Solar Cell Motorcycle's Parking Security System

By

Wan Zaimi Bin Wan Abdullah

Dissertation submitted in partial fulfillment of
the requirements for the
Bachelor of Engineering (Hons)
(Electrical & Electronics Engineering)

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CERTIFICATION OF APPROVAL

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Approved by,

____

(Dr Noohul Basheer Zain Ali)
Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH,PERAK
December 2009

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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WAN ZAIMI BIN WAN ABDULLAH

ABSTRACT

This project is about a solar cell motorcycle's parking security system. The objective of this project is to design and construct a solar power system for supplying the power to the motorcycle's parking security system. Before this, the motorcycle's parking security system was supplying by electrical energy. This is not so efficient and not applicable if the system only depending on that source. In this problem, the solar energy has advantages because sun will be around for all the time. The scopes of study in this project are to understand the working of solar system, analysis the factors that need to be considered in the project, design and implement a solar system on the motorcycle's parking security system. The methodology is a project management process. This includes the project flow from the selection topic to construct the prototype and the final product desired. It also contain the duration of each step to archive the desired product. The expected outcome from this project is the solar power supply to motorcycle's parking security system.

ACKNOWLEDGEMENTS

The author wishes to take the opportunity to express his utmost gratitude to the individual that have taken the time and effort to assist the author in completing the project. Without the cooperation of these individuals, no doubt the author would have faced some minor complications throughout the course.

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CHAPTER 1

INTRODUCTION

1.1 Background of study

Solar energy is one of the renewable energy that can be use in the future. From the solar energy, we can convert it to become an electrical energy. The solar energy can bring a lot of benefits for country like Malaysia which has a high sun exposure.

This project study is intended to develop solar source power system for motorcycle’s parking security system. Before this, the motorcycle’s parking security system got the power from the electric energy. In order to improve the previous project, an additional of alternative power source needs to be done on this system. The additional power source is solar power energy. As we all know, solar energy is one of the renewable energy source that have been discussed in all around the world. I have been trying to come out with an energy source that could supply the power same as electric energy. With the solar energy and existing electric energy on this system, we can call it **solar energy hybrid system.** The hybrid system is one that integrates more than one generating source, for instance photovoltaic system which will supplement the existing electric energy. [1]

From the energy conversion from solar energy to electrical energy, a solar power system for the motorcycle’s parking security system will be design. This system will generated energy from sun and convert it to be electrical energy then supplying to the motorcycle’s parking security system.

1.2 Problem statement

The motorcycle's parking security system is very intelligent system design in order to avoid the motorcycle theft in our country. The ETP group comes up with a lot of ideas of developing special locking mechanism for motorcycles to overcome the motorcycle theft problem. Thus, a locking mechanism for motorcycle that functioned to prevent the risk of losing motorcycles in public places was successfully created. [2]

But, the proposed motorcycle's parking security system used electricity from electrical power. It is not so efficient if the system just depend on the electrical power as a power source. This is because there are some problems would be face by the consumers if they only depend on the electric energy as a power source. For instance, we cannot run the system if lost power occurred. So, we need an alternative power source to act as a back up or supplement the existing electric energy.

By constructing the solar system to the motorcycle's parking security system, the project become more popular, more intelligent and more effective because while the project used the electrical power as a power source, it used to be reward by the local and foreign evaluators. So, the level of popularity of the project would be increase by the constructing of the solar power system on this project as an improvement of the project.

1.2.1 Problem identification

The design process continues with a detailed feasibility study. The reviews data provided by the conceptual analysis summary, confirms the data, and adds information, as necessary but some of the data is not appropriate with the current project, to complete the application review for energy conservation and load analysis. Using these data and computer programs suitable for the size and complexity of the project but some function in the computer program is not available to do some simulation, the review data completes performance analyses to verify and establish size of the system. Cost estimates and economic analysis follow, and, if necessary, performance/cost iterations are made to identify the most cost-effective design. The author will summarize and prepare a system design description and, if the cost effectiveness is acceptable, the detailed system design will begin.

1.2.2 Significant of the project

In the future, solar energy can be an important energy to generating electrical energy. Because it is a renewable energy and it will live in a long period. This will be the advantage of this device because it uses the solar energy and it has the market value. People also can apply the solar power as an alternative power source in their daily life because solar power also can deliver the volumes of energy same as the other power source such as electric energy. For example in this project, solar power systems will be added as an alternative power source. With the construction of the solar power system on this project, it will become more popular and more intelligent. This project can be one of the application or renewable energy in human life. The universities will be able to use and apply this research to update their parking systems and be able to design this particular project in the future.

The project will be able to apply because of the appropriate weather and the advantages by using the solar power. In Malaysia, We have almost half a day with sun light everyday throughout the year. The temperature is about 30C and may be hotter sometime depends on the weather. So, Malaysia is highly suitable for using solar power, this is because we are located strategically near the equator. Average location in Malaysia can obtain about 6 Sun hour per day, which is a lot. With the appropriate location and weather of our country, solar energy can be applied on the system. There are some advantages and benefits by using solar electricity to supply power to this project such as spend less money on power bills, save the environment from any pollutants that release into atmosphere and it was energy independence because it makes us less dependent on foreign energy sources.

1.3 Objectives and scope of study

The main objectives of this work are to develop and construct a solar source power system on the motorcycle's parking security system.

The scopes of studies involved would be on:

- To construct the solar power system
- To supply motorcycle's parking security system using solar power
- To come out the solar power system prototype
- To test the functionality of the solar power system
- To design the charge controller circuit
- To design the tracker for placing the solar panel

1.4 Relevancy of project

This project is relevant to the study of solar electricity as well as the study of how the solar work and produce the energy. This project is also relevant to the most current research aims for reducing the level of pollution and the applications of solar technology will be using for the human's benefits. The project is also relevant to recent studies where energy generated from natural resources such as sunlight have a unique characteristic which influence how and where they are used.

1.5 Feasibility of project within the scope and time frame

The project is feasible as it analyzes the data which can be obtained from the existing projects; motorcycle's parking security system. But after analyzed and used the data from the existing project, one must get the information about the solar system from various references starting from the collecting data, proceed with the calculation and lastly to design the project. This project is low in cost for analysis and brings huge benefits for the future.

CHAPTER 2

LITERATURE REVIEW

2.1 Solar radiation

The solar energy comes from sun. This energy need to radiate long distance from sun to the Earth. It is approximately about 1.495 x 10^{11} m. The radiation of solar energy from the sun to the Earth is come in two ways. First is the extraterrestrial radiation. This radiation takes the path from the sun surface until the outer layer of the Earth atmosphere. Second is the terrestrial radiation. This radiation path is from the outer atmosphere layer to the Earth surface. The terrestrial radiations differ from the extraterrestrial radiation because of the Earth atmosphere layer. The Earth atmosphere layer have obstacle like humidity, cloud, air particle and etc. These things can block and bent the solar radiation from the sun. The bent radiation course of Earth atmosphere is the terrestrial radiation. The terrestrial radiation comes in two ways, beam radiation and the diffuse radiation. Beam radiation is true solar radiation from the sun while the diffuse radiation is the reflected solar radiation from obstacle object like mountain, building or even tree. This solar radiation can be measure. The measurement instruments for solar radiation are Pyrheliometer and Pyranometer. The Pyrheliometer is specially to measure the beam radiation. The Pyranometer can be used to measure either beam radiation or diffuse radiation or we can use the Pyranometer to measure both of beam radiation and diffuse radiation. [3]

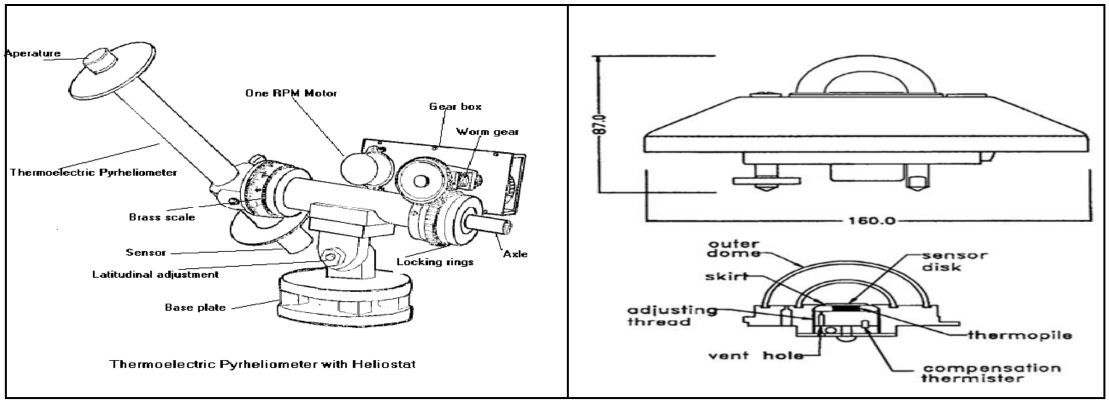

Figure 1: Pyrheliometer and Pyranometer[4]

