ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Electrical Wheel Chair

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Abstract:
This is a wheel chair which runs electrically without any manual effort. Manual wheelchair is designed for handicapped people who can move themselves from one place to other by manual effort. But this electrical wheelchair is very much useful for the elderly people who don't even have the strength to draw the wheels in the desired direction. These motorized wheelchairs are used by those not only with traditional mobility but also cardiovascular and fatigue based conditions. Electric wheelchairs have improved the quality of life for many people with physical disabilities through the mobility they provide. The most basic task of the chair is to take input from the user, usually in the form of a small joystick, and translate that motion into power to the wheels to move the person in the desired direction. Power chair design basically consists of drive system, chassis, power supply (battery),and controller. These are generally four-wheeled or six wheeled and non-folding, however some folding designs exist and other designs may have some ability to partially dismantle and transit.

Four general styles of power-chair drive systems exist: front, center or rear wheel drive and all-wheel drive. The user is provided with the advantage of unparalleled control of the wheelchair in terms of both user input and vehicle ability. This abstract briefly describes how the application of both mechanical and electrical implementation has turned the wheelchair into a smart and adaptive means.

I. INTRODUCTION:

An electric wheelchair or electric powered wheelchair (EPW) is a wheelchair that is propelled by means of an electric motor rather than manual power. Motorized wheelchairs are useful for those unable to propel a manual wheelchair or who may need to use a wheelchair for distances or over terrain which would be fatiguing in a manual wheelchair. They may also be used not just by people with 'traditional' mobility impairments, but also by peoplewith cardiovascular and fatigue based conditions. The electric-powered wheelchair was invented by George Klein who worked for the National Research Council of Canada, to assist injured veterans after World War-2.

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In the worldwide context an estimated 100-130 million people are suffering with disabilities and need wheelchairs. Experts predict that this number would increase by 22percent over the next 10 years. Many disabled people are relying on the electrical wheelchair; this is the reason why this motorized wheelchair is developing in newer shapes with additional latest enhancements

Construction:

An electrical wheelchair comprises of:

1) Chassis
2) Drive train
3) Steering system
4) Power supply(battery)
5) Controller.

Fig 1: prototype of Electric wheel chair

II. CHASSIS:

Generally chassis of wheelchairs are classified as folding and non-folding type. But as this type is powered, so folding is not possible. The chassis is made up of iron pipes of 1 inch diameter which are welded to build the desired structure. The length of the chair is 42.8cms and the width is 44cms.Height from the ground level is 48cms. In order to provide base and support to the drive train and the steering mechanism iron angulars of 2.5cms width and 2.5cms height is used. The thickness of the angular is 3mm. It totally consists of 5 wheels, where the front two wheels act as steering wheels , the rear middle wheel acts as the main drive wheel and the other two rear wheel are used to bear the counterweight. The rear drive wheel is larger than the other two rear wheels. The diameter of the drive wheel is 30cms. It is attached with the chassis with the help of two suspension springs of length 31cms. The diameter of the other two rear wheels is 27.5cms. These suspension springs are provided to prevent jerks reaching the person on the chair, when the chair passes throughuneven ground surfaces.

Drive Train

The drive train comprises of the following components:

1) Motor (24V-2.3A)
2) Gear box-1(1:5)
3)Gear box-2(1:10)
4) Chain sprocket (16Teeth)
5) Chain link
6) Chain sprocket (24Teeth)

Here the wheels are driven using a chain drive. It consists of a Motor (24volts-2.3A). The speed of the motor is 750 R.P.M. The output of the motor is 309 KW. This motor is paired with a internal gear box for increase of torque and reduction in R.P.M. When load is acted and during ascending and descending conditions a very high torque is required, which can be obtained by decreasing the speed.

In order to increase torque, the gear ratio is to be increased. The output shaft of the gear box is connected with a chain sprocket with 16teeth and the diameter of the driving sprocket is 7cms. The axle of the drive wheel consists of another chain sprocket with 24teeth and the size of the driven sprocket is 10.5cms.The drive is transmitted to the driven sprocket from the driving sprocket by a chain link of 90cms. The size of the driving sprocket is smaller than the driven sprocket because it helps in increasing the torque and reducing the speed.

