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transformer / Gabriel Anak Jatu.

**AN INTERACTIVE LEARNING ON ALTERNATING CURRENT  
POWER TRANSFORMER**

**GABRIEL ANAK JATU**

**MAY 2006**

“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 (Industrial Power).”

Signature :  .....

Supervisor's Name : AIDA FAZLIANA BT. ABDUL KADIR .....

Date : 04 MAY 2006 .....

AN INTERACTIVE LEARNING ON ALTERNATING CURRENT POWER  
TRANSFORMER

GABRIEL ANAK JATU

This Report Is Submitted In Partial Fulfillment Of Requirements For The Degree Of  
Bachelor In Electrical Engineering (Industrial Power)

Fakulti Kejuruteraan Elektrik  
Kolej Universiti Teknikal Kebangsaan Malaysia

May 2006

"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."

Signature :  .....

Name : GABRIEL ANAK JATU .....

Date : 04 MAY 2006 .....

Dedicated to my beloved parents and Cindy...

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## ABSTRACT

As the world is now facing the new era of globalization, almost thing is becoming global. Global here means that everything is at your fingertips, where everything is being done with the help of the “main brain” of all: computer. This includes the businesses, daily routines, and even educations. The Information Technology era has pushed the education style to evolve from the primitive way which is from the verbal speech lecturing into the computer based knowledge system. So now, we can see that most of the education levels are using computer in their daily activities. Thus, the students and the teachers especially, will make a full use of this technology in order to up to date their level of knowledge through modern style of education, which often be called, Computer Aided Learning (CAE). In conjunction, Electrical Engineering field is also very important in the modern society. Thus, the knowledge of Electrical Engineering should be explored thoroughly, whether theoretically or practically. Here, Alternating Current Power Transformer as one of the most fundamental auxiliary in Electrical Engineering is being explored theoretically, in order to come out with the adequate theoretical knowledge to be implemented into the IT based system which is called an “Interactive Learning System”. This project will deeply study the various aspect of Alternating Current Power Transformer, to be implemented into the Interactive Learning System, so that the output would be useful for the Electrical Engineering users in the future.

## ABSTRAK

Dalam dunia berhadapan dengan era globalisasi, hampir kesemua perkara turut menjadi global. Istilah global di sini bermaksud semua benda berada di hujung jari anda, di mana semua perkara dilakukan dengan bantuan “otak utama” kepada semua: computer. Ini termasuklah perniagaan, rutin harian, mahupun pendidikan. Era Teknologi Maklumat telah menyebabkan kaedah pendidikan turut berubah daripada pendekatan yang primitif, iaitu daripada kuliah secara lisan kepada sistem pendidikan berasaskan komputer. Oleh yang demikian, pada hari ini, kita boleh lihat kebanyakan tahap pendidikan telah menggunakan komputer dalam pelbagai aktiviti harian mereka. Sehubungan dengan itu, para pelajar dan tenaga pengajar terutamanya, akan menggunakan dengan sepenuhnya teknologi sebegini demi mengemaskinikan tahap pengetahuan mereka melalui kaedah pendidikan moden, yang juga dipanggil Pendidikan Berteraskan Komputer. Sehubungan dengan itu, bidang Kejuruteraan Elektrik juga merupakan suatu aspek yang sangat penting kepada masyarakat moden. Oleh yang demikian, pengetahuan mengenai Kejuruteraan Elektrik juga perlu diterokai, samada secara teori mahupun secara amali. Di sini, Pengubah Kuasa Arus Ulang Alik yang merupakan salah satu daripada perkakasan asas dalam Kejuruteraan Elektrik telah diterokai secara teori, demi menghasilkan pengetahuan teori yang cukup untuk dilaksanakan ke dalam system berasaskan Teknologi Maklumat yang dinamakan “Sistem Pembelajaran Interaktif”. Projek ini akan mendalami pelbagai aspek dalam Pengubah Kuasa Arus Ulang Alik, untuk dilaksanakan dalam Sistem tersebut, supaya apa yang dihasilkan adalah berguna kepada pengguna daripada bidang Kejuruteraan Elektrik di masa hadapan.

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## LIST OF ABBREVIATION

AC	-	Alternating Current
i-LAPT	-	An Interactive Learning On AC Power Transformer
CAI	-	Computer Assisted Instruction
IT	-	Information Technology
IE	-	Interactive Education
LAN	-	Local Area Networks
CBT	-	Computer Based Training
CD	-	Compact Disc
EMF	-	Electromagnetic Force
OC	-	Open Circuit
SC	-	Short Circuit

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Project Background

The main purpose of this project is to fulfill the requirement for the Final Year Project (BEKU 4973/4983). Besides, its rationale is to increase the knowledge and expertise of the undergraduate students of Kolej Universiti Teknikal Kebangsaan Malaysia (KUTKM) in solving the problems through knowledge-based research in order to produce the competent and productive technologist.