This apparatus use the concept of heating the blackened manganin strips. In this instrument, tow identical blackened manganin strips are arranged so that one strip can be exposed to the radiation and the other one will be electrically heated. When there are no differences in temperature between the two strips, the electrical energy to the strip must equal the solar radiation absorbed by the exposed strip. From the radiation measurement, we can identify the radiation value at every place in the world. To get the maximum value of solar radiation, the instrument needs to face the sun so that the radiation can directly go to instrument without being bent. [4]

2.2 Solar panel

Figure 2: Solar panel

Solar panel or photovoltaic panel is use to convert the solar energy to electrical energy. The energy conversion consists of two parts. First, the generation of an electron-hole pair by the absorption of light. Then, the second part is the generating of electrical power from the electrons and holes separation process. The typical solar panel used today is the crystalline silicon solar cell. This type of solar cell uses the p-n junction principle. [5]

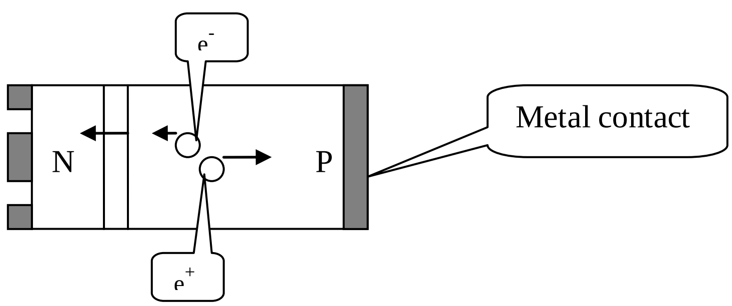

Figure 3: p-n solar cell [5]

The thick p-type is the bulk of the cell. After the light absorption process occurs, the minority carrier from the bulk (electrons) will diffuse to the junction before they will swept across the junction by the strong built-in electric field. This process produces the electrical power. The electrical power then being collects by the metal contact at the front and back of the solar panel. There are two criteria that will make an effect on how the solar cell can absorb the light and convert it to become electrical energy. First is the antireflection coating and the second is the light trapping. The antireflection coating is a thin layer of a dielectric to reduce the reflection of light from the surface of the cell. The light trapping feature includes a textured top surface combined with an optical reflecting back surface. [5]

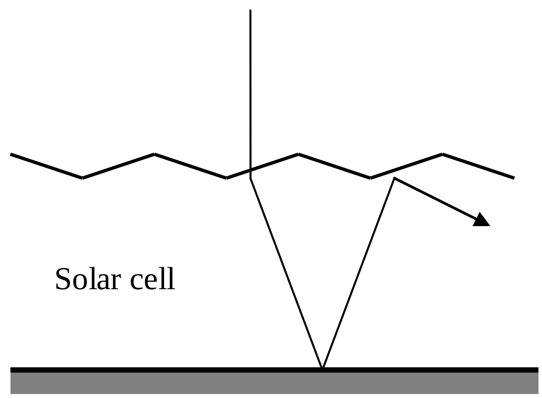

Figure 4: Light trapping [5]

The electrical energy that is generated from photovoltaic panel not a stable in voltage and current. From the photovoltaic panel the electrical energy will flow to stabilizer circuit before go to installed battery. The stabilizer circuit is for stabilizing the value of voltage and current generated. [5]

2.3 Charge controller circuits

Once our solar panels were up and running, the next obvious requirement was some sort of charge controller, since continuous overcharging would boil the electrolyte dry and ruin the expensive battery bank. [6]

Charge controllers intended for solar panels work by monitoring the battery voltage, and once it reaches full charge, the controller simply shorts the solar panel leads together. This doesn't harm the solar panels, but it does waste whatever power they're generating. The energy ends upheating the transistors in the controller. [6]

This type of controller is not ideal for the other generator, since shorting the output of the genny while it's spinning at high speed will generate a huge current spike, possibly destroying the controller and perhaps even the generator in the process. On the other hand, simply unhooking the generator from the batteries is not a good idea either, since with no load on it, the generator might destroy itself. [6]

The ideal solution is to charge the batteries until they reach a full charge, then switch to an alternate load where the energy can be safely handled. While we're at it, this energy should be used for some useful purpose. [6]

2.4 Voltage indicator circuit

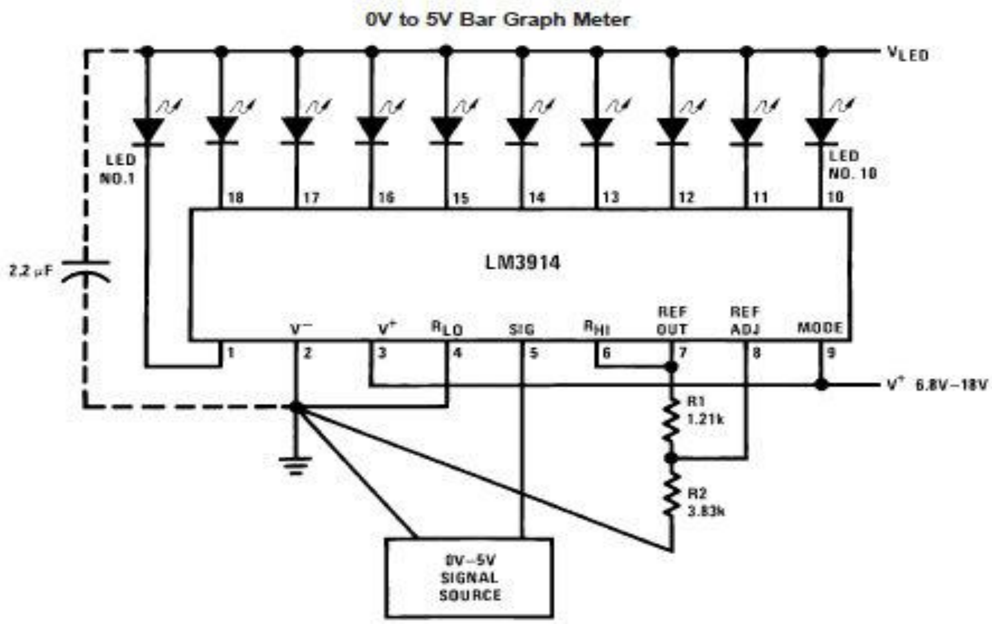

Figure 5: Voltage indicator circuit

The objective of this circuit is to design and build a battery tester that is able to test various types of dry cell and rechargeable battery with a voltage of 3V to 12V. The LM3914 is a monolithic integrated circuit that senses analog voltage levels and drives 10 LEDs, providing a linear analog display. Current drive to the LEDs is regulated and programmable, eliminating the need for resistors. The circuit contains its own adjustable reference and accurate 10-step voltage divider. The low-bias-current input buffer accepts signals down to ground, or V−, yet needs no protection against inputs of 35V above or below ground. [7]

Versatility was designed into the LM3914 so that controller, visual alarm, and expanded scale functions are easily added on to the display system. The circuit can drive LEDs of many colors, or low-current incandescent lamps. The LM3914 is very easy to apply as an analog meter circuit. A 1.2V full-scale meter requires only 1 resistor and a single 3V to 15V supply in addition to the 10 display LEDs. Grounding method is typical of all uses. The 2.2 µF tantalum or 10 µF aluminum electrolytic capacitor is needed if leads to the LED supply are 6" or longer. [8]

2.5 Solar geometry

When designing any type of system that relies on solar radiation, it is important to take into consideration the seasonal and hourly changes in position of the sun. This has a direct influence on the incident angle of sunlight, so it is valuable to incorporate a system that can adjust to the position of the sun. It is also helpful to consider the position of the sun when deciding the placement of solar panels. [9]

