DEVELOPMENT OF SOLAR BATTERY INDICATOR

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ABSTRACT

The objective of this project is to create or design the solar battery indicator to monitor the percentage capacity of the battery. The purpose of the use solar energy in this project is to replace the existing energy by use the solar energy to charge the battery using the charging circuit and to improve the solar energy to a new application. This project design is separated into two basic parts which are the charging circuit which is solar charging circuit and the solar battery indicator circuit. The main task of charging circuit use in this project is to charge and store the sun energy from solar panel into the battery. The battery use in this project is 12V 7A lead-acid battery which is fit for storing the energy from the solar panel. The solar battery indicator circuit using as the load for the 12V 7A lead-acid battery. Main task of this circuit is to check the capacity of the battery when the battery is charging and when the battery is use. The circuit will display the percentage of the voltage capacity in the battery by using the seven-segment display and the range of the voltage charge and discharge will use LED as monitoring display.

ABSTRAK

Objektif projek ini adalah untuk membina pemapar bateri solar untuk memapar peratusan kapasiti sesebuah bateri. Tujuan penggunaan tenaga suria ini adalah untuk menggantikan tenaga yang sedia ada bagi mengecas bateri disamping menggunakan litar pengecas dan menambah baik penggunaan tenaga suria untuk kegunaan aplikasi baru. Projek ini dapat dibahagikan kepada dua bahagian dimana bahagian pertama ialah pengecas suria manakala bahagian kedua meliputi litar pemapar. Tugas utama litar pengecas dalam projek ini adalah untuk mengecas dan menyimpan tenaga daripada tenaga suria melalui panel suria kedalam bateri. Bateri yang digunakan dalam projek ini adalah 12 V 7A bateri asid sulfurik yang mana telah disesuaikan untuk menyimpan tenaga daripada panel suria. Litar pemapar bateri akan digunakan sebagai beban untuk bateri ini. Tugas utama litar pemapar ini adalah untuk menyemak kapasiti bateri semasa bateri dicas dan dinyahcas. Litar ini akan memaparkan peratusan voltan yang terdapat dalam bateri dengan menggunakan pemapar seven-segmen dan julat semasa bateri dicas dan dinyahcas akan dipaparkan melalui LED.

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LIST OF SYMBOLS

A	-	Ampere
Ah	-	Ampere per hours
R	-	Resistor
kWh	-	kilowatts per hours
W	-	Watts
m^2	-	meter square
m	-	mili
V	-	Voltage
u	-	mikro
F	-	Farad

LIST OF ABBREVIATION

DC	-	Direct Current
PWM	-	Pulse Width Modulation
IC	-	Integrated Circuit
AC	-	Alternating Current
Ni-Cd	-	Nickel-Cadmium
DP	-	Decimal Point
Q	-	Transistor
LED	-	Light Emitting Diode
BCD	-	Binary Code Decimal
SC	-	Short Circuit
PV	-	Photo Voltaic

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CHAPTER 1

INTRODUCTION

1.1 Overview

Solar energy is the light and radiant heat from the Sun that influence Earth's climate and weather sustains life. Solar power is synonym to solar energy or more specifically to refer the electricity generated from solar radiation. Solar energy technologies can provide electrical generation by heat engine or photovoltaic means; space heating and cooling in active and passive solar buildings, day lighting, hot water, thermal energy for cooking, and high temperature process heat for industrial purposes. Since this technology is still new in Malaysia, so the using of solar as electric source is limited. So, in this case, solar energy is use to replace the existing power supply because solar energy is the renewable energy and can minimize the pollution to the earth.

This project is use the solar energy as the main supply and applies the existing solar energy to a new application. To supply the required voltage to the battery

indicator, a voltage regulator needed to reduce the voltage from the solar panel which is up to 20 VDC depend on the sunlight energy to 5 VDC. The first step to start this project is to make a research and thorough analysis about the panel solar that will be used for this project. After obtaining the data needed, a charger circuit must be design to charge the battery. This will ensure that the charger which will be charge the battery are functioning and will be able to supply the battery indicator circuits which have function as a load. Besides that, the battery indicator needs to be design as the monitor to the battery capacity. This battery indicator will use seven – segment and light emitting diode (LED) as the display.

1.2 Objective

The aim of this project is to design or invent the solar battery indicator which uses the solar energy using solar cell to produce the electric energy. On the other hand, this project wants to implement the renewable energy to replace the permanent energy such as oil or charcoal. The objective of this project is to:

i. To use a renewable energy in order to replace the existing supply.

ii. To charge and stored solar energy in the battery using the charging circuit.

iii. To design the battery indicator to monitor the percentage capacity of the battery.

1.3 Scope of Project

These projects obviously focus on hardware implementation. This project is divided into two parts of hardware implementation which are solar charger circuit and the battery indicator circuit. Several scopes need to be proposed in these projects which are:

i. Solar panel will produce up to 20V DC from sun energy depend on sunlight.

ii. The output from the solar panel will use to give supply to the battery 12V DC 7Ah by using the charger circuit.

iii. Voltage regulator will reduce the voltage from battery which is from 12V DC 7Ah to 5V DC to the battery indicator.

iv. Battery indicator will use seven – segment and LED as monitoring display.

v. Charged battery will use when the solar supply cannot operate.

