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DEVELOPMENT OF POWER ELECTRONICS LEARNING SOFTWARE

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Bachelor of Electrical Engineering

July 2012

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DEVELOPMENT OF POWER ELECTRONICS LEARNING SOFTWARE

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A report submitted in partial fulfilment of the requirement for the degree of

Power Electronics and Drives

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JULY 2012

I declare that this report entitle Development of Power Electronics Learning Software 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.

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ABSTRACT

Nowadays, e-learning is widely used no matter inside country or outside country. Most e-learning system used in the field of education is more effective and save time in understanding difficult subject. This is due to the traditional education system is no longer effective and attractive. This software is designed to have different approach in teaching method and learning process of power electronic subject. Visual Basic (VB) is used as a medium to generate the Graphical User Interface (GUI) for the users. Power Electronics topics that covered in this project consists of half wave rectifier, full wave rectifier, DC-DC converter and DC power supplies. In the designed software, users can always choose a topic they are interested in. For each topic, a two dimension (2D) illustration will be generated. Some input parameters are needed to be entered by user to generate the required output waveform. In addition, short notes are also included to enhance student's understanding. The result of this project is e-learning software that is based on power electronics syllabus.

ABSTRAK

Pada masa kini, e-pembelajaran digunakan secara meluas tidak kira dalam negara atau di luar negara. Kebanyakan sistem e-pembelajaran digunakan secara meluas di dalam bidang pendidikan kerana ia lebih berkesan dan menjimatkan masa dalam memahami sesuatu subjek yang sukar. Hal ini, adalah kerana sistem pendidikan tradisional tidak lagi berkesan dan menarik. Perisian ini direka adalah untuk mendapatkan pendekatan yang berbeza dalam kaedah pengajaran dan pembelajaran didalam mata pelajaran Elektronik Kuasa. Projek e-pembelajaran Elektronik Kuasa ini dibangunkan dengan menggunakan perisian *Visual Basic* (VB) sebagai satu medium untuk membentuk *graphical user interface* (GUI) untuk pengguna. *'Half-wave rectifier'*, *'Full-wave rectifier'*, *'DC-DC converter'* dan *'DC power supplies'* adalah antara bab yang utama dimasukkan didalam e-learning ini. Dalam perisian yang direka, pengguna boleh memilih topik yang mereka berminat. Setiap bab mempunyai demo dengan gambaran ilustrasi dua demensi (2D). Pengguna boleh memasukkan parameter input yang diperlukan untuk mendapatkan gelombang keluaran yang dikehendaki. Di samping itu, nota ringkas juga dimasukkan bagi meningkatkan kefahaman pelajar. Hasil daripada projek ini adalah untuk membangunkan perisian e-pembelajaran berdasarkan sukatan pelajaran elektronik kuasa.

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LIST OF SYMBOLS

VB	-	Visual Basic
GUI	-	Graphical User Interface
DC	-	Direct Current
AC	-	Alternating Current
V	-	Voltage
I	-	Current
R	-	Resistance
L	-	Inductance
C	-	Capacitor
D	-	Duty ratio
Vs	-	Voltage source
Vo	-	Voltage output
Vin	-	Voltage input
Vrms	-	Voltage in rms
Irms	-	Current in rms
Io	-	Current Output
N	-	Number of turn

CHAPTER 1

INTRODUCTION

1.1 Project Background

E-learning method has been widely utilized not only for university level but also for school level as well. E-learning system is one of the electronic learning that uses the computer as a medium of delivery [1]. Regardless what the fields are, e-learning is greatly needed to facilitate the learning process and to ease the understanding process among students and instructors. It is designed to create an interesting and interactive learning environment.

Learning process in engineering subjects can be very difficult if the learning process to be taught verbally or using slide presentation [2]. This is due to these methods have important limitations. Power Electronic subject involves plenty types of waveforms and calculations. A main difficulty in the learning process is the three phase circuit, to clearly represent the waveforms of the voltages and currents. Because of this, students tend to spend longer time in tasks that is not directly related with learning of the circuit [2].

The software is designed to develop e-learning software for power electronics syllabus. This project will be loaded with a concise and compact notes, tutorials, and theory for students who are using this software. E-learning for power electronics will help students to master the power electronic subject easily without having to use a lot of notes and references in their learning. It has combinations of animations and visual pictures. Besides, graphical illustrations will also appeal to student whose using this software to make it even more effective. Visual Basic (VB) is the main software used in developing this project.

