Design and Fabrication of Electric Tri-Cycle

Akash Kumar Mandal[1] Arkaraj Patra[2] Manish Kumar Sahni[3] Sanjay Muraw[4]
[1,2,3,4]M. Tech Student
[1,2,3,4]Gokul Institute of Technology and Sciences, India

Abstract— Nowadays Electric Rickshaw are becoming very popular. Pollution is manmade, which we can see in our daily life. In old model of auto-rickshaw IC engine was used and hence because of its environmental impact pollution level rises and the automobile becomes more costly. Maintenance of such conventional machine is move. To avoid these drawbacks we plan to build new type of electric tricycle. Which runs on battery and solar energy and this model is also economical. The aim of our project is to make the Tri-cycle which operates on battery and save fuel and money. In our project we have used KTC Controller for controlling the operation of tri-cycle. As the size of the tri-cycle is small so it is also useful for disabled person. Here an Electric tricycle is built, and several configurations are simulated and analyzed in the advance design software (CATIA V5 R20). Additionally, the structural analysis is determined using the analysis software (ANSYS 19.2).

Keywords: KTC Controller, Electric Tri-Cycle, Solar Panel

I. INTRODUCTION

As India contains the total population about 125 crores, here most of the person are living standard life but among the total population, most of the people are unable to live a happy life. The reason is that, most of the person are unable to live a happy life due to their disability. Most of the disabled person who have problems on leg cannot move anywhere easily for their source income and basic needs. It is seen that most of the disabled person in India are using manual type Tri-cycle that runs with the help of hand pedal and chain drive mechanism. The past technology of rickshaw is manually operated by the help of pedals. This results in to more human effort and more time to travel. These results are later IC engine powered rickshaw came in use.

Which reduce the human efforts but consumes more amount of fuels.

This also increases the air and sound pollution also required more maintenance. The objective of our project is to design an electric tri-cycle which operates battery and solar energy and avoid the drawback of rickshaw. The purpose is to avoid energy crisis in India. It reduces the human effort, operating cost and maintenance cost. An electric and solar based tri-cycle keeps the environmental clean and healthy. We have used KTC controller to control the speed of the motor which is operated using accelerator. The battery can be charged from sun by using solar panel and with the help of electric charger in the absence of sun light.

This paper will give brief description about the use and benefits of electric tricycle for disabled person by replacing the manual tricycle. This also saves the time of disabled person and give them feeling of equality in the society.

Fig. 1: Electric Tri-Cycle

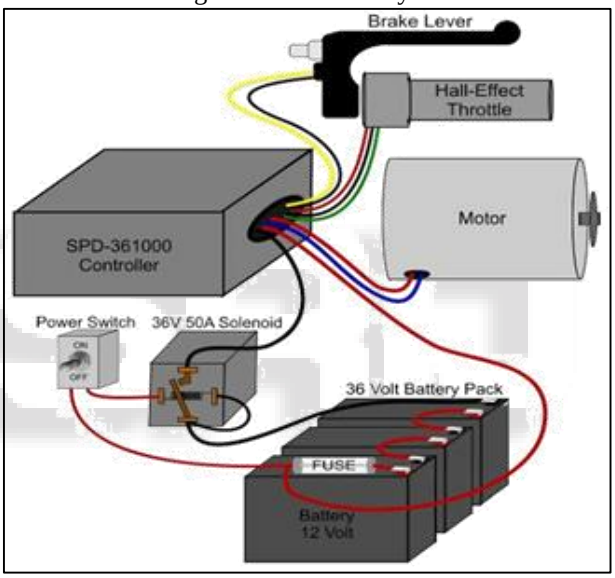


Fig. 2: Wiring sequence for the operation of Motor

A. *Electric Tri-cycle*

The above shown Tri-cycle in fig.1. is of very small and narrow type that can carry at least two persons but is more suitable for a single person. This can run up to 50km with the speed of 25-30km/hr. For this the suitable battery required to cover the distance is of 12volt 50mah/battery. In other case, directly a lithium-ion battery of 48volts and 50mah can be used. As the lithium ion batteries are of less weight, it can increase the efficiency of Electric Tri-Cycle.

