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Analysis of Triwheeler for Handicapped Person

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ABSTRACT
Solar plays a vital role in day to day life. In this project we have discussed that how solar tri-wheeler will help to reduce the eff ort of handicapped person. All the designs specification considered after analyzing the problems from the handicapped person. Comfort of the person in the tri-wheeler is an important and we have given importance to it. The main content of the tri-wheeler is Solar PV panel, Brushless PMDC motor, Charge controller and battery. In this project we have discuss about the main idea of this project and to get a larger picture on what is the problem in the current technologies, what that we want to achieve in this project and the area that will cover on this project. This project is divided into some categories that are project background to describe the reasons to do this project, problem statement to inform about the problem or weakness of the existing technology, objective to make sure what actually this project must achieve and scope of this project to specify what will be used in this project.

In automobile sector, the need for alternative fuel as a replacement of conventional fossil fuel, due to its depletion and amount of emission has given way for new technologies like Electric vehicles. Still a lot of advancement has to take place in these technologies for commercialization. The gap between the current fossil fuel technology and zero emission vehicles can be bridged by this technology. The electrical power is used to achieve either better fuel economy than a conventional vehicle, better performance and it cause less pollution. Driving mode selectivity improves this system more economical, stable and more efficient..
Keywords - Solar Panel, DC Motor, Motor Controller, Battery

I. INTRODUCTION

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 tricycle 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 SPVs, equipped with advanced technology, have been built with the backing of major auto manufacturers, including General Motors, Ford, and Honda.

For the colleges having very large area, their is need to be travel a lot of distance for various purposes from one place to another. Instate of using car or motorcycle that are costly and pollute the environment by the emission of incombustible fuel such as carbon monoxide, nitroxide which cause several effects on human body, for avoiding such a thing this solar tricycle are really helpful for saving cost as well as which are environment friendly.

As a student, their allowance is limited and only can be used for their material and for their food to survive at the campus. 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.

II. MATERIALS AND METHODOLOGY :

The title of the project may be lead, because it going to be easy fabricating a full sized solar tri-wheeler. It is not only difficult but also very costly. So it is better to do this as a project which includes lots of study and then a demonstration of how the solar energy can be converted and stored in batteries and then how it can be used to run the vehicle. May be with the staffs permission you may be able to use your colleges water heater solar panel if there is any. The project includes lots of calculations on how much energy can be stored, how fast the energy can be stored, how maximum efficiency can be achieved etc. The solar powering system of the tri-wheeler consists of:

1. Solar Array which collects solar energy and convert it to electrical energy.
2. Batteries to stir power.
3. Motor controller which adjusts the power input to the motor.
4. An electric motor which drives the vehicle.

