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Eye Gesture controlled Wheelchair using Sensor Goggles

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ABSTRACT

In order to help patients suffering from neck-down paralysis, a wheelchair can be designed which can be used by the patient independently. While there exist various wheelchairs that provide help to patients in different forms, most of the wheelchairs tend to be of a higher price range. There also exists wheelchairs that support the mobility of the patients by using finger gestures. While such wheelchairs are cost effective, not all patients can use them due to certain body restrictions. It is due to these reasons, a wheelchair that can be operated using the gestures of the patient's eyeball is being built. The patient can use their eye-ball movements to determine the direction of movement of the wheelchair. The detection of the eyeball movements will be implemented with the help of IR sensors, which in turn will help make the wheelchair system cost efficient. Through this paper, it is intended to envisage sensor goggles which will work depending on the motions of the eyeball of the user. The sensor will then send the signal to the microcontroller, which in turn will send the respective signals to the DC geared motors. This will ensure movement of the wheelchair in the direction intended by its user.

Keywords— Dual IR sensors, DC geared motors, wheelchair, paralysis, eye-ball movement.

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I. INTRODUCTION

In medical conditions where a patient is paralysed from below his neck (medical condition known as quadriplegia), the patient cannot perform a majority of his tasks by himself and requires additional assistance for day-to-day activities. The patient is bound to a wheelchair in order to travel. An additional help is required to carry the wheelchair from one place to another as the patient cannot handle the wheelchair by himself. This is because the general wheelchairs available in the market are designed to be operated manually.

This presents the idea of a wheelchair that can be operated by the patients themselves, without the need of an additional helper to move the wheelchair. The expected outcome of the project is to create such a wheelchair that can be directly operated by the patient using only his eye-gestures, thereby, providing the patient to traverse independently. While this has been done previously [4] using an embedded control type structure, detection of eyeballs is done using bioelectric signals. Due to the usage of laptops and signal measurement devices, the overall structure becomes bulky.

The paper shows the design of a pair of sensor-based goggles [2] that will capture the eye-gestures of the patient and direct the wheelchair in the direction the patient intends to move. The sensor used in this project is a self designed dual IR sensor which provides better detection.

The upcoming sections further explain in depth the project based on eye gesture controlled wheelchair using IR sensor goggles[3].

Section 2 gives the literature survey based on other similar projects. Section 3 gives an in depth description of the methodology that is being used to make the project. This includes the overall design, the implementation algorithm, hardware platform, design and implementation. Section 4 provides the expected result and Section 5 provides the conclusion.

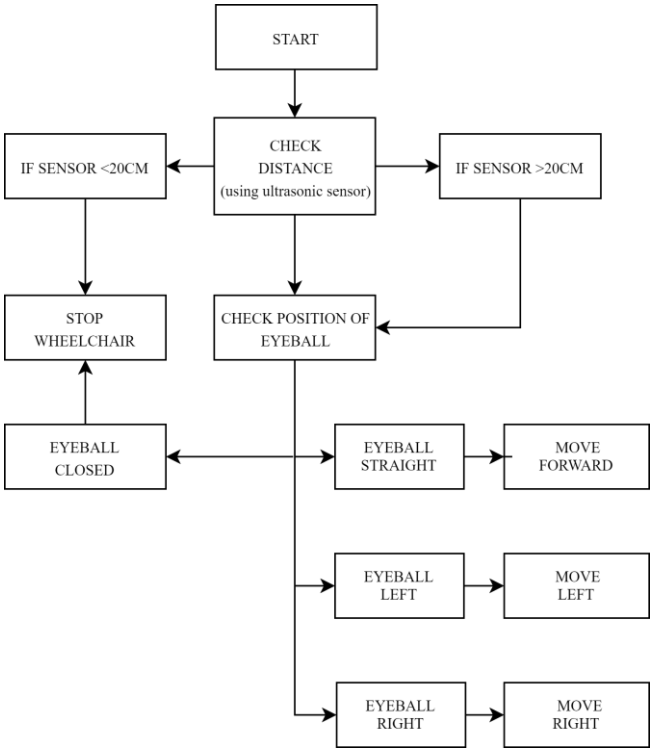

Fig. 1 Process Flow

II. LITERATURE SURVEY

1. Eye-gesture controlled intelligent wheelchair using Electro-Oculography-IEEE(INSPEC Accession Number:14484104) Authors: Theja Ram Pingali, Sarthak Dubey

While many previous projects have been done in order to build an eye gesture controlled wheelchair, the general trend observed in their mechanism is using electro-oculography. Electrooculography (EOG) is a technique for measuring the corneo-retinal standing potential that exists between the front and the back of the human eye Electrooculography procedure is complex, time consuming and expensive.

The technique of EOG is nothing but the measurement of the resting potential of the eye ball. The procedure of this EOG based wheelchair consists of EOG signal acquisition, signal conditioning module, control module and intelligence algorithm. The use of silver coated electrodes has been done to measure changes in the EOG signal of the retina of the eye. The signal conditioning module then amplifies the measured signal and also cancels out any noise with the help of low pass filters. All the information of the retina is then passed on to the micro controller. There is also a program that helps avoid any obstacle in the path of the wheelchair. Two separate micro controllers are used , one for User Instruction Process and the other for Drive Control Module. As usage of two microcontrollers makes the system relatively complex, the size of the project overall becomes large.