The title of this project is “An Interactive Learning on Alternating Current Power Transformer”. However, due to friendliness towards the future users, this project is renamed according to its acronym which creates the “i-LAPT” software. This project is a software based, which contains a learning course for a general Alternating Current (later will be mentioned as AC) Power Transformer. Thus, the software developed will produce an interactive learning course system for AC Power Transformer.

Examined the title of this project, the word interactive itself has many conceptions: Interactivity implies a dialogue between two parties. Interactivity is the extent to which users can participate in modifying the form and content of a mediated environment in real time [1]. Interactivity, in the context of interactive multimedia, is the functionality afforded by a system that responds to the user. Choices made by the user will determine the "system's" response to the input and the next bit of information presented for consideration [2].

In education field, there are several types of interactive learning systems:

i. Online discussion

This category includes chat rooms, moo's & muds where the interactivity is between the student, instructor and other collaborators.

ii. Posting based discussions

This category includes list serves and bulletin boards where the interactivity is extended over a longer period of time but is still between the student, instructor and other collaborators.

iii. Hypertext

The interactivity is between the student and the subject matter.

iv. Computer-assisted instruction (CAI)

The student and the computer interact, with immediate feedback on a tutorial basis.

v. Simulations

The learner, and sometimes other collaborators, interacts with a model or scenario representing a real situation

For this project, the interactive learning system will be focused on Single Phase AC Power Transformer only, through three interactivity bases:

#### Computer-assisted Instruction (CAI)

The end user will interact with the system, with immediate feedback on a tutorial basis. There is tutorial section in the system, where the student will be assessed through tutorial on each topic/section.

#### Hypertext

There is calculation interactivity (self calculation) placed in this system, where the users enter the value to obtain the desired values, such as voltage regulation, efficiency, including the transformer transformation. The calculation is being done fully by the calculation module programmed in the system.

#### Simulations

In this system, there is some simulation that should be done within the system itself. Each section will provide a simulation session which is called “virtual lab”, in order to enable the student to understand the real situation of each topic through simulation scenarios.

Thus, through this system, as it is including all related aspects that related to Single Phase AC Power Transformer, so it will be easier for the user to understand the concept virtually interactive.

## 1.2 Problem Statement

As the world is now facing the Information Technology (IT) era, almost every aspect of lifestyle are adapted to the system gradually. Living in the era, the students are more exposed to the computer. Almost everything that they do needs the assistance of computer, such as assignments, and finding resources for their additional

knowledge (learning process). Learning is primarily the process through which we become the human beings we are, and it involves a variety of media, strategies, and processes, of which interactive multimedia is just one. Using these media and technologies, we get the information and knowledge from the outside world and then interpret them in our own level of knowledge [3].

Aside from changing the character of the traditional classroom, technology has had the potential to change another facet of education—textbooks. The development of computers made it possible to automate programmed instruction, which marked the beginning of educational software. The development of inexpensive graphic video terminals made it feasible for educational software to include graphics with text. More recently multimedia computers have enabled instructional designers to include audio, video and animation in their products.

Although educational software has been developed for several decades now, it has not eliminated the need for traditional printed materials. Again, it may be that printed materials will remain a key element of education in the future. Nonetheless, the importance of educational software, if only to supplement the classroom and textbooks, is well accepted. Among the challenges is the need to train teachers to effectively use technology and to assure a plentiful supply of high-quality educational software. However, that there is currently too little high-quality educational software available—particularly at the more advanced educational levels. Although new technology, such as inexpensive multimedia computers that can reproduce digitized audio and video, has increased interest in developing educational software, one of the key obstacles is the high cost of production. Actually, it is difficult to make a profit developing educational software. The problem is a combination of high cost and low demand. Improved tools for developing educational software should make it possible to reduce production costs. Increasing the demand is a more complex problem, however. The low demand is due, in part, to limited funds available to school systems. It may also be due, in part, to a perceived low benefit compared to the cost. Clearly, finding ways to produce such software less expensively and demonstrating its benefit would both contribute to the greater production of such software in the future.

