SOLAR ENERGY MONITORING SYSTEM

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ABSTRACT

Solar energy is energy from the sun. This energy drives the climate and weather and supports virtually all life on Earth. Heat and light from sun, along with solar based resources such as wind and wave power, hydroelectricity and biomass, account for most the available flow of renewable energy. Solar power is becoming increasingly popular, as environment friendly renewable energy source that produces no pollution, requires minimal maintenance and energy from the sun is free. There many technologies for solar energy application through the residential, commercial, industrial, agricultural, and transportation sectors. The solar energy wide variety of technologies is flexibility. One types of Solar Energy system is Solar Photovoltaic Power. Photovoltaic Standalone system, Photovoltaic Hybrid system, Photovoltaic Grid Tie system is types of Solar Photovoltaic Power. Photovoltaic system use cell to convert sunlight into electricity. The PV cells consist of one or two layer of a semi conducting material, usually silicon. When light shines on the cell it creates an electric field across the layers causing electricity flow. So, the greater intensity of the light, the greater electricity flows. PV cells are referred to in terms of the amount of energy they generate in full sunlight; know as kilowatt peak or kWP. This project is to design a Solar Energy Monitoring System. The system use LCD to display as the meter to view that measurement of voltage and current in the system. The design uses a PIC microcontroller (PIC 16F877) as control unit and optimizes the use of feature that exist in PIC microcontroller such as analogue to digital converter (ADC). Then to design a signal conditioning circuit, which is, consist of transducers (voltage sensor and current sensor).

ABSTRAK

Tenaga Suria adalah tenaga dari matahari. Tenaga suria ini dibawa oleh iklim, cuaca dan menyokong segala kehidupan di bumi. Tenaga Haba dan cahaya dari matahari, berserta sumber-sumber semulajadi suria seperti angin dan tenaga gelombang, tenaga hidroelektrik and tenaga biojisim. adalah tenaga yang ada serta boleh diperbaharui. Tenaga Suria adalah tenaga yang sedang meningkat popular, sebagai tenaga sumber mesra alam yang tidak mengeluarkan pencemaran alam, memerlukan penyelengaran yang rendah dan sumber tenaga matahari percuma dan berterusan. Sekarang ini banyak teknologi digunakan untuk Tenaga Suria telah diaplikasi di rumah, komersial, industri, pertanian, dan sektor pengangkutan. Teknologi Tenaga Suria adalah sangat luas and mudah berubah-rubah. Salah satu teknologi sistem suria adalah Tenaga Suria Fotovolta (PV). Suria Fotovolta mempuyai beberape jenis iaitu Sistem Fotovolta berdiri sendiri,Sistem Hibrid Fotovolta dan Sistem Grid Tie Fotovolta. Sistem Fotovolta (PV) adalah menggunakan sel untuk menukarkan cahaya matahari kepada tenaga elektrik. Sel PV mengandungi satu atau dua lapisan bahan semi konduktor yang biasanya seperti silikon. Sinaran cahaya matahari pada permukaan sel akan meghasilkan persilangan lapisan medan elektrik disebabkan oleh pengaliran elektrik. Semakin kuat keamatan cahaya matahari, semakin banyak pengaliran elektrik. Sel PV adalah merujuk kepada jumlah penuh tenaga yang dihasilkan oleh cahaya matahari seperti puncak kilowatt atau kWp. Sistem Pemaparan Tenaga Suria ini telah direka untuk Sistem Fotovolta berdiri sendiri. Sistem ini mengunakan LCD sebagai meter untuk memaparkan pengukuran atau sukatan voltan dan aliran arus elektrik dalam sistem Fotovolta. Sistem ini juga direka menggunakan PIC micro kawalan (PIC 16F877) sebagai unit kawalan dan optimis menggunakan ciri-ciri yang ada di dalam PIC micro kawalan seperti penukaran signal analog kepada signal digital. Selain itu, menghasilkan penyesuaian litar dimana mengandungi sensor (voltan sensor dan arus sensor).

