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Hand Gesture Controlled Wheelchair

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Abstract - *According to the World report on disability by World health organization (WHO), about 15% of the world's population lives with some form of disability, of whom 2-4% experience significant difficulties in functioning. So, they need a wheelchair for their mobility. These days there are various wheelchairs available in the market such as joystick-controlled wheelchair, voice recognition-controlled wheelchair, head gesture-controlled wheelchair, whose cost range between 80,000 to 1,50,000. In this case disabled people faces more difficulty due to unidirectional use of wheelchair control system. To overcome this problem, we have tried to develop "Hand gesture-controlled wheelchair". This can be used in both hands and can be controlled by his/her companion, if the person is not able to operate it. This current work is implemented with Arduino based device such as Arduino Uno and Nano as Arduino is the open source electronic platform, easy to use in hardware and software section.*

***Key Words*: Handicapped, Wheelchair, Arduino UNO, Arduino NANO, Gesture, Accelerometer, Gyroscope**

1. INTRODUCTION

As in 21st century the human life is becoming fast and advance. So, everyone is running behind the technology and its innovation. With such pace of life normal human being can easily run behind the technology, but what about the especially abled / disabled people of our society?

In the world, people are busy in their own work but disabled & older age people are dependent on other person for mobility. So, there are few people who take care of these people properly. In order to give them the independence we thought to design an automated wheelchair in terms of increasing their mobility and their requirements.

To drive wheelchair in our environment is a challenge for people using their arm or hands. The wheelchair is developed to overcome such problems. The automated wheelchair is an easy transportation for the physically disabled persons. The work represents a hand gesture-controlled wheelchair using gesture control technique. Wheelchairs are used by the senior aging group and people facing some kind of disability and injuries. The main aspect to develop this project is to make senior aging group and physically disabled person independent. The user can control the wheelchair using his/her hand gesture.

In this wheelchair the automation is not isolated as the luxurious thing. It is to be beneficial for all common people. So, how to reduce the physical strength used by old age people & handicapped people to operate the wheelchair is paramount aim. As many such people has their own wheelchair but they can't afford automation in it. In current scenario the automatic wheelchairs are available in market, but it is costlier than the wheelchair that we have designed.

2. LITERATURE REVIEW

Some research has been done in this field of control using Human/Hand Gesture:

Chowdhury, SM Mazharul Hoque. (2019) Diss. JAHANGIRNAGAR UNIVERSITY. Smart wheelchair for disable people. In this Prior art they have constructed Smart wheelchair for disable people in which the wheelchair will be controlled using certain commands. Claims which they have made are if user faces any critical situation an emergency message will deliver to them.

Shruti Warad, Vijayalakshmi Hiremath, Preeti Dhandargi, Vishwanath Bharath, P.B.Bhagavati (2015) Speech and flex sensor controlled wheelchair for physically disabled people. Paper describes an intelligent motorized wheelchair for physically handicap person using dependent user speech controlled and flexes sensor technology. In this project, to drive the wheelchair they are using speech commands "forward, backward, maximum, medium, minimum and stop". Direction of the wheelchair is controlled by flex sensor application. The wireless link between the glove & wheel chair enables any person to operate.

Shayban Nasif & Muhammad Abdul Goffar Khan (2017) (EEE department Rajshahi University) "Wireless Head Gesture Controlled Wheelchair for Disable Persons". In this project they have developed hands-free wheelchair for physically disabled persons. It works based on the Head Gesture Recognition Technique using Acceleration sensor. Acceleration sensor is used for the gesture recognition RF module is used for the smart wireless controlling.

3. TECHNOLOGY USED

In wheelchair circuit, we have used Arduino Nano and Uno. As Arduino is easy to use in hardware and software categories. It is freely available platform. As shown in Fig-1 we have used accelerometer and gyroscope, in gyroscope there are three co-ordinate axes. In which we have used two coordinate axes and set ranges for that coordinate like if (x>=3000 RPS) chair will take forward movement and if (x<=-3000 RPS) chair will take reverse movement. Similarly, with left and right movements. It sends the detected signal to the Arduino UNO. (RPS=Revolution per Second).

The wheelchair comprises of two main parts, one is transmitter part, placed on the hand of the user and the another one is receiver part which is placed in the chair. These both units are wireless module. Both the units consist of RF module pair which is used for transmitting and receiving the signal respectively. The chair will move as soon as the person changes the wrist gesture.