1.2 Problem Statements

This project is developed based on a few problems occur that basically involve power electronic learning process.

Demands to quality of education in engineering sciences are increasing [3]. Thus, the learning process in the engineering field can be very difficult. This is due to the education system is purely based on lecture that uses notes and references book. This learning system becomes quite tedious and students are not giving enough attention in the class. Thus, students are not able to dominate subject that they learned.

Power electronics subject is usually taught theoretically, which make it difficult and time consuming to be understood by the student. On the other hands, one of the main difficulties in learning process mainly in three phase circuit is to clearly represent the waveform of the voltages and currents. Because of this, the students spend long time in task that directly not related with the learning of the circuit [2].

At present in teaching process of this subject the blackboard and transparencies are used. Nevertheless these methods have important limitations. The use blackboard is not the right method in the case of representing complex waveforms especially in three phase systems. With the use of transparencies or slides, some complex graphical waveforms can be represented but just for one or small number of cases [2].

Typical learning methods do not have animations and graphic illustrations which reduce the student's focus in class. In addition, the notes or reference books use in class contain information that is not important which will be time consuming to be read in order to understand the subject.

1.3 Objectives

In completing this power electronic e-learning project, there are few objectives to be achieved which are:

- To develop e-learning software that is based on power electronic syllabus by using visual basic software.
- To differentiate and improved e-learning software that designed beforehand. The software is designed will be an user-friendly and multipurpose software that allowed user to access notes, tutorials for each topics covers in this project.
- To make use of animation and graphical illustration available in Visual Basic in designing this software.

1.4 Scopes

This project is implemented using Visual Basic 6.0 program on computer. Scope consists of:-

- The scope of this e-learning project is limited to power electronics syllabus. The topics covered in this project are half wave rectifier, full wave rectifier, DC-DC converter and DC power supplies.
- This e-learning project is targeted to be used by lecturer and university level student who is taking bachelor program in electrical engineering.
- Visual Basic software is used in this project since it has special tools that allow user to create waveform animations.

1.5 System Design

As mention in the project section before, this learning software will compress with 4 major aspects which are introduction, notes, tutorial and graphical illustration and it covers important topic in power electronics. Figure 1.1 shows the structure chart of subtopic that will cover in this power electronics.