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Sprockets and Chains:

A sprocket is a toothed wheel upon which a chain rides. Contrary to popular opinion, a sprocket is not a gear.

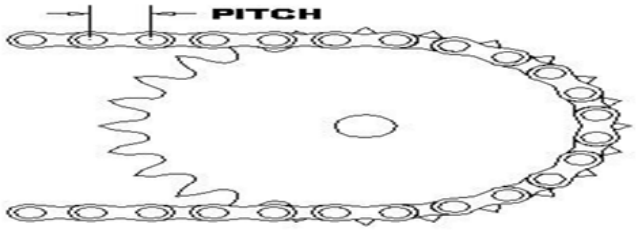

Fig 2: Chain Sacket

Steering System:

The front wheels are used to steer and move the chair in the desired direction. The motion is transmitted to these wheels with the help of another motor(24Volts-2A). In this case also in order to increase torque, the motor is connected with a gear box of gear ratio (1:25). The speed of the gear box is 280 R.P.M. As the output of the motor is connected to the gear box the speed at the output of the gearbox is decreased by 25times and the speed is 11 R.P.M. As the speed is decreased by 25times and the torque is increased by 25times.

The steering is achieved as the wheels are connected with the help of 6 bar link mechanism, which is driven by the output of the gearbox. The size of the steering wheels is smaller when compared to the rear drive wheels. The diameter of the steer wheels is 16cms. The output shaft of the gear box is connected at the center to the link-1 which is 40cms in length. The two ends of the link-1 are connected to the ends of two links i.e. link-2 and link-3. The two steer wheels are attached to link-2 and link-3. The other two ends of link-2 and link-3 are joined to the links-4, 5, 6 and 7.The lengths of the links are mentioned below:

Link- 1	- 40 cm
Links- 2, 3	- 10 cm
Links- 4, 5	- 10 cm
Links- 6,7	- 5 cm

III. STEERING LINKS MECHANISM:

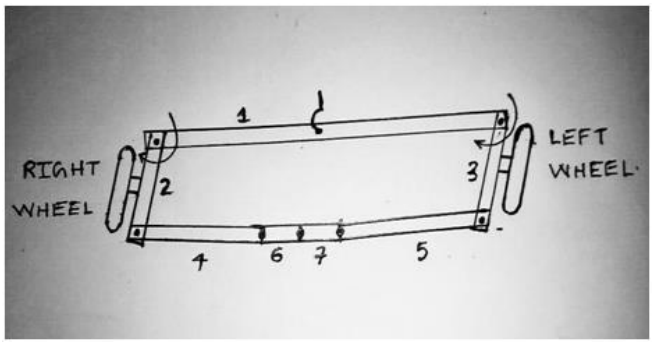

Fig 3: Turning to right

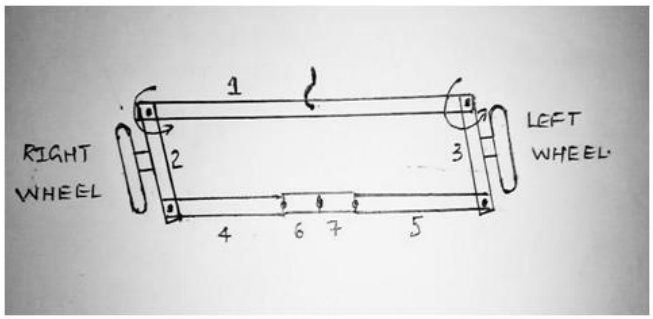

Fig 4: Turning To Left

IV. CONTROLLER UNIT:

The main parts of the controller unit are:

- Relay Switches
- Pulse Width Modulator
- Mosfet
- Remote Controller

Relay Switches:

These controller units are arranged in a circuit board in whichrelay switches plays a key role in it. There are four relay switches. Two are connected to drive motor and remaining two are connected to steering motor. In the drive motor, when the rotation is forward one relay remains switched ‘ON’ and the other remains in ‘OFF’ position and vice-versa. Similarly in the steering motor, when the steer is towards left one relay remains switched ‘ON’ and the other remains in ‘OFF’ position and vice-versa.

