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Design and Modeling of a Solar Powered Vehicle for the Disable Persons

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ABSTRACT

In the present scenario, fast moving world is definitely to meet dangers like scarcity of fuel, problem of reducing pollution in atmosphere, and the rapidly increasing use of fuel like petrol, diesel, and coal because of this problem people are facing economic problems. So to overcome all these problems it has been planned to utilize maximum amount of solar energy. The difficulties are involved in the mobility of the especially abled people in the society. It has been observed that specially abled people are basically using some assistive devices like, crutches, artificial limbs or legs etc. and manual wheel chairs for their day- to-day movements. But, these wheel chairs are crude or of inefficient in design. Crutches are most commonly used for walking for shorter distances and thewheelchairs and hand-cranked tricycles are useful for the persons with leg disability and Tricycle are designed such that persons with hands & legs disability can be benefited. The basic Tricycle is a three-wheeled design, pedaled by especially abled person in the side and seat in the middle for sitting arrangement. A Novel idea on solar powered hybrid tricycle can provide a non-polluting and a very silent transport system. It will be self-operated and independent in nature, using solar energy from the sun. The battery can be charged from solar panels when the tricycle is moving or if it is on a rest and from a charging socket when need. Mounting the solar panel to this vehicle will assist the cyclist in riding the tricycle, reduce fatigue, increase speed and also it provides roof to the traveller.

KEYWORDS: Electric Tricycle, Handicap, BLDC motor, MCU ADC, Battery Technology, Brushless Direct Current.

1. INTRODUCTION

Electric vehicles, which use 100% electric power, use electric motors instead of an internal combustion engine to provide motive force. Solar-powered vehicles (SPVs) use photovoltaic (PV) cells to convert sunlight into electricity. The electricity goes either directly to an electric motor powering the vehicle, or to a special storage battery. PV cells produce electricity only when the sun is shining. Without sunlight, a solar- powered car depends on electricity stored in its batteries.

Since the 1970s, inventors, government, and industry have helped to develop solar-powered cars, boats, bicycles, and even airplanes. In 1974, two brothers, Robert and Roland Boucher, flew an extremely lightweight, remote-controlled, pilotless aircraft to a height of 300 feet. It was powered by a PV array on the wings. (The U.S. Air Force funded the development of these aircraft with the hope of using them as spy planes.)

The first totally solar-powered car was built in 1977. It was small, lightweight, and cost relatively little. Experimental SPV's, equipped with advanced technology, have been built with the backing of major auto manufacturers, including General Motors, Ford, and Honda.

The differently abled person are not abled to move from one place to another easy. In state of using car or motorcycle that are costly, so they prefer to use tricycle as their vehicle. There several types of tricycle that can be chosen such as paddle tricycle, motorized tricycle and electric tricycle. But there are some weaknesses about that type of tricycle. To overcome the weakness this project will develop a better tricycle. Because of India is located in the topic of Capricorn area, this project will make used the energy of the sun that rarely used in India to generate the tricycle.

As what had been mention earlier, there are several types of tricycle that can be categories that is paddle tricycle, motorized tricycle, and electric tricycle. The weakness of the tricycle make people do not like to used tricycle. First, paddle tricycle needs a lot of energy to paddle the tricycle. The user will surely be tired after used the tricycle. This will not suitable for differently abled people to use to go to their desired area because they will be tired when they are in the class and will lost their concentration while hearing the lecture. Next, motorize tricycle that used fuel as it prime mover. The tricycle use fuel that is costly. Besides that, motorize tricycle will make pollution that can be very bad for our environment especially in this period that global warming happen to the earth. Lastly, electric tricycle that generate by battery can be only be sufficient for about an hour. The user needs to find power supply to recharge the battery or else they need to paddle the tricycle that used more energy compare to the normal tricycle because of the weight.

2. PROPOSED METHODOLOGY

The tricycle will consist of following components:

- Solar Panel
- Brushless DC motor
- Battery
- Charge Controller
- Throttle.

