

Technology for The Aid of Quadriplegics

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Abstract. To aid paraplegics, variety of electric wheelchairs exist in the market. Unfortunately, these cannot be used by persons with higher degree of impairment, such as quadriplegics, i.e. persons who, due to age or illness, cannot move any of their body parts, except head. An attempt is made to make lives of the people suffering from this problem simple and by simpler we mean self-reliant, which will thereby reinstate their confidence and their happiness. The idea is to create a Head Motion Controlled System which allow movement of the patient's wheelchair depending on the movements of the head. We know that a person suffering from quadriplegia can partially move his eyes and tilt his head, thus presenting an opportunity for detecting those movements. We have implemented a technology where a patient sitting on the Wheel Chair is able to move in a direction just by tilting his head in that direction.

Keywords:Arduino Uno,Ultrasonic Sensors,DC motor, PWM, AVR

1. Introduction

The number of persons who are paralysed and therefore dependent on others due to loss of self-mobility is growing with the population. The development of the wheelchair for paralysed users is surprisingly recent as compared to the conventional manually powered wheelchairs and advancing to electrical wheelchairs [1]. Conventional wheelchair use tends to focus exclusively on manual use which use which assumes users still able to use their hands which excludes those unable to do so. Diseases or accidents injuring the nervous system also frequently because people lose their ability to move their voluntary muscle. Since voluntary muscle is the main actuator enabling people to move their body, paralysis may restrict the movement of their locomotor organ such as arm, leg and others. Paralysis may be local, global, or follow specific patterns. Most paralysis are constant, however there are other forms such as periodic paralysis (caused by genetic diseases), caused by various other factors.

2. Motivation and Background

The life of persons suffering from quadriplegia can be made simpler and similar to an ordinary man life. The Head motion controlled wheel chair and other intelligent wheel chairs will help the quadriplegic persons in their day to day life and can prove as turning point in their life [2, 3]. The proposed wheel chair is suitable for indoor environment for quadriplegics, who can use their head for the mobility of wheel chair. It can be utilized in offices/malls/homes and the person can easily move with the help of his head with proper training. For severe quadriplegics, the only residual movement present is the head, so this head motion control wheel chair will be a boon for them. If done with mass production, this will be a cost effective solution and is a true help for patients suffering from quadriplegia.

It is suitable for indoor environment and more features can be added to make it more effective for outdoor environments. There do already exist some wheel chairs with joystick control and also with head motion control. The joystick control wheel chair requires hand motion to control joystick and in head motion controlled wheel chair a person require a helmet for the head with accelerometer circuit which sense the tilt motion of head and moves the wheel chair accordingly. The other kinds of wheel chairs that exist in the market and their limitations are stated below.



2.1. Joystick Controlled Wheel Chair

This wheel chair works on the movement of joystick [4]. When a person moves joystick with his finger, the wheel chair moves according to it. In this method the hands of the person should work properly. If a person is completely paralysed this wheel chair is not so useful for him/her.

2.2. Accelerometer Controlled Wheel Chair

This wheel chair works on the principal of tilt motion [5, 6]. The person sitting on the wheel chair needs to wear a helmet equipped with an accelerometer sensor so that when he moves his head the sensor sends the signal for the required direction. In this wheel chair the paralysed person always needs to wear a helmet so as to operate the wheelchair, which is not always feasible.

3. Implementation

The implementation of this head motion controlled wheel chair consists of following components.

3.1. Ultrasonic sensor

Ultrasonic sensors are used to measure the distance between the object. Here we have used HC-S04 which has max. Range of 200cm. It consists of 4 pins: Vcc, trigger, echo, ground. Sensor transmits ultrasonic waves for short time interval. After striking from any object, the signal is received back by the sensor. As we know the speed of the wave and the time taken between transmitted and received signals thus we can calculate the distance between the object and the sensor. The input from the first sensor is used to detect the forward and backward motion of the head and input from the second sensor is used to detect the left and right motion of the head.

3.2. Arduino Uno(microcontroller)

It receives the input from the sensors and sends the output logic to our motor driver circuit according to position of the head with respect to the sensors. The code running on arduino continuously monitors the distance of head from each sensor and it takes its decision depending upon this distance.

3.3. Motor Driver

It consists of ULN 2803 IC and relays. It accepts the logic from Arduino Microcontroller and switch the motors according to the logic received by it.

Figure 1 shows the block diagram of the system. This system has Arduino Uno board as the main brain behind the control action. Two ultrasonic sensors continuously measure the distance of head and send it to the arduino. The arduino then makes the decision to control the movement of the motors which in turn controls the movement of the wheel chair. When the distance received from the ultrasonic sensor is between the preset values only then the control action is initiated. In order to smooth the movement, Pulse Width Modulation (PWM) is used. Head motion can be at any angle and the movement is decided by distances measured by both the ultrasonic sensors. The system has been implemented practically and is working satisfactory. This is very cost effective and efficient system. The circuit arrangement for the said system has been shown in "Fig.2". The final circuit mounted with the wheel chair is shown in "Fig.3".