Basic design and operation:

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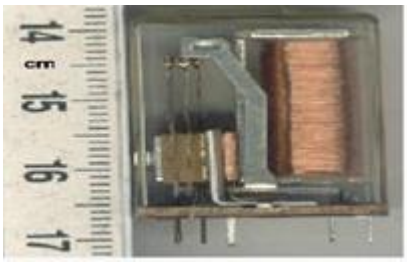

Fig 5: Simple electromechanical relay

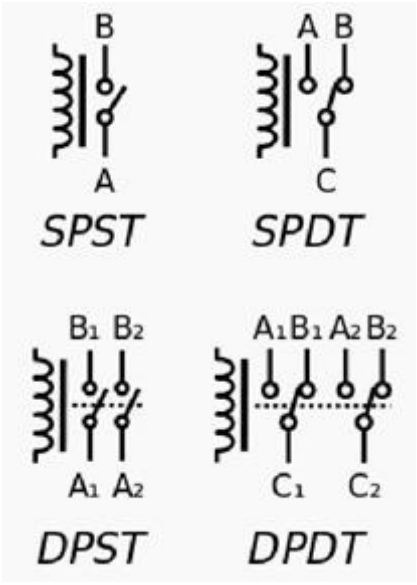

Fig 6: Pole and throw

Circuit symbols of relays. (C denotes the common terminal in SPDT and DPDT types.) Since relays are switches, the terminology applied to switches is also applied to relays; a relay switches one or more poles, each of whose contacts can be thrown by energizing the coil.Normally open (NO) contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive. It is also called a "Form A" contact or "makes" contact. NO contacts may also be distinguished as "early-make" or "NOEM", which means that the contacts close before the button or switch is fully engaged.Normally closed (NC) contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive. It is also called a "Form B" contact or "break" contact. NC contacts may also be distinguished as "late-break" or "NCLB", which means that the contacts stay closed until the button or switch is fully disengaged.

Change-over (CO), or double-throw (DT), contacts control two circuits: one normally open contact and one normally closed contact with a common terminal. It is also called a "Form C" contact or "transfer" contact ("break before make"). If this type of contact has a "make before break" action, then it is called a "Form D" contact.

The following designations are commonly encountered:

SPST (Single Pole Single Throw): These have two terminals which can be connected ordisconnected. Including two for the coil, such a relay has four terminals in total. It is ambiguous whether the pole is normally open or normally closed. The terminology "SPNO" and "SPNC" is sometimes used to resolve the ambiguity.

SPDT (Single Pole Double Throw): A common terminal connects to either of two others. Including two for the coil, such a relay has five terminals in total.

DPST (Double Pole Single Throw): These have two pairs of terminals. Equivalent to twoSPST switches or relays actuated by a single coil, including two for the coil, such a relay has six terminals in total. The poles may be Form A or Form B (or one of each).

DPDT (Double Pole Double Throw): These have two rows of change-over terminals.Equivalent to two SPDT switches or relays actuated by a single coil, such a relay has eight terminals, including the coil.

V. PULSE WIDTH MODULATOR

Pulse width modulator:

There are two modulators. Medium torque low speed modulator isfor the control of steering and another is high torque low speed modulator is for the drive. By adjusting the modulator, the torque in the motors can be varied. Pulse-duration modulation (PDM) is a modulation technique used to encode a message into a pulsing signal. Although this modulation technique can be used to encode information for transmission, its main use is to allow the control of the power supplied

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to electrical devices, especially to inertial loads such as motors. In addition, PWM is one of the two principal algorithms used in photovoltaic solar battery chargers, the other being maximum power point tracking. The average value of voltage (and current) fed to the load is controlled by turning the switch between supply and load on and off at a fast rate. The longer the switch is on compared to the off periods, the higher the total power supplied to the load. The PWM switching frequency has to be much higher than what would affect the load (the device that uses the power), which is to say that the resultant waveform perceived by the load must be as smooth as possible. Typically switching has to be done several times a minute in an electric stove, 120 Hz in a lamp dimmer, from few kilohertz (kHz) to tens of kHz for a motor drive and well into the tens or hundreds of kHz in audio amplifiers and computer power supplies.