Parameter	Value
Length	1250mm
Width	660mm
Height	1400mm
Clearance	150mm
Frontal area	1.5m^2
Kerb weight	90kg
Daily Distance Driven	40-50 km

Table 1: Physical Dimension of Electric Tri-Cycle 1.0

Specification	Brushless Electric Tri-Cycle Motor
Rated output power	750W

Rated voltage	48/60V DC
Rated speed	2800 RPM
No load speed	3100 RPM
Full load current	≤20/16A
No load current	≤5/4.5A
Rated torque	2.56N.m
Efficiency	≥75%
Gear ratio	1:6
Application	Small and medium size E-Tricycle

Table 2: Physical Specification of Motor Used in This Tri-Cycle

B. Selection of Battery:

An electric battery is a device consisting of one or more electrochemical cells that convert stored chemical energy into electrical energy. Each cell contains a positive terminal, or cathode, and a negative terminal, or anode. Electrolytes allow ions to move between the electrodes and terminals, which allows current to flow out of the battery to perform work. Battery: (50 Amp Hour 12 volts) *4 Sealed Lead Acid Battery.

C. Solar panel:

Solar panel are made of photo voltaic (PV) cell which converts sun light in to electrical energy. This electricity can then be fed in to your home's main electricity supply. The technology behind solar is relatively old, despite their futuristic appeal but while the basics are the same the efficiency of solar panels has improved greatly in recent years. Rated power 20W frame heavy duty aluminum kind of connection water proof junction box, can be customized guarantee of power 90% within 10 years, 80% within 25 years, kind of glass and its thickness Low iron, high transparency tempered glass of 3.2mm SLA Battery voltage 12 size 555*340*22.

D. Use of solar energy in detail:

Solar energy is very large, in exhaustible source of energy. The power from the sun interrupted by earth is approximately 1.8/10MW, which are many thousands of times larger than the present consumption rate on the earth of all energy sources. The quantum of energy India's land area receive from sun is equivalent to 15 thousand time sits consumption requirement as project for 2004 in addition to its size, solar energy has to others factor in favour. Firstly, unlike fossil fuel and nuclear power, it is an environmentally clean source of energy. Secondly, it is free and available in adequate quantities is almost all part of the world people live. But there are some problems associated with its. The real challenge is utilizing solar energy is of an economic concern. One has to strive for the development methods of collection and storage so that large initial investment required at present in most applications are reduced, solar energy in India: A large amount of solar radiation fall on India and for most of the country very few days are without sunshine. India lies within the latitude of 7N to 37N with annual average intensity of solar radiation as 500 to 600 calories/cm/day with more such insulation available in arid and semi-arid regions average solar radiation falling on India in arid and semi-arid regions in 7.5Kwh/m/day. Solar energy 5×10Kwh/year potential to meet basic energy needs to of teeming millions who live in rural India. Solar energy is an important, clean, cheap and abundantly available renewable energy. The sun radiates heat and light. The heat, light, received from the sun supports the environment on the earth through the following well known effects. Temperature balance on the earth. Photo synthesis by biological plants production of oxygen or organic materials, production of organic chemicals and biomass. Wind due to unequal heating of water: land surfaces. Heating of ocean water ocean thermal energy wave of ocean: ocean wave energy. Tide in ocean: ocean tidal energy (due to gravitational forces) the sun produces enormous amount of energy of heat and light sustained nuclear fusions reactions. The solar energy received on the earth in the form of radiation is used for heating and producing an electric energy. Among the non-conventional sources of energy solar energies most promising. Hence our project is based on the solar energy conversion to mechanical energy to run in normal Tri-cycle.

II. PROBLEMS IDENTIFICATIONS

Earlier most of the activities are done by manually, Gradually. So many big and small equipment are developed to ease human activities, thus the reduce the human efforts to do the things. Nowadays most of the activities which included human efforts and are either replaced or automated by the use of machines or other kinds of equipment. Skilled persons are required for auto rickshaw.

