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DESIGN AND DEVELOPMENT OF E-TRICYCLE FOR PHYSICALLY CHALLENGED PEOPLE

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ABSTRACT

Mobility of physically disabled person is a concerning social issue nowadays. Manually operated tricycles, wheelchairs, modified vehicles, etc. are usually vehicles for the disabled. Electric tricycles are designed to solve this problem. The goal of the electric tricycle project is to improve the mobility of the disabled in India by optimizing the use of renewable energy. Many disabled people now use manual tricycles. However, in this community, some existing hand tricycle users do not have the physical strength or coordination ability to move their arms and hands on the tricycle. The purpose of this project is to add an electric transmission system and control system to the manual tricycle process, to provide tricycle users with higher mobility, mobility and comfort, a simple and easy-to-use transmission system design, and reliable, stable and practical the control system. This article describes an attempt to design and manufacture a tricycle for the disabled. This tricycle is specially designed for wheelchair users.

I. INTRODUCTION

Transportation is one of the most important sources for increasing mobility of humans. In transportation vehicles play a very crucial role. Normal human being uses these vehicles very easily but for a disabled person it is very inconvenient. Nowadays various hand driven tricycles are available for them but most of them are designed primarily for the basic functional use for moving on road without considering many important aspects, aesthetics and it has limited application. Various methods have been researched and used to increase mobility of disabled people. Some research focuses on improving the mobility of wheelchairs; motor vehicles such as buses, trucks, cars, and motorcycles are usually suitable for this purpose; the disabled use special vehicles such as tricycles as transportation; however, the existing wheelchairs require the disabled to take the wheelchair from the wheelchair. Go up and down and enter special vehicles such as public transportation buses, trains, and cars. these are some of the problems that the we are trying to solve with the new tricycle design. This project is mainly focused on the research on the design and development of a modified tricycle for disabled persons. The tricycle is designed to accommodate the disabled person along with the wheelchair with ease and convenience. This is achieved by allowing the disabled person run his/her tricycle with the help of motor powered by solar energy over long distance without being dependent on the traditional means of public transport. It is hoped that this new design will ease and improve mobility. The final engineering drawing as well as stress analysis of essential components using commercially available 3D modelling software is done. An attempt has been made to provide unique, cost effective, purpose serving tricycle for disabled person.

II. METHODOLOGY

The electric tricycle is designed and modeled with computer aided software and analyzed by finite element analysis methods. Following considerations were considered:

1.The product should be suitable for local manufacturing capabilities.

2.The attachment should employ low-cost materials and manufacturing methods.

3. Must use locally available materials and skills. Solar panel, battery, BLDC hub motor, controller, throttle, battery charger, locally available solar charge controller should be used. Standard tools that are used in the machine shop, such as hacksaws, files, punching, medium duty welders; Drilling machine; The small turning and milling machine must be suitable for the production of the parts required for the machine.

4.It should be accessible and affordable by low-income groups, and should fulfill their basic need.

5.It should be simple to operate, maintain and repair.

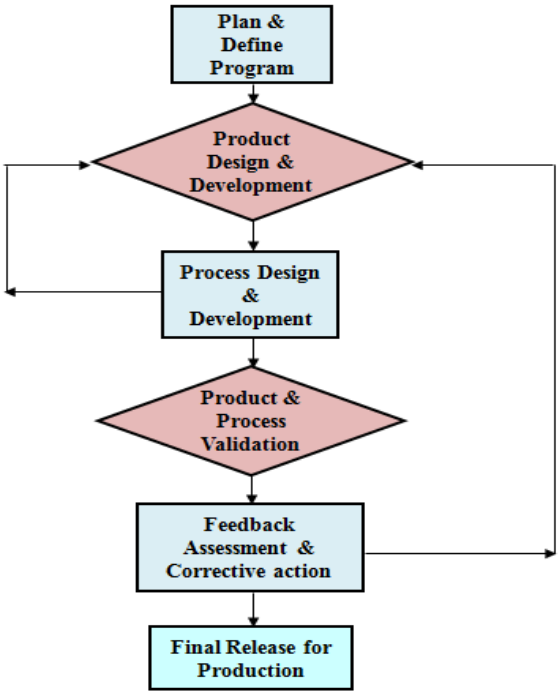
6.It should provide most comfortable, safe and easy transport mode for physically challenged people.

