# Android Based Automated Wheel Chair Control for Physically Challenged Person

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ABSTRACT

This project is related to the android-based wheelchair controller. The system is designed to control a wheelchair by using an android device. The objective of this project is to facilitate the movement of disable people or handicapped and also the senior people who are not able to move well. The result of this design will allow the special people to live a life with less dependence on others. Android technology is a key which may provide a new approach of human interaction with machines or tools. Thus their problem can be solved by using android technology to control the movement of a wheelchair. In this project, Basic4android interface is designed to program the android device that will be able to control the movement of wheelchair. This project integrated IOIO board and direct current motor to create the movement of wheelchair. The results of this project showed that this project can be used for future research works and to design excellence innovation that meets market need and public interest.

Keywords: Android, Direct Current, IOIO Board and Motor.

## 1. INTRODUCTION

While the needs of many individuals with disabilities can be satisfied with power wheelchairs, some members of the disabled community find it is difficult or impossible to operate a standard power wheelchair. This project could be part of an assistive technology. It is for more independent, productive and enjoyable living. Android-based wheelchair controller is a system where the DC motor is used to move the wheelchair. Nowadays, handicapped people face problem to control wheelchair by themselves. Sometimes they need other people to help them. This project will provide a new way to control the movement of wheelchair such as turn direction to left, right, forward and reverse direction. The overall wheelchair operation uses DC motor and motor driver module combines with microcontroller system for instance IOIO board. Android-based wheelchair controller that consists of android device and a control box that can be attached to standard wheelchairs to control the movement by using a DC motor. Bluetooth communication protocol is used to communicate sensory and command information between the android device and the control box. There are 4 options for basic motions of a wheelchair to be to be applied by the user [4]. The four conditions of the wheelchair can be described as the following:

a. Moving forward
b. Moving backward
c. Turning to the right
d. Turning to the left

This project also provided a controller to the electrical appliance by using radio frequency as a wireless connection between control box and electrical appliance. Figure 1 shows the block diagram for overall of the project.

## 2. DRIVE WHEEL

The location of the drive wheels the wheels powered by the motor in the rear, middle or front of the chair has a definite effect on the chair's performance in different environments.

## 3. MANEUVERABILITY

The position of the drive wheels significantly affects the space needed for the chair to turn around, and the way the chair maneuvers in tight spaces. Mid-wheel drives are the most maneuverable because they have the smallest 360-degree turning circumference and the tightest turning radius (20 to 26 inches), making those excellent indoor chairs.

Front-wheel drives have a turning radius of 25 to 28 inches and a larger 360-degree circumference than mid-wheel drives. However, they actually navigate around tight corners better than the other two drive systems because the position of the pivot point gives them a very short front end. But turning around in a small space is tricky because of the long back end.

Rear-wheel drives have the largest 360-degree circumference and turning radius (30 to 33 inches) of the three drive systems, making them more difficult to maneuver in tight spaces. In addition, the footrests on a rear-wheel drive chair take up more space because they're typically angled forward at anywhere from 80 to 60 degrees in order to clear the larger front casters. The amount of space taken up by the footrests varies depending on the drive system and the particular angle required by the user. When the footrest angle changes, so does the turning radius measurement. This makes comparing the turning specifications on chairs a little tricky. Most experts include the footrests in the turning radius measurement, but most manufacturers don't due to the variability of footrest angles.

Because mid-wheel drives have small front casters that are wider apart than on other drive systems, 90-degree footrests add less than an inch to the turning radius. On front-wheel drive chairs, there are no front casters to interfere with having 90-degree footrests. When the footrests are counted in the turning radius measurement, they add less than an inch.

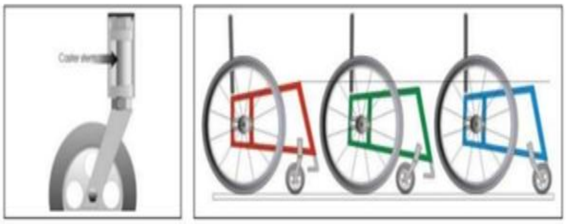
Another factor that affects maneuverability is how the weight is distributed on the wheelchair. “Chairs have an ideal weight distribution, and the further away you get from that, the more you impact the [maneuverability], “What you find sometimes with the rear-wheel drive is that a lot of the weight is over the casters, and they perform very poorly”. Mid-wheel and front-wheel drives are less sensitive to problems caused by weight distribution than rear-wheel drives.

## 4. HANDLING OBSTACLES AND INCLINES

Front-wheel drives are optimal for traversing obstacles such as curbs, grass, gravel, uneven terrain and snow. This is because the 14-inch drive wheels are the first wheels to encounter obstacles and they pull the rest of the wheelchair over them. A rear-wheel drive means the drive wheels are pushing the front casters over obstacles. Because pushing is harder than pulling, rear-wheel drives aren’t quite as efficient going over obstacles as front-wheel drives.