1.4 Problem Statement

Nowadays, there are many type of energy that can be used as a power supply by using the equipment that can convert it to into electricity. Solar energy is the renewable energy that not be commercialize as a supply than other energy such as hydro energy and charcoal energy and not many appliances use this solar energy. So this project main objective is to use the solar energy as main supply and implement it to other electrical appliances. On the other hand, the battery use cannot display the percentage of the capacity of the battery when it in use or charge. Hopefully, this battery monitoring circuit will overcome the problem by display the capacity of the voltage by using the percentage of use and discharged of the battery.

1.4 Thesis Organization

Including this chapter, it consist of 5 chapter altogether. Chapter 1 is contained full description of the project, chapter 2 is article review, chapter 3 consists of the project methodology, mostly about the project flow and how it's organized. Chapter 4 presents the expected result, while the conclusion in chapter 5.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A review of the article was performed to identify studies that relevant to the topic. A combination of the following keywords was used to identify relevant material. In this chapter, the researcher reviews article and past research about the component and device used to make this project a reality. Literature review has been made from various sources like journals, books, articles and others. A study about this project had being identified which are solar battery indicator which is integrated with the solar panel to produces power supply from sun energy, voltage regulator to give the suitable voltage to the solar battery indicator, solar charger to charge the battery, suitable battery specification use for this project and seven-segment and LED display to monitoring the capacity of the battery.

2.2 Solar Energy

A solar cell or photovoltaic cell is a device that converts sunlight directly into electricity by the photovoltaic effect. Photovoltaic are the field of technology and research related to the application of solar cells in producing electricity for practical use [1] means that the electric energy can be produce by the solar energy by using the solar panel and output energy from solar panel can be used for the domestic use. Solar power technologies provide electrical generation by means of heat engines or photovoltaic [2] that means the solar energy can provide the electric energy by using the suitable technology to convert the sun energy to the electric energy. Solar panel which is also known as photovoltaic is a device that is capable to converting at least a portion of solar light incident thereon into electrical energy [3]. It means that solar energy can convert its energy into the electric energy which we need to use solar energy as main supply to the project. The wind and solar power constitute the primary power generation system and diesel generators act as backup.

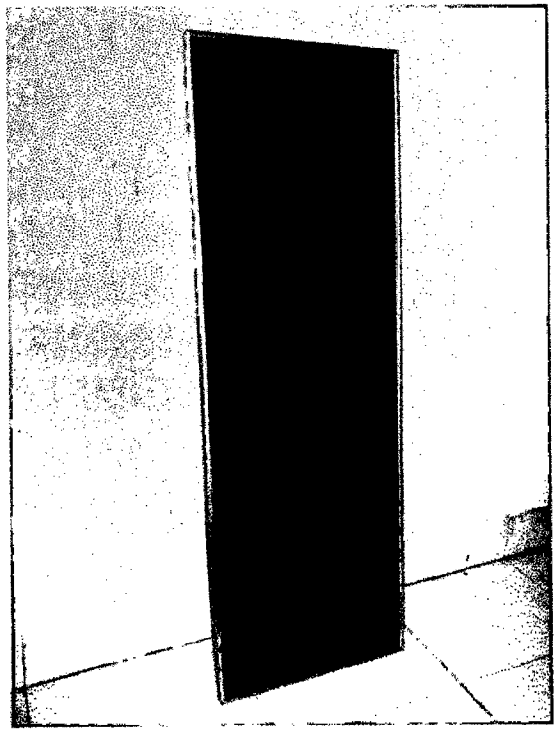

Figure 2.1: Solar Panel

Model	Sunmodule SW80 mono/RSE
Rated Max. Power, Pmax(W)	80(±5%)
Open Circuit Voltage, Vsc(V)	21.9
Rated Voltage, Vrated(V)	17.5
Short Circuit Current, Isc(A)	5
Rated Current, Irated(A)	4.58
Maximum System Voltage, (V)	715AC

Table 2.0: Solar Panel Specification

2.3 Voltage Regulator

Voltage regulator which is has a function to fix the output voltage in certain value will play important role. It includes a capacitor to provide a regulated voltage and a regulation circuit for closing the regulation switch when the regulated voltage is below reference voltage [4]. This is because every appliance must get stable voltage to operate. In this case, a voltage regulator needs to be design in case to get appropriate value of voltage. Voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. Depending on the design, it may be used to regulate one or more AC or DC voltages [5] means that the main function of the regulator is to give the maintain voltage and it convert the AC or DC voltage according to the system design of the regulator.