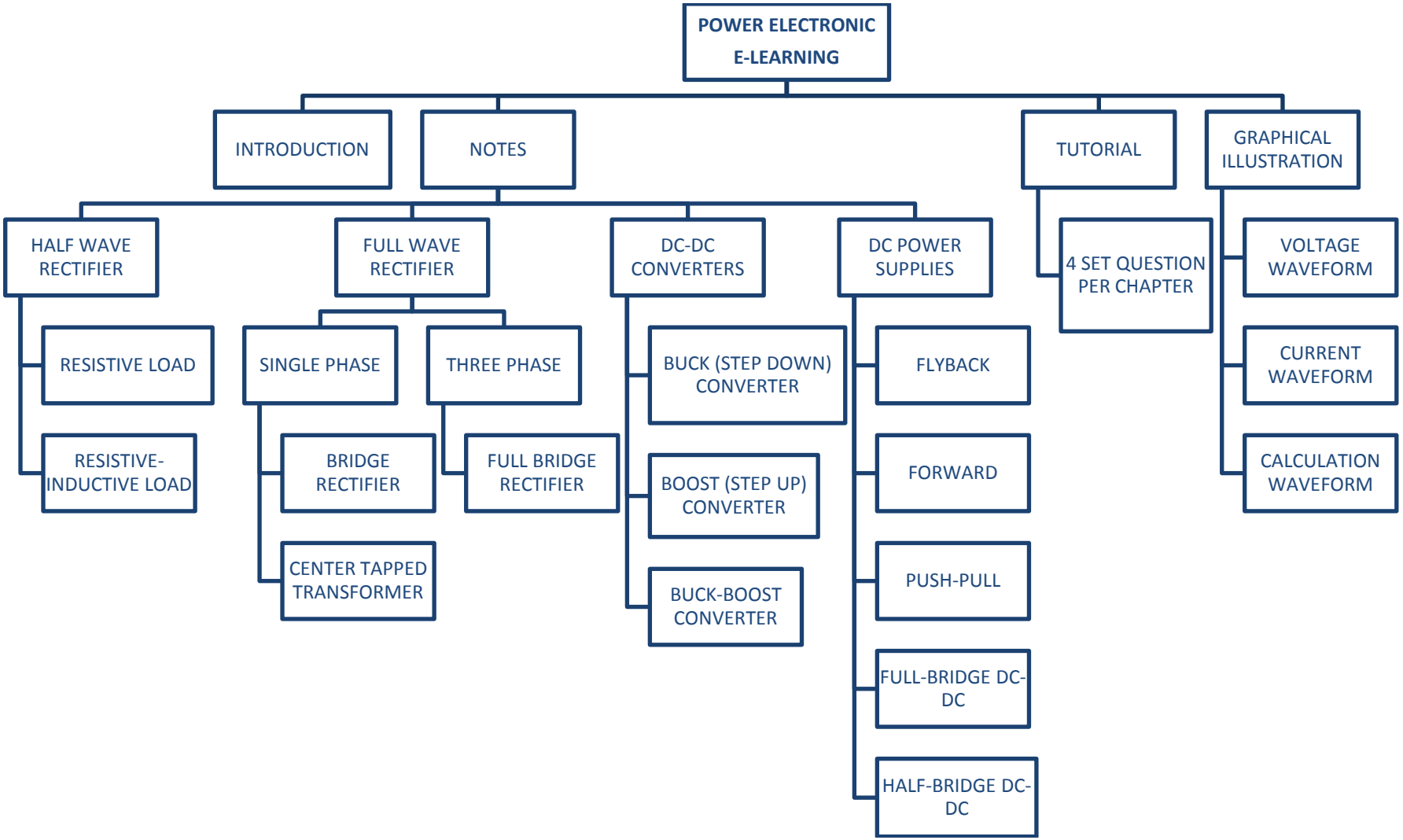


Figure 1.1: Structure chart for Power Electronics E-learning

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will focus more on the explanations of the e-learning system and the theory of power electronic syllabus that will be revealed in the e-learning. The literature is done so that further and deeper understanding of the project can be gained. It is also as a main references and guidance for this *"E-learning for Power Electronics Syllabus"* project.

Developing this e-learning system many research has been made through number of journals and e-learning systems that have been implemented. Knowledge from the research is used to develop new ideas in creating this e-learning system. This section will focus on e-learning system and e-learning in power electronics.

2.2 E-learning System

Process of learning the e-learning is based on the use of electronic hardware and associated with learning through the internet [10]. In the era of globalization, technology has significant influence on education. In education, the used of the internet is not only focused on finding information but also as a medium of delivery of teaching materials and provide effective learning environment [11]. There are various types of software used for e-learning developments for instance; Java-Applets, Visual Basic, Macromedia, Game Maker and others [1, 2, 3].

2.2.1 First research on '*Interactive Learning of AC Power Transformer*'.

The e-learning project had been developed by a student from UTeM for the final year project. It is developed by using Macromedia software as it interface system. There are many advantages and disadvantages that can be learned and acquired to develop e-learning project power electronics. From the observations, this e-learning project conducted by [12] has several advantages that can emulate. Among the advantages are:

- The system is presented in a very simple way and facilitates the users to utilize the system. E-learning software is developed with feature presentation that is easily understood by users.

- The theory is practically applied – Animated e-learning that enable users to develop a clear understanding and save time to understand the theory contained in these subjects more easily.

Among weaknesses that were indentified in that project e-learning is:

- Presentation mode consists of too much text –the use of too much text will cause students a bored to read and understand on matter intended to be delivered. The use of long text in the project will also filling the space and make unattractive pages.

- Colour and background for this software is not suitable – for example text and background colour are too bright to make it difficult to be read. In order to overcome this problem, suggestion or steps can be taken by using dark colour background for text or script. Contras in the colour play an important role in the delivery of the text to facilitate reading in the project and look more attractive.

- The project is less interactive – lack of animation or sound in the system cause project less interactive. To resolve this problem, approach to be taken is to use a diagram or appropriate graph to show a visual representation.

- Buttons do not work – in the project provided button does not work well. Such as the front page there is button 'EXIT' does not work.

2.2.2 Second research on *'My Intelligent Electrical Cost System'*.

MyIECS was designed in 2008 by Aida Fazlina, Jurifa and Junaidah [13]. This e-learning is developed by using Visual Basic (101 VB.NET). The software is about calculating the amount electric consumption and costing that used by the user. The advantages for this project are summarized as below:

- The system is presented in very simple way and well arranged. Arrangement of words and simple commands. Also this system is user-friendly.