7.It should provide sustainable green mobility vehicle.

8.It should provide alternative to petrol bike.

9.It should reduce environmental pollution.

10. Overweight should be avoided because strength is the main criterion.



Problem identification

The 2011 census estimated that the total number of people with disabilities in India is closed to 2.68 Cr. (over 2.2% of our population). Most of them prefer conventional means for transportation for travelling purpose, conventional means of transport includes petrol bikes, public transport such as buses, railways which leads to environmental pollution, loss of their energy and time. Some modern wheelchair for physically challenged people were available but it has limited applications and they are costly.

We have decided to design and develop a e-tricycle for physically challenged people as it provides seamless services and it is eco-friendly, where other IC engine vehicle emit greenhouse gases. Solar powered e-tricycle is a better alternative for polluting vehicles. E-tricycle has more stability, easy to operate, easy to maintain, self-balanced. And cheap as compared to 2-wheeler petrol bike. It is more comfortable than bikes, even for frequent travel per day. Hence e-tricycle has been proposed.

Having seen such problems up close, this solar powered e- tricycle will help the physically challenged peoples to travel over long distance by crossing all the barriers. Physically challenged peoples by using this solution now no longer have to depend on public transportation methods for long distance travelling and have to spend on costly petrol bikes which leads pollution. It is an easy to operate and affordable solution for them. What's more – Existing hand operated tricycles can also be modified.

NEEDS OF E TRICYCLE

2.1 SIGNIFICANCE:

- Electric tricycle may be utilized by anyone, especially physically challenged.
- Tricycles are stable and no need to balance.
- Improves living conditions of physically challenged people
- Affordable alternative over petrol bike.
- Cargo Carrying & stability benefits.

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- Easy to drive.
- Zero Emission.
- Seamless services.
- Sustainable development goal 7 (clean & affordable energy for all).
- Sustainable development goal 10 (reduced inequalities).
- Less maintenance.

2.2 RESPONSIBILITIES:

- Overall vehicle Performance.
- Individual system / aggregate performance.
- Cost & Quality.
- Reliability.
- Weight.
- Manufacturability.
- Serviceability.

III. MODELING AND ANALYSIS

In order to integrate to electrical system with the tricycle to assist the driver, there are number of modifications that had to be made to the tricycle frame. The required modifications in the tricycle frame are done with the help of the CATIA V5 software shown in the fig.

