SOLAR POWERED WHEELCHAIR

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ABSTRACT

As per the census 2011 (2016 updated) disabled population of India particularly physically disabled the count is 54,36,826 Which is huge and continuously increasing other than medical treatment these people are dependent on the wheelchair for their movement. But the old generation manual wheelchair is dragged by the other person not by the disabled person. With the help of an automatic wheelchair the disabled person can move the wheelchair without the help of others. But automated wheelchair requires power and due to the continuous declination of the fossil fuels and demand still increasing there is a need to find alternatives that is renewable source. People are switching over the renewable source of energy for their requirements, Solar energy is one of the source which is free of cost and present in abundance so by automating the wheelchair with the help of power generated by solar energy it can cut the overall cost of fuel and become eco-friendly in nature and can set a limit in the world of Automation.
In this paper "Solar Powered wheelchair", its construction, working and component used is studied in detail, and all the project work is done in Nagpur.

keywords: *Solar Panel, Charge Controller, Lead-acid Battery, Microcontroller ATmega16, DC Relays, DC Motors.*

1. INTRODUCTION

Physical disability is one of the disabilities which requires time for its healing. Probably months or even years and sometimes the disability is permanent, So there is a huge question on the movement of these disabled people, Because for the day to day work of a human it requires movement from one place to another due to the lack of ability to move this disabled people unwillingly need the help of a wheelchair, But the manual wheelchair is so constructed that it is dragged by the other person apart from the disabled person, This lead to the requirement of the person for the movement of the disabled person in Manual wheelchair. This drawback can be terminated by introducing automatic wheelchair. As the horizontal of Technology is increasing day by day the whole world is moving towards Automation a wide range of wheelchair working on the Motion control ,Gesture control, Bluetooth control etc. are continuously launching in the market. Most of the wheelchairs either requires AC supply for charging the battery or fossil fuels (for the fuel engine type wheelchair). This drawback can also be eliminated by introducing a renewable source of energy for supplying power, that is Solar energy. Solar energy is one of the major source of energy which is present in abundance and free of cost.

Our project "Solar Powered Wheelchair" is based on the Automatic wheelchair which is driven by the DC motors and it gets the power generated by the Solar Panel. The Automation involves the movement of the wheelchair forward, backward, right, and left with the help of Joystick which is connected to the PCB circuit board. The whole wheelchair works on the 12 volt DC supply to the motors through the relay circuit .This paper gives an idea about the construction, working and component used in the Automatic Wheelchair and supplying energy to this Wheelchair through solar energy (solar panel) which ultimately reduces fuel cost and creates the whole wheelchair eco-friendly.

1.1 Construction

The "Solar Powered Wheelchair" has a metallic chair fabricated on the metal frame. The frame has two part the front part is moveable and the rear part is fixed. This frame have wheels aligned to it, Together forming a wheelchair. There are total 4 wheels two in the front side and two in the rear side of the wheelchair. There is a placement of two DC Motors, One is aligned with the two front wheels for the purpose of direction control mainly LEFT and RIGHT .Once the command is given to the microcontroller ATmega16 through joystick control the the front motor operates for approx. 5 sec and the moveable part of the frame turns to an angle and then the motor stop, turning the wheelchair in either direction. The Other motor with gear system is placed on the right wheel of the rear side of the frame. The left wheel is aligned with the right wheel with the shaft connected to it. This motor is for the movement of the whole wheelchair in the FORWARD and BACKWARD directions. These motors are attached to a Printed Circuit Board which have 4 relays, Opto-couplers ,transistors, diodes, resistors , microcontroller ATmega16 ,LED screen, IC 7805, Pot, capacitor bank placed in it. This PCB board is placed between the Lead-acid battery and Motors There is a placement 20Watts/12V solar panels on the top of the wheelchair. The above solar panel is fabricated on the metal frame with an inclination to absorb maximum sunlight and the frame is attached to the lower frame of the wheelchair which also provides a roof to the wheelchair.

