UNIVERSITI TEKNIKAL MALAYSIA MELAKA (UTeM)

FACULTY OF ELECTRICAL ENGINEERING (FKE)

FINAL YEAR PROJECT II (FYP II)

BEKU 4973

SOLAR FARM POWER DISTRIBUTION

CONTROL 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 Control 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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A report is submitted in partial fulfillment of the requirement for the degree

of Bachelor in Electrical Engineering (Power Electronics & Drives)

Faculty of Electrical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2012

I declare that this report entitle "*Solar Farm Power Distribution Control 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: ....

Name : ....

Date : ....

..

To my beloved mother and father

ACKNOWLEDGEMENT

First and foremost, I would like to take this golden opportunity to express my appreciation to my final year project supervisor, Dr.Abdul Rahim Bin Abdullah for being a dedicated lecturer guiding me through this project to run smoothly. This project cannot be completed and perfected if without the valuable suggestion and useful information from my supervisor. His patience and enthusiastic in guided me through this final year project have gave me a great courage in completing this project.

Apart from that, I also would like to thanks to my friend for the helped especially Khairulzaman Bin Mohd, Mohd Zabri Bin Abu Bakar and Nur Hafizah Tul Huda Binti Ahmad in giving me their morals support during this project development and also shared some information with regards to the NI DAQ 6009 system and the software guide

Last but not least, I would like to express my deepest love and gratitude to my beloved parents for giving me unlimited encouragement during my studies in University Technical Malaysia Malacca (UTeM)

ABSTRACT

Nowadays, distribution network has become a very popular topic in the industry. The increasing amount of distributed generating such as solar farm, wind farm and micro-turbines connected to the distribution networks as well as the tighter requirements on reliability and quality coming from regulations and customer. A problem that appears is their control system where this system develops for select the energy sources by personal computer and panel box depends on their requirement. This particular research aims to build and design a graphical user interface (GUI) that can display panel system to control the operation with construct the panel system that is selecting of the energy source by using personal computer and panel box. This project presents a system that can control power distribution with three power energy source from Tenaga Nasional Berhad (TNB), solar farm and generator. Control system part are consist combination of software and hardware with using data acquisition (DAQ) as the interface to communicate between hardware and software. To make it user-friendly, controlling system is developed in order to select or choose the energy source with two different condition but same function. At the same time, this system can display and monitoring power source.

ABSTRAK

Pada masa kini, rangkaian pengedaran telah menjadi satu tajuk yang sangat popular dalam industri. Jumlah pengagihan penjanaan yang semakin meningkat seperti tenaga solar, tenaga angin dan mikro turbin yang di sambung ke rangkaian pengagihan, serta keperluan yang lebih tinggi ke atas keboleharapan dan kualiti yang datang daripada peraturan – peraturan dan pelanggan. Satu masalah yang wujud ialah sistem kawalan di mana sistem yang di bangunkan ini untuk memilih sumber kawalan yang mana sistem beroperasi secara ini berkembang untuk memilih sumber tenaga mengunakan komputer dan kotak panel mengikut keperluan. Kajian seperti ini bertujuan untuk membina dan merekabentuk (GUI) boleh memaparkan sistem panel untuk operasi kawalan bagi membina sistem solar yang memilih sumber tenaga menggunakan computer dan kotak panel. Projek ini mewakili system yang akan mengawal tenaga pengagihan ia mempunyai tiga sumber tenaga yang mana tenaga daripada Tenaga Nasional Berhad, tenaga solar dan juga generator. Bahagian sistem kawalan adalah terdiri daripada gabungan perkakasan dan juga perisian dengan DAQ sebagai perantara yang diperlukan untuk ia berkomunikasi antara satu sama lain. Bagi menjadikan ia mudah dan sesuai di gunakan, sistem kawalan di bina bagi memilih sumber tenaga dengan dua keadaan yang berbeza dan mempunyai fungsi sama. Pada masa yang sama, sistem ini akan memaparkan dan mengawasi sumber tenaga.

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AC	-	Alternating current
DC	-	Direct current
GUI	-	Graphical User Interface
LED	-	Light Emitting Diode
DAQ	-	National Instrument Data Acquisition
TNB	-	Tenaga Nasional Berhad
VB	-	Visual Basic

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CHAPTER 1

INTRODUCTION

This chapter will discuss the overview of project development for Solar Farm Power Control Distribution. That are study of each part will be considered as part of the development of solar system distribution. Moreover, the aims and specified objectives of the project, the scope and the problem statements have been discussed from this chapter. Finally, all system should be designed for panel system application. In addition this chapter applies some of the concept of switching relay by control using software.