Themotor which is a prime mover of the tricycle is placed at the bottom of the seat which is connected to the axle of the cyclethrough chain drive.

The motor gets the power from the battery which is rechargeable either from the main source of electricity or from the solarpanels, which are kept on the top of the tricycle. The solar panel is a module which contains number of solar cells which areconnected either in series or in parallel, thus it converts the solar energy into electric energy to charge the battery.Since the electricity generated by the solar panel is fluctuating therefore it requires a DC charge controller which converts the fluctuating current or electric power into a constant electric supply which is the provided to charge the batter by the chargecontroller.

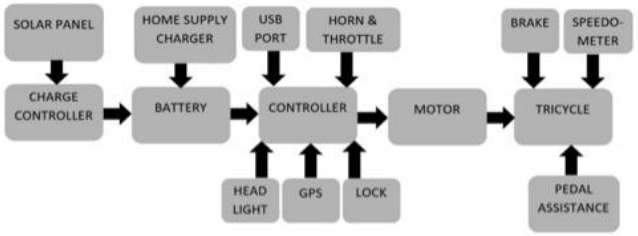

Fig 1. Proposed Topology

A. Solar Panel:

Solar PV panels are designed to generate/collect desired energy required by the solar tricycle. Power needed to run the solartricycle is indirectly supplied from solar panel. Basically this solar panel when exposed to the sunlight produces DC current(solar electricity) which is stored in a battery and used by motor as per the requirement, as and when required basis.The solar panel consists of solar cells. The amount of power output of a solar cell depends on solar cell efficiency and solarcell area. Usually 30~36 solar cells connected in series are laminated together to make a so-called solar PV module.

B. Brushless Dc Motor:

The prime mover to be used in this solar tricycle is a permanent magnet D.C. motor. The main reason for using this motor is thatit is highly efficient and the flux density does not decrease with time. It's performance characteristics suite very well to the requirement of our solar tricycle.Brushless DC motors use a rotating permanent magnet or soft magnetic core in the rotor, and stationary electrical magnets onthe motor housing. A motor controller converts DC to AC. This design is simpler than that of brushed motors because

iteliminates the complication of transferring power from outside the motor to the spinning rotor. Advantages of brushless motorsinclude long life span, little or no maintenance, and high efficiency.

C. Battery:

Given the current market, lead-acid is the only viable battery technology for electric vehicle conversion. The following is a list of
criteria to use in selecting an electric vehicle battery.

1) Voltage:

Batteries are available in both 6V and 12V units. Most standard, wet-cell, golf cart batteries are 6V units. Most sealed batteriesare 12V units.

2) Amp-Hour Rating:

The capacity of a battery is rated in amp-hours. This rating must be specified with a given discharge rate.

3) Discharge Rate:

The discharge rate of a battery is the minimum length of time during which the battery must be discharged in order to meet thespecified amp hour rating.

4) Watt-Hour Rating:

The watt-hour rating is a true indication of the energy Capacity of a battery, like the amp hour rating, this rating must bespecified with a discharge rate. The watt-hour rating of a battery is the amp-hour rating multiplied by the specified voltage of the
battery.

3. Working Methodology

The tricycle wheelchair is work on the single slider mechanism which is operated by steering. On comparison with old traditional hand pedal wheelchair which have of chain mechanism, instead that we use crank lever mechanism. When we have to go in forward in direction then just move steering from backward to forward with little effort which move the tricycle in forward direction and when we have to go in reverse direction then we have to first stable the tricycle and then move steering from forward to backward in direction which move tricycle in reverse direction. The steering is provided for giving direction and for too & flow motion which move tricycle in forward & reverse direction. The above Fig. shows a complete mechanical system in which the crank lever mechanism is the main component. On that mechanism a steering is mounted for operating the tricycle, which define the direction to tricycle and used to take turning to the left or right.