1.2 Working

The "Solar Powered Wheelchair" works on the power generated by the solar panel 20Watt/12V which gives approx. 500 milli Ampere current and then the same power is feed to the Lead-acid battery of 12V\2.5Ampere Hour through charging. As we know that solar power is not constant in supply so it needed to be stored first for the constant supply to the DC motors. There is a placement of a charge controller before the battery to limit the over-charging of the battery. There is also a provision to charge the battery through rectified AC supply via charge controller in extreme weather condition when the sunlight is not enough to generate the power. In between battery and solar panel there is a control circuit that is for direction control and known as directional control circuit (PCB circuit). The direction control circuit is isolated in two parts. The one section where the operating voltage is 5v and the other section where the operating voltage is 12v with the help of opto-coupler. The reason behind isolating the circuits into two is to protect the microprocessor ATmega16. In case of failure of relays the electromagnetic coil in the relay get highly energized due to high rush in current which ends up changing the logic of the microcontroller ATmega16 and in some case damage the battery as well. The section one components are IC 7805 , LCD screen, microcontrollers ATmega16, capacitor bank, resistors and transistors. The A port of microcontroller is attached to the output, B port is kept open , C port to the input and the D port to the LCD screen. The LCD screen display the program code which is feed in the microcontroller for direction control operation. The IC 7805 is used to step down the voltage from 12V to 5V for the operation of section one components. The Capacitors are used to store the electrical energy and use the stored energy again in the circuit when required. The capacitor is charged through the battery and discharged in the same circuit. On the other section we have the components like relays and resistors, diodes and transistors. There is placement of 4 DC relays, 2 for on 1 DC motor and 2 relays for other DC motor. The relay of 7A,12V\250V works on the NO and NC contactor objective. There is approx. 2 milli Ampere current loss in the each relays. The resistors function to control the flow of current to other components when large amount of current rush in a circuit during any abnormal condition occur in the PCB. The diode's function in this circuit is to allow an electric current to pass in a single direction, while closing it in the opposite direction. After the directional control circuit the power is feed to the DC motors with the gear assembly attached to it for smooth motion. The specification of DC motor is 12VDC, torque generated is approx. 10kg/n and the speed is 60 RPM. The front motor is for LEFT and RIGHT motion and the rear motor is for FORWARD and BACKWARD motion. The proper operation of motors is elaborated in table3.1.

The input command is given by Joystick, As it is known that the joystick works in the X-Y axis, so the direction of the wheelchair also depend on the X-Y axis. The positive X axis is for FORWARD direction and negative X axis is for BACKWARD direction. Same with the Y axis the positive Y axis is for RIGHT direction and negative Y axis is for LEFT direction. As far as the wheelchair is getting command the wheelchair will be motion in either direction and when the joystick comes to its original position the wheelchair comes to rest and it stops.

2. MAJOR COMPONENTS

2.1 Solar Panel
The solar panel is used as an informal term for a photo-voltaic (PV) module. A PV module is a convention of photo-voltaic cells organized in a frame for installation. Photo-voltaic cells utilize sunlight as a source of energy and generate direct current electricity. An assembly of PV modules is called a PV Panel, and a system of Panels is termed as an Array. Arrays of a photovoltaic system generates and supply solar electricity to electrical equipment.

2.2 Charge Controller
A charge controller is primarily a voltage or current regulator or both to control battery from over-charging. It modulates the voltage and current feed from the solar panels leading to the battery. Most 12 volt panels put out about 16 to 20 volts, so if there is no regulation the batteries will be destroyed from overcharging. Most batteries requires around 14 to 14.5 volts to get full charged.

2.3 Lead-acid Battery
Lead-acid batteries are the most common in PV systems because their initial cost is less and because they are easily available near-by everywhere in the globe. There are variety of different sizes and designs of lead-acid batteries, but the most important norm of selection is that they are deep cycle batteries. Lead-acid batteries are accessible in both wet-cell (requires maintenance) and sealed no-maintenance versions. AGM and Gel-cell deep-cycle batteries are highly recommended because they are maintenance free and they last very longer.

