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Design and Fabrication of RF Controlled Wheel Chair

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Abstract - *Wheelchair is used for those who find difficult to walk due to polio, illness, and injuries in spinal cord, broken legs due to accident, brain injury and muscular dystrophy for individual control and for some specific activities. For hospital wheelchair, sports wheelchair and manually operated wheelchair needs extra force by the occupant to push the wheelchair by hand with the help of handles. People using the wheelchairs cannot move anywhere like a normal person by themselves as they always depend on other people. So instead of depending on others an automatic system can be adopted and the wheelchair can be operated by user using joy stick control. Wheelchair can be controlled by a joystick by the command it sends the signal to digital signal and to the motor driving IC. The IC controls the movement of wheelchair which will be detected by the sensor. Further, Robotic wheelchair have introduced for locomotion control in which the robot enhances and will provide a benefit to the people who cannot use hands and legs. In the development of a voice controlled wheelchair, the voice commands are fed to the system with recognition commands to control the movements of wheelchair in different directions and with different speeds and are connected to the sensors which receives the signals. Radio frequency (RF) controls are used in wireless devices that are used to operate audio, and other electronic equipment's. The radio frequency transmission using infrared remotes transmits radio waves to that command to push the button. In this work I designed and fabricated the wheel chair by using accelerometer sensor for user control and RF controller for remote monitoring.*

Key Words: **PIC16F877A, MEMS Accelerometer sensor, RF Controller, Arduino.**

1. INTRODUCTION

In the history of a wheelchair, the first wheelchair was developed in "Stone state of china "that was used for transporting disabled persons and heavy objects from one place to other. In 1655, Stephon Farfel, 22 years old para pelagic watch maker built a world's first self-propelling wheelchair with three wheels and it appeared as hand bike with the cranks mounted on the hand wheel. The rolling chair in 1887are used for the treatment of people by accommodating servants to push the rolling wheelchair. Further the Atlantic City in 1993, persons by name Harry C and Jennings S invented the first light weight steel folding portable wheelchair.

1.1 Types of Wheelchairs

- Manual Self-Propelled Wheelchair: Self-propelled wheelchair has four wheels in which two are caster wheel and other two are larger wheels and one seat with cushion.
- Manually Attendant Self-Propelled Wheelchair: This type of wheelchair is as same as manual self-propelled wheelchair. These wheelchairs are used in airports to transfer the passengers from one end to other to their flights and are accommodated.
- Powered Wheel Chair: Powered wheelchairs are operated by using electricity and most commonly we use batteries and electric motors that will assist to move the wheelchair and it is operated by joystick.
- Single Arm Drive Wheelchair: The user will operate the wheelchair manually with a single arm in the large wheel fitted with two concentric hand rims and the small rim is connected to the opposite wheel by connecting an inner axle.
- Sports Wheelchair: The sports wheelchair is developed for disabled athletes.
- Smart Wheel Chair: A smart wheelchair or a power chair can be controlled by different systems. Power chair eliminates the user task of driving or controlling wheelchair.
- All-Terrain Wheelchairs: The all-terrain wheelchair helps users in terrain conditions. This wheelchair has been developed in two different formats like hybridize wheelchair and mountain bike wheelchair.

1.2 Advantages of Wheelchair

- Wheelchairs are used to transport disabled persons easily from one place to another place.
- They are ideal for going long distances.
- It can be used in many surfaces.
- They offer customable options to improve comfort level of the user.
- It can be operated by systems without depending on any other person.
- This type of wheelchairs is very much useful in this pandemic situation like covid-19.

1.3 Disadvantages of Wheel Chair

- Transport of the wheelchair is difficult.
- Weight is high.
- Power consumption is more.
- Requires regular maintenance.
- Learning commands can be a learning curve.
- It can result in repetitive strain issues.

2. RELATED WORK OR LITERATURE SURVEY

The hand gestures are controlled by wheelchair in turn controlled by a MEMS accelerometer sensor technique. The sensor is a micro electrical and mechanical sensor that has highly sensitive sensor which detects the movement of the hand by tilting and with the help of an accelerometer. The wheelchair direction can be changed and it was controlled and interfaced with two dc motors to control the direction of the wheelchair. [1]. The joystick control wheelchair is very important for physically disabled people. This technology is used in powered wheelchair to monitor the intelligent system with the instruction of robotics and control the wheelchair by using joystick to move the direction of the wheelchair. [2]. The design of low-cost DIY moving wheelchair using AT mega 1284p based on retina movement for the disabled person with quadriplegia. The eye movement in the form of electrographic signal are transferred between the MAT lab script and the micro controller on detect the retina movement. This paper helps the physically disabled people without legs. [3]. The wireless head gesture controlled wheel chair for the disabled persons. In this paper the wheelchair has used accelerometer sensor that is used for head gesture recognition. The smart wireless controlled by radio frequency and the data will be sent wireless to the micro controller with motor driving circuit to control the movement of the wheelchair. [4]. The steering control in multi degrees of freedom two wheeled wheelchairs on slope environment. In this system the gyro sensor is used to measure the angle pitch in the wheelchair. In this system two-wheel motors and the two steering motors and it was proven theoretically by simulation. [5]. Invoice-controlled wheelchair, the user can control the system by speech conveniently. This paper explains the hardware that was developed for voice recognition commands for speech processing and it is controlled with recording command, recognition command and locomotion command.