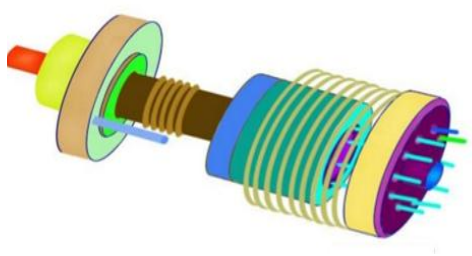
## 5. CASTER DESIGN

Caster stems must be kept as vertical as possible. Caster stems that are not vertical cause a number of problems. If the stem leans forwards at the top the chair is difficult to turn and the knees are lower wheeling forwards than when wheeling backwards. The chair is difficult to keep in a straight line and the knees raise up higher when rolling forwards.



## 6. SMARTPHONE

A Smartphone is a mobile phone built on a mobile OS, it has more advanced computing capability and connectivity than a ordinary phone. Most Smartphone’s are equipped with accelerometers for user interface control that are used to present landscape or portrait views of the phone’s screen, based on the way the device is being held. Also most smart phones have Bluetooth Wireless Technology inbuilt in the device for various small range wireless applications like headset, file transfer, wireless input devices etc.



## 7. ACCELEROMETER

An accelerometer is a device that measures proper acceleration. Proper acceleration is different from the acceleration (i.e. rate of change of velocity), e.g. an accelerometer at rest on the surface of the Earth will measure an acceleration g= 9.81 m/s2 straight upwards whereas, accelerometers in free fall orbiting and accelerating due to the gravity of Earth will measure zero.

An accelerometer is an electromechanical device that will measure acceleration forces. These forces may be static, like the constant force of gravity pulling at your feet, or they could be dynamic - caused by moving or vibrating the accelerometer. The Smartphone Accelerometer is a semiconductor IC that measures motion and its intensity in all 3 axes and directly can provide values to suitably designed application. Often accelerometers is used to present landscape or portrait views of the devices screen based on the way the device is being held.

## 8. RELAY

Each two relays are connected to one DC motor driven by a transistor. One relay is used to operate the motor, and the second is used to switch or shift the phase in order for the motor to turn in the opposite way. The order is sent by an android application to a microcontroller which will drive a transistor. The latter will operate the coil of the relay. The relay is always connected to +VCC, on one side, and to the collector of the transistor on the other side (the transistor is acting as a switch in this stage). Once the microcontroller sends a voltage to the transistor, the collector connects to the emitter (already linked to the ground). Thus, the relay circuit gets all the power it needs and the motors consequently turn in the same direction and speed. Similarly, the other two relays are connected in a flipped way in order to change the polarities of the motors and thus change the direction of the rotation. This will allow the user to gain full control of the movement of the wheel chair in all directions.

## 9. BLUETOOTH

Bluetooth present in the Smartphone can be tapped using protocol stacks in the app design environment of the mobile operating system. BWT-enabled devices operate in the unrestricted 2.4-gigahertz (GHz) Industrial, Science, Medical (ISM) band. The ISM band ranges between 2.400 GHz and 2.483 GHz. BWT-enabled devices use seventy-nine 1-megahertz frequencies (from 2.402 to 2.480 GHz) in the ISM band. BWT-enabled devices use a technique called frequency hopping to minimize eavesdropping and interference from other networks that use the ISM band. With frequency hopping, the data is divided into small pieces called packets. The transmitter and receiver exchange a data packet at one frequency, and then they hop to another frequency to exchange another packet. They repeat this process until all the data is transmitted.

BWT devices randomly hop between frequencies up to 1600 times per second much faster than other types of devices that use the ISM band. This means that if another device, such as a 2.4-GHz cordless phone, interferes with a BWT network at a particular frequency, the interference only lasts for about 1/1600 of a second until the BWT devices hop to another frequency. This gives BWT networks a high immunity to interference from other 2.4-GHz devices. There are three classes of BWT radio devices, each with a different maximum range: Class 1 (100 meters); Class 2 (50 meters); and Class 3 (10 meters). HP notebooks feature Class 3 BWT radios, and HP printers feature Class 1 radios. BWT-enabled devices hop between frequencies up to 1600 times per second.

Pairing is a bonding procedure that allows you to avoid entering access information each time two devices establish a connection. If Secure Connection is enabled, devices will pair automatically the first time they connect (a password, or passkey, must be successfully exchanged). When you pair two devices, they generate and store a common link key so that you do not need to enter the passkey. Paired devices exchange encrypted data that cannot be deciphered by unauthorized devices.

- One of the devices is not powered on.
- A service connection is interrupted or the service is stopped.
- One or both of the devices are restarted.

