

COMPUTER AIDED EDUCATION ON PHOTOVOLTAIC SYSTEMS

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MAY 2008

“I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Power Electronic and Drives)”

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Date : 7 May 2008

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Fakulti Kejuruteraan Elektrik  
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“I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in the references.”

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Especially thanks to my families and my all friend for your support and understanding. To my supervisor Mrs. Aida Fazliana Binti Abdul Kadir, thank you for your guidance and advised .....

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## ABSTRACT

The objective of this project is to design and develop an e-learning courseware for photovoltaic (PV) systems. Its has been develop by using Macromedia Flash MX and Swish Max software. Its designed to be an interesting and interactive learning environment and allow everybody to learn about these technologies with their own way. Photovoltaic technology has been in use over 40 years and it is very reliable and well proven on earth and in space. Photovoltaic or solar energy the most is easy, quiet, clean and portable. Solar electricity requires no fuel except the sun. This project focus on introduction of PV Basics, PV system design (grid connection and stand alone system), PV Components for typical system, and analysis of the stand alone system and grid system. All this tutorial and virtual lab will contains on the build up software, then at the end the user should be able to understand a detail about Photovoltaic system.

## ABSTRAK

Projek ini bertujuan untuk membina e-pembelajaran bagi sistem kuasa solar atau dengan nama lain „sistem photovoltaic“. Ia di bina dengan menggunakan perisian Macromedia Flash MX dan juga Swish Max. Ia di reka berkonsepkan suasana pembelajaran yang menarik dan interaktif. Di mana sistem atau kaedah pembelajaran ini membenarkan sesiapa sahaja untuk belajar tentang teknologi ini dengan gaya atau cara tersendiri sesuai mengikut keselesaan termasuklah di rumah. Kuasa elektrik dari photovoltaic (PV) telah di gunakan sejak 40 tahun yang lalu. Ia terbukti berkesan dan boleh diguna pakai untuk semua keperluan termasuklah di ruang angkasa. Photovoltaic (PV) adalah satu sumber kuasa yang paling senang, senyap, bersih dan mudah alih. Ia tidak memerlukan bahan api selain dari sinar cahaya matahari. Projek ini menekankan pengenalan asas bagi photovoltaic, rekabentuk sistem PV, komponen- komponen dalam sistem PV serta analisis sistem PV berdiri sendiri dan sistem PV yang bersambung ke grid. Selain itu, perisian ini dilengkapi dengan makmal maya dan juga tutorial bagi menambahkan pengetahuan pelajar tentang sistem PV.



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## LIST OF ABBREVIATIONS

PV	-	Photovoltaic
UPS	-	Uninterruptible Power Supply
IGBT	-	Insulated Gate Bipolar Transistor
Si	-	Silicon
sc-Si	-	Single Crystalline Silicon
mc-Si	-	Multicrystalline silicon
pc-Si	-	Polycrystalline Silicon
a-Si	-	Amorphous Silicon
CIS	-	Copper Indium Diselenide
CdTe	-	Cadmium Telluride
DC	-	Direct Current
AC	-	Alternate Current
BOS	-	Balance Of System
PCU	-	Power Conditioning Unit
PWM	-	Pulse Width Modulation
MPP	-	Maximum Power Point
Wh	-	Watt Hour
Ah	-	Amp Hour

## CHAPTER I

### PROJECT BACKGROUND

#### 1.1 Introduction

One revolutionary impact of the information technology in today's knowledge-driven economy is that it changes the way people learn, communicate, work and live. With the presence of the Internet, learning will no longer be bounded by the old traditional form that is merely dependent on classroom training or based on books alone. In fact, nowadays people can easily obtain knowledge or information by just a simple click of the mouse in the comfort of their home. E-Learning has become a new trend whereby each individual is able to set their own learning pace anytime anywhere. It can be a very rich learning experience that can even surpass the level of training experienced in a crowded classroom.

##### 1.1.1 Problem Statement

This project like all others is created to solve problems that we humans encounter everyday. Upon completion of this project, the problems that we face will hopefully be solved or at least reduced.

Here are several encounter problem:

- i. There are no such type of e learning for Photovoltaic (PV) system.
- ii. Many users not have proper understanding about Photovoltaic.
- iii. Always need to be evaluate (battery due to capacity lost).