Main components used in this tricycle:

Batteries	4
Solar Panel	1
KTC Controller	1
Brushless DC motor	1
Electric charger	1
Solar charger	1
Accelerator	1
Wheel	3
Sprocket	2

A. Battery Charging Design:

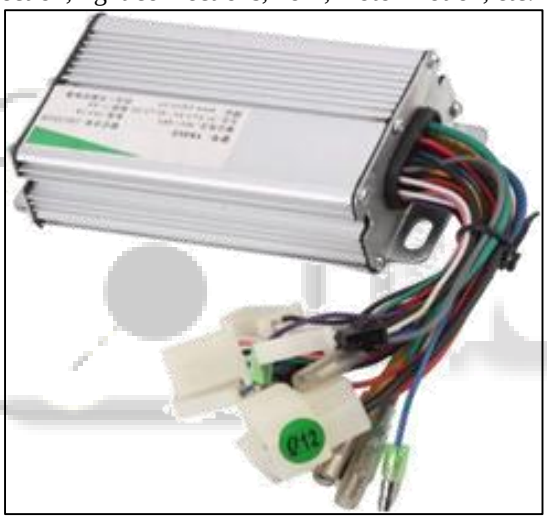
Analytical calculation of current and charging time of the battery:

1) The current produced by the solar panel (I) was calculated by knowing the maximum power(P) of the solar panel and the voltage rating (V) of the battery that is given by I=P/V Therefore, I=20/12 = 1.66 Ampere but actually the solar panel specification is 1.14 Ampere.
2) Charging time (T) was computed by the solar panel, T= (battery rating in ampere hour)/ (total current consumed by the solar panel). Therefore, T=7.2/1.66=4.33 hours.

B. KTC Controller

The controller is ok to working with 48v and 60v batteries. Max current 30A. It works well with 500w-1000w hub motor, geared or gearless, which speed under 3000RPM. It works for hall sensors motor and also hall sensorless motor, 60/120 phase degree.

This controller is able to control all the operation in motor as well as it has many other specifications. It controls the key connection, light connections, horn, motor motion, etc.

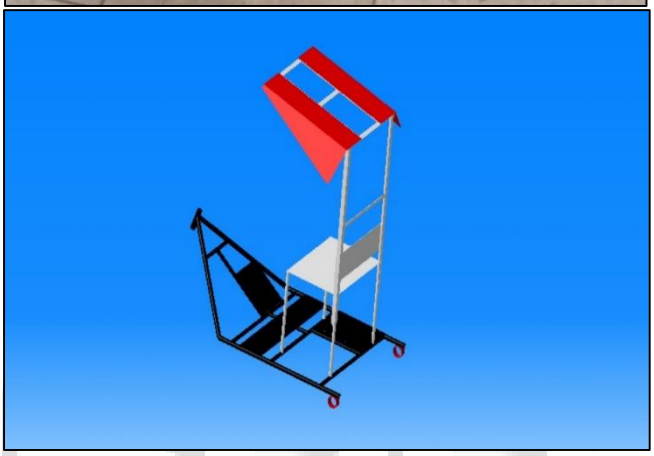


C. Fabrication Procedure

The chassis of this tricycle is made from 25mm OD and 20mm ID hollow pipe. The pipe is bended and welded at one end for the handle and front wheel movement. At another end axle is mounted to the chassis with the help of two bearings.

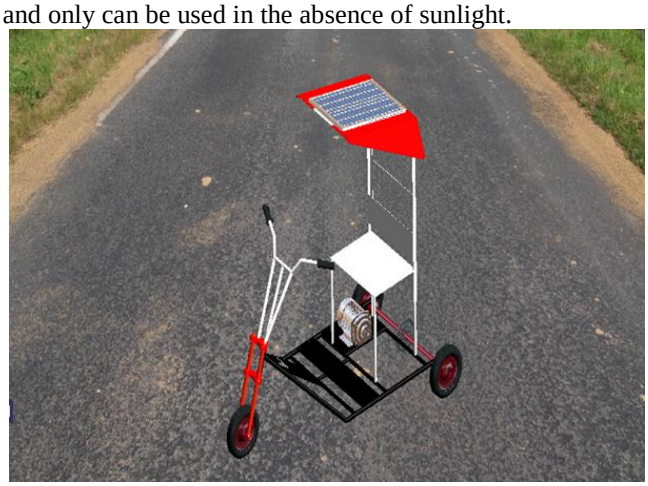
These bearings help to reduce the friction on axle. A 3mm thick sheet metal is jointed to the chassis where motor is mounted. The power from motor to the rear axle is transmitted through chain drive mechanism.