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES

LIST OF FIGURES

LIST OF FIGURES

LIST OF SYMBOLS

F	Farad
G	Giga
Hz	Hertz
M	Mega
p	Piko
V	Volts
VDC	Volts Direct Current
Ω	Ohm

LIST OF ABBREVIATIONS

ADC	Analog to Digital
PC	Personal Computer
BASIC	Beginners All Purpose Symbolic Instruction Code
AC	Alternate Current
DC	Direct Current
DAC	Digital to Analog
EEPROM	Electrically Erasable Programmable Read-Only Memory
I/O	Input Output
LCD	Liquid Crystal Display
PIC	Peripheral Interface Controller
RAM	Random Access Memory

LIST OF APPENDIXES

CHAPTER 1

INTRODUCTION

1.1 Background

The Solar Energy Monitoring System is a system which is developed using sensor and microcontroller technology to display the exact value of solar system. The system is separated into two parts are Solar Photovoltaic System and Solar Energy Monitoring System. This thesis will concentrate more on Solar Energy Monitoring. The sensor circuit is important part at dc and ac side to sense the signal to PIC microcontroller (ADC) and reading the signal by using some command which is programmed into PIC microcontroller. The device has liquid crystal display (LCD) with connect to switches to getting some value parameter programmed in PIC microcontroller by selecting switch.

1.2 Introduction to the Project

The solar energy has many technologies types that can build. Among of that are electricity generation. The electricity generation has three ways are photovoltaic; concentrating solar and experimental solar power. The Photovoltaics (PV) has been mainly developed for small and medium-sized applications, from the calculator

powered by a single solar cell to the PV power planet. The Photovoltaic Power System has three types are Photovoltaic Standalone system, Photovoltaic hybrid system and Photovoltaic Grid Tie system. The Figures 1.1, Figure 1.2 and Figure 1.3 below show the types of Photovoltaic system. But the system use Photovoltaic standalone system because time for implement are faster than a replacement system, the cost is much less expensive to develop, implement and operate. The Figure 1.4 shown

In this project, master device used PIC Microcontroller to interface with the Sensor module. The program for it has been written using PICBASIC language. Microcode Studio is used to write and compile the program while PICkit 2 v2.40 programmer is used to program the PIC16F877.