The position of the sun can be described by two different angles. The first angle is the solar azimuth (Z), which is defined as the clockwise angle between the sun and the cardinal direction of true north. It is measured up to the horizontal projection of the sun's position onto the Earth's surface (as shown in the Figure 6). The second angle is the solar altitude or elevation (Y), indicating the angle of the sun's position from the horizontal (as shown in the Figure 6). The angle of incidence is not a measure of the sun's position, but rather a measure of the amount of radiation incident on a vertical surface. The angle of incidence is related to the solar altitude as follows:

X=90 degrees-Y

Together, the two angles provide useful information about the orientation of incoming sunlight on an object or structure. Knowing this, solar collectors and other devices should be installed so they are within 20° of either side of perpendicular to the sun. By incorporating a system that adjusts to the incident angle of the sun, we can further control the angle incident on the surface of the collector. For example, hinging light shelves so they are adjustable for the optimal angle. [9]

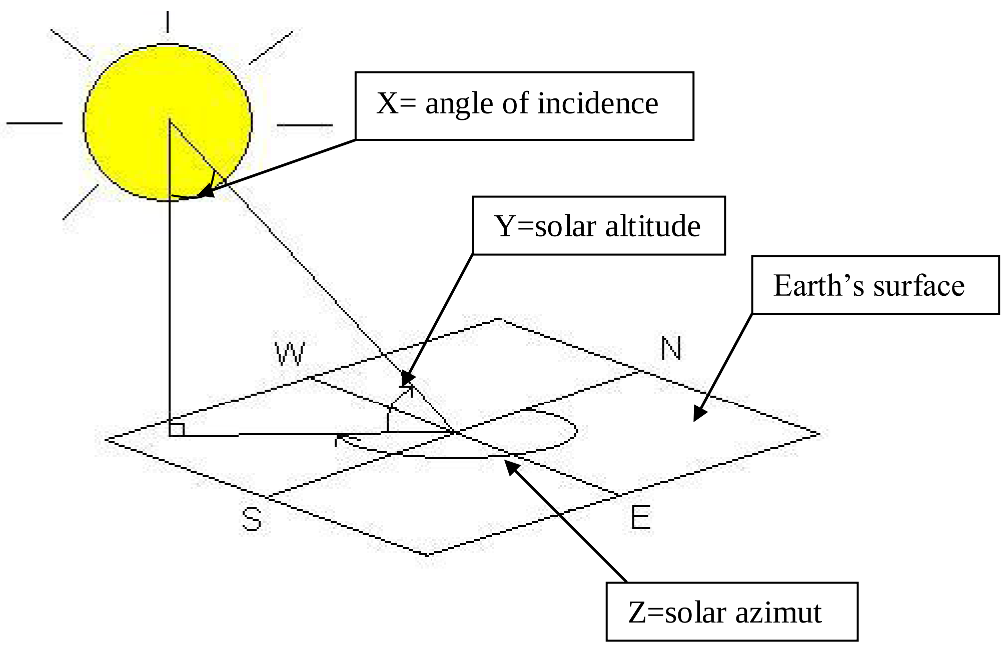

Figure 6: Solar geometry diagram [9]

2. 6 Batteries

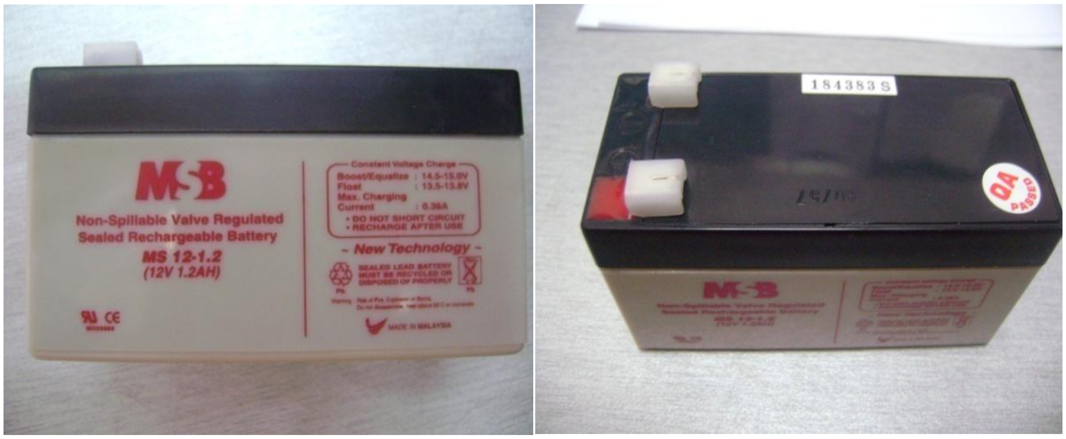

Figure 7: Battery

Batteries are a key component in a stand-alone renewable energy system. If we are installing a wind, solar or hydro electric system that will be tied to our utility grid, we will still need batteries if we are trying to use power in the event of an outage. Without batteries, we can only use power at the time we produce it. We will not have power when the sun isn't out if we don't have batteries in our solar electric system. In renewable energy systems, Deep Cycle Batteries provide the energy storage for the system. Unlike car battery, deep cycle batteries that are used in renewable energy applications are meant to be discharged and recharged (cycled) repeatedly. To maintain healthy batteries and prolong battery life, most manufacturers suggest limiting the depth of discharge to about 20%. That means the batteries will be at 80% capacity or better. At the very least, we cannot allow the batteries to be discharged below 50% Depth of Discharge (DOD). Often an inverter will have a Low Voltage Disconnect feature that will disconnect loads at a given set point. Low voltage alarms can provide audible warnings as well. Ammeters, Voltmeters, Battery Monitors can help better maintain battery health and provide statistics about the overall health of the system. [10]

2.6.1 Battery type

From the observation about the device battery, there are two type of battery that usually used. The first type is the Lithium-Ion battery and the other one is the Lithium-Polymer battery. For the first type battery (Lithium-Ion type), it operation is base on the moving of Lithium ion particle between anode and cathode. For the charging purpose, the Lithium ion move from cathode to anode and for the discharge purpose, it moves from anode to cathode. This type of battery has several advantages compare to other battery type. The advantages are best in energy to weight ratio, no memory effect and slow loss in charge in idle mode. But if have mistreating on the battery, it can explode. Inside the battery, there are three major parts which are anode, cathode and electrolyte. The material for anode is usually graphite. The material for

the cathode can be either one of this three: a layered oxide, such as lithium cobalt oxide, one based on a polyanion, such as lithium iron phosphate, or a spinel, such as lithium manganese oxide. Liquid electrolytes in Li-ion batteries consist of lithium salts in an organic solvent, such as ether. A liquid electrolyte conducts Li ions, acting as a carrier between the cathode and the anode when a battery passes an electric current through an external circuit. [11], [12]

Lithium-Polymer battery is another type of rechargeable battery. It still uses the Lithium-Ion technology but the difference is the electrolyte that use in this battery. The electrolytes for this battery type not exist in the organic solvent, but in a solid polymer composite such as polyethylene oxide. The advantages of Li-poly over the lithium-ion design include lower cost manufacturing and being more robust to physical damage.[11],[12]

2.7 12V DC Motor

An electric motor uses electrical energy to produce mechanical energy, usually through the interaction of magnetic fields and current-carrying conductors. They may be powered by direct current (for example a battery powered portable device or motor vehicle), or by alternating current from a central electrical distribution grid. The physical principle of production of mechanical force by the interactions of an electric current and a magnetic field. The conversion of electrical energy into mechanical energy by electromagnetic. A DC motor is designed to run on DC electric power. [13]