1.1 Project Background

Solar energy technologies, which harness the sun"s energy to generate electrical power. This technology is one of the fastest growing sources of renewable energy on the market today. Presently, solar energy is solving some of the most urgent problems the world now faces cause in tropical and whether countries like Malaysia, solar energy potential has been utilized in wide of application of remote and urban areas and has been growing rapidly. Solar energy is a clean and sustainable source of energy that you can use for solar electricity, solar heating, solar cooling solar and so on. Solar energy one of renewable energy sources that will reduce our national dependence on foreign oil and enhance our homeland security because of their environmental and economical merits.

Modern-day power control distribution management systems is a systems that help manage power distribution assets and play an important role in ensuring reliable and efficient power distribution. Control power distribution is a device fitted with multiple outputs designed to distribute electric power depend by method that are use for control power before generate load. Besides that, control power distribution is real-time adjustment

to changing generation, load and failure conditions of the distribution system, usually without technician intervention. The interest control power distribution can help to improved control and greater accuracy and also smooth starting and stopping.

1.1   Problem Statements

The crisis for oil spill disaster spreading across ocean, forced the consumer to find the clean and cheaper energy sources. In addition, unite in finding alternative energy solutions to current issues such as the greenhouse effect and the depletion of the ozone layer. Unlike fossil fuels, solar energy doesn't produce the harmful pollutants responsible for increasing the greenhouse effect which leads to global warming. So, when using solar energy can eliminating of greenhouse gas, in cooperation with the innovation in energy storage and delivery.

Nowadays, technologies focus by using control power distribution, to save energy consumption and to reduce environmental pollution. But, have much method for control system depends on efficiency and accuracy systems operate advantages and disadvantages in this method and so on. Controlling system by using PC can help control and monitoring switching to facilitate the handling process. Moreover, can help reduce employment of energy and easy to manage system without the external problems involving employees.

1.2   Project Objectives

The main objectives of this project are as follow:

a) To control power distribution system by using personal computer (PC) and panel box
b) To develop user friendly control system by using graphical user interface (GUI)
c) To design the panel system for control operation and construct the circuit that able control switching for varieties power sources

1.3   Project Scopes

The solar farm power distribution control system is specifically of two scopes:

a) The system solar farm power distribution control system is parallel with three energy resources which are Tenaga Nasional Berhad (TNB), solar and the genset
b) Write and compile the programming language of visual basic 2010 to be use as the coding to control the solar distribution power system.

CHAPTER 2

LITERATURE REVIEW

2.1 Renewable Energy Resources in Malaysia

Malaysia's viable renewable energy resources are biomass, solar, wind and hydro. The utilization of renewable energy sources help reduces our national dependence on foreign oil and enhances our homeland security because of their environmental and economical merits. Research and development promote and support the production of high quality and relevant output, products and services for citizens. Where has a crucial and important part in the ongoing efforts to further improve production processes, to raise the quality standards of products and services and to cut costs through the introduction of new and innovative method.

Research on renewable energy in "ICT Applications in Green and Renewable Energy Sector" can implement in two ways where produce renewable energy and also support the current renewable energy production process. In term of, technologies and methodologies, typically applied to ICT field, could be reused in the future to produce energy in different and efficient way and next way is the current ICT tools may help to support the current green energy production process aimed at enhancing the efficiency and the safety of the employed plants [3]

2.2   Solar Energy

Solar energy utilization is an important field in developing and using of renewable energy. With the shortage of coal, fossil oil and other fossil fuels, and the increasingly serious of environment pollution, people are paying more and more attention on the development and utilization of renewable energy and pollution-free energy. Solar energy that are namely for such an energy, has been under the world attention. Exploitation and utilization of solar energy, can save a large number of fossil fuels, slow down the growing change of global climate, and also protect the environment where the human survival[4].

A paper proposed by Yoshiaki NAKANO from University of Tokyo have target in their IEEE " Ultra – High Efficiency Solar Cell Development Activity in " SOLAR QUEST ", the international Research centre for Global Energy and Environment Technologies" is the dramatic improvement in photovoltaic conversion efficiency, which will innovate energy cycle in the world in a manner that reduces the use of fossil fuels, and thus eliminating the emission of greenhouse gas, in cooperation with the innovations in energy storages and delivery[5].

The abundance of solar energy throughout the year in Malaysia due to the geographic location provides strong reason for the implementation of an efficient solar energy system. Studies show that solar panels constitute a large portion (57%) of the total cost to install solar energy system .The energy sector is one of the most important sectors in the nation. When utilization of sale and purchase reduce, that can help the sector has contributed to the development and economic well being of the country [6][7].