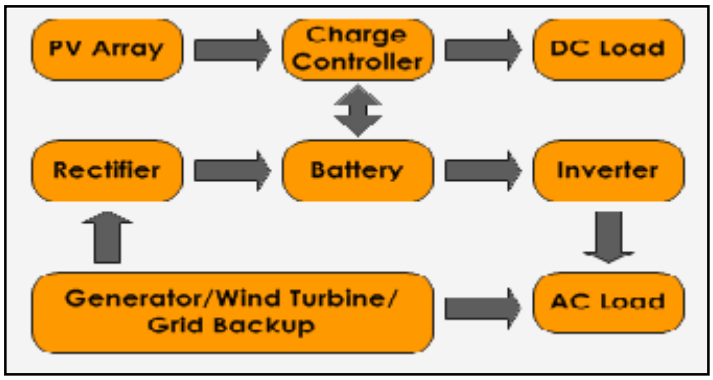

Figure 1.1 Photovoltaic Standalone System

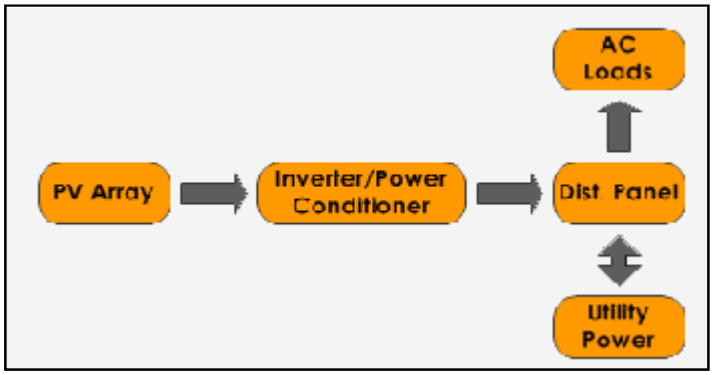

Figure 1.2 Photovoltaic Hybrid Systems

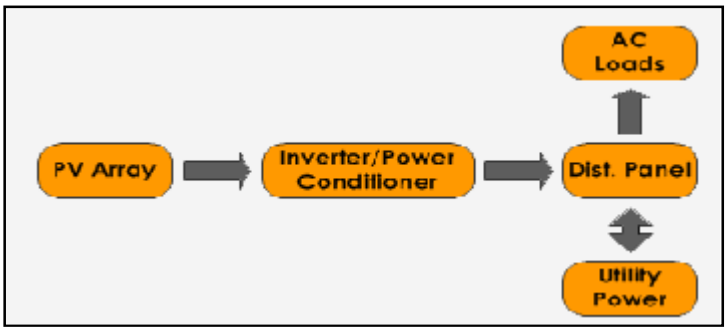

Figure 1.3 Photovoltaic Grid Tie Systems

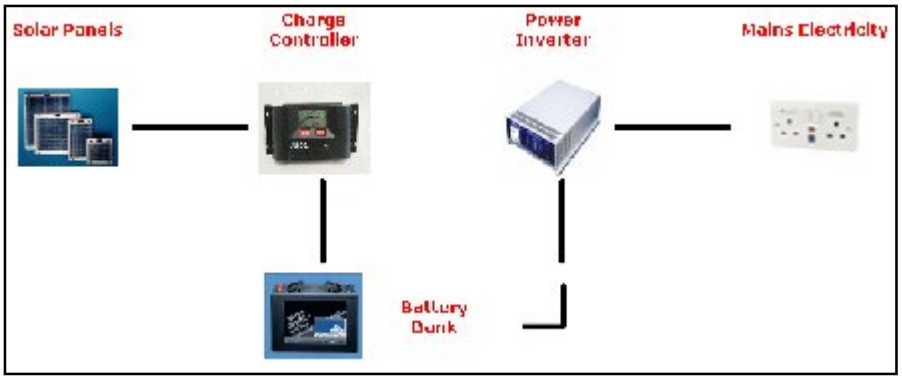

Figure 1.4 Block diagram for Photovoltaic Standalone System

1.3 Problem Statement

Nowadays, solar system are widely use at residential, commercial, agricultural and transportation. The user can use the system but unknown of voltage and current that insert the system use to the loads. The user need to measurement by multimeter to know what value of measurement of the system is suitable to appliances consumer.

So, the Solar Energy Monitoring system is build to make easier to user use the solar system. It cans only just enough to push the buttons to display the value measurement and the LCD will display values of measurement what user are chosen.

1.4 Objectives

The objective of this project is:

(i) To develop Solar Energy Monitoring for photovoltaic standalone system

1.5 Scope of Project

This Solar Energy Monitoring system which is specifically has three scopes.

(i) Design a signal conditioning circuit; this is consisting of transducer (voltage sensor and current sensor). - The signal conditioning circuit is a circuit interface to microcontroller (PIC 16F877) read for obtain suitable value at DC and AC side between 0 to 5 volts using sensor.

(ii) Design a microcontroller PIC16F877 as control unit and optimize the use of feature that exists in microcontroller such as analogue to digital converter (ADC). - The main components such as PIC microcontroller, analog to digital converter (ADC) that have available in PIC16F877, Analogue to Digital (ADC) will convert the exact value from sensor to sense to PIC16F877 betweens 0 to 5 volt.

(iii) Design LCD display as a meter to view measurement of voltage, and current. - The display in this system contains LCD and switches to indicate the value of voltage and current at dc and ac side.

1.6 Thesis Overview

This Solar Energy Monitoring System final thesis is a combination of 6 chapters that contains and elaborates specific topics such as the Introduction, Literature Review, Methodology, Architecture, Result and Analysis, Conclusion and Further Development that can be applied in this project.

Chapter 1: Basically about the introduction of this project.