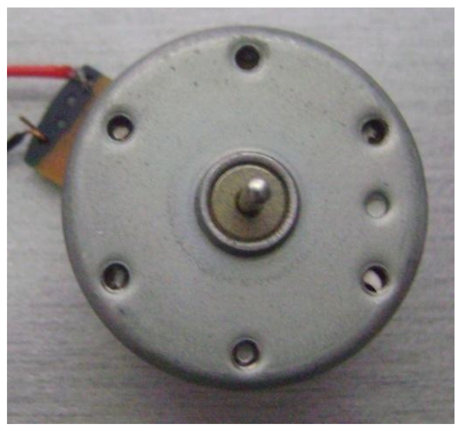

Figure 8:12V DC motor

CHAPTER 3

METHODOLOGY

3.1 Procedure identification

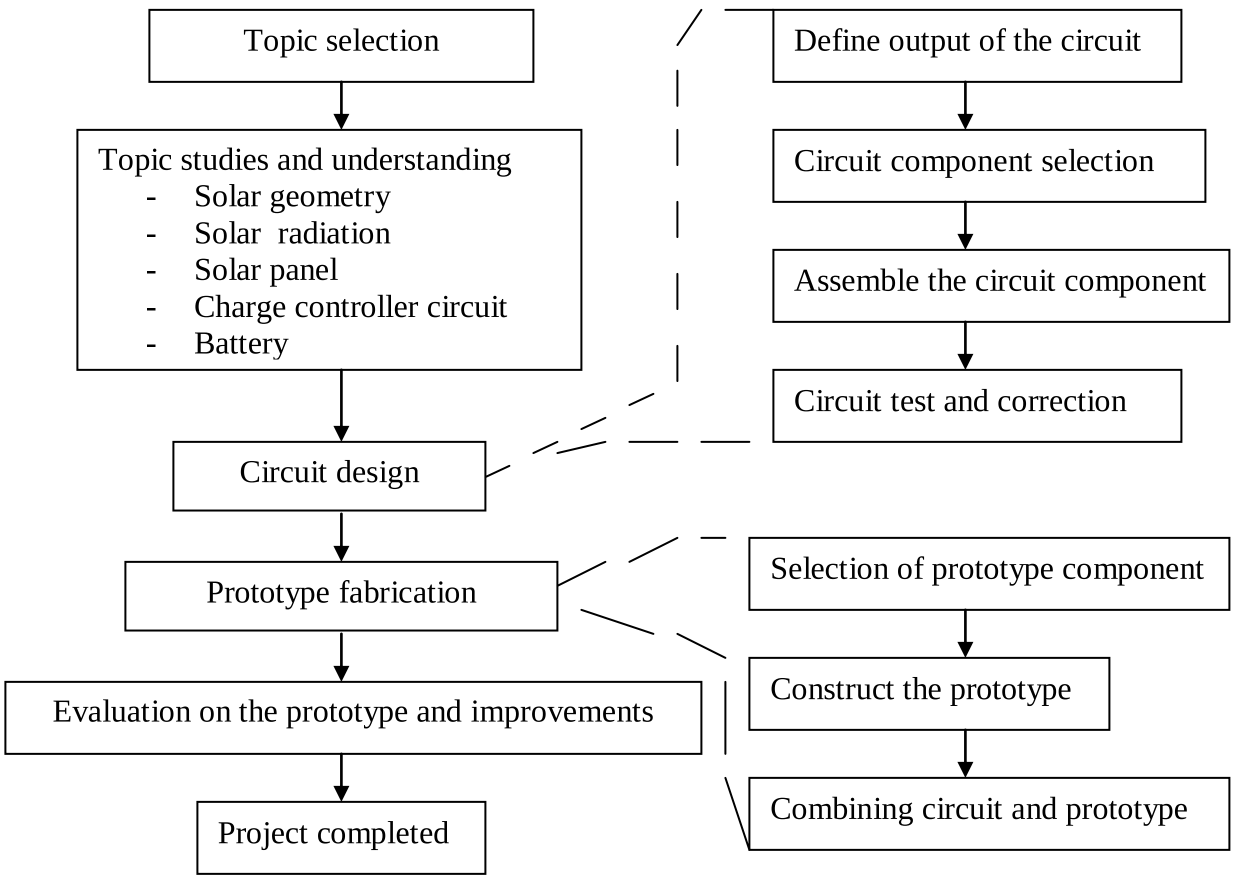

Figure 9: Project methodology

3.2 Project activities

This chapter includes conceptual design and model drawing. The design of the system is follows the system block diagram as shown below:-

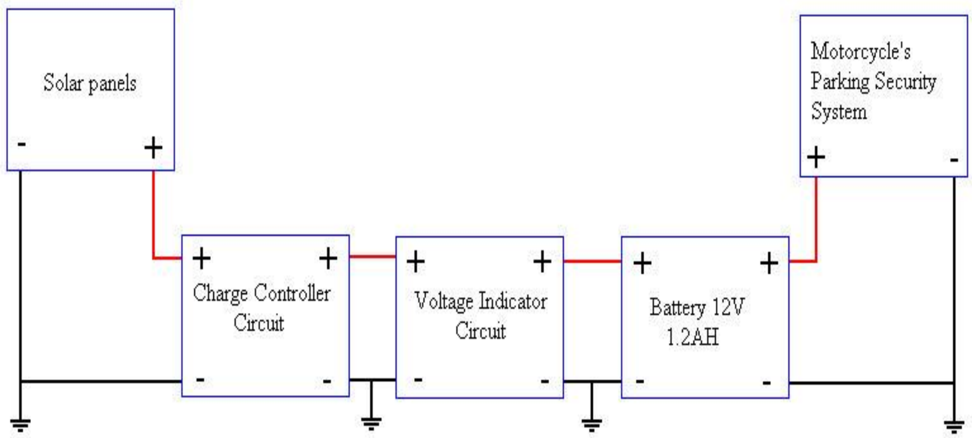

Figure 10: Block diagram of the system

For the project activities, the author gave more concentrating on circuit design and prototype fabrication of the project. These two stages are the most important part in the project methodology. Under the circuit design stage, it was stating with define output of the circuit, then circuit component selection, assemble the circuit component and circuit test and correction. Under the prototype fabrication stage, it was staring with selection of prototype component, construct the prototype and combining circuit and prototype.

3.3 Sizing of the solar panel

To correctly size the solar system, there are a number of factors that will go into the decision and some actual data should be collect to be performed in the calculation. The factors that we need to consider not only from the solar panel specifications but from natural factor as well such as weather or insolation. Insolation is a number of hours in a day that a solar panel will produce its rated voltage or we also can call it "sun hours". For the calculation part, all the data must be taken from the actual value. There are a few methods or procedures of calculation must be followed in order to get the accurate size of solar panel. [14]

Firstly, estimate the total power usage (wattage) of the appliances. All the electrical appliances that need to be supply by solar power had been listed and how many watts each consume also calculated. Secondly, daily watt-hour requirement had been calculate. In this procedure, we estimate how many hours we expect to use each appliance each day. Multiply each appliance's wattage by its estimated daily hours' usage to calculate the daily Watt-hour requirement for that appliance. Add up the daily Watt-hour requirements of all appliances to determine the total daily Watt-hour requirement. Thirdly, we calculate the minimum wattage of the solar panel. We took the total daily Watt-hour requirement you calculated in second procedure, and divide by the number of hours of usable light we expect in an average day. Lastly, we calculated the battery size. Battery capacity is measured in Amp-hours (Ahrs). To calculate how large a battery we need, take the total daily Watt-hour requirement calculated in second procedure and divide this by the battery voltage (12V or 24V) to convert back to Amp-hours.

All the calculation must be done after we finished with the data reduction and all the data that cannot be considering for the calculation can be ignored to avoid the confusion and complication in the calculation.

3.4 Sample of calculations

Sizing Solar Panel System

- In sizing the solar panel size, firstly listed how many appliance that intend to power from solar system and how many watt each consumes. From the discussion, only one controller need to power from the solar system. In the ETP final report state that:

  Power Supply = 12V

  Coil Resistance = 320Ω

  Relay Coil Current = Supply Voltage ÷Coil Resistance

  I = 12V ÷320Ω

  I = 37.5mA

  So, Power (Watt) = Supply Voltage (V) × Relay Coil Current (I)

  = 12V × 37.5mA

  = **0.45Watt (Watt consume by controller)**

  But, allow for the normal energy losses and inefficiencies in a solar electric system, increasing the number of Watt that calculated above by 30%

  (30% × 0.45Watt) + 0.45Watt = 0.585Watt

  So, now we can look for a solar panel that can power 0.585Watt controller.

- Then, estimate how many hours expected to use the controller each day. Multiply controller wattage by its estimated daily hours' usage to calculate the daily Watt-hour requirement for that controller. Add up the daily Watt-hour requirements of all the appliances to determine total daily Watt-hour requirement. Here, we don't need to add up the daily Watt-hour because we used only one controller.