## 1.2 Objectives

The objective of this project is to design and construct a computer aided education by using macromedia flash software consist of photovoltaic system that can be used for education especially teaching & learning of high technology used computer.

The main purpose of this project is :

- i. To built the new interactive learning education for Photovoltaic System.
- ii. To present a comprehensive picture of present state and application of photovoltaic energy.
- iii. To built a useful tutorial for calculate battery and module sizing
- iv. To analyze the Stand Alone System and grid connected to Photovoltaic System.

## 1.3 Scopes Of Work

This project is software based, which consists a learning courseware for photovoltaic (PV) system. Its has been designed and develop to be used as the most interactive learning. This type of learning is a new way to everybody learn in variety condition with condusif environment and allow students to learn about these technologies at their own pace, in the comfort of their own home.

Below are the scope for this project:

- i. Design and build up computer aided education of a control system consist of photovoltaic system as one of renewable energy recently have.
- ii. Design using Macromedia Flash MX and Swish Max software.
- iii. The software design consist for its system design, basic of PV, PV sizing array, sizing battery,stand alone system and grid connected to PV system design, PV component and virtual lab of PV system.

## **1.4 Report Structure**

There are six chapter in this report, first chapter is about project background. In this chapter includes for an introduction, problem statement, objective and scope of work. Second chapter is about literature review and its wrap up for study of similar system and others literature. Third chapter is about theoritical background, its contain theoritical for photovoltaic review and calculation of system sizing and also e-Learning review. Follow by chapter IV, methodology, in this part, its shows the flow chart of the project and courseware development. Then chapter V covers for result of project and discussion for courseware content. Last chapter is about conclusion and recommendation for future work.

## CHAPTER II

### LITERATURE REVIEW

#### 2.1 Study Of Similar System

##### 2.1.1 E-Learning Of Fluid Power: Pneumatics by C.L. Kho, Patrick S.K. Chua and F.L. Tan[13]

This paper describes the development of a multimedia teaching package in pneumatic circuit design. It discusses the concept of e-learning, presents the pneumatic contents covered in the package and also the development processes. Various types of emergency circuit design techniques have been incorporated into the package to suit different needs of users. Macromedia Flash MX has been used as the main development platform for this interactive teaching package. The courseware has been fully tested. It serves as a supplementary teaching package for the instructor or a self-learning package for learners who are interested in pneumatic circuit design.

The focus of this paper is on emergency circuit design although the courseware developed also covers other topics in pneumatic circuit design and pneumatics components/system. Multimedia teaching package in fluid power hardly exists today. The only one reported in the literature is by Tieh and Lee (2002) whose work is aimed at vocational trainees (National Trade Certificate NTC-3) in basic pneumatics and the work was only at the beginning stage. The work reported in this paper is part of a continuing effort to develop a complete multimedia teaching package in pneumatics especially on the design of pneumatic circuits.

### **2.1.1.1 Methodology Of The Project**

The authors use Macromedia Flash MX as the major development software in constructing the courseware. Macromedia Flash MX is a powerful development tool, with the ability to pull in and deliver a wide variety of web media and data sources. It is suitable for creating multimedia teaching package, animated logos, web site navigation controls, long-form animations, entire Flash websites, or web applications.

### **2.1.1.2 Significant and Contribution Of The Research**

This reference give me a guide lines on what is the actual need to design and develop the course ware. The criteria of e- Learning need to be consider while build the course ware which is, the content must be easy for user to used it. In other word friendly user. Beside that, this e – Learning must be well built functionality, so that user can used that without any problem for example fast when operating the courseware.

### **2.1.2 Control of Three-Phase Stand-Alone Photovoltaic Systems with Unbalanced Loads by P. Sanchis, Member, IEEE, A. Ursúa, E. Gubía, J. López and L. Marroyo, Department of Electrical and Electronic Engineering, Public University of Navarra, Pamplona, Spain.[14]**

#### **2.1.2.1 Sumarization Of Reference**

This case deals with the control of three-phase four-wire stand-alone photovoltaic systems. In these systems, the structure consisting of a three-phase inverter and a delta-wye transformer is especially interesting. It includes galvanic isolation, as demanded by many regulations, and can provide a neutral point in order to supply single-phase loads. This paper proposes a new control strategy for this system that deals with the natural coupling between variables and external