4. Design and Simulation Modeling

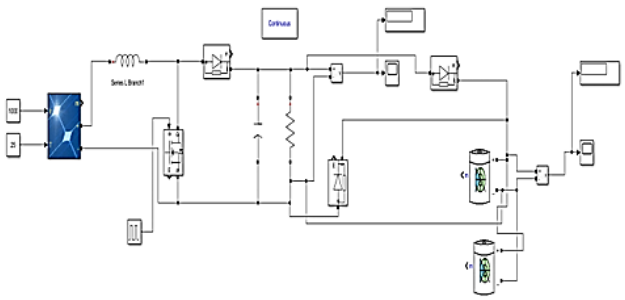

Fig 2.Simulation Model

Figure 3 illustrated a simulation model of charging the battery by the solar panel. Because sunlight intensity changes throughout the day, a buck-boost converter is employed to boost the voltage from the solar panel to a constant value of 24 V. The two 12 V batteries connected in series are charged using the output voltage from both converters, which is provided through a controller.

In Matlab Simulink, create the body of a hybrid tricycle with a single axle and three tyres. The vehicle body represents a single axle body in motion, , taking into account parameters such as body mass, aerodynamic drag, grade externally specified mass, angle of gradeability, vehicle velocity, and the vehicle body's centre of gravity. 4. RESULT AND DISCUSSION The construction procedure entails attaching the various components to the tricycle frame. To begin, construct a carriage with a frame for a solar panel installation on a traditional bicycle. It also serves as a shaded rooftop for the rider. For weight balancing and shading, the solar panel is movable and set above the rider. It protects the rider from sunburn and provides a shading effect. The flexibility of the panel allows it to tilt in response to the situation. Hence we connect the two tyres in the back of the bicycle using axile. This makes balance for the bicycle. The solar charge controller is screwed into place on the carriage. This allows the battery to be charged using solar power. We can charge the battery through the line supply using an adaptor in an emergency. The

DC motor is properly aligned to the back wheel shaft, ensuring that the weights are completely balanced. The carriage's battery enclosure, in which two 12 V, 12Ah lead-acid batteries are fitted in series. To transfer power from the battery to the motor, wirings are pulled from the battery and routed through the controller. The tricycle controller connects all of the electrical components of a hybrid E-tricycle, such as the battery, motor, throttle, power socket and GPS module. The handlebar houses the speed controller (throttle), brake lever, headlight, and horn. The total cost for an adaptive hybrid tricycle approximately 17000rs, hence it's economically affordable. As a result, there are no operating costs, no pollution, and no environmental impact. As a new means of transportation, it can be easily embraced.

5. APPLICATION

1. It can be used in the campus for the drive for thenormal persons, to move within the campus in the smooth road.

2. It is best useful for the small city drive foranybody including the handicap.

3. It can be used for material transportation withoutusing fuel propulsion.

4. It can be used by the handicap for the normal transport and even for the self-employedhandicap persons for their daily livelihood

6. CONCLUSION

From a future energy system perspective, with the increasing consumption of non-renewable resources such as petroleum, diesel, and other fossil fuels, we must shift our focus to renewable sources such as solar, hydropower, biomass energy, and other alternatives. It is a simple means of transportation that has high torque, is pollution-free, and provides us with a convenient form of transportation for people of all ages. Furthermore, it is a quiet and traffic-free means of transportation. The hybrid electric tricycle has a top speed of 28 kmph with pedalling and a top speed of 22 kmph without pedalling. On a plane, a road tricycle can travel at a speed of 2225 kilometres per hour, but on a rough/muddy road, the speed range is decreased to 16-18 kilometres per hour. The battery backup period is about 48.5 minutes. The mileage is determined by the battery's ampere rating. Without the use of a solar panel, it can travel up to 25 kilometres on a single charge. When using a solar panel, the battery is automatically charged based on the amount of sunlight collected. A solar panel's charging period is usually around 6 hours. The charging stations aren't necessary because charging takes place during the ride or parking. As a result, we use a solar panel to charge the battery with solar energy into electrical energy. We recharged with an adaptor in the event of an emergency.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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