We want to use the controller for 8 hours per day. So,

Controller Wattage (Watt) × Estimated Daily Hours (hour) = Daily Watt-hour
0.585Watt × 8hours = 4.68Watt-hour
Total Watt-hour = 4.68Watt-hour

- The wattage of solar panel could be calculate by taking the total Watt-hour requirement in calculation above and divide by the number of hours of usable light in an average day (8 hours).This will give the minimum wattage of solar panel.

Total Watt-hour ÷ number of hours of usable light in an average day = Wattage of solar panel
4.68 Watt-hour ÷ 8 hours = 0.585 Watt

- The next calculation is to know the size of battery. Battery capacity is measured in Amp-hour. Usually battery voltage that we used is 12V.To calculate how large battery required, take the total daily Watt-hour requirement and divide it by battery voltage to convert back to Amp-hour.

Total Watt-hour ÷ Voltage Battery = Battery Capacity
4.68 Watt-hour ÷ 12V = 0.39 Amp-hour.

3.5 Finding the equipment

After all the gathering data for problem determination had been done, all the equipment that is required in this project need to be finding as soon as possible. The specifications of the equipments are collected and the locations where we can get the equipments need to be searching by using the internet. All the problems during the finding equipment process are recorded.

3.6 Define output of the circuit

Before start the designing process, we defined the output of the circuit. Solar charge controller, its function is to regulate the power flowing from a photovoltaic panel into a rechargeable battery. It features easy setup with one potentiometer for the float voltage adjustment, an equalize function for periodic overcharging, and automatic temperature compensation for better battery charging over a wide range of temperatures. The solar charge controller is able to handle reverse polarity connection of both the battery and photovoltaic panel.

The design goals of this circuit were efficiency, simplicity, reliability and the use of field replaceable parts. A medium power solar system can be built with the solar charge controller, a 12V (nominal) solar panel that is rated from 100 milliamps to 20 amps, and a lead acid or other rechargeable battery that is rated from 500 milliamp hours to 400 amp hours of capacity.

It is important to match the solar panel's current rating to the battery's amp-hour rating (C). A typical maximum battery charging current is C/20, so a 100 amp hour battery should have a solar panel rating of no greater than 5 amps. It is advisable to check the battery manufacturer's data sheets to find the maximum charge current. On the other hand, if the solar panel output current is too low, the battery may take too long to charge.

3.6.1 Circuit component selection

The circuit component selection has been made after the circuits completely design. The right selection of the components will guarantee the circuit would be function properly. From the solar charge controller circuit diagram, we are using all types of electronic components, including:

- Resistors
- Capacitors
- Inductors, Connectors, and Interconnection Devices Switches, Relays
- Wire and Cable
- Integrated Circuits.

3.6.2 Assemble the circuit component

After the circuit component selection is completed, electronic components must be attached to form a functional printed circuit assembly. The connection of the circuit based on the circuit diagram.

3.6.3 Circuit testing and correction

After the board has been populated it may be tested in a variety of ways:

- While the power is off, analog signature analysis, power-off testing.
- While the power is on, in-circuit tests, where physical measurements (i.e. voltage, frequency) can be done.
- While the power is on, functional test, just checking if the circuit board assembly does what it had been designed for.

If there is some errors are detected, the correction of the circuit had been made in order to get the expected result. The error occurred because of the wiring connection, short circuit, wrong polarity of the component on the circuit board, the components is damaged and etc.

3.7 Prototype fabrication

There are three parts under the prototype fabrication stage which are:

- Selection of prototype component
- Construct the prototype
- Combining circuit and prototype

3.7.1 Selection of prototype component

The selection of the prototype component after the designation of the overall system is complete. For this project, the components of the prototype are solar panel, charge controller, battery, wires and cables. All of these components playing important role in the solar system in order to fabricate the solar system to the motorcycle's parking security system.

3.7.2 Construct the prototype/ Combining circuit and prototype

For the constructing process, the prototype will be constructing according to the designation of the project. The diagram of the system and design of the stand/base for the solar system would be the reference in order to construct the prototype. The complete circuit will be combining together with the prototype to form one complete prototype.

3.8 Tools or hardwares/software required

The tools required are:

- simulation software (Pspice)
- solar panel
- battery
- charge controller circuit

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Solar panel testing

Testing the panels is a straightforward process. In order to test the panels we need to have at least one voltmeter and ammeter and a good sunny day. One way to test the panels is as follows. This method is testing the panel without any loading. This means that the panels are not connected to anything.

1. Take the solar panel out into the sunlight.
2. Aim the panel such that it is perpendicular to the sun.
3. Using the volt meter on the leads from the panel

    - Measure the panel voltage
    - Switch the Volt meter to current and check the current

4. Power is calculated by multiplying the current by the voltage

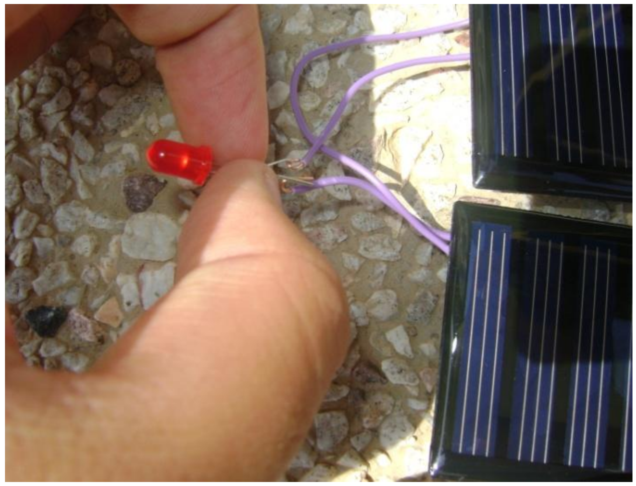

Figure 11: Testing solar panel using LED

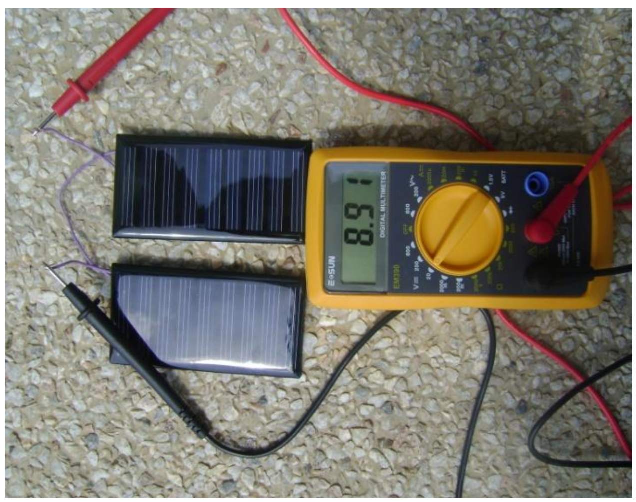

Figure 12: Testing solar panel using multimeter (cloudy day)

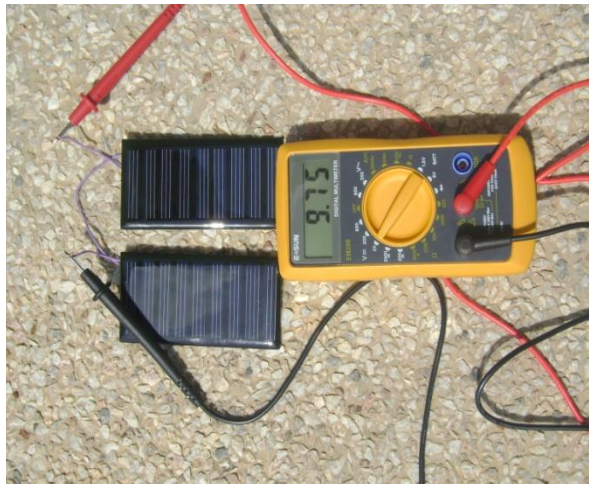

Figure 13: Testing solar panel using multimeter (Sunny day)

From the result of in the figures above, there is the different of value display on multimeter screen. The value actually is the value of voltage produced by solar panel. The value during the cloudy day is less than the value during the sunny day. From the testing we can conclude that the electrical energy that is generated from solar panel not a stable in voltage and current.