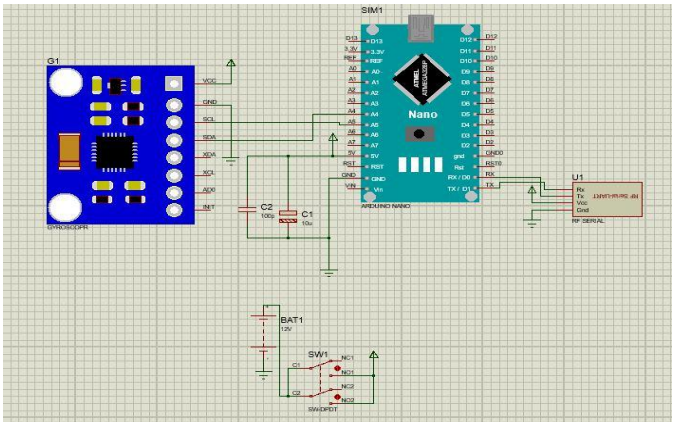

Fig -1: Transmitter circuit

In this circuit we have used 3.6V chargeable Lithium battery for power supply to the circuit. DC to DC Converter is used in the circuit. It converts the variable power supply by the battery to a constant 5V power supply to the Arduino Nano. Finally, Arduino Nano sends the signal to the RF Module and it transmits the signal to its pair that is connected in the receiver circuit. As shown in Fig-2 the transmitted signal by the RF module of transmitter circuit is received by its pair in receiver circuit. It sends the received signal to the Arduino Uno.

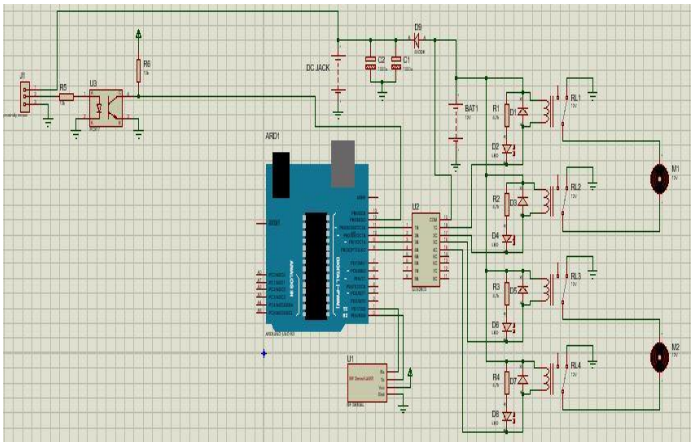

Fig -2: Receiver circuit

12V Power supply is given in the circuit. For that the chargeable battery is used. Finally, Arduino Uno sends the received signals by RF Module & Ultrasonic Sensor to the Relays connected in the circuit and accordingly the chair works. We have used 4 relays in the circuit. For each motor 2 Relays are used. According to that our wheelchair take Left, Right, Forward & Backward movements.

The transmitter transmits up to 50 meters of the range so that the user can operate the wheelchair from anywhere under this range. If the person is not able to operate the wheelchair by his own and the person has his companion with him then his companion can operate the wheelchair using his gesture.

4. FLOW CHARTS

The flow chart for transmitter circuit is shown in Fig-3 which is in the user's hand. Arduino Nano is used in this circuit for controlling all the operations of transmission. Main components of the transmitter circuit are Lithium battery, DC to DC converter, Accelerometer & Gyroscope, Arduino Nano and RF module (radio frequency module).

