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SOLAR FARM POWER DISTRIBUTION

MONITORING SYSTEM

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Bachelor of Electrical Engineering (Power Electronics & Drives)

June 2012

I hereby declared that I have read through this report entitled “*Solar Farm Power Distribution Monitoring System*” and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Power Electronics & Drives)

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**This report is submitted in partial fulfillment of requirements for the degree of
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JUNE 2012

I declare that this report entitle “*Solar Farm Power Distribution Monitoring System*” is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

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Date :

To my beloved mother and father

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ABSTRACT

Solar power is becoming increasingly popular, as environment friendly renewable energy source that produces no pollution, requires minimal maintenance and one of the famous energy source because of it free. The output solar power is non-linear and changes with solar irradiation depend on other factors as well such as the location, time and weather condition. A problem that appears is their output which is intermittent and parameter monitoring system is required. So, the solar farm power distribution monitoring system is developed to make easier to user to display the performance of power distribution parameters on computer. An effective and efficient monitoring solar system is the most important aspect in order to ensure their implementation will going smoothly and not be affected because of the failure system. This project presents a system that can monitor power distribution voltage and current waveforms using data acquisition (DAQ). Therefore, DAQ is used to sample voltage and current signals. To make it user-friendly, a user interface has been developed using the Visual Basic 2010 and display parameters of measurement from power distribution such as voltage (rms), current (rms), frequency, real power, apparent power and power factor.

ABSTRAK

Tenaga solar menjadi semakin popular, sebagai sumber tenaga mesra alam yang tidak mencemarkan, memerlukan penyelenggaraan yang minima dan salah satu sumber tenaga yang terkenal kerana ianya percuma. Keluaran tenaga solar bukan linear dan berubah-ubah dengan sinaran suria bergantung kepada faktor-faktor lain seperti lokasi, masa dan keadaan cuaca. Satu masalah yang muncul ialah keluaran yang dihasilkan tidak tetap dan sistem pemantauan parameter diperlukan. Jadi, projek ini dihasilkan untuk memudahkan pengguna memantau keluaran parameter melalui komputer. Sistem pemantauan yang cekap dan berkesan merupakan aspek yang paling penting untuk memastikan pelaksanaan akan berjalan dengan lancar dan tidak akan terjejas disebabkan kegagalan sistem. Projek ini membentangkan satu sistem yang boleh memantau voltan dan arus gelombang kuasa pengagihan dengan menggunakan DAQ. Tambahan lagi, DAQ digunakan untuk mensampel isyarat voltan dan arus. Untuk menjadikan ia mesra pengguna, sistem pemantauan dihasilkan dengan menggunakan Visual Basic 2010 dan memaparkan nilai parameter talian kuasa pengagihan seperti voltan (rms), arus (rms), frekuensi, kuasa sebenar, kuasa ketara dan faktor kuasa.

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LIST OF ABBREVIATIONS

AC	-	Alternating current
DC	-	Direct current
GUI	-	Graphical User Interface
DAQ	-	Data Acquisition
RMS	-	Root Mean Square
VB	-	Visual Basic
GPRS	-	General Packet Radio Service

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CHAPTER 1

INTRODUCTION

1.1 Introduction

One of the most popular renewable energy that currently been studied in Malaysia is solar energy. As environment friendly renewable energy, it also contributes to the improvement in power quality and increase the reliability of the electric power system. An effective and efficient monitoring solar system is the most important aspect in order to ensure their implementation will going smoothly and not be affected because of the failure system. The monitoring system is developed by using software which is Visual Basic and high precision DAQ Card. All the parameter of measurement such as voltage (rms), current (rms), frequency, real power, apparent power and power factor can be monitored and collected at the same time. The data acquisition (DAQ) systems using NI USB 6009 are becoming increasingly practical for monitoring due to large flexibility in software and hardware. It offers 8 analog input (AI0 – AI7) and 2 analog input signals (AO1 & AO2). In these project only three inputs has been used for voltage and current respectively.

1.2 Problem Statements

Nowadays, the use of solar energy is expanded day by day which can be one of the alternative power that people choose to use. The benefits of using solar monitoring system are environmental friendly, cost effective and sustainable product to enhance the quality of life. Besides that, the solar energy also can help user to save the electricity which is usually use a main power supply.

Before this, the user only use the electricity but unknown of voltage and current that insert to the loads. The measurements are taken by multimeter to know what value of voltage and current is suitable to appliances consumer. In previously, the readings taken by employee on manual. In this way will cause an error when taking the readings. So, this project is made because can make the user easy to check the performance of measurement parameters on computer.

Other than that, fuel is a highly used as a material to generate electrical energy. The price of fuel was increase in global market from time to time and the stocks for this material rapidly decrease. As an engineering student, the projects of development of solar monitoring system are provided.

1.3 Project Objectives

The main objectives of the implementation of the solar farm power distribution monitoring system are:

- i. To develop solar farm power distribution monitoring system that can measure and display voltage (rms), current (rms), frequency, real power, apparent power and power factor on the computer in real time.
- ii. To design monitoring system which provide accurate value data of measurement parameter.
- iii. To develop user friendly monitoring system.

1.4 Project Scopes

The scopes of this project are listed as follows:

- i. This system utilize the Visual Basic 2010 software and NI USB-6009 DAQ device.
- ii. This project only can measure voltage (rms), current (rms), frequency, real power, apparent power and power factor.
- iii. Voltage and current signals are measured between 0 to 500 volt and 0 to 100amp for three phase power line.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Chapter 2 will discuss about the literature review. Literature review is a body of text that aims to review the critical points of the solar farm power distribution monitoring system. In this chapter, the research for the explanation from people who are master in solar monitoring system is done. The references of the explanation are done by referring to the books and internet.