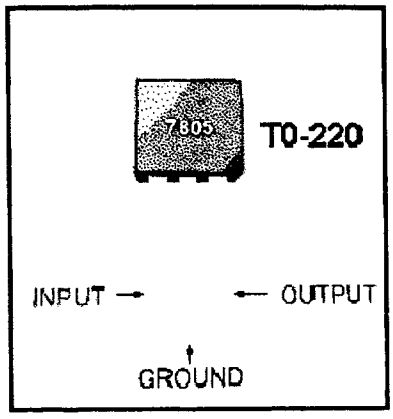

Figure 2.2: Voltage Regulator

2.4 Solar Charger

A solar charger employs solar energy. They are generally portable. Solar chargers are also used for charging of lead acid or Ni-Cd battery bank up to 48 V & hundreds Ampere-Hours (up to 400Ah) capacity. For such type of solar chargers, generally intelligent charge controllers are used. A series of solar cell array plates are installed separately on roof top of buildings & can be connected to battery bank through intelligent charge controllers. As solar chargers are good source of green energy, such arrangement can also be used in addition to mains supply chargers for energy saving during day times [6].

2.5 Lead-Acid Battery

Knowledge of the charge efficiency of lead-acid batteries near top-of-charge is important to the design of small photovoltaic systems. In order to know how much energy is required from the photovoltaic array in order to accomplish the task of meeting

load, including periodic full battery charge, a detailed knowledge of the battery charging efficiency as a function of state of charge is required, particularly in the high state-of-charge regime, as photovoltaic systems are typically designed to operate in the upper 20 to 30% of battery state-of-charge [7]. It means we have to know the energy produce by the solar panel to ensure the lead/acid battery is charge.

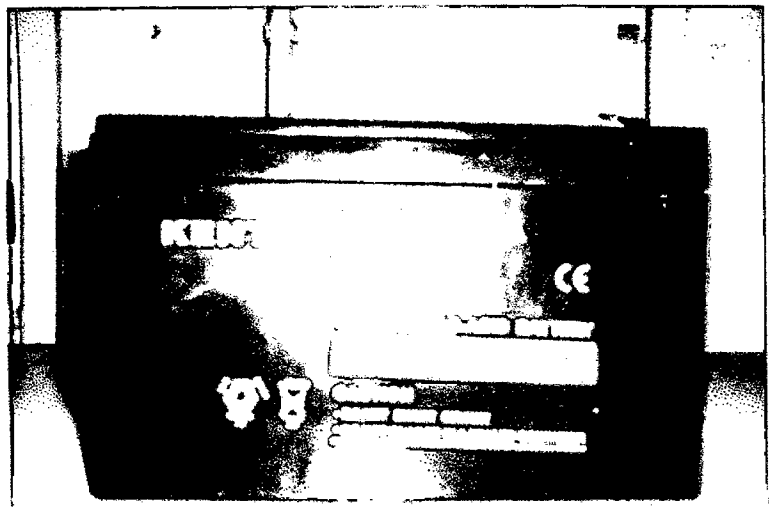

Figure 2.3: Lead-acid battery

2.6 Seven-segment

A seven segment display, as its name indicates, is composed of seven elements. The seven segments are arranged as a rectangle of two vertical segments on each side with one horizontal segment on the top and bottom. Additionally, the seventh segment bisects the rectangle horizontally [8]. There are 2 type of seven-segment which are common anode which is the supply from the positive supply and seven-segment connected to negative supply is called common cathode. The segments of a 7-segment display are referred to by the letters A to G, where the optional DP decimal point is used for the display of non-integer numbers.

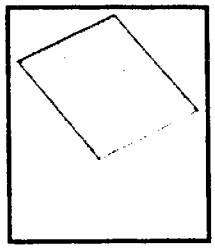

Figure 2.4: Seven-Segment Displays

2.7 Types of Charger

There are various types of battery chargers like mobile battery charger, car battery charger and etc. The duty of all the chargers is the same, that is, to basically charge a battery. With many types of chargers out in the market, it is essential to find out which would suit ones' requirement and necessity, so that the chargers can be of maximum use to the user.

2.7.1 Switch Mode Regulator

Also called as a Switcher, these regulators use the modulation of pulse width for controlling the voltage. The power wastage is also comparatively less in this type of charging. The size of the whole component can be reduced with the help of using high switch frequency [9].

2.7.2 Series Regulator or Linear Regulator

This type of charging is less complex but the power wastage is more here. Here the load current moves through the regulating transistor, which is usually a device of high power. Due to the unavailability of switching, the current produced is pure DC type and so there is no need of an output filter. It is very suitable for low noise producing devices [9].

2.7.3 Shunt Regulators

They are common photo-voltaic systems as they are quite inexpensive to build and easy to design. This type of charging does not allow over-charging, as the PV output is shunted when the voltage reaches the correct level, and hence the name [9].

2.7.4 Buck Regulator

This is a switching type of charger that uses a step-down DC-DC converter. Here the heat loss is very less and the efficiency is also very high. Also these types of chargers can handle high current-outputs [9].

2.7.5 Pulse Charging

These types of chargers make use of a series transistor, which has the facility of being switched as well. Part of the cycle it acts as a switch regulator and so less wastage of power and heat is maintained. When the charger is at rest, the polarization is reduced as well. These types of chargers require current limiting in its input sources, for safety features and reasons.