2.4 Microcontroller ATmega16
Microcontrollers play an important role in the development of embedded systems. They are used where automation is an integral part of the system.
- Atmega16 is a 40-pin low power microcontroller which is developed using CMOS technology.
- CMOS is an advanced technology which is mainly used for developing integrated circuits. It comes with low power consumption and high noise immunity.
- Atmega16 is an 8-bit controller based on AVR advanced RISC (Reduced Instruction Set Computing) architecture.
- It is a single chip computer that comes with CPU, ROM, RAM, EEPROM, Timers, Counters, ADC and four 8-bit ports called PORTA, PORTB, PORTC, PORTD where each port consists of 8 I/O pins.

2.5 DC Relay
  A relay is an electrically controlled switch. Many relays use an electromagnetic coil to control a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is required to control a circuit by a low-power signal, or where many circuits must be controlled by one signal.

2.6 DC Motors
  A dc motor converts electrical energy into mechanical energy, very typically through the interaction of magnetic fields and current carrying conductors.. Many types of electric motors are there classified into by the type of voltage required AC or DC. The input requirement of a DC motor is current/voltage and its output result is in form is torque (speed).

3. LITERATURE SURVEY
      The present article presents the partial results in the development of a wheelchair controlled by the direction control circuit (PCB) and the supply given to the direction control circuit (PCB) is through the Solar Panels which is used for battery charging. This paper is inspired from an ICCIT Research Paper Titled "A Study on Low Cost Solar Powered Wheel Chair for Disabled People of Bangladesh" that was presented in the ICCIT International Conference DOI: 10.1109/ICCITechn.2015.7488037 at MIST, Bangladesh, in December 2015. The above paper approach was dealing with low budget automatic wheelchair powered by solar panel for disabled people. Our paper deals with the motion of the automatic wheelchair from the power generated by the Solar Panel via battery.

4. BLOCK DIAGRAM

In below block diagram, we can see that the system consist of following major components

1. Solar panel

2. Rectified AC supply

3. Battery

4. Charge controller

5. Directional control

6. Motors

In the system, power supply provided by battery by the solar panel via charge controller where the charge controller limits the overcharging of the battery. There is also a provision of charging the battery by rectified AC supply. Then the supply from the battery flow to the directional control, Where there is diodes, rectifiers, capacitors, microcontroller and relays for giving the direction to the wheelchair motion. At the end there is a placement of DC motors with the gear assembly for the smooth motion the front motor is for LEFT and RIGHT direction and the rear motor is for FORWARD and BACKWARD direction
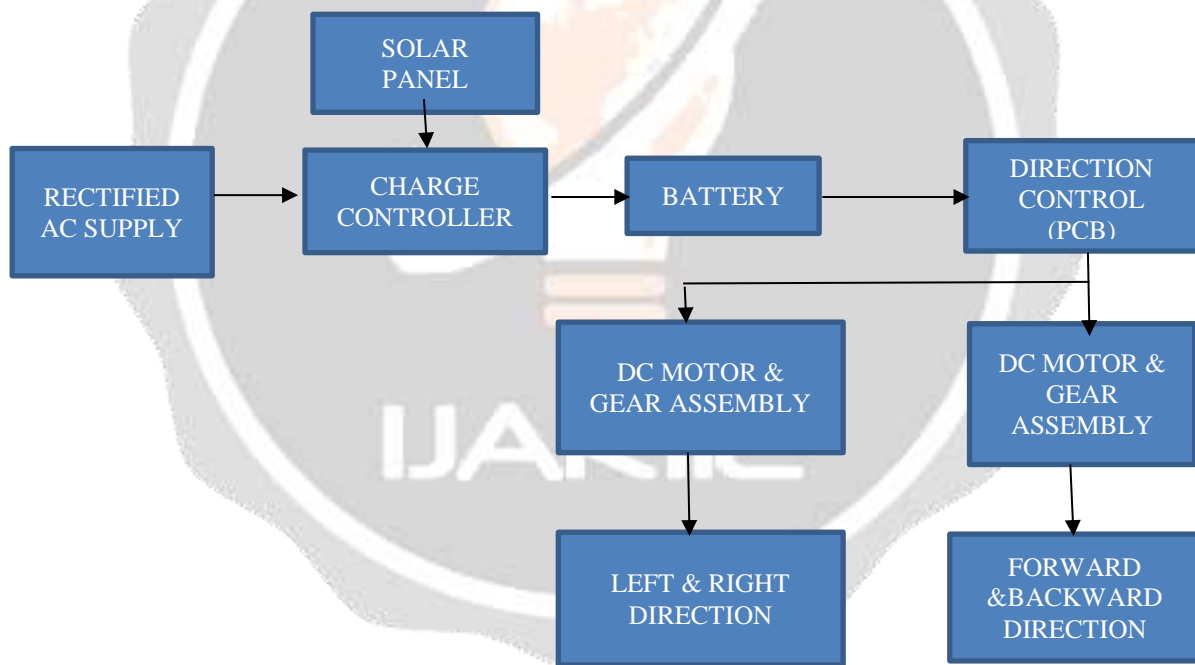

