

Literature Review on Solar Powered Wheelchairs

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Abstract— Person mobility means freedom for the physically challenged. One of the best invention in the techno field that helped both an elderly and the handicapped is the mobility vehicle. The fact that they are no on longer depending on someone else to perform daily duties is a big step a forward. A large variety of mobility vehicles are available, from which one is to be selected as per requirements. Mobility vehicles are design based on the usage i.e. either indoor or outdoor. They make the use of their conventional energy for recharging. The cost of the vehicle may not be an affordable one for the lay man.^[8]In this paper and attempt is made in fabricating the solar powered trike that can use as both indoor and outdoor environments, also it is made on an encryption on related research paper on solar powered tricycle projects and includes the method and consideration regarding proper working of the tricycle. This paper further consist of components like Solar PV Panel, Brushless PMDC motor, Charge controller and battery, hub motor etc. This paper will discuss about the main idea of the components and also emphasises on the work of other researchers on solar powered project.

Key words: Solar Assisted Wheel chair (SAWC), Hub motor, Solar PV panel, Research paper, Lead acid battery, Voltage regulator, motor controller.

INTRODUCTION

The Solar Assisted Wheelchair is consist of aHub Motor, a Solar Panel, Lead acid Battery and Voltage Regulator.

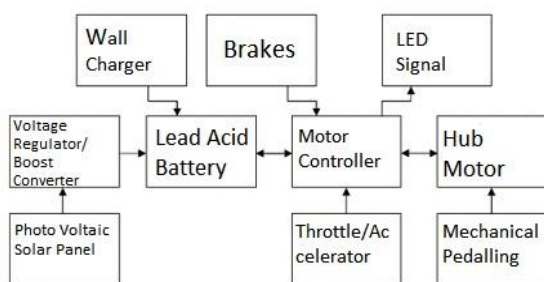


Fig. 1 Block Diagram of a Solar Assisted Trike

HUB MOTOR

The hub motor is a conventional DC motor. The hub motor generates high torque at low speed which is highly efficient and which doesn't need sprockets, brackets and drive chains. This means they are very reliable and have a long life. The main characteristic of Brushless DC Machines is that they may be controlled to give wide constant power speed ranges.^{[1][2]}

SOLAR PANELS

A solar cell is an electronic device which can use photovoltaic (PV) effect to directly convert sunlight into electricity. Light shining the solar cell will produce both a voltage and a current to generate electric power. A variety of materials and processes can satisfy the requirements for PV energy conversion, but in practice nearly all photovoltaic energy conversion uses semiconductor materials in the form of a p-n junction conventionally, solar photovoltaic materials use inorganic semiconductor materials.

LEAD ACID BATTERY

Lead acid batteries are one of the most popular types of battery in electronics. This have a many advantages over other conventional types of batteries, the lead acid battery is the optimum choice for a solar assisted bicycle^[6]. Current supplied from battery indicates the flow of energy from the battery and is measured in amperes (or Amps). The higher the current flow faster the battery will discharge.

VOLTAGE REGULATORS

Charge controllers or voltage regulators protect batteries from being overcharged, which can shorten their life as well as the life expectancy of the equipment being powered. Electronic circuitry in the regulator measures battery voltage, which rises as the battery state-of-charge (SOC) increases. At some voltage (which is different for different types of batteries at different temperatures), the regulator will limit the charging of the battery. Regulators for photovoltaic (solar electric), wind and water powered systems perform the same function as a voltage regulator in an automobile. However a regulator from a car will not work in a remote power system due to a few differences

FABRICATION OF WHEELCHAIR

The present work involves in design and fabrication of solar powered wheel chair. A motorized wheelchair, power chair, electric wheelchair or electric-powered wheelchair (EPW) is propelled by means of an electric motor rather than manual power.^[7]They can also be used not just by people with 'traditional' mobility impairments, but also by people with cardiovascular and fatigue based conditions. Power chairs are generally four-wheeled and non-folding, some folding designs exist and other designs have some ability to partially dismantle for transit. Manual wheelchairs are fitted with an auxiliary electric power system. This can take one of three forms: integrated with the hub of hand-propelled wheels, so that any force on the push rims is magnified by the drive

system, or mounted under the wheelchair and controlled as for a power chair, but with the motive force either transmitted to the main wheels via a friction drive system, or delivered directly through an auxiliary drive wheel. The electric motors of power chairs are usually powered by 4 or 5 amp deep-cycle rechargeable batteries, similar to those used to power outboard boat engines. These are available in wet or dry options. Dry-cell batteries are preferred for power chair due to shipping problems. Many power chairs carry an on-board charger which can be plugged into a standard wall outlet which is a hassle for the user. In order to overcome this disadvantage an alternative system is designed such that the batteries can be charged even without a wall outlet.