2. Eyeball gesture controlled automatic wheelchair using deep learning-IEEE (INSPEC Accession Number: 17595327) Authors:Adarsh Rajesh ; Megha Mantur

This is a wheelchair system that can be completely controlled with eye movements and blinks that uses deep convolutional neural networks for classification. In artificial neural learning, expertise is required in the biotechnical field to understand the in depth functioning of the brain.

The camera used in this project is used to constantly capture images of the wheelchair's surrounding. The images that are captured are then preprocessed and passed on to the classifying module. Classification (of position of the user's retina whether left, right or centre) is done which is based on deep convolution neural networks. This entire process is time consuming and increases the cost of the project. With the help of the outputs received, decision is made by the controller as to which direction the wheelchair will move in. The directions are then passed on to the motor driver IC and the wheelchair moves in the respective direction. The camera converts all the images to grayscale and the images are converted to 50 x 50 in order to pass the convolution neural network. The convolution neural networks, which is also called ConvNets is used to pass on input images. The process of classification is done by data processing , convolution using ConvNets, maxpooling, where highest value of pixel is chosen. The process consists of layers of neurons which are further classified so as to detect the direction of the retina.

3. Eye Controlled Wheelchair - IEEE(INSPEC Accession Number: 15435616) Authors:Bharat Thakur ; Kush Kulshrestha

This is successfully achieved by investigating the user's natural gaze behavior using eyeball tracking in NI LabView. The prototype consists of a camera, image processing software and a motor controller to drive the wheelchair. Besides being a reliable, convenient and extremely useful, this prototype promises a cheap solution to the latest technology access. Tracking algorithm utilized is shape adapted mean shift algorithm in NI Vision assistant. The eyeball tracking outcomes are then used to produce suitable wheelchair motion taking the user to the intended location

Use of cameras is done to collect the images of the retina and further analysis and processing is done to the images to locate the position of the eyeball. Live Image Acquisition is done and this input is forwarded to NI Labview. The camera is also capable of collecting images in dark conditions. The input images received are then processed using digital image processing techniques. NI Vision Acquisition Software, NI Vision Assistant, Motor Controller(using H- Bridge principle) are the major components used in order to make this project work. The overall system has ben divided into two different parts.

The initial part detects the movements of the eyeball and the latter part is to drive the wheelchair using the motors. Once the movements of the eyeball is detected, the signals are passed to the DAQ device and the motor controller.

Labview itself decides the direction of motion of the wheels.

4. Sensor Based Eye Controlled Automated Wheelchair (IJRASET) ISSN: 2321-9653. Authors: Ms. Kale Taibai, Prof. S. A. Jagtap

The project discuss about a wheelchair based on eye gesture and hand gestures.A microcontroller can act as a master controller for the movement of the automatic chair using eye and hand gestures.This wheelchair mainly consists 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 rotation of the eyeball and send the values to the control module.
The main components used in this project are the Eye Blink sensor module, PIR sensor module, Accelerometer module, Micro controller,Crystal Oscillator, Motor Driver(DC Motors- Left & Right), Voltage Rectifier, Voltage Regulator and Power Supply Module.
The Eye Blink sensor that has been used has Infrared sensors that detect the movement of the eyeball. The sensor module is fixed on a spectacle so as to detect the motion of the eyeball easily. The PIR sensors detect if any form of change occurs in the IR radiation due to changes in the external environment. The micro controller that has been used in the module is AT89S51. The micro controller receives information of the retina movements in the users eye and passed on respective commands to the DC motor. The DC motor is responsible move the wheels of the wheelchair in the correct direction. For this, L239 motor drivers are used. An additional feature has been added in this project in order to move the wheelchair in forward and backward direction- as per the user's decision.If the user's hand moves up, the wheelchair moves in forward direction and if the hand is positioned down, the wheelchair moves forward.

III. METHODOLOGY

This paper presents an eye gesture controlled wheelchair using sensor goggles.

A. *Overall Design*

The solution that we propose is to design a dual IR sensors module which will be placed on the goggle so that it can detect the motion of the eye-ball of the patient. The patient is merely supposed to look in the direction he wishes the wheelchair to go. When the IR sensor detects the position of the eye-ball [2], it sends the respective signal to the controller. With the help of the program that has been fed to the controller, the controller will send respective signals to the dc geared motor. The motors will then ensure that the wheels move in the respective direction.

B. *Implementation Algorithm*

The algorithm given below shows all possible circumstances acknowledged by the IR Sensor and the ultrasonic sensor and the decision to be made by the controller in each of these circumstances.

Initially, the IR sensor checks the position of the eye-ball.
In case the eyeball is in the middle, the microcontroller sends a signal to move straight. When the eyeball is at the left side[9], the IR sensor sends the data to the controller and the controller signals the DC geared motor to move leftwards. Similarly, when the sensor detects rightward movement of the eyeball, the DC geared motors move right, thus moving the wheelchair at the right side[1].