2.3 Power Source Controller System

Previous FYP 2009 represents about the renewable energy uses solar energy as power sources to connect the load for home application. The automatic switch for renewable energy will be designed and connected between two energy sources of main energy from Tenaga Nasional Berhad (TNB) and solar energy sources for home application. The control system of this project consists by Programmable Intelligent Controller (PIC 16F877A) as the control circuit to communicate between switch and sensor. Photovoltaic cell sensor sense the light of the sun and transfer signal to the microcontroller. The microcontroller process all signal and then source ca automatic selected depends on sensor signal.

The control system is the key element in the control of a system when there is more than one input. Operation of a system depends on what that want to generate. The latest technology that requires new understandings in order to make captured solar energy available energy source for the future. The goal in control system is to control the operation in systematic. Besides that, have certain system to make the stable technology by the control strategy of transformation, charging and storage and so on. The paper from Yuehua Huang, Yang Xu and Xingchen Zhou from College of Electrical Engineering & Renewable Energy China Three Gorges University, they use Matlab software to simulate the Wind-solar Hybrid Generating System. Using mathematical model the result not only the system tracking very well, but bring about the little charging current float and rush [8].

"The Smart Charger for Stand Alone Solar PV", is a paper present by Nowshad Amin et. al (2008) have involved in this paper present a cost effective with function to disconnect and reconnect battery and load during battery charging. . The three inputs are used to detect the voltage and current of the circuit and send the data to microcontroller in order to obtain the accurate and efficient disconnect or reconnect action to protect the battery and load. This controller is equipped with Liquid Crystal Display (LCD) display to display temperature, battery voltage and current flow through to the battery. The input part of charge controller is current circuit, battery voltage sensing circuit, and temperature sensing circuit The system is control by using Programmable Integrated Circuit (PIC)

microcontroller to control and coordinate the activity of controller. The Programmable Integrated Circuit (PIC) microcontroller to control and coordinate the activity of 9km controller. The PIC microcontroller will operate according to the program inside its .memory. In this project the C code is written to provide. For the output it consists panel battery connect or disconnect, low voltage warning circuit and status indicator. The LED is used as indicator show the status of the system[9].

As a conclusion, from this literature review the proposed solar farm control power distribution controlled system by interface visual basic using NI USB 6009 because is better compared to other method because the programmable integrated circuit (PIC) is complicated method compared using NI USB 6009 as proposed by ex-final year student batch 2008. Where the project that are implemented is "Renewable Energy Automatic Switch For Home Application". This method is choosing because it required less cost compared using microcontroller where equipment from national instrument has own advantages compared then microcontroller. The parameter of microcontroller is controlled signal from input microcontroller. The proposed system of automatic switch is consist Light Dependent Resistor sensor (LDR) where LDR sensor will connect with the microcontroller PIC16F877A that PIC is the main part of control circuit hardware to carry out the switching. The function LDR sensor is to sensor either condition dark or cannot. When the condition detect dark, automatic switch can switching TNB source but this project can control in manual and automatically condition but still use same principles with different method and equipment. A part of that, NI USB 6009 has own supply at devices compare the PIC microcontroller. This implemented this project is same with this project cause the microcontroller is used to control main switch power sources 240 VAC/50Hz to select and switch either primary or secondary power sources to the load. Besides that, the implementation of the NI USB 6009 to provide user"s feedback for further necessary action. Apart from that, another unique advantages of NI USB 6009 is has consist digital and analog signal from that can using output and input to be control the load.

2.4 Project Background

2.4.1 System overview / brief model solar farm power distribution controlled system

The Figure 2.1 shows the block diagram of the " Solar Farm Power Distribution Control System " where that are consisting of three main section is that consists controller unit, switching unit and load section. The main component of the panel solar farm control using by NI USB 6009. The concepts of system are automatically system depends on NI USB 6009. The three energy will be distributed according on selected at system (GUI Panel) or Main board (Panel box). The will be apply at any application. In this system that is implemented at place or plant use solar farm as one of source to distribute source to load.

The main purpose to control power supply from Tenaga Nasional Berhad (TNB), Solar Farm and Genset. After selected on the system, the sources can distribute to the load. Usually, TNB distribute source to the load in alternating current (AC) 415/240V. Solar farm is a direct current, before solar distribute the source to the panel; solar source must change in alternating current (AC) by using inverter. The inverter function is convert from direct current (DC) to alternating current (AC). Genset or distributed generator system is an electrical generator where the device that generates electricity from mechanical energy.

The project focuses on designing control unit for control the selection of power distribution. The role of the control unit is to control the incoming from Solar Farm, Tenaga Nasional Berhad (TNB) and Genset by using interface NI USB 6009. The NI USB 6009 with combination switching circuit for control from low voltage to switching high voltage load before distribute . It can control unit the selection of power distribution by using PC and Panel Box.