[A] Design Consideration

The main factors that are considered for the fabrication of the wheel chair are weight or load, speed, width and height of the wheel chair. The body of the wheel chair is constructed to withstand a load of 80-100kg, including itself-weight and the speed is limited to 3-5km/hr for safety.^[4] The height and width of the chair are slightly modified from that of a conventional model. The solar frame is provided with an adjustable slot so that the height can be adjusted as required.

[B] Components of Wheel Chair

The structure of wheel chair consists of Main frame, Steering mechanism, Power source, Wheels, Casters, Indicators and other accessories.

a. MAINFRAME

This is the skeleton of the wheel chair. This carries entire load of the person using the chair. This is made up of hollow cast iron rods of 35mm diameter. The rods are cut into different lengths, and are arc welded so that it gains the strength to withstand the load as well as the capacity to resist the vibrations during the travel. The height of the frame is 105cm, width is 57cm, and seating area is 41 X 41 cm²

b. WHEELS

These are called wheel hub motor, (also called wheel motor, wheel hub drive, hub motor or in-wheel motor) an electric motor that is incorporated into a hub of a wheel and drives directly. Hub motor electromagnetic fields are supplied to the stationary windings of the motor. The outer part of the motor follows, or tries to follow, those fields, turning the attached wheel. A purported advantage of this design is that no additional transmission system is needed, increasing the efficiency of the drive system. The wheels used are alloy wheels with a diameter of 50 cm and a thickness of 7.5 cm. The capacity of the motor is 240 W and speed 500 rpm at no load.

c. CASTER

A caster (or castor) is an un-driven, single, double, or compound wheel that is designed to be mounted at the bottom of a larger object (the "vehicle") to enable the object to be easily moved. They are available in various sizes, and

are commonly made of rubber, plastic, nylon, aluminium, or stainless steel. Casters are found in numerous applications, including shopping carts, office chairs, and material handling equipment. High capacity, heavy duty casters are used in many industrial applications, such as platform trucks, carts, assemblies, and towlines in plants. Generally, casters operate well on smooth and flat surfaces. The diameter of the caster used is 15cm and thickness is 3.5 cm

d. POWER SOURCE

The Power required to run the motor is supplied through a rechargeable battery. Rechargeable batteries are available in many different shapes and sizes, ranging from a button cell to megawatt systems connected to stabilize an electrical distribution network. Different combinations of chemicals are commonly used in these cells.^[5] They include lead-acid, nickel cadmium (Ni-Cd), nickel metal hydride (NiMH), lithium ion (Li-ion), and lithium ion polymer (Li-Ion polymer). Rechargeable batteries cost less with minimum environmental impact than disposable batteries. Some rechargeable batteries types are available in the same sizes as disposable types.

e. STEERING MECHANISM

It is designed to enable hemi-pelagic wheelchair users to drive, brake and steer a single-lever wheelchair entirely through the two drive wheels. It is unlike all other single lever chairs that include a separate mechanical linkage to one caster for steering control. The steering mechanism consists of a pipe with a concentric solid shaft. Two forks fitted into the ball bearings in the pipe are used for attaining the steering motion. Two forks are welded to the caster clamps, and connected together with a solid rod to the handle.

RESULT

To provide a cost effective mobility vehicle for the disabled, a solar powered wheel chair is fabricated with the indigenous materials like iron bars, hub motors, casters, bearings forks, accelerator and brakes. The wheel chair is powered by the rechargeable battery of capacity 48V i.e.) 12X4 in series. A solar panel of 18V capacity 4 numbers is provided for charging the battery on grid. The cost of the wheel chair is Rs.25000. The cost can be further minimized by using optimization techniques and improved design methodology. A right hand steering mechanism is provided, which can be even made a left hand depending upon the requirement. The entire body of the wheel chair is given a rust free coat and is painted in metallic silver to give aesthetic look. The height of the solar frame can be adjusted by using the fasteners provided at the back rest. The speed is limited to 3km/hr for safety and to avoid vibration of the solar frame. A charge indicator is provided for checking the battery levels. Reverse horn is also provided for safety purpose. The fabricated solar powered wheel chair is presented in the figure below.



Fig. 2 Solar powered wheel chair

CONCLUSION

The attempt made in fabricating a Solar Powered Wheel Chair with the available indigenous material is successful. The working of the wheel chair shows the indigenous infrastructure and the capabilities of the wheel chair. The Recharging capacity of the panels is satisfactory. The desired functionality of the Steering Mechanism is achieved. The wheel chair can provide an uninterrupted journey of 8KM or it can travel up to 4 hours continuously. The attempt made in fabricating a Solar Powered Wheel Chair with the available indigenous material is successful. The working of the wheel chair shows the indigenous infrastructure and the capabilities of the wheel chair. The Recharging capacity of the panels is satisfactory. The desired functionality of the Steering Mechanism is achieved. The wheel chair can provide an uninterrupted journey of 8 KM or it can travel up to 4 hours continuously.

- The recharging time can be minimized by increasing the capacity of the Solar Panels.
- The Panels are sensitive to vibrations.
- Flat surfaces are more preferred than steep ones.

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