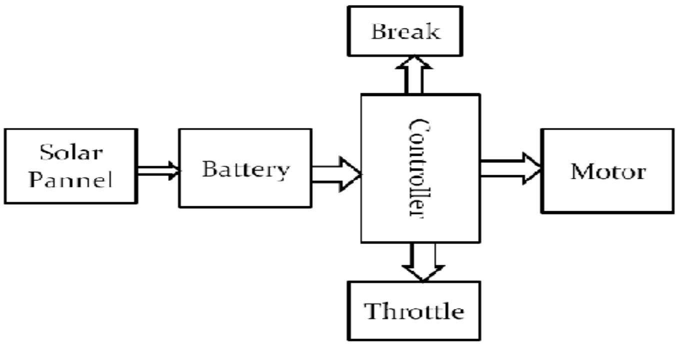


Figure 4.1: Block Diagram

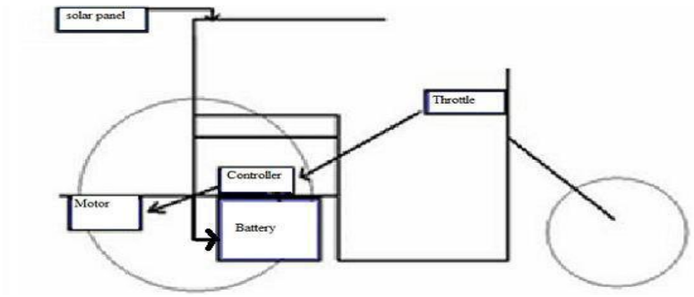


Figure 4.2: Actual Model Connection

a. Solar panel

A photovoltaic module or photovoltaic panel is a packaged interconnected assem- bly of photovoltaic cells, also known as solar cells. The photovoltaic module, known more commonly as the solar panel, is then used as a component in a larger photovoltaic system to offer electricity for commercial and residential applications. The primary difficulty with solar power and indeed with its cousin wind power has been one of efficiency. There is more than enough energy hitting the earth in the form of solar radiation to meet power needs of our species. Estimates indicate that there is four times as much wind energy available for our use as the species uses every year. Solar power is even more dramatic, the sun showers the planet with more energy every day than we use in a year. So the difficulty has never been the availability of sun and wind, they are readily available.

Figure 4.3: Solar Panel

2.2 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.

Figure 4.4: Battery

1. Voltage: Batteries are available in both 6V and 12V units. Most standard, wet-cell, golf cart batteries are 6V units. Most sealed batteries are 12V units.We also use 12v batteries
2. Amp-hour rating: The capacity of a battery is rated in amp-hours. This rating must be specified with a given discharge rate.Amp-hour rating of our batteries is 7Ah.
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 the specified amp hour rating.
4. Watt-hour rating: The watt-hour rating is a true indication of the energy Capacity of a battery, like the amphour rating, this rating must be specified with a discharge rate. The watt-hour rating of a battery is the amp-hour rating multiplied by the specified voltage of the battery.
5. Energy density: Energy density is the energy capacity of the battery, in watt-hours, divided by the weight of the battery, in kilograms. This is a critical factor in selecting an electric vehicle battery-the amount of energy a battery carries per unit weight.
6. Cycle-life: Cycle-life is the number of times a battery can be fully discharged before replacement. However, in most real applications, a lead-acid battery will exceed its specified cycle-life, since the battery will not be fully discharged every time it is used.

2.3 Brushless Direct Current

Brushless Direct Current (BLDC) motor is a type of synchronous motor, where mag- netic fields generated by both stator and rotate have the same frequency. The BLDC motor has a longer life because no brushes are needed. Apart from that, it has a high starting torque, high no-load speed and small energy losses. The BLDC motor can be configured in 1-phase, 2-phase, and 3-phase. Three-phase motors are the most popular among all the configurations and are widely used in e-bikes. The structure of a BLDC motor is divided into two parts:

1. Moving part called the rotor, represented by permanent magnet
2. Fixed part called the stator, represented by phase windings of magnetic circuit

Figure 4.5: BLDC motors

2.4 Stator

The stator of a BLDC motor consists of stacked steel laminations with windings placed in the slots that are axially cut along the inner periphery. Traditionally, the stator resembles an induction motor; however, the windings are distributed in a different manner. Most BLDC motors have three stator windings connected in star fashion. Each winding is constructed with numerous coils that are interconnected to form a winding. One or more coils are placed in the slots and they are interconnected to make a winding. Each winding is distributed over the stator periphery to form an even number of poles.

2.5 Rotor

The rotor is made of permanent magnet and can vary from two to eight pole pairs with alternate North (N) and South (S) poles Unlike a brushed DC motor, BLDC motor can be controlled electronically. To rotate the BLDC motor, the stator windings must energized in a special sequence. The rotor position must be known in order to understand which winding will be energized next. The rotor position is sensed using Hall Effect sensors that are embedded in the stator. Most BLDC motors have three Hall sensors embedded in the stator on the non driving end of the motor.