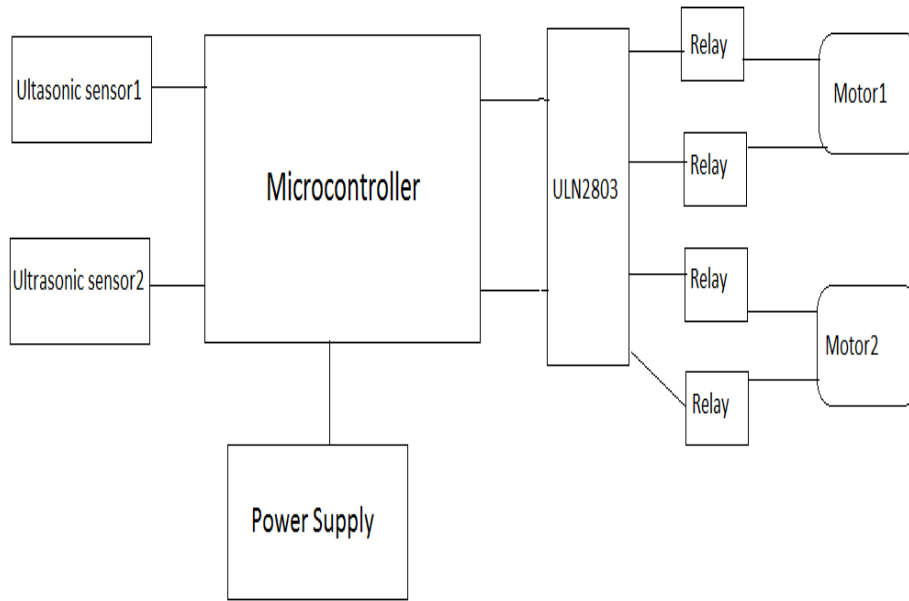


Fig. 1 Block Diagram of Head motion Controlled wheel chair

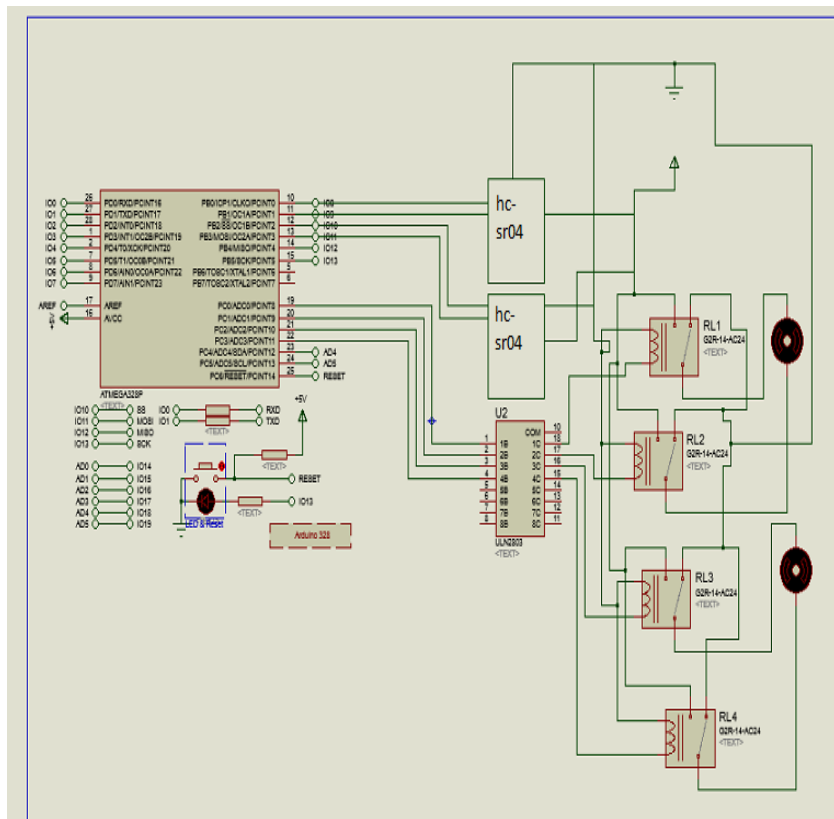


Fig. 2 Circuit arrangement for head motion controlled wheel chair



Fig. 3 Head motion controlled wheel chair

Conclusion

We have designed an electric motorized wheelchair using two ultrasonic sensors which didn't interfere in the comfort of the person. We used the ultrasonic sensors to detect the head movements which will be further processed to drive the motors. At later stages, more modifications can be done to this wheel chair. We can add wireless patient monitoring system to it with which doctor sitting at remote place will be able to consult the patient. Moreover, GSM module can be added to it with which we can also control wheel chair wirelessly. Also, a training has to be given to the person for having the control over the chair.

Acknowledgement

We wish to acknowledge all the Faculty Members and other contributors for helping us in implementing the idea and special thanks to DST for funding the project.

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