Fig-**2.1** : Block diagram of the solar powered wheelchair
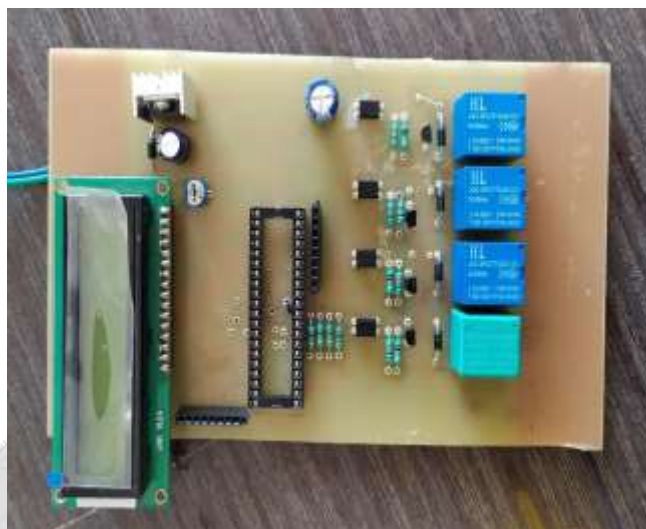
5. HARDWARE DISCRIPTION

Fig-3.1 : Hardware description of directional control circuit(PCB).

        This is hardware of directional control circuit consist relay which received a particular high or low voltages from comparator IC 7805. In driving circuit, four relay R1, R2, R3, R4 is required for controlling the two dc motor. For forward direction relay R1 is ON, for backward direction relay R2 is ON, for left direction relay R1 & R3 is ON and for right direction relay R1 & R4 is ON.

Table-3.1 : Direction control by the motor operation.

DIRECTION	MOTOR 1	MOTOR 2
FORWARD	CLOCKWISE	OFF
BACKWARD	ANTI-CLOCKWISE	OFF
LEFT	CLOCKWISE	CLOCKWISE
RIGHT	CLOCKWISE	ANTI-CLOCKWISE

6. CONCLUSION

        Our project "Solar Powered Wheelchair" has been successfully developed, and has achieved its aim and objective successfully. It is capable to control the wheelchair motion for disabled people using renewable source of energy that is solar power. Improvements can be made by running the wheelchair on direct solar power without battery.

        The design and development of this automatic "Solar Powered Wheelchair" based on microcontroller ATmega16 and sets of relays for direction control and can be successfully implemented on a commercialized scale for the physically handicapped and old age people The automatic wheelchair helps the severely disabled people to lead their life in an uncomplicated way. The low cost of the assembly of this automatic wheelchair is really a boon for the general public. For further development the project can be developed as-

- Addition of wireless system.

- Sensors can also be mounted in different sections left, right and back.

- There can also be the execution of intelligent home navigation for disabled people and elderly to go through the entire house and get help from technological interface for the navigation.

7. REFERENCES

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