When ever the rotor magnetic poles pass near the Hall sensors, they generate a high or low signal, which indicates that N or S pole is passing near the sensors. Based on the combination of these Hall Sensor signals, the exact sequence of commutation can be determined. Because of the increasing popularity of e-bikes, motors designed specifically for e-bike applications are now commercially available. These motors vary a great deal in how they are mounted to a bicycle and in how the power is applied to them.

2.6 Throttle

An electrical signal accelerator works on the principle of Hall Affect generator, which produces speed controlling signals based on the rotation of the actuator.

Figure 4.6: electrical Throttle

The throttle cable has almost become redundant on todays motor vehicle. The drive-by-wire system is by no means a new concept as it was introduced by BMW on their 7 series range back in 1988. The system BMW use is referred to as EML (German term for electronic throttle control). The system has now found its way onto other vehicles with humbler routes and can be found on base models. Historically a mechanical linkage between the accelerator pedal and the throttle butterfly has always existed, be it via a cable or via rods and linkages. These have now been replaced by sophisticated electronic control modules, sensors and actuators. This system is also referred to Fly-by-Wire.

The vehicles on board electronic systems are able to control all of the engines opera- tion with the exception of the amount of incoming air.The use of throttle actuation ensures that the engine only receives the correct amount of throttle opening for any give situationThe optimisation of the air supply will also ensure that harmful exhaust emissions are kept to an absolute minimum and drivability is maintained, regardless of the circumstances. Coupling the electronic throttle actuation to the adaptive cruise control, traction control, idle speed control and vehicle stability control systems also means finer control can be achieved.

2.7 Controller

1. Battery Voltage Detect

The battery has a positive terminal and a negative terminal. In case of correct polarity, diode D5 is turned on and it supplies the normal power. In case of wrong polarity, diode D5 is on the reverse voltage and it does not turn on. The diode can protect other devices in system including the MCU ADC input. If the ADC result is lower than a preset value, undervoltage protection can occur. The battery in e-bike contains leadacid. The voltage discharge cannot be too low; otherwise, the voltage discharge will cause permanent damage to the battery. The ADC should detect this voltage during normal operation. If the battery voltage is less than a certain preset value, the MCU will go into undervoltage protection mode.

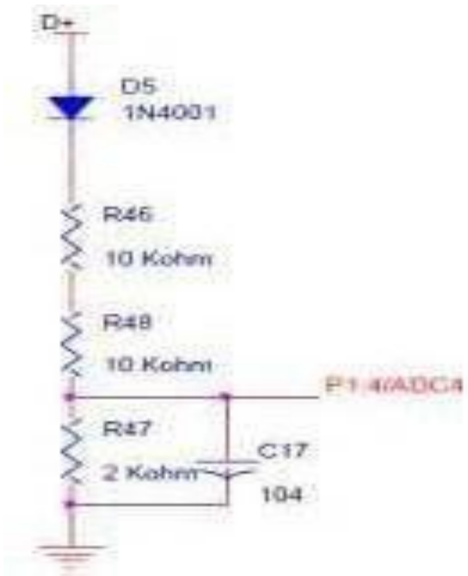


Figure 4.7: Battery Voltage Detection Schematic

2. Handbar Voltage Detection

Jumper S4 is used for speed limitation. When S4 is on connected, R61 is connected in parallel with R59, which makes the ADC input voltage much lower than the time S4 is off.