4.2 Charge controller circuit design

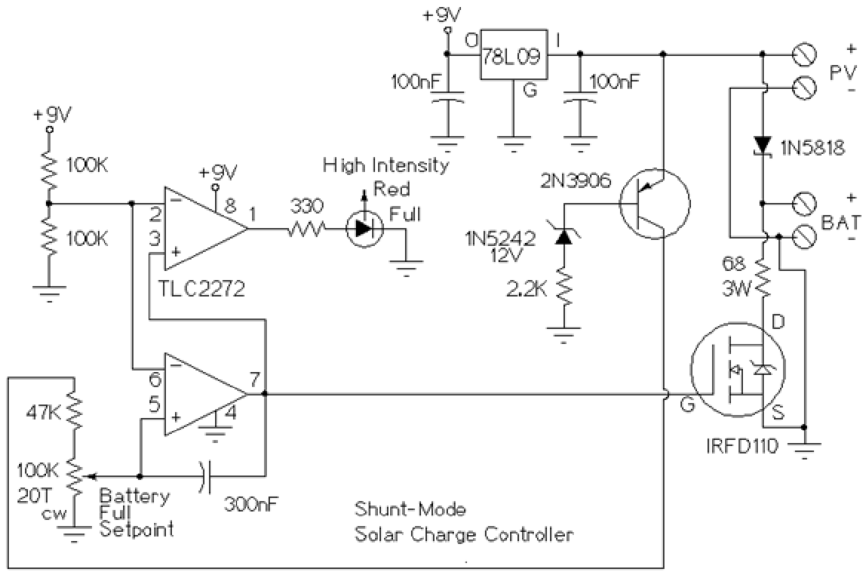

Figure 14: Charge controller circuit [15]

This circuit is for a shunt-mode charge controller. In a shunt-mode circuit, the solar panel is permanently connected to the battery via a series diode. When the solar panel charges the battery up to the desired full voltage, the shunt circuit connects a resistive load across the battery to absorb the excess power from the solar panel. The main advantage of shunt-mode solar regulation is the lack of a switching transistor in the power path between the solar panel and battery. Switching transistors are non-perfect devices, they waste a percentage of available solar power as heat. Inefficiency in the shunt-mode controller's switching transistor does not affect charging efficiency, it only turns on when excess power is purposely being wasted.[15]

Solar power is routed from the PV panel through the 1N5818 Schottky diode to the battery. When the battery reaches the full setpoint, the output on the lower half of the TLC2272 dual op-amp turns on. This activates the IRFD110 MOSFET transistor and connects the 68 ohm 3W load resistor to the battery. The load across the battery causes the battery voltage to drop, and the comparator circuit turns back off. This oscillation continues while solar power is available. The 300nF capacitor across the op-amp slows the oscillation frequency down to a few hertz. The two 100K resistors in series provide a regulated 4.5V reference point for use as comparator reference points.[15]

The 2N3906 transistor is wired with a zener diode in its base circuit, when the PV voltage is above 12V, the 2N3906 transistor turns on and enables the comparator circuit. The upper half of the TLC2272 op-amp inverts the dump load control signal, this is used to power the high intensity red LED. The LED turns on when the battery reaches the full setpoint. The LED does not waste any useful charging power since it only turns on when the battery is full. Before start the constructing the circuit, the simulation of the circuit have been done by using Pspice. The figure below shows the simulation results.

