned hardware along with the software proved to be the great tool which makes the life of the paralytic people independent.

Future Scope

This system can also be extended to locomotion of the wheelchair in reverse also.

We can also implement obstacle sensors in this system which will be very helpful to the paralytic people in dodging the obstacles.

The system can be extended to control the equipments around such fans, lights, etc.

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