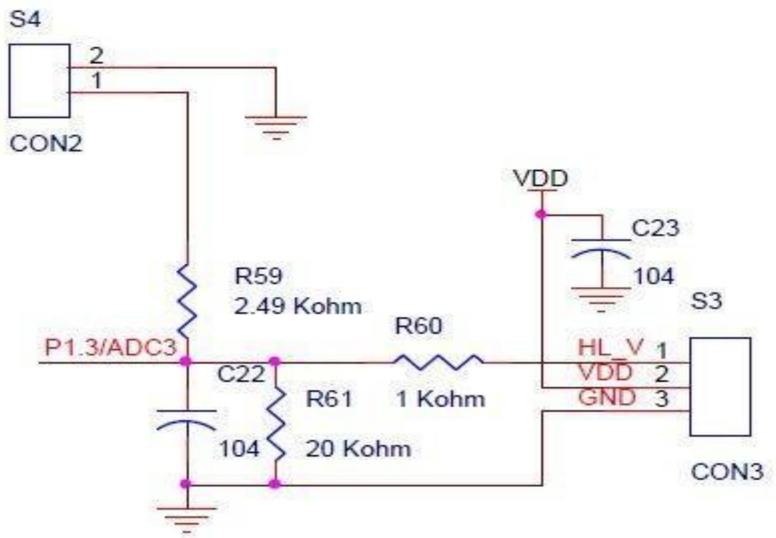


Figure 4.8: Handbar Voltage Detection Schematic

3. Feedback Current Detection

One LM358 op-amp (operational amplifier) is used for the measurement of system feedback current. Gain control resistors (R16, R17) ensure that the ADC input voltage is within the range of 0 to 5 V.

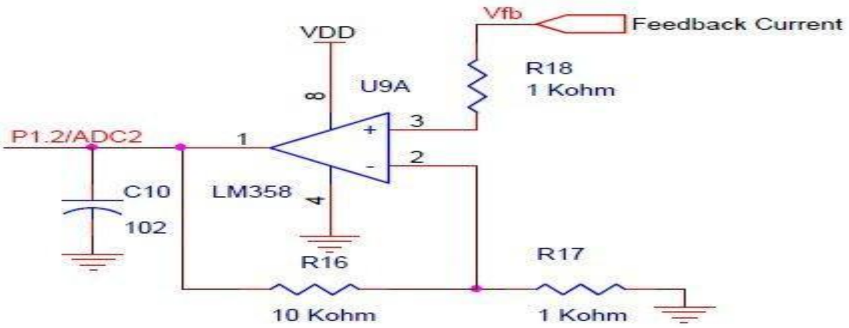


Figure 4.9: Feedback Current Detection Schematic

4. Overcurrent Detection and System Overcurrent Protection Circuit

The controller can judge over current using two types of outside conditions: Condition 1: The feedback current abruptly rises up to an unexpected value which could be caused by MOSFET short or motor rotation blockage.
Condition 2: The current is above a preset safe value (usually 50 A), which is set for the system safety. Condition 1 is protected by an external comparator as Condition 2 is realized by feedback current detection.

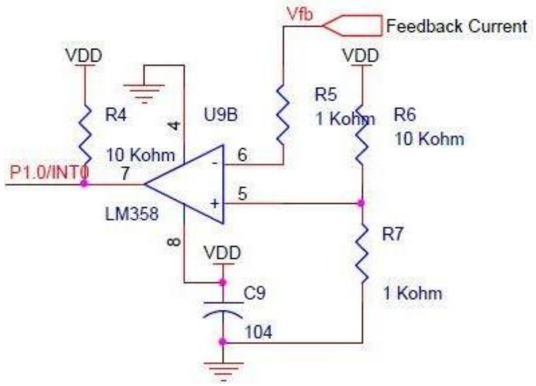


Figure 4.10: Overcurrent Protection Schematic

5. Brake Mechanism

The brake mechanism can support both high-level and low-level brake signals. The ADC has the wave form shown in figure below regardless of the brake signal.