Chapter 2: Describe about the literature review for the development of the Solar Energy Monitoring System.

Chapter 3: Discuss on the full methodology of this project.

Chapter 4: Discuss about the architecture of the project that consist the hardware design and the software implementation.

Chapter 5: Discuss all the results obtained and the limitation of the project. All discussions are concentrating on the result and performance of the Solar Energy Monitoring System

Chapter 6: Discuss the conclusion and further development of the project.

CHAPTER 2

LITERATURE REVIEW

This chapter reviews about the study that have been done before developed the Solar Energy System. Some of them are about the systems that are look alike this Solar Energy Monitoring System. Other, they are the study about the main components used.

2.1 User Monitoring System

There's another aspect of the Rockies' scoreboard, affectionately referred to as the "Rock pile," that provides valuable information, though of a different variety. The solar panels that power the Rock pile 46 panels in all, rated at just under 10 kW are connected to an Internet-enabled energy metering and monitoring system that shows the fans, in real time, how much power is being produced by the panels and how much pollution has been prevented through the use of this clean, renewable source of energy (Chris Beekhuis, Fat Spaniel Technologies, June 11, 2007)[1]

From the article above published on June 11, 2007 by Chris Beekhuis, Fat Spaniel Technologies, the User Monitoring System is a proposed system to consists are three principal benefits of keeping score for a solar electric power system, the

most glamorous. A user interface linked to a power system-whether it's a solar panel system, small-scale wind or other clean energy source-helps remind energy consumers that their decision to purchase renewable energy is having an immediate and measurable impact.

The second benefit of renewable user energy monitoring services is data collection for service, maintenance and performance tuning. By capturing and storing real-time and historic information about energy production and consumption, system component health, and local environmental variables, an independent, user monitoring service can provide instant, data-rich likes how much power is a system generating and are the components functioning properly, or has there been a failure. Monitoring helps notify system installers and distributed utilities instantly when something goes wrong, enabling quick and easy repair. A well-designed monitoring system can turn renewable energy system performance data into usable information that can be presented on the monitor.

The third benefit offered by independent system monitoring is transparency. The best way to track a system's real energy output to ensure accurate Performance Based Incentive payments, protect ratepayer investments in capacity-based or expected performance-based rebate programs, and to grow vibrant and trusted financial markets for Renewable Energy Credits and Carbon Credits, is through independent metering and monitoring. In fact, a fundamental economic tenet is that markets don't function at all without meaningful, verifiable information that comes from trusted sources. As renewable energy steps up to the plate to tackle the twin problems of energy consumption and global warming, independent metering and monitoring.

2.2 Analog Circuit

Under this analog circuit, most and electronic component will be discussed. It consists of

(i) Solar Photovoltaic
(ii) Power Inverter
(iii) Microcontroller PIC 16F877
(iv) Voltage Transformer
(v) Bridge Rectifier
(vi) Current Sensor

(i) Solar Photovoltaic

Photovoltaic is the direct conversion of light into electricity at the atomic level. Some materials exhibit a property known as the photoelectric effect that causes them to absorb photons of light and release electrons. When this free electrons are captured, electric current results that can be used as electricity. The Figure 2.1 below illustrates the operation of a basic photovoltaic cell, also called a solar cell. Solar cells are made of the same kinds of semiconductor materials, such as silicon, used in the microelectronics industry. For solar cell, a thin semiconductor wafer is specially treated o from an electric field, positive on one side and negative on the other. When light energy strikes the solar cell, electrons are knocked loose from the atoms in the semiconductor materials. If electrical conductor is attached to the positive and negative sides, forming an electrical circuit, the electrons can be captured in the form of electric current.

This electricity can then be used to power a load, such as a light or a tool. A number of solar cells electrically connected to each other and mounted in a support structure or frame is called a photovoltaic module. The current produced is directly dependent on how much light strikes the module. Multiple module can be wired together to form an array. The larger the areas of a module or array give the more electricity that will be produce. Photovoltaic modules and arrays produce direct