3. TOOLS AND TECHNIQUES

The figure shows various steps involved in the project

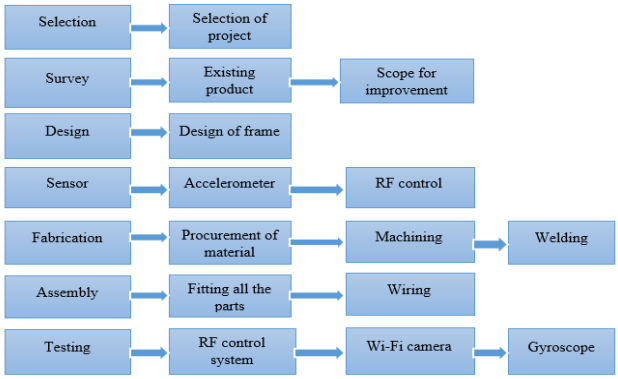


Fig -1: Various steps involved in the project

4. HARDWARE IMPLEMENTATION

4.1 Frame

Frame is a structural support of a physical component which is designed by using solid works software and fabricated by mild steel pipes. The rectangular part dimension is chosen based on the space required to sit comfortably by a normal person.

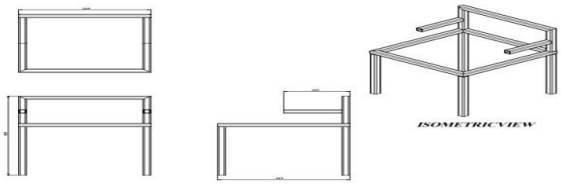


Fig -2: Design of frame

Table -1: Properties of the Material Used

Properties	*Values*
Density	7850 kg/m^3
Young's modulus	2x10^5 MPa
Poison ratio	0.3
Bulk modulus	1.66x10^5 MPa
Shear modulus	7.69x10^4 MPa
Tensile yield strength	250 MPa
Ultimate tensile strength	250 MPa
Compressive yield strength	460MPa

4.2 Caster Wheels

A caster is a single or a double wheel which is made up of fiber or plastic material by taking the considerations of

strength of materials. The center hub of the wheel revolves around the swivel point and is located in a small circle and it makes easy to move heavy loads.

Fig -3: Caster wheels

Advantages of using caster wheels:

- Use on virtually any floor surface under almost all operating condition.
- High capacities.
- Light weight but resistant to impact, shock and abrasion.
- Will not compress under rated capacities.
- Oil and chemical resistant.

4.3 Rear wheels

Rear wheel or drive wheels are made up of spokes or mags and hub. The hub is the center of the wheel. Rear wheels of manual wheel chairs are normally equipped with quick release axles for easily handling during transportation. In this project rear wheels plays vital role in changing the direction of the chair.

Fig -4: Large wheel

4.4 Radio frequency module

The radio frequency is an electromagnetic wave that lies in the range from 3KHZto 300 GHz. Those frequencies can be used for communication for radar signals. When the button is pressed, the RF transmitter module is been pressed and it transmits radio waves that corresponds to the binary command instead of sending of the light signals.

Fig -5: Transmitter module

Fig -6: Receiver module

4.5 Relay

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays.

Fig -7: Relay

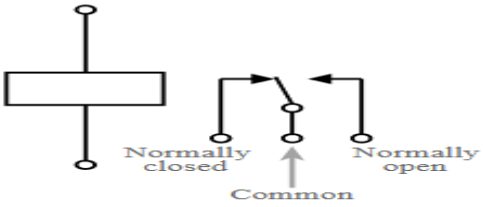


Fig -8: Relay switch

4.6 Microcontroller (Arduino)

The microcontroller PIC16F877A is used This RF controlled wheel chair is developed on the PIC16F877A platform. The PIC16F87FA is of 40-pin microcontroller. It is a RISC microcontroller which is fabricated in CMOS and to access the program memory and data memory simultaneously. It is having a separate instruction bus and data bus. Except the program branches it is having 35 single word instructions. The operating speed of PIC16F877A is having a clock input of DC-20MHz and an instruction cycle of DC-200.