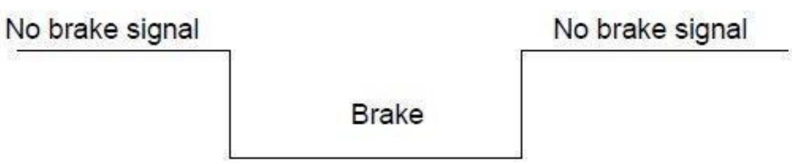


Figure 4.11: shows the brake mechanism circuit

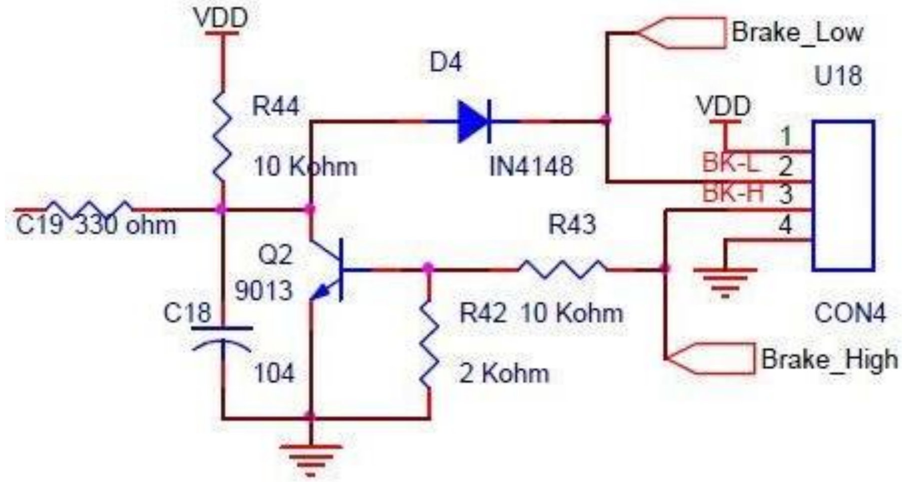


Figure 4.12: Brake Mechanism Schematic

6. Hall Sensor Position Detection

The synchronization between the rotor and rotating field requires knowledge of the rotor position. The BLDC motor used in this application has 3 Hall sensors. Figure below shows the Hall sensor position detection circuit and velocity meter circuit.

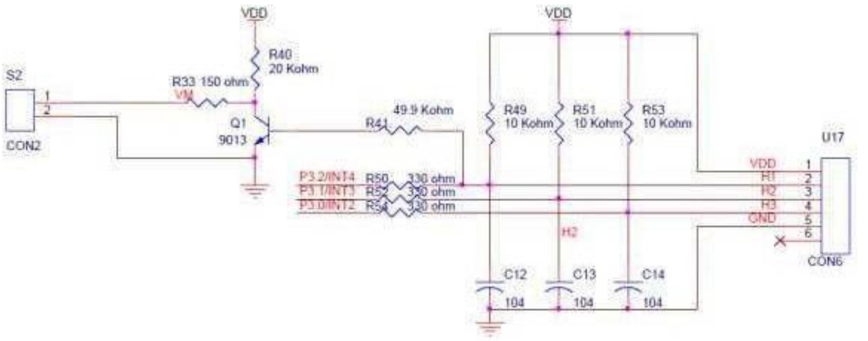


Figure 4.13: Hall Sensor Position Detection Schematic

Figure below shows the output signal flow of sensors, which describes the electrical rotor position. Eight possible signal combinations can be used as the output of the three sensors. Two of these combinations are not valid for position detection and are usually caused by an open or short sensor line. The other six combinations will be detected by external interrupts both at the rising and falling edge.

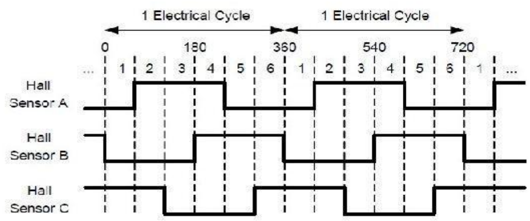


Figure 4.14: Hall Sensor Position Waveform Diagram

2.8 Advantages

1. Solar energy creates absolutely no pollution. This is perhaps the most important advantage that makes solar energy so much more practical than oil. Oil burning releases harmful greenhouses gases, carcinogens and carbon dioxide into our precious air.
2. Solar energy is a completely renewable resource. This means that even when we cannot make use of the suns power because of nighttime or cloudy and stormy days, we can always rely on the sun showing up

the very next day as a constant and consistent power source.