2.2 Previous Project

2.2.1 On-line monitoring of the efficiency of Photo-Voltaic panels for optimizing maintenance scheduling

On-line monitoring of the efficiency of Photovoltaic panels for optimizing maintenance scheduling is one of the methods to monitor solar farm. The major drawback of solar radiation and photovoltaic conversion is the low energy density and the low conversion efficiency that can be reduced to unacceptable levels by several factors, including pollution and dust deposit on the panels. Therefore, it is extremely important to monitor the production of every photovoltaic generation plant and compare it with the incident solar radiation, in order to schedule maintenance at the optimal time to keep the

overall generation efficiency at an acceptable level. This method proposes a remote monitoring system for on-line tracking of the energy performance of a photovoltaic generation plant. The main goal of this system is to monitor the generated energy and relate the measured value to the climatic conditions. In this way, it is possible to keep the generating stations at a pre-defined minimum level of efficiency, also by optimally scheduling maintenance operations [1].

2.2.2 Performance Monitoring of Solar Stand Alone Power

The performance monitoring of solar photovoltaic (PV) power system is very essential for initial system evaluation, and continuous output optimization. Currently, PV system monitoring is complicated and expensive and limited to large scale grid connected solar PV plants. A simple and economic method that can be used by stand alone PV power systems. The method uses reference cells to collect real time data and an electronic subsystem for processing. This method is to integrate reference cells and processing electronics with the PV module to provide an economical solution to small PV system performance monitoring and optimization. Using small reference cells to estimate module or array output power have at least three advantages. First, the voltage and current to be measured is very small compared to the total module or array values. Second, the load does not have to be disconnected temporarily to measure array or module current. Third, the electronic circuits used to acquire and process data will be simpler [2].

2.2.3 GPRS based Power Quality Monitoring System

A cost effective scheme was proposed to realize real-time power quality monitoring for remote distribution system. The key point is to realize the communication between monitoring substations and monitoring centre. The communication can be carried out based on General Packet Radio Service (GPRS) and it has the merit of always online, flexible structure and low cost. The design scheme was applied to power quality monitoring systems. The scheme can work where the monitoring substations were located

in remote wild farms or on mountains. The communication method can also be used in applications where the data flow is not so heavy and there is difficult in wire communication. There are two typical network topology using GPRS for data transmission where the data centre accesses the data through digital data network and through internet [3].

2.3 Present Project

From the previous project like above, the different method to monitor solar system have found. As a conclusion, from this literature review the proposed solar farm monitoring system by interface visual basic using NI DAQ card 6009 because is better compared to other method. For my project *Solar Farm Power Distribution Monitoring System* use Visual Basic 2010 software to display voltage(rms), current(rms), frequency, real power, apparent power and also power factor in real time. This are make a different with my project. For the *On-line monitoring of the efficiency of Photo-Voltaic panels for optimizing maintenance scheduling* use LabVIEW Software. So from that the hardware and software development which are Visual Basic and Data Acquisition Card(DAQ Card) are used. The explanation about this type is explained below.

2.3.1 Solar Energy

As solar energy is a part of widely recognized renewable energy sources, the solar energy source is free of cost and clean energy whereby environmental impacts are negligible. In tropical countries like Malaysia, solar energy potential has been utilized in wide range of applications of remote and urban areas and has been growing rapidly. Since solar energy depends on solar presence in a particular zone, correct and accurate information from the sun, seasonal changes of the solar energy and the amount of solar energy received from the sun are necessary to be evaluated and the basic parameters of solar energy system are needed to be as accurate as possible [4].

Solar energy is one of the renewable energies on which nowadays scientists interested in energy sources are focused. A problem that appears is their output which is intermittent and therefore storage, careful control and parameter monitoring are required. The solar energy availability depends on season, weather conditions, pollution or geographical position. Autonomous renewable systems, such as solar energy powered networks, experience real-time variations of input energy [5].

Solar photovoltaic based power and energy systems is gaining recognition due to the availability and high solar insolation in most parts of India and its inherent advantage of direct conversion to power unlike a solar thermal system. Solar Photovoltaic technology, its application in the remote areas, its advantage as a stand alone system, environment friendly and inexhaustible source are some of the positive features of this wonderful source of nature. Solar photovoltaic s can also be utilised for bulk power for grid interconnected applications. It has a good scope for utilisation on the hybrid system, for pumping of drinking water and remote area power systems[6].



Figure 2.1: Photovoltaic array system

2.3.2 Visual Basic

It's a computer programming system developed and owned by Microsoft. Visual Basic was originally created to make it easier to write programs for the Windows computer operating system. The basis of Visual Basic is an earlier programming language called BASIC that was invented by Dartmouth College professors John Kemeny and Thomas Kurtz. Visual Basic is often referred to using just the initials VB. Visual Basic is easily the most widely used computer programming system in the history of software [7].

Visual Basic was one of the first systems that made it practical to write programs for the Windows operating system. This was possible because VB included software tools to automatically create the detailed programming required by Windows. These software tools not only create Windows programs, they also take full advantage of the graphical way that Windows works by letting programmers "draw" their systems with a mouse on the computer. This is why it's called "Visual" Basic [9]. One of the major reasons why Visual Basic has been so successful is that it includes everything that is necessary to write programs for Windows [7].