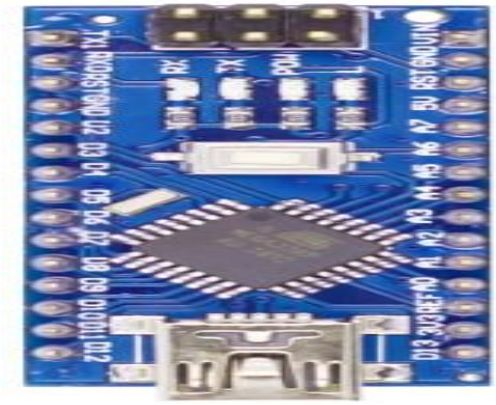


Fig -9: Microcontroller (Arduino)

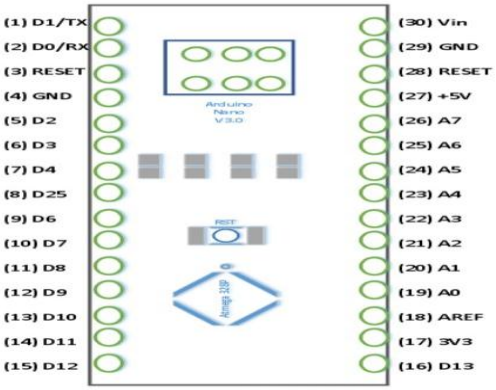


Fig -10: Pin diagram of microcontroller

4.7 Accelerometer Sensor

This sensor is of MicroElectroMechanical system and it is highly sensitive which is able to detect the tilt. Based on tilt, this accelerometer sensor will do changes in the wheelchair directions.

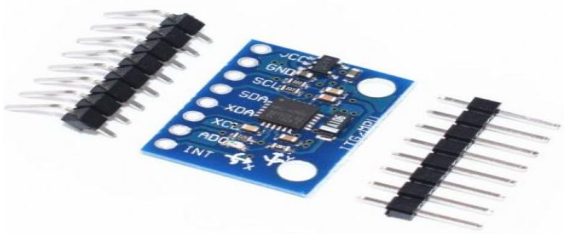


Fig -11: MEMS accelerometer sensor

4.8 DC Motors

Electric motor is employed as a part of all the mechanical hardware. Electric motors are a strategy for changing over vitality. Motor take electrical imperativeness and gives mechanical essentialness are output.

Fig -12: DC motor

4.9 Wi-Fi Camera

Wi-Fi camera is operated by transmitting the video through a Radio Transmitter.. The video is sent to a built-in storage device through cloud storage and is easy to access of video clips.

Fig -13: Wi-Fi camera

4.10 Battery

A battery is a device consisting of one or more electrochemical cells with external connections for powering electrical devices such as flashlights, mobile phones and electric cars

Fig -14: Battery

5. SOFTWARE IMPLEMENTATION

Arduino programming language is very simple similar to C language. Here an open-source Arduino programming was IDE is utilized to compose code and transfer to the board. Because it is easier to compare to the other software. This IDE software will allow writing sketches for different Arduino boards this can run through windows, Mac OS X, and Linux. Here in this work, arduino programming language is used, which is very simple hardware programming language called processing and is similar to the C language.

After the sketch is written in the arduino IDE (integrated development environment) it should be uploaded on the arduino board for execution.

6. WORKING OF PROJECT MODULE

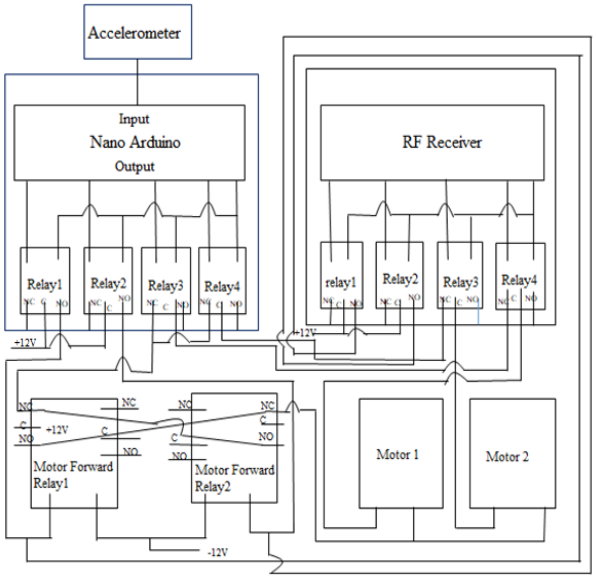


Fig -15: Block diagram of working of project module

Above figure shows the Main block diagram of project module:

The device that acts as input are

1. Power supply

2. Wi-Fi Camera

3. Accelerometer control

The device that acts as output are

1. DC Motor

2. Gyroscope

Transmitter unit: This unit mainly consists of Nano arduino board for self-controlling operation by the patients.