3. Solar panels and solar lighting may seem quite expensive when you first purchase it, but in the long run you will find yourself saving quite a great deal of money. After all, it does not cost anything to harness the power of the sun. Unfortunately, paying for oil is an expensive prospect and the cost is still rising consistently. Why pay for expensive energy when you can harness it freely.
4. Solar powered panels and products are typically extremely easy to install. Wires, cords and power sources are not needed at all, making this an easy prospect to employ.
5. Solar power technology is improving consistently over time, as people begin to un- derstand all of the benefits offered by this incredible technology. As our oil reserves decline, it is important for us to turn to alternative sources for energy.
6. Oil, which is what most people currently use to power their homes, is not a renewable resource. This means that as soon as the oil is gone, it is gone forever and we will no longer have power or energy. Very little maintenance is required to keep solar cells running. There are no moving parts in a solar cell, which makes it impossible to really hurt them. Solar cells tend to last a good long time with only an annual cleaning to worry about.
7. Solar cells make absolutely no noise at all. They do not make a single peep while extracting useful energy from the sun. On the other hand, the giant machines utilized for pumping oil are extremely noisy and therefore very impractical.
8. Because an SPV has few moving parts, service requirements are less than for conven- tional cars.
9. Since there is no internal combustion engine and no combustion takes place, there are no emissions.
10. Electric vehicles are very quiet. Noise comes only from the electric motors.
11. Because SPV energy is 100power, and the only requirement is that they must be operated in sunshine.
12. Added emissions are not produced by power plants, since SPV's do not rely on utility- generated electricity.

3. Design of Electric Triwheeler

Notations

d = diameter of the cycle rim in meters. r = radius of
cycle rim in meters. omega= Angular velocity of cycle
shaft. N = Speed of cycle wheel in RPM .
v = Linear velocity of the cycle in kmph.
N1=Normal reaction of the road on each tire in Newton.
mu=Coefficient of friction = 0.3
F=Frictional force between tire and road in Newton.
T=Torque developed on the shaft due to frictional force in Newton-meteres. P=Power required to ride the cycle in Watts.
t=time required to charge the battery by A- C Supply in hours.

Tri-wheeler data Specification

1.Diameter of wheels=D=46 cm

2.Peripheri of wheels=3.14*D
=3.14*4
=144.51cm=0.14
3.Distance per minute=speed* Periphery
=336.0*0.14
=48.55m/min
ute
4.Distance per hour=48.55*60=2913m/hr

Motor Specification(company standard)

1.Power=250
watt
2.Voltage=48
volt

3.Max Current capacity=20
Ah 4.Speed in rpm=336.0
rpm

Battery Specification

8 Li- ion Battery with 12 V and 7 amp-hour rating are used .The selection of battery depends on its voltage, ampere and wattage rating etc. The total power of fully charged battery in two hours is 672 Watt-hours.

1.Power =672 watt
2.Voltage =48 volt
3.Current =14 Ah

Calculation of Torque

P= (2*3.14 * N *T) /60
250= (2 *3.14 *366 *
T)/60 T= 7.10N.m
T=7.10x9.81
T=69.70kg.m

Electrical charging

Time required to fully charging the battery is calculated

Power Supplied to Battery during AC Charging.