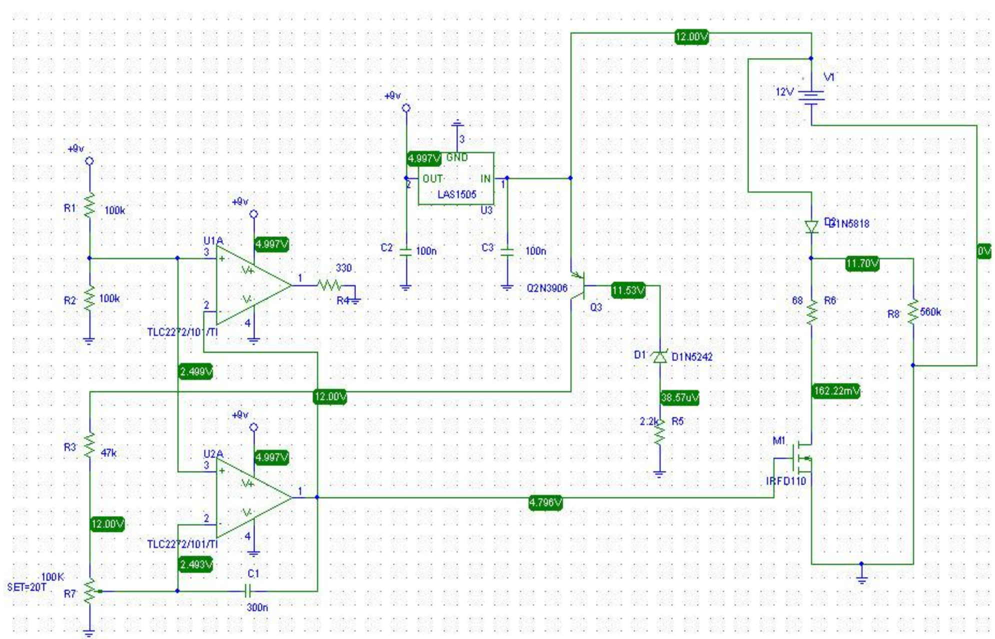

Figure 15: Simulation result shows voltage output

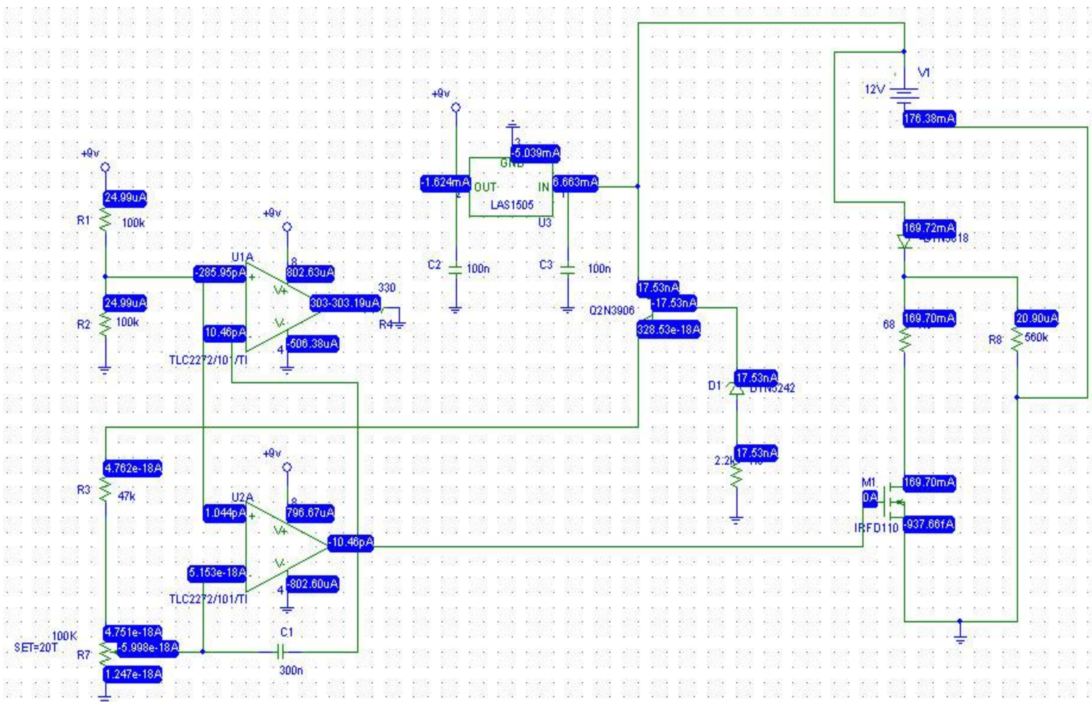

Figure 16: Simulation result shows current output

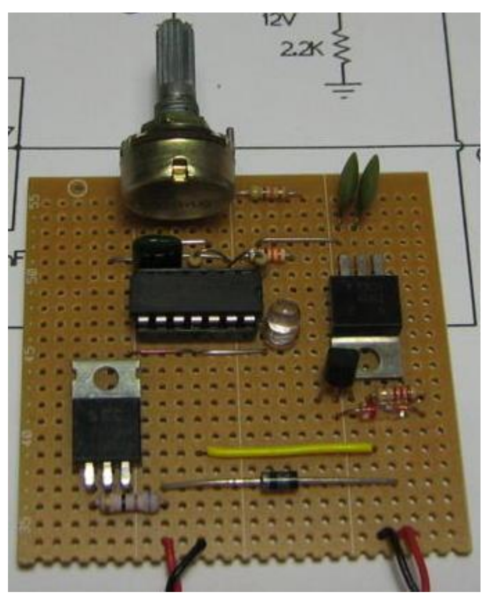

Figure 17: Charge controller circuit

4.3 Battery voltage indicator circuit design

The objective of this circuit is to design and build a battery tester that is able to test various types of dry cell and rechargeable battery with a voltage of 3V to 12V. The LM3914 IC senses the voltage levels of the battery under test and drives the 10 LEDs to ON or OFF based on the voltage that is detected. The current driving the LEDs is regulated by using the external resistor R2 and hence limiting resistors are not required. The schematic shows the simple connections where the reference voltage at pin 8 can be adjusted by adjusting the variable resistor VR1. The voltage at pin 8 will set the maximum scale of the LED.

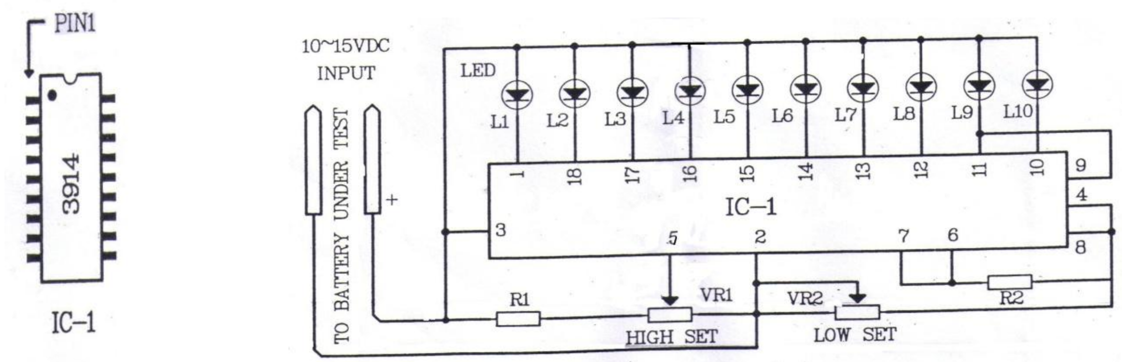

Figure 18: Voltage indicator circuit diagram

4.3.1 Implementing of the circuit

Components	Description
R1	3.9K
R2	1.2K
IC-1	LM3914
VR1	10K (PRESET POTENTIOMETER)
VR2	10K (PRESET POTENTIOMETER)
L1	Indicate 3V (value of battery voltage)
L10	Indicate 12V (value of battery voltage)

Table 1: Components and description

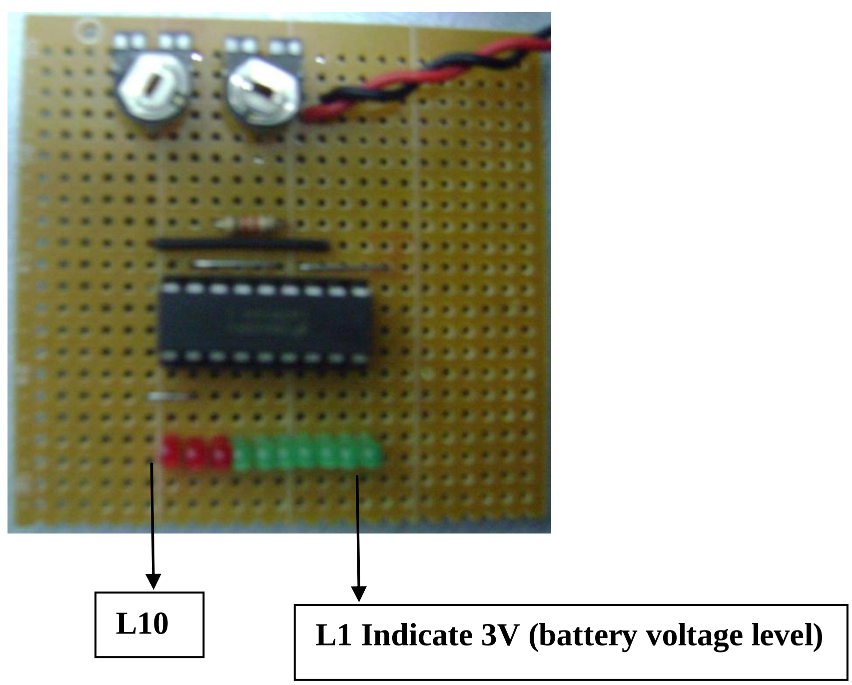

Figure 19: Circuit components

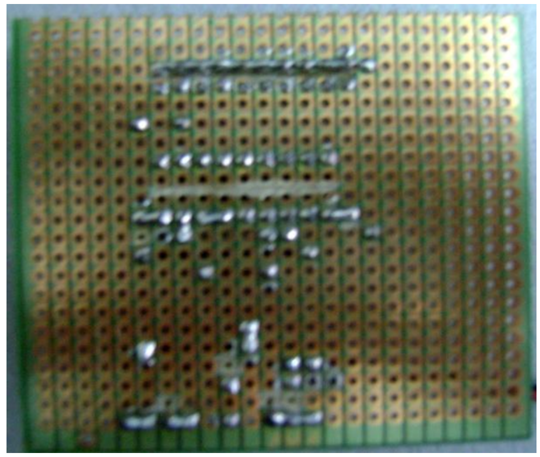

Figure 20: Soldering circuit

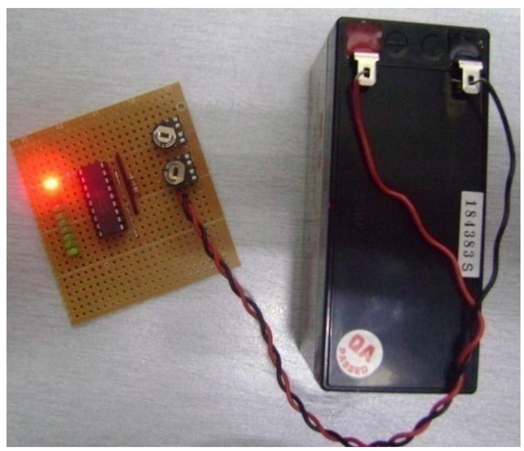

Figure 21: Testing of the circuit using 12V battery

Figure 22: Testing of the circuit using 9V battery

The scale of the LED starting from L1 up to L10.The L1 will indicate 3V and the remaining LED will indicate the higher value and the maximum value will indicated by L10 which is 12V. Figure 20 shows the value of the battery is 3V.

4.4 Tracker design

The geometry of the tracker was created in order to allow the solar panels to absorb light efficiently. This was done by allowing rotation in the east-west direction for tracking the sun daily. This tracker was designed to be placed on a ground. The platform designed for the placement of the collecting solar panels was placed so that the panels would be aligned with it the rotational axis. Materials selection for the tracker was simple. The woods used to construct the tracker. In my selection of solar panels, size and power needed to be balanced effectively. The panels were to be as small as possible in order to add minimal stress and weight to the tracker but also needed to be powerful enough to power or charge the battery. Therefore, the most powerful of the intermediate sized panels available were selected. The panels purchased also appeared to be the most reliable of our options.

4.4.1 Detailed design

From the top view, we can observe the platform of the tracker. The platform are using for placing the solar panels in the system. Width for the tracker is 21.5 cm and length is 29.5cm as shown in the Figure 22.