The term duty cycle describes the proportion of 'on' time to the regular interval or 'period' of time; a low duty cycle corresponds to low power, because the power is off for most of the time. Duty cycle is expressed in percent, 100% being fully on.The main advantage of PWM is that power loss in the switching devices is very low. When a switch is off there is practically no current, and when it is on and power is being transferred to the load, there is almost no close to zero. PWM also works well with digital controls, which, because of their on/off nature, can easily set the needed duty cycle.PWM has also been used in certain communication systems where its duty cycle has been used to convey information over a communications channel.

MOSFET:

Metal Oxide Semiconductor Field Effect Transistor is widely used forswitching and amplifying electronic signals. The main aim of the MOSFET is to control the voltage and current flow between the source and the drain. The traditional metal–oxide–semiconductor (MOS) structure is obtained by growing a layer of silicon dioxide(SiO2) on top of a silicon substrate and depositing a layer of metalor polycrystalline silicon (the latter is commonly used). As the silicon dioxide is a dielectric material, its structure is equivalent to a planar capacitor, with one of the electrodes replaced by a semiconductor.

Remote controller:

It consists of four keys and takes the input from the user and movesthe chair in the desired direction. Two keys are for steering purpose i.e. (left and right) and the other two keys are for drive purpose i.e. (forward and backward)

Fig 7: Controller unit

Advantages and Limitations

Advantages:

Minimal effort to mobilize: Minimal effort is needed to control the wheel chair because you use a simple joy stick.

Independence: With an electric wheelchair, you don't have to depend on someone else to push the chair, allowing you the independence of moving about.

Adaptable for severity of disability: The adaptability of an electric wheelchair is astounding. People who have only control of their fingers and have been set up to move their wheelchair using controls.

Going up hills and ramps: The power of an electric wheelchair makes it easier for you to go up or down

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hills.

Power for distance: When using a manual chair to go a far, you need to take intoaccount how much energy and ability you have to come back. With an electric wheelchair, you are only limited by the amount of power left in your battery pack.

Disadvantages:

As wonderful as a new electric wheelchair may be to help you regain some mobility, they aren't for everyone. They do have drawbacks, which need to be taken into consideration.

Maintenance & repair: The cost of maintaining and repairing an electricwheelchair can be substantially higher than a manual wheelchair.

Initial expense: Electric wheelchairs are typically more expensive than standardmanual wheelchairs.

Size: Electric wheelchairs are larger than manuals and may not be suitable in everyhome.

Weight: Electric wheelchairs are much heavier than manual chairs. The size andweight makes them less portable than manual chairs and perhaps be too heavy for some lifts.

Limited power: If the battery packs are not recharged properly, you may end upwith a dead battery before you return home.

Difficult for Others to Maneuver: If you become unable to move your electricwheelchair on your own, pushing it is very difficult because of its weight and its build.

VI. CONCLUSION:

This project resulted into a successful prototype of an Electrical Wheelchair. This minimized expense is pretty affordable for many people and it can be even cheaper when taken for mass production.

This project can be counted as a good initiative for comfort and betterment of the physically handicapped and disabled people's way of living.

Future Scope:

There are plenty of scopes to upgrade this prototype to ascend and descend stairs very easily by the arrangement of castor wheel and increasing the torque. There are also chances of adding Voice recognition and Gesture recognition, so that it might be utilized by the paralyzed people. Not only these but many more advancement can be done according to user requirement such as Heart beat Analyzer etc.