P =V*I

P = 12 * 7
P = 84 W

Wattage of single battery used is 84watt. But we are using 8 batteries the total wattage of the battery unit is 672watt.
Therefore the time required to charge the battery completely is
t = 8 hours

Solar Panel charging

solar panel of 1000 W capacities were selected due to space constraint. To charge the battery completely, it needs 672 / (100) = 6.72 hours are required. The solar panel is a photovoltaic converter which works only in bright sunlight. If cloud blocks the sun rays or during night the solar panel does not work. To make the solar energy available throughout the day, a solar charger is incorporated

4. Result

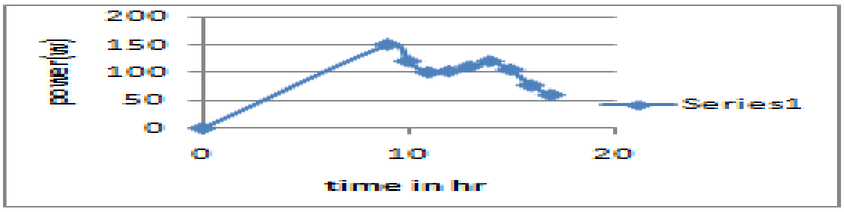


Figure 5.1: Power Produced by Solar Panel

Observation table

Sr.No	Load	Running AMP
1	0	0
2	40	4
3	45	5
4	50	6
5	55	7
6	60	8
7	65	9
8	70	10
9	75	11
10	135	13

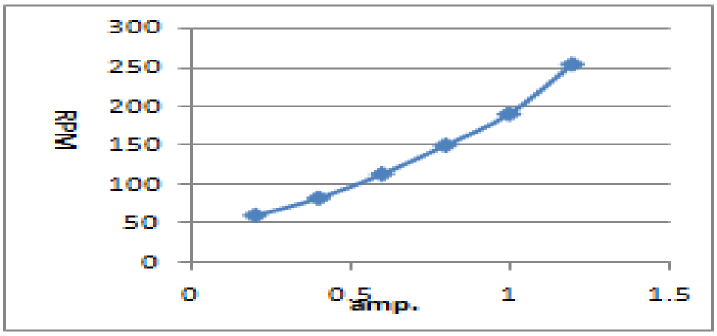
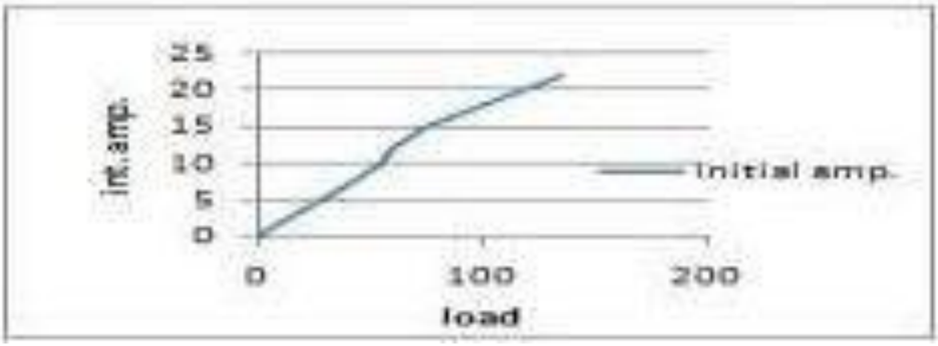


Figure 5.2: Relation between RPM and AMP

Figure 5.3: relation between running AMP and load



46
Figure 5.4: Relation between initial AMP and no load

V. Conclusion

Solar energy, a renewable source of energy is an upcoming form, which if properly used, can give rise to tremendous energy which can further be used in different forms. Research is still in progress on applications like solar powered automobiles, solar powered steam turbines, etc. A solar electric triwheeler, is a basic type of automobile which can run both on solar power as well as electricity. With an unhealthy hike in the prices of petrol and diesel, an automobile running on solar power can create a trend. This kind of a triwheeler is user friendly. It is very simple to use and manage. It comes at an affordable cost and the per unit electricity consumption is very less. It can be used even during the times when there is no sunlight. Because, the suns energy trapped by the solar panel can be efficiently converted in electrical energy and stored in a battery. The importance of these kinds of applications is gradually increasing with the diminishing non renewable energy sources like fossil fuels and the like. The solar powered wheeler has the following salient features. A cycle can run at an average speed of 15 kmph (without pedaling) with a maximum of 30 kmph with pedaling.

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