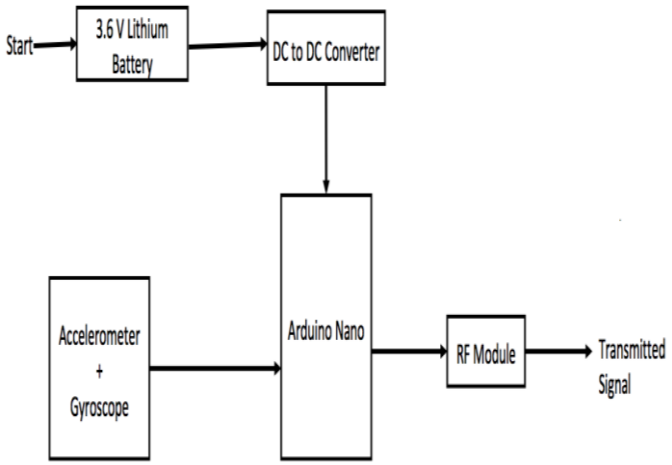

Fig -3: Transmitter block diagram

The Fig-4 shows the flow chart of receiver circuit which is in wheelchair. In this circuit Arduino Uno is used for controlling the operations to receive the signals and according to that it gives instructions to motors for movement using relays. Main components in receiver circuit are proximity sensor, Arduino Uno, Buzzer and Relays.

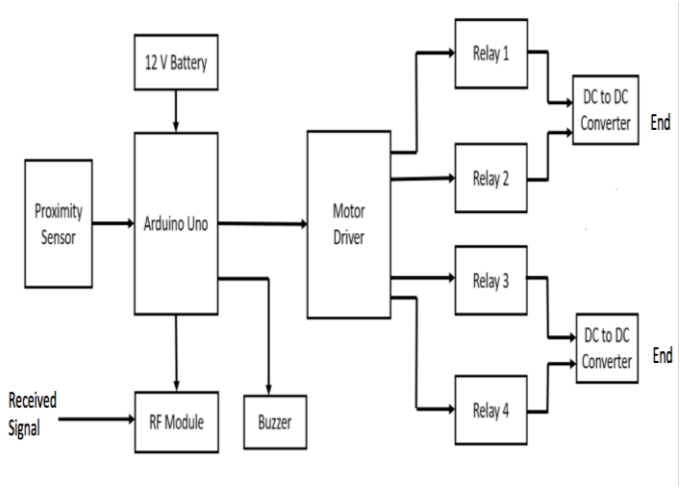

Fig -4: Receiver block diagram

5. WORKING

The wheelchair works according to the instruction given by the user through hand gesture. According to user's gesture, both motors work as shown in the Table-1. The Wheelchair will go in the direction in which our hand gesture shows.

Table -1: Working of the motors in wheelchair

Movement of motors according to hand gesture		
Direction of hand gesture	**Movement of left Motor**	**Movement of right Motor**
Forward	Forward	Forward
Backward	Backward	Backward
Right	Forward	Stop
Left	Stop	Forward

The working of the proximity sensor is in the chair that if any obstacle or any unwanted thing comes suddenly in front of the wheelchair, then it will sense that and then our chair will stop at that place only using braking system implemented in it, and it will give beep sound using buzzer also. The chair will not take that movement until the object is clear from there, but it will take all other movements other than that. Other work of buzzer is that, when user switches on the circuit then it will make to user that the circuit is on by its beep sound.

A switch is given in the wheelchair near to the user's hand, so that user can switch on or off the circuit according to requirement. A toolbox is also given in to the wheelchair in which the user i.e. disabled person can put his useful things in that, for example medicine, gloves, first aid box, etc.

6. ADVANTAGES

- The wheelchair is ergonomically sound.
- It is user friendly and cost effective.
- One can take wheelchair from one place to another place without dismantling the circuits.
- If user is unable to operate the wheelchair, in that case his/her companion can operate it within a certain range.
- Aesthetically the design of the original Wheelchair is not changed, so that the user can use it manually also.

7. FUTURE ASPECTS

The wheelchair will provide more mobility in future and it will make people familiar with the machine. We can further improve wheelchair by making it with high accuracy. The safety measures can be included into the wheelchair like implementation of high-power sensor like Ultrasonic sensor for object detection. Artificial Intelligence can also be included to make wheelchair more technically advance.

8. CONCLUSION

The wheelchair is fully automated and reduces the effort and physical strength of the disabled person. It will come in affordable cost or if anyone have his own traditional wheelchair then also automation can be implemented in it using the circuits. It is as foldable as the original wheelchair is, so that we can take it from one place to another place without any difficulty. It is capable of carrying the load up to 100 Kgs. User can use it by his own or his companion can also operate it under a certain range. The main aspect to design this wheelchair is to make senior age people and handicapped people to be independent.

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[4] "Wireless Head Gesture Controlled Wheelchair for Disable Persons" presented by Shayban Nasif & Muhammad Abdul Goffar Khan (EEE department Rajshahi University).

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