You can manually pair your device with another connected device by right-clicking the device icon in My Bluetooth Places and selecting Pair Device from the shortcut menu. To unpair a device, right click the device icon in My Bluetooth Places, and then select unpair Device from the shortcut menu.

**10. BATTERY**

An electric battery is a device consisting of one or more electromechanical cells that converts stored chemical energy into electrical energy. Each cell contains a positive terminal, or cathode, and a negative terminal, or anode. Electrolyte allows ions to move between the electrodes and terminals, which allows current to flow out of the battery to perform work.

There are two types of batteries: primary batteries (disposable batteries), which are designed to be used once and discarded, and secondary batteries (rechargeable batteries), which are designed to be recharged and used multiple times. Batteries come in many sizes, from miniature cells used to power hearing aids and wristwatches to battery banks the size of rooms that provide standby power for telephone exchanges and computer centers. The storage battery or secondary battery is such battery where electrical energy can be stored as chemical energy and this chemical energy is then converted to electrical energy as when required. The conversion of electrical energy into chemical energy by applying external electrical source is known as charging of battery.


Whereas conversion of chemical energy into electrical energy for supplying the external load is known as discharging of secondary battery. During charging of battery, current is passed through it which causes some chemical changes inside the battery. This chemical changes absorb energy during their formation. When the battery is connected to the external load, the chemical changes take place in reverse direction, during which the absorbed energy is released as electrical energy and supplied to the load. Now we will try to understand principle working of lead acid battery and for that we will first discuss about lead acid battery which is very commonly used as storage battery or secondary battery

**11. MOTOR**

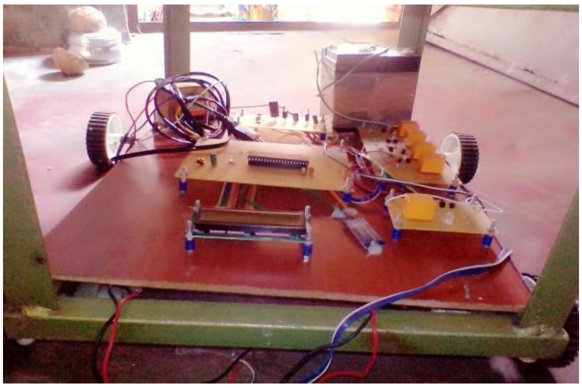
There are two motors used in the wheel chair to drive the wheels and other two are freewheels. The two motors will be connected to the microcontroller through the board. The motor will be programmed to run at a particular range of speed predefined. To move forward and backward both the wheels will move clockwise and anti-clockwise respectively, but to turn right and left one motor will be completely stopped and other motor will keep running, let's say if we have to turn left, left wheel will completely stop and right wheel will run and to turn right, right wheel will completely stop and left wheel will keep running. A tabular chart depicting the different speeds fed through programme are given below A timer programme is added in the motor programme for delaying the motor reaction after the signal is given to it by given seconds (1 or 2). The complete programme is given as follows –

```
$regfile = "m16def.dat".
$crystal = 1000000
ConfigLcd = 16 * 2
ConfigLcdpin = Pin , Rs = Portb.2 , E = Portb.3, Db4
= Portb.4,
Db5 = Portb.5 , Db6 = Portb.6 , Db7 = Portb.7
ConfigAdc = Single, Prescaler = Auto , Reference =
Avcc Start
Adc
Config Timer1 = Pwm, Pwm = 8, Prescale = 1,
Compare A Pwm = Clear
Down, Compare B Pwm = Clear Down
Start Timer1
Do
Cls
Lcd "forward"
Pwm1a = 150
Portd.6 = 0
Pwm1b = 150
Portd.3 = 0
Wait 2
Cls
Lcd "left"
Pwm1a = 100
Portd.6 = 0
Pwm1b = 0
Portd.3 = 0
Wait 2
Cls
Lcd "stop"
Portd.6 = 0
Portd.3 = 0
Pwm1a = 0
```

```
Pwm1b = 0
Wait 2
Loop
End
```

**12. HARDWARE KIT**

In our project we have designed for disabled persons. The person who were controlled by independently. Disabled persons may not dependent someone our project controlled by smart phone the handicapped person itself controlled the wheel chair.



**13. CONCLUSION**

In our project we designed and fabricated Android Based Automated Smart Wheelchair, which can be used on inclined and flat terrains and obstacles. Users can use their existing android phones to download and install the android app to use it as a controller for their wheelchair. The use of the existing android phone considerably reduces the cost of the wheelchair. The operation of the wheelchair is done by tilting the smartphone in different directions. Front wheel drive provides high maneuverability, have less turning radius as compared to rear wheel drives and are optimal for handling obstacles and inclines. Obstacle avoiding feature is provided with the help of IR sensors. The optimization of ergonomics has been added in our design to make the wheelchair more convenient and comfortable.

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