- In this system also shown the current time and date in front pages. System also easier for the user to calculate the total electrical consumption and costing in automatically calculate without error compare calculate by traditional.

- Notes and information are nicely compressed into simple term and enable the user to understand. These ideas coincide with the purpose of e-learning concept which is less word but more information.

- Button in the form of picture can attract user and more interactive. Users can directly understand function of the button just by looking at the icon without reading the instruction.

The advantages that can be identified are:

- The system left many empty spaces on the main page. This space is empty without any function and makes the introduction page looks unusual. It is recommended that the blank spaced is replaced with the animation and general information to make it more interesting and create the professional image.

- Furthermore, this system is design without interactive sound and button. These weaknesses must be taken to improve e-learning will be developed later.

- This system does not provide any tutorial or exercise to test and gather information and the statistics of user understanding. This slot also be refer as the platform to designer to evaluate either this software is successful to help the student or not.

2.3 E-learning for Power Electronics

This e-learning focuses on a multimedia and interactive system to help teaching power conversion technique for AC/DC, DC/AC, and AC/AC is described as a tool for both teachers and students. In each difference topologies the user can select among types of loads: resistive, inductive, capacitive, and combinations. During the simulation the circulating current direction and state of semiconductor switches is shown, by means of changing colors. The multimedia system includes documentation on all subjects, showing the basic concept and equations in pdf format and links to industrial manufacturers. Macromedia software is used to develop this e-learning [2].

The e-learning done by [3] discussed about the tap changer communication. This e-learning shows how the movement of currents and voltages in the commutation circuit with interactive animation. In addition, four step 'smart' commutations for positive and negative polarity voltage are discussed in this journal. It shows in detail how the movement of voltage and current in the circuit can be seen using a different color. In the interactive animation that made include circuit, waveform and state diagrams are very effective in understanding the topic under discussion. This e-learning developed by using *iPES*. iPES is constituted by HTML text with Java-Applets for interactive animation, circuit design and simulation.

2.4 Literature Survey on Power Electronics Syllabus

The power of electronics can be defined as conversion of electric power from one form to another form by using electronic device [1].The topic will be covers are:

- Half-wave Rectifier
- Full-wave Rectifier
- DC-DC Converter
- DC power supplies

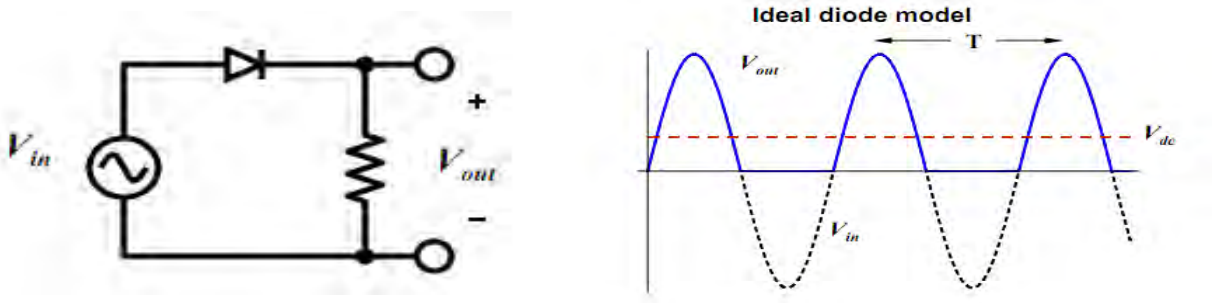
2.4.1 Half-Wave Rectifiers

A rectifier converts alternating current (AC) to direct current (DC). The purpose of a rectifier is to produce an output that is purely DC or voltage or current waveform that has a specific DC component [1]. In half wave rectifier subsection will cover resistive load and resistive inductive load.

2.4.1.1 Resistive Load

The diode is a basic electronic switch that allows current to flow in one direction only. For the positive half-cycle of the source in this circuit, the diode is on (forward-biased). Considering the diode to be ideal, the voltage across a forward-biased diode is zero and current is positive [1].

Theoretically the forward biased waveform output should be:



(a) (b)

Figure 2.1: (a) Half-wave rectifier with resistive load in positive cycle; (b) Voltage waveform

For the negative half-cycle of the source, the diode is reverse-biased, making the current zero. The voltage across the reversed-biased diode is the source voltage, which has negative value [1].