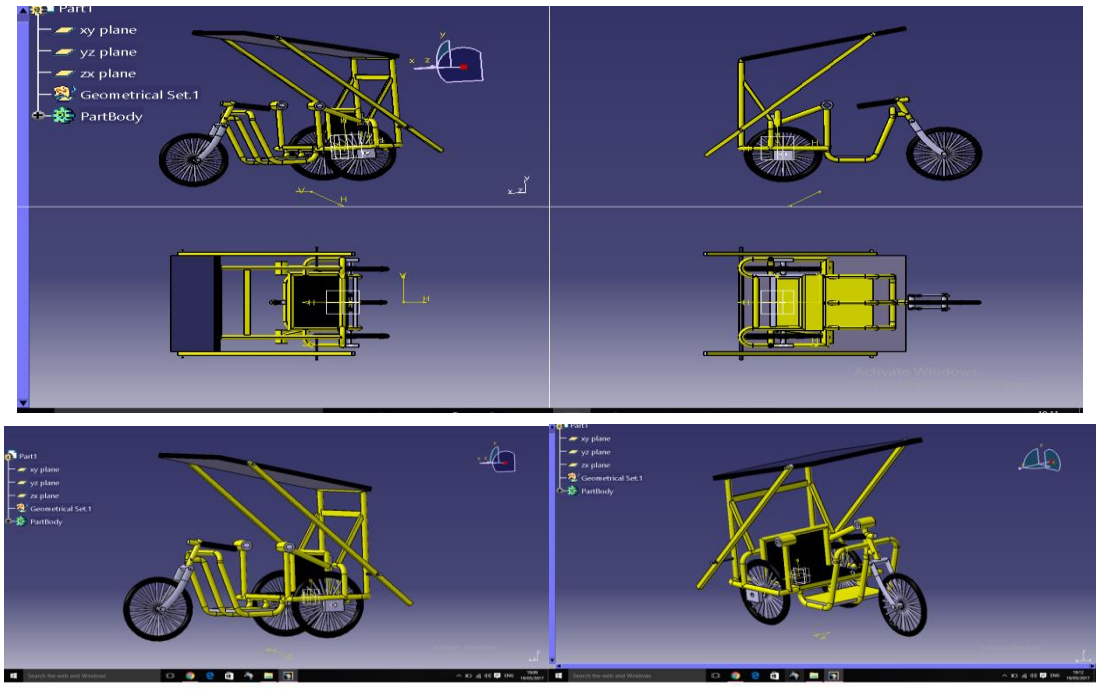

Figure- 1: CATIA model of tricycle

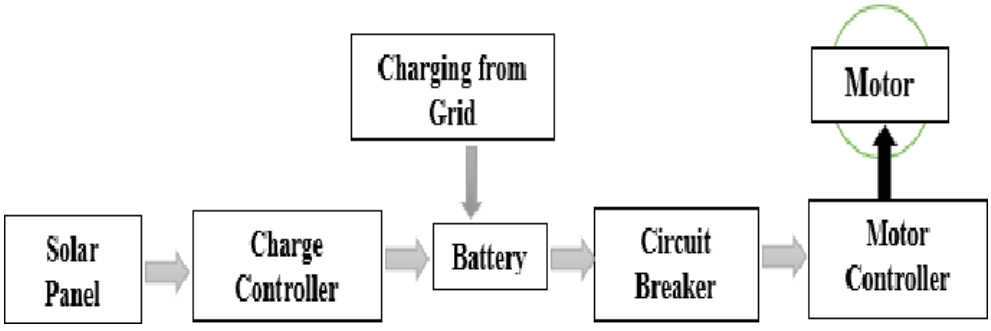

Figure- 2: Block diagram of E-tricycle

The block diagram mentioned above provides us with detailed information about the arrangement of tricycle body components. The main drive motor of the tricycle is located on the underside of the seat and is connected to the axle of the bicycle. The electric motor draws power from a rechargeable battery, whether it is the main power source or a solar panel mounted on the top of the tricycle. A solar panel is a module containing multiple solar cells connected in series or parallel, which converts solar energy into electrical energy to charge the battery. Since the electric energy produced by solar panels fluctuates, a DC charge controller is required to convert the fluctuating electric current or electric energy into a constant power source. It was developed for charging the battery using a charge controller. Here we provide four 40W, 12V solar panels, all of which are connected in series. The total output power of the solar panels is 160 W, 48 V. So, we use four 12 V batteries, all of which are connected in series. Due to the serial connection, all batteries are powered by 48 V. We use a 430 rpm, 48 V BLDC motor.

COMPONENTS OF TRICYCLE:

1. Solar Panel:

The tricycle is powered by solar energy. The battery is charged with solar energy through solar cells. Solar cells directly convert the energy of sunlight into electrical energy through the photovoltaic effect. The photoelectric effect is to generate voltage. Photovoltaics and photovoltaic effects are related to sunlight, but the difference is that when exposed to sufficient radiant energy in photovoltaic energy, electrons will be ejected from the surface of the material, and the generated electrons will be transferred to different valence bands for conduction in the material. This causes the voltage between the two electrodes in the photovoltaic cell to increase.

Figure- 3: Solar panel used for this project

Table- 1: Electric ratings of solar panel

Parameter	Rating
Maximum power	42.87 W
Open circuit voltage	22.8 V
Short circuit current	2.55 A
Rated voltage	18.80 V
Rated current	3.00 A
Module weight	3.70 kg
Module dimensions	4500 mm x 6750 mm
Operating temperature	-40° C to 80° C

2. Battery:

The battery is the main storage of electric energy. Whenever energy is needed at this time, the battery will provide power to the engine to propel the vehicle forward. We use four rows of 12 V 26 Ah batteries in series. All batteries are connected to each other. VRLA (Valve Regulated Lead Acid) batteries, better known as sealed batteries (SLA) or maintenance-free batteries, are rechargeable lead-acid batteries. VRLA can be installed in any location and does not require frequent maintenance.