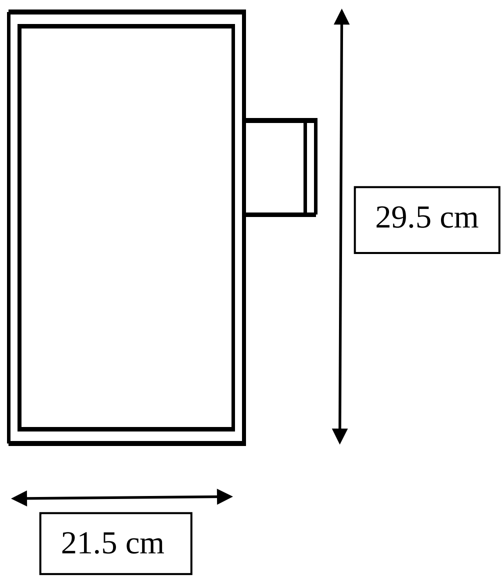

Figure 23: Top view

The front view and right view will specify the composition of the different facades of the tracker. These are drawn to scale so that measurements can be taken for any aspect necessary. Height of the tracker is 45 cm as shown in the Figure 24.

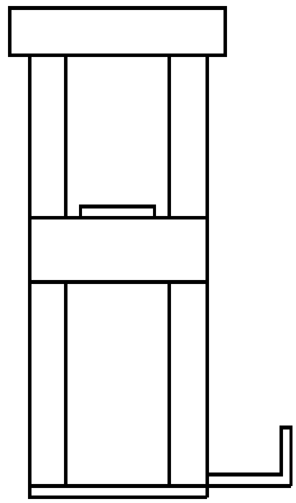

Figure 24: Front view

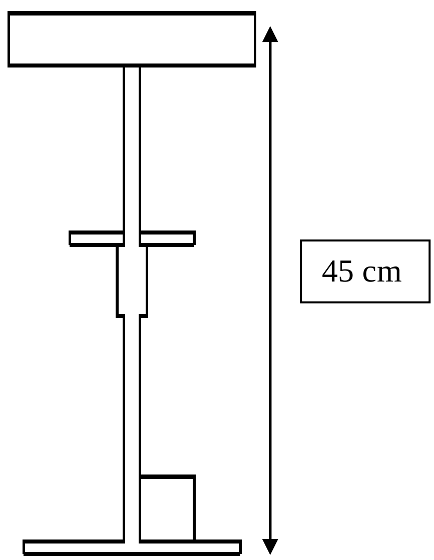

Figure 25: Right view

Isometric projection is a method of visually representing three-dimensional objects in two dimensions, in which the three coordinate axes appear equally foreshortened and the angles between any two of them are 120 degrees. An isometric view of an object can be obtained by choosing the viewing direction in a way that the angles between the projection of the *x*, *y*, and *z* axes are all the same, or 120°. Another way in which isometric projection can be visualized is by starting in an upper corner and looking towards the opposite, lower corner.

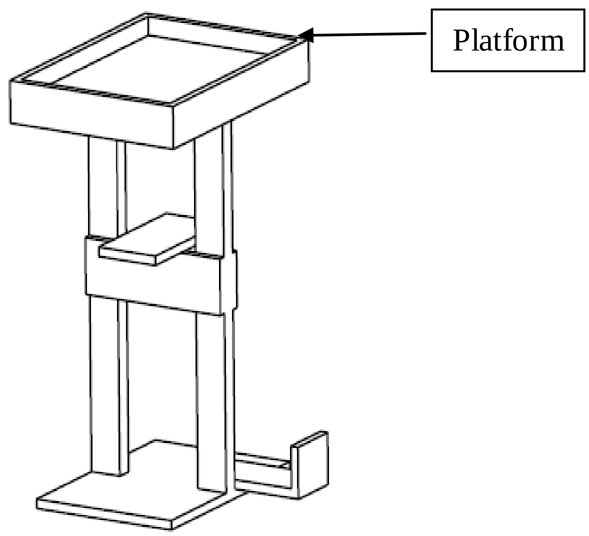

Figure 26: Isometric view

Figure 27: Tracker

The tracker is easily adjusted in order to get the maximum sun light. This design we call Northern or Southern Hemisphere designation. This is because it can be adjust 120 degrees of East/West rotation around North/South axis. The installation Elevation Adjustment Bolt on this design is for this purpose.

4.5 DC motor reversing

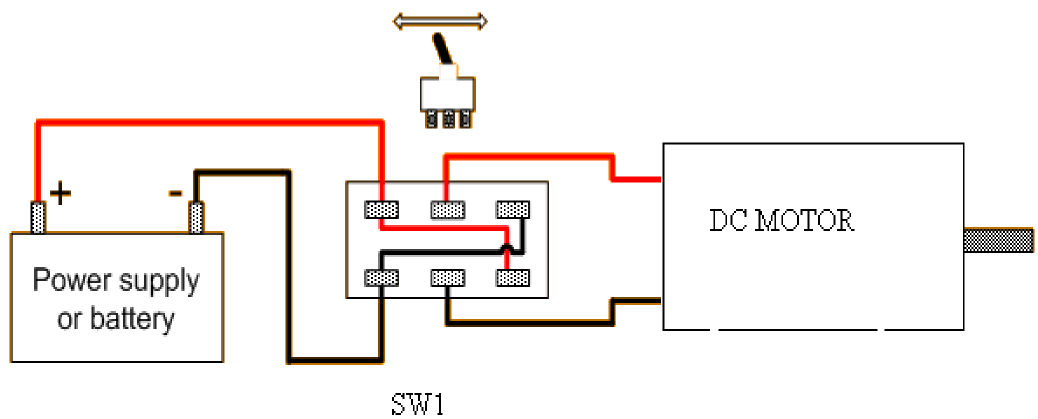

Figure 28: DC motor reversing connection

DC motor reversing can be achieved with the use of a simple changeover switch, and when wired as shown in Figure 28, does exactly what it says, it changes over the polarity of the voltage when operated therefore changing the direction of the motor. As DC motors can draw lots more current under loaded conditions, it's a good idea to ensure the DC Amps rating of your switch can handle the required loaded current of the motor. Figure 28 shows a typical hook-up with the changeover switch shown as SW1, the switch has six connections and when wired as shown the motor will change direction when the switch is operated. This simple solution may be enhanced by using a 3 position double pole changeover switch. This will then give FORWARD, REVERSE and OFF control without any additional wiring. When DC Amperage exceeds 8 to 10 Amps it is often no longer practical to use a simple switch.

This part will represent the motorcycle's parking security system. The rotation of the motor will represent lock and unlock. The FORWARD rotation will shows lock and REVERSE rotation will shows unlock.

CHAPTER 5
CONCLUSSION AND RECOMMENDATION

5.1 Conclusion

As a conclusion, the project is found to be successful although there are some difficulties need to overcome. Most of the work done is follow the time frame. The project fulfils the three out of for objectives where:

- Tracker is successfully designed with maximum efficiency modification
- Charge controller circuit for the system is well design and implement on veroboard
- Implemented voltage indicator circuit to test the voltage 12V battery

All the information on the subject of the project are provided in report are well organized. The system is well designed and the data has calculated precisely to get the desired outcome.

5.2 Future Work

In the future, a more detailed model of the photovoltaic module can be developed from the one presented in this work. The more detailed model may take into account the effect of shading or partial shadows on the operation of the module. Also the effects of scaling up the photovoltaic sources may be investigated to determine the suitability for large scale deployment.

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APPENDICES

APPENDIX A
FYP I PROJECT MILESTONE

No. Detail/ Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Selection of Project Topic	■													
-Propose Topic														
-Topic assigned to students														
2 Preliminary Research Work		■	■											
-Introduction -Objective -List of references/literature														
-Project planning														
3 Submission of Preliminary Report				●										
4 Project Work				■	■	■	■							
-Reference/Literature														
-Practical/Laboratory Work														
5 Submission of Progress Report								●						
6 Project work continue -Practical/Laboratory Work								■	■	■	■			
7 Submission of Interim Report Final Draft												●		
8 Submission of Interim Report														●
9 Oral Presentation														●

APPENDIX B
FYP II PROJECT MILESTONE

No.	Detail/ Week	1	2	3	4	5	6	7	8	9		10	11	12	13	14
1	Project Work Continue	■	■	■	■	■	■	■								
2	Submission of Progress Report								●							
3	Seminar									■		■	■			
4	Project work continue								■	■	Mid - Semester Break	■	■			
5	Poster Exhibition											●				
6	Submission of Dissertation (soft bound)															●
7	Oral Presentation															●
8	Submission of Project Dissertation (Hard Bound)															●

Indication:

●	Suggested milestone
■	Process