Receiver unit: The receiver unit is of RF control based that is remotely controlling the patients by radio frequency controller.

7. RESULTS AND DISCUSSION

7.1 Wheel Chair Movement Using Accelerometer

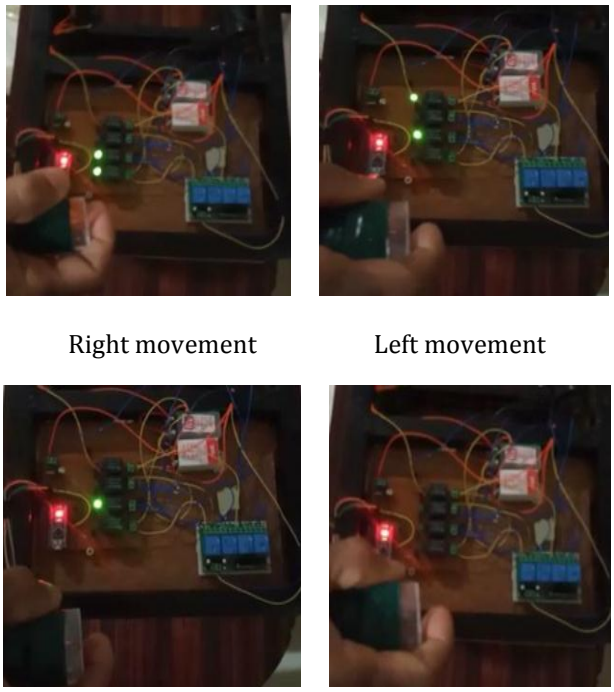
Based on hand movements with holding accelerometer inside and changing the MEMs gesture, the chair works as following:

In forward: WHEEL moves in forward direction.

In reverse: WHEEL moves in reverse direction.

In left: WHEEL moves in left direction.

In right: WHEEL moves in right direction.



Right movement Left movement

Forward movement Reverse movement

Fig -16: Gesture based accelerometer movement of the wheel chair

7.2 Wheel Chair Movement Using RF Control

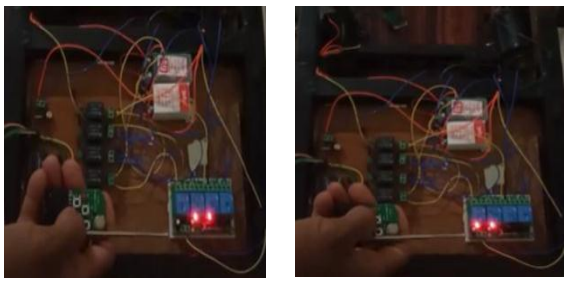
Based on the operation of the buttons A, B, C and D on RF transmitter unit, we can monitor the direction of the chair by using Wi-Fi camera for live streaming and its direction as follows:

In C: WHEEL moves in forward direction.

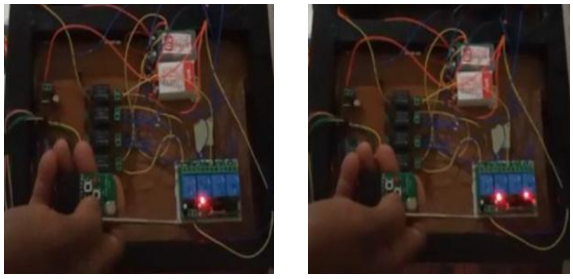
In A: WHEEL moves in reverse direction.

In D: WHEEL moves in left direction.

In B: WHEEL moves in right direction.



Right movement Left movement



Forward movement Reverse movement

Fig -17: RF based movement of wheelchair

8. CONCLUSION AND FUTURE SCOPE

It can be concluded that proposed model is controlled based on hand gesture using accelerometer sensor and RF module. The arduino Nano microcontroller which is the biggest advantage works with 32 bit data and it sends the data with in a fraction of second. The wheel chair receiver and control unit interact without any traffic by RF transceiver which is fixed in both transmitter and receiver unit which makes the entire process to work faster. In arrangement of hand gesture-based chair, there is need to consider predetermined number of signals. This kind of control could enhance efficiency, decrease the impacts of dull movements and enhance security. Proposed utility serves lot of applications the field of development, hospitals, industries, old age homes and domestic use. In future this wheel chair can make into much smarter by adopting Wi-Fi technology that is the wheel chair can be monitor by the Wi-Fi signals.

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