Figure- 4: Battery used for this project

Table- 2: Specifications of battery

Parameter	Rating
Type of battery	VRLA (Valve Regulated Lead Acid Battery)
Voltage	12 V each, total 48 V
Amp-hour rating	26
Rating	12
Weight	9 each
Recharging time	8-10
Float voltage (V)	13.5
Boost voltage (V)	13.8

3. BLDC hub motor:

The hub motor is a conventional DC motor. The rotor is located outside the stator, while the permanent magnets are installed inside. The stator is installed and fixed to the shaft, and the hub relies on the AC power provided by the battery to rotate. In-wheel motors produce high torque at low speeds, are highly efficient, and do not require pinions, brackets or transmission chains, which means they are very reliable and have a long service life. The main characteristic of Brush less DC Machines is that they may be controlled to give wide constant power speed ranges

Figure 5: BLDC hub motor used for this project

Table- 3: Ratings of BLDC hub motor

Parameter	Rating
Power	250 W
Current	5 A
Speed	430 rpm
Voltage	48V

4. Controller:

The controller is used to govern the motor voltage and alternate voltage score with the time to offer the motor. Motor controller adjustments voltage DC to AC. The controller is a multi-practical tool and the mind of our vehicles. It offers sign to all main electronics additives like accelerator, show panel, brakes, etc. It turns on while it gets voltage from the battery and materials energy from that battery to the motor on receiving the accelerator sign. Low voltage reduces off display the battery voltage and close down the motor if the battery voltage is simply too low that point protects the battery from over discharge.

5. Throttle:

It is used to accelerate the vehicle and maintain its speed. Whenever the throttle is in action, the throttle is converted into a signal at that moment and the signal is sent to the controller. The controller receives the signal from the motor and the motor starts to accelerate.

6. Solar charge controller:

Provides a stable current ratio from the solar panel to the battery. Due to changes in solar radiation, the output power of solar panels will change from time to time. In order to allow continuous current to flow into the battery, we provide two solar charge controllers connected in series.

Figure- 6: Solar charge controller used for this project

Table- 4: Charge controller ratings

Parameter	Rating
Maximum power	12/24 V
Maximum current	10A
Power	12/24 V

7. Battery charger:

The battery charge externally by charger.

IV. RESULTS AND DISCUSSION

Speed measurement

We have used the android application to measurement the speed of E-tricycle. Maximum speed, minimum speed, and average speed are measured by this application. We have considered two places in different trial runs. Results of them are shown below in table,

Sr. No.	Trip	Distance	Time Taken	Average Speed	Maximum Speed
1.		1.6 km	3.31 min	12.81kmph	20kmph
2.		6.7 km	35.41 min	11.35kmph	20kmph

We have compared our solar tricycle with other vehicles available in India. Comparison is show in table below:

Parameter	**Solar Tricycle**	**Moped**	**Bicycle**
Max speed (kmph)	20	20	20
Pedaling requirement	No	No	No

Initial cost			
Operating cost	Nil	Rs. 1/km	Nil
Weight - Vehicle only (kg)	80	66	9
Max. traveling distance at a stretch in km	40-45	198	15-20
Fuel used per 100 km	Nil	1.5 L	Nil
Charging time (hr.)	3.5 – 4	NA	NA
Type of energy used	Solar	Petrol	Muscle power
Driving noise (dB)	Noiseless	65-70	Noiseless
Driver's license required	No	Yes	No
Helmet required	No	Yes	No
Age limit	No	Over 18	No
Engine size (cc)	NA	69.90	NA

V. CONCLUSION

1. An attempt has been made to design and fabricate a motorized retrofitted tricycle for disabled people.

2. A model has been developed and manufactured to effectively ensure the mobility of persons with physically challenged.

3. One of the important classes we've got found out is that designing the suitable era is a massive challenge. Appropriate is extra than simply availability for replication, it considers longevity, reliability, and efficiency.

4. The model which we have fabricated seems to be appropriate considering the results obtained.

5. This project provides scope to add advancement in various aspects of working and mechanism for future development.

The solar tricycle was successfully developed as per the design for disabled community. This tricycle works on solar source and employs BLDC motor to drive the tricycle. The average and maximum speed was obtained as 12.8kmph and 20kmph respectively. Various vehicles of same category available in India was compared for different parameter and it was concluded that solar tricycle proved to a complete blessing to the disable community compared to other vehicle using various sources of energy. Due to limited solar energy during cloudy/rainy days provision is made to charge the battery using external electric power source.

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