The chassis contains of a welded chair on it below which one metal box is made to place the batteries and controller. The roof is made with the support of chair by welding on it. Above the roof, solar panel is placed.

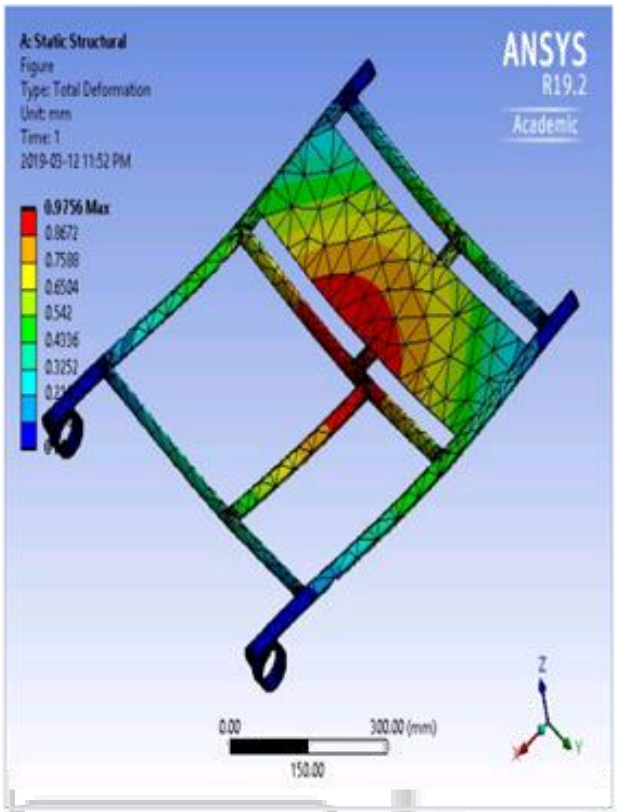


III. Result and Discussions

Our project entitled "Design and Fabrication of Electric Tri-Cycle" is successfully completed and the results obtained are satisfactory. It will be easier for the people who are going to take the project for the further modifications. This project is more suitable for a common man as it is having much more advantages i.e. no fuel cost, no pollution and no fuel residue and this can be operated by using solar energy. Disabled person may not have to apply more effort and they can handle it easily. This system has the facility of charging the batteries while the tri-cycle is in motion. So, it is more suitable for tricycle because due to this the charge in battery will be stored and only can be used in the absence of sunlight.



IV. LOAD ANALYSIS IN ANSYS SOFTWARE



Material Data

Structural Steel

TABLE 17
Structural Steel > Constants

Density	7.85e-006 kg mm^-3
Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat	4.34e+005 mJ kg^-1 C^-1
Thermal Conductivity	6.05e-002 W mm^-1 C^-1
Resistivity	1.7e-004 ohm mm

TABLE 18
Structural Steel > Color

Red	Green	Blue
132	139	179

TABLE 19
Structural Steel > Compressive Ultimate Strength

Compressive Ultimate Strength MPa
0

TABLE 20
Structural Steel > Compressive Yield Strength

Compressive Yield Strength MPa
250

TABLE 21
Structural Steel > Tensile Yield Strength

Tensile Yield Strength MPa
250

TABLE 22
Structural Steel > Tensile Ultimate Strength

Tensile Ultimate Strength MPa
460

TABLE 23
Structural Steel > Isotropic Secant Coefficient of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
22

TABLE 24
Structural Steel > S-N Curve

Alternating Stress MPa	Cycles	Mean Stress MPa
3999	10	0
2827	20	0
1896	50	0
1413	100	0
1069	200	0
441	2000	0
262	10000	0
214	20000	0
138	1.e+005	0
114	2.e+005	0
86.2	1.e+006	0

TABLE 25
Structural Steel > Strain-Life Parameters

Strength Coefficient MPa	Strength Exponent	Ductility Coefficient	Ductility Exponent	Cyclic Strength Coefficient MPa	Cyclic Strain Hardening Exponent
920	-0.106	0.213	-0.47	1000	0.2

TABLE 26
Structural Steel > Isotropic Elasticity

Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa	Temperature C
2.e+005	0.3	1.6667e+005	76923	

TABLE 27
Structural Steel > Isotropic Relative Permeability

Relative Permeability
10000

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