C. *Hardware Platform*

In this section we describe the hardware design of the eye gesture controlled wheelchair using sensor goggles. The hardware components consists of sensor goggles which has dual IR sensor DC geared motors, MSP430 microcontroller, ultrasonic sensor and motor driver circuit for mechanical transmission which controls the direction of rotation of motors connected to the wheelchair. The dual IR sensor[5] which are fitted on the goggles have a transmitter and a receiver, transmitter emits infrared light which is incident on the eyeball of the user. Black part of the eye absorbs the infrared light and the white part reflects the infrared light, this signal is sent to the microcontroller in the form of the voltage, accordingly the position of the eyeball is detected and the wheelchair is intended to move in the desired direction.
The ultrasonic sensors are widely used applications in cases where distances are to be measured. They emit sound signals at an extremely high frequency which is inaudible to human ears. The sound signal is reflected back when it strikes the obstacle and thus distance can be calculated based on time consumed Ultrasonic sensors are fitted on the wheelchair to detect the obstacle in the path.
Motor drivers are the interface between the motors and control circuit. The motor requires a high amount of current whereas the controller circuit works on low current signal. So the function of the motor driver is to take low current signals and turn them into high current signals. This motor driver in the circuitry works on H Bridge principle[3]. There are four switches in this mechanism. At a time two switches conduct[6]. Accordingly, the conducting switches the direction of the motor is determined.

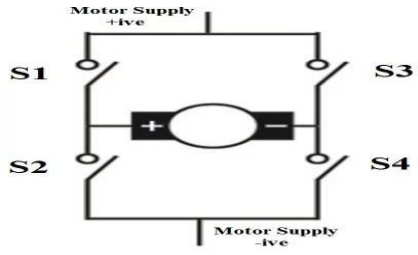

Fig. 2 DC Motor Driving using H Bridge

DC geared motor is a combination of electric motor and geared box.

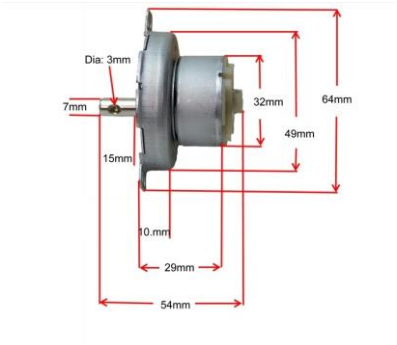

Fig. 3 DC Geared Motor

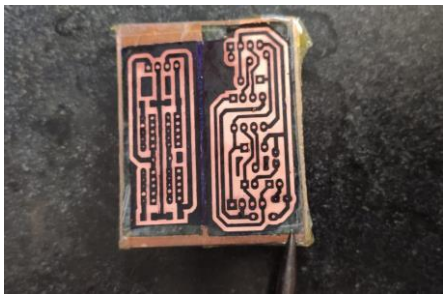

Fig. 4 PCB of IR Sensor goggle

D. *Design and Implementation*

The overall functioning of the wheelchair is divided into two parts. The first part is to correctly determine the position of the eyeball using the sensor goggles[4]. The second part is to move the wheelchair in the direction of the user's eye gesture with the help of DC geared motors.

In order to summarise, the following steps have been taken in the direction of making this project. Initially, the testing of the dual IR sensors[5] was done on the breadboard using two IR sensors. On completion of the breadboard testing, the circuit diagram for the project was designed. This was followed by the PCB layout design, PCB printing and components mounting. The IR sensor based goggle has been designed.

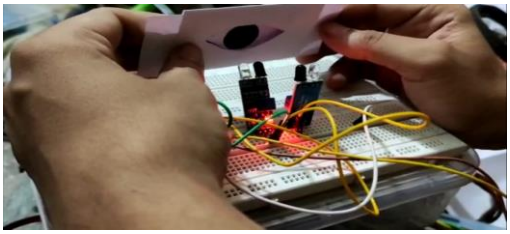

Fig. 5 Breadboard Testing

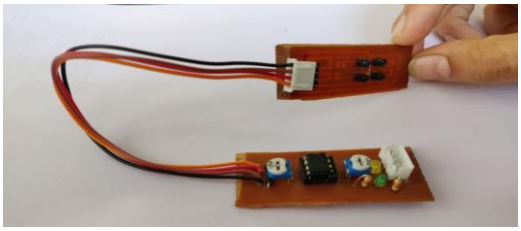

Fig. 6 Circuitry of IR Sensor Goggle

IV. EXPECTED OUTCOME

The expected outcome is that the sensor goggles accurately determine the motion of the eyeball and the wheelchair moves in the direction intended by the user.

V. CONCLUSION

An efficient and robust method for controlling the wheelchair using eye gestures has been presented.

With the help of this project, we intend to ease the travelling of a wheelchair bound patient. This wheelchair will be very helpful to patients who require constant assistance for travelling through a wheelchair.

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