### 1.3 Project Objectives

The objectives of this project are:

- To develop an interactive learning system for AC Power Transformer.
- To design the interactivity of the system by following the seven principles of multimedia design. Below are the principles:

i. Multimedia Principle

The instructional environment involves words and pictures rather than words or pictures alone. Actually, this is the basic principle of the interactivity in a coursework system. Here, there will be instruction for the users on how to operate the system by themselves. Through simple instruction, they will experience such a real learning scenario, though they just do it virtually through the interactive coursework system.

ii. Modality Principle

The instructional environment involves auditory narration and animation rather than on-screen text and animation. Another aspect that should be taken into consideration upon the construction of the system is the auditory of the narration and animation. Here, some relevant audio setting will be added into the system, so that the users will be enjoying the whole learning session of i-LAPT, not only visually, but audibly as well.

iii. Redundancy Principle

The instructional environment involves narration and animation rather than on-screen text, narration, and animation. It cannot be denied that every interactive courseware is involving with the instructional environment. This includes narration and animation. So, according to this principle, the system will be providing a redundant instructional environment in which combining both narration and animation.

iv. Coherence Principle

The instructional environment is free of extraneous words, pictures, and sounds. A logic relationship between these elements is a must for any courseware as the users will be evaluating the relevance of such elements throughout the system they used. To avoid this, all the elements were being examined for their suitability before they could be included into the system.

v. Signaling Principle

The instructional environment involves cues, or signals, that guide an individual's attention and processing during a multimedia presentation.

vi. Contiguity Principle

Words or narration and pictures or narration are presented simultaneously in time and space. As this is the interactive learning, so the narration, pictures, and words are combined together for the whole coursework of this system. Through this, the users will be able to get the theoretical knowledge regarding AC Power Transformer, as well as their imaginary concepts virtually. This will save their time where they do not need to find book, place and hardware to learn such basic concepts of AC Power Transformer.

- vii. When individuals experience concurrent narration and animation in short, user-controlled segments, rather than as a longer continuous presentation. This is the overview idea of interactive learning system which is developed in this system. Basically, in this i-LAPT system, the users will no longer experience the continuous presentation, for example in the lecturing session. So, this system is designed by also considering this aspect.

## 1.4 Project Scope

Electrical engineering discipline is dealing with many types of electrical machines and devices. One of the important basic devices in Electrical Power system is the AC Power Transformer. In electrical engineering field, there are various kinds of power transformer. The most basic type is the Single Phase AC Power Transformer. To become an expertise in Power Transformer, one should know every basic concept of the transformer by studying the single phase AC power transformer first. Therefore, the scope of this project is limited to the study of single phase AC Power Transformer only. And the highlighted topics will be:

1. Magnet and Magnetism
2. Alternating Current System
3. Basic Transformer
4. Electromagnetic Force Equation of Transformer
6. Transformer's Equivalent Circuit
7. Voltage Regulation
8. Efficiency
9. Transformer Testing – Open Circuit/Short Circuit Test

These topics are essential and adequate for the learning of Single Phase AC Power Transformer.

## 1.5 Project Significance

This project is to develop such a learning system for Alternating Current Power Transformer. Anyway, this is not an ordinary system, as the system that will be developed is an interactive learning system. So, the end user of this system will be experiencing a different method in learning the AC Power Transformer. Now is the time for the classroom of the future.

Technology tools are enabling interactive education (IE) to become strength in developing a worldwide culture of learning. IE will foster life long learning. Learning

will be assisted by feedback between the student and the computer or other collaborators [4]. Education will consider individual differences and depend on what the learner achieves, rather than the length of the program. This should be implemented in the engineering field, as engineering itself refers to the application of science and technologies into the real life of the world.

Particularly, AC Power Transformer is among the important utility of the power system, which the students of Electrical Engineering field should know, and in other words should be on their finger tips. As this system will cover all basic concepts of AC Power Transformer, it is hoped that it would provide a significant input to the users.

## **CHAPTER 2**

### **LITERATURE REVIEW**

The construction of the system requires a lot of set ups. This is so, in order to provide a relevant and adequate system for the users. The review for this system could be classified into two aspects, which first, is related with the theories and analysis of the transformers in the electrical engineering aspects. Another one is the review of the system through the various commercial outcome that produced by certain companies and individuals.

#### **2.1 AC Power Transformers**

##### **2.1.1 History of Transformers**

The success of the transformer is reflected in how important and transparent this technology has become in many modern electrical devices. This was not always the case as the transformer was first developed in the late 1800's and revolutionized the electrical distribution industry. The first practical transformer was showed to the public in 1883 at the Royal Aquarium of London by a Frenchman, Lucian Gaulard, and an Englishman, John Dixon Gibbs. While neither man was an electrical engineer, they discovered that electricity can be transferred over long distances to light incandescent lamps. This theory was demonstrated in 1884 where lamps were powered in Rome, Italy via a power plant located in Tivoli.

George Westinghouse heard of this invention, bought the rights and instructed one of his engineers, William Stanley, to study its commercial viability. The Gaulard-