AN INTERACTIVE LEARNING ON LOAD FLOW ANALYSIS (I-LOLA)

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MAY 2008

"I hereby certify that I have read and understood the following project thesis. To my opinion, this thesis is sufficient in term of scope and quality in term of scope and quality to achieve partial fulfillment of requirement for the Degree of Bachelor in Electrical Engineering (Industrial Power)."

Signature :.....

Name of Supervisor : Puan Jurifa Binti Mat Lazi

Date : 7 May 2008

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

Faculty of Electrical Engineering
Universiti Teknikal Malaysia Melaka

MAY 2007

"I hereby declared that this report is a result of my own work except for the works that have been cited clearly in the references".

Signature : .....

Name : Mohd Faqruddin Bin Che Ishak

Date : 28 April 2008

Specially dedicated to my beloved family,

Che Ishak Bin Ibrahim

Rohani Binti Othman

Mohd Fawwaz Bin Che Ishak

Mohd Fazreen Bin Che Ishak

Nur Athirah Farhanin Binti Che Ishak

Nur Amirah Farhana Binti Che Ishak

Puan Jurifa Mat Lazi, Puan Hakimah Abdul Aziz, and all my friends,
Thanks for guidance and support...

Mohd Faqruddin Che Ishak
Faculty of Electrical Engineering, UTEM
June 2004 – May 2008

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ABSTRACT

This project aims to analyze the power flow with the simulation and also to do the learning module about load flow analysis. Nowadays, the improvement of technologies such as internet has used widely by users especially students to gain knowledge. E- learning is the perfect method of learning, instead of old teaching in class. As we know, power flow studies, form an important part of power systems analysis. They are necessary for planning, economic scheduling, and control of an existing systems as well as planning its future expansion. The users will be able to determine the magnitude and phase angle of voltage at each bus and active and reactive power flow in each line with "self calculation" which are programmed in "Macromedia Flash MX". The users also will be able to know the power flow direction which supported with colorful icons. Using "Power World Simulator", the simulation on load flow analysis will show more specifically what is going on this topics. From the interactive learning program, the users especially student will enjoy and can experience also mastered in this topic.

ABSTRAK

Tujuan projek ini adalah menghasilkan satu modul pengajaran berkomputer (e-learing) dan membuat dan membuat satu analisis bersimulasi tentang Aliran Beban. Pada masa kini, kecanggihan teknologi contohnya internet telah digunakan secara meluas oleh orang ramai terutamanya pelajar untuk menambah ilmu pengetahuan. Modul pembelajaran elektronik ini merupakan satu kaedah yang berkesan berbanding cara pembelajaran lama di dalam kelas(menggunakan papan putih misalnya). Sebagaimana yang kita ketahui, pengajian tentang Aliran Kuasa menjadi satu bahagian yang penting dalam analisis sistem kuasa. Ianya amat penting untuk merancang, penjadualan yang ekonomik (penjimatan), dan mengawal sistem yang ada untuk merangka sistem untuk masa hadapan. Dengan "Pengiraan Sendiri" yang telah ditetapkan didalam Atucara Flash MX, para pengguna boleh menentukan magnitud dan darjah fasa bagi voltan pada setiap bas dan juga dapat menentukan kadar aliran kuasa aktif dan kuasa reaktif pada setiap talian. Selain itu juga, para pengguna juga akan dapat mengetahui arah aliran beban yang akan ditunjukkan oleh grafik dan ikon yang berwarna warni. Menggunakan atucara simulasi " Power World Simulator", para pengguna boleh menerokai dengan lebih mendalam tentang aliran beban ini. Menerusi program pembelajaran interaktif ini, para pengguna terutamanya pelajar boleh menghayati dan menguasai topik analisis aliran beban dengan mudah.

This project is been developed based on the problem arise related to Load Flow Analysis. The common problem are usually the understanding on Load Flow Analysis. Actually people especially student had a problem on how to calculate the line flow and losses using Newton- Raphson and Gauss- Seidel.

The other problem is, difficulty of getting information on power system analysis specifically on load flow analysis. Nowadays, the teaching method was used make students bored to learn from book and they also can't experience and mastered the subject themselves.

So, by Interactive Learning On Load Flow Analysis, and also the simulation using Power World Simulator, it will be the good alternative for student to study with more interesting.

1.4 Report Structure

In this report, it consist of eight chapters namely Introduction, Literature Review, Load Flow Analysis Theory, Project Methodology, Software Development, Project Result, Analysis on Load Flow, and Conclusion.

i. Introduction explained about the important of e-learning nowadays and to targeted audiences. It also explained about the project scope that will guide throughout this project development.
ii. Literature Review described about e- learning journals. These journals helped as guidelines and gave a brief idea about what e- learning should have and how to implement it in educations and engineering world.
iii. Load Flow Analysis Theory chapter consists of the formulas and theories that are being used related in Load Flow Analysis such as line flow and losses, power flow solution, and others.

iv. Project Methodology defined the method that being used in developing the e-learning project. This method helped to organize time and work so that the project runs as planned.

v. Software Development described the process of how the software is being developed from phase to phase. It also showed the advantages usage of Macromedia Flash MX in developing the project interactively.

vi. Project Results showed the results that have been achieved throughout the project development. It also stated target audiences for this project and benefits to people as this project helps in various ways.

vii. Analysis of Load Flow Using Power World Simulator chapter described the simulation that have been made to analyzed the load flow. It showed the power active and reactive also the losses that we can simulate.

viii. Conclusions discussed about future development, suggestions and improvement that can be added to the project in the future.

CHAPTER 2

LITERATURE REVIEW

This chapter reviews existing project created to get an idea about the project design, conception, specification and any information that related to improved the project. This literature review includes studies, research and software development concerning on load flow analysis application, behavior and design as they related to e-learning development.

2.1 Introduction

What is Electronic Learning Module? When talk about e-learning, some people say its only can run via internet. Actually, E- Learning allows users to learn anywhere and usually at any time, as long as users have properly configure with computers or cell phones.

2.2 Previous E- Learning

To make the interactive electronic learning module, a few literature review have been made regarding to make flash more interesting. Actually from the UTEM Portal, the several research have been made regarding to flash project.

Mrs. Aida Fadzliana, Mrs, Jurifa Mat Lazi and Zairusfaizery Jopeny has made Computer Aided Education On Three Transformer. They discuss about three phase transformer including theory, also the lab simulation on transformer.

Another e-learning produced by Mrs. Jurifa and Mrs. Aida Fadzliana topic on My Intelligent Electric Cost Systems. They show the best power consumption to use the electrical equipment to decrease the cost of electricity.

2.3 Journals Related To E- Learning

Basically, internet is the best way to gain information about topic that being search about beside using books. Journal search on internet indicates various types of comment and topics regarding the usage of e-learning. From the IEEE Explorer, the several journal have been research beyond the expectation on load flow analysis.

By J.M Ngundam and F. Kenfack, they do the Interactive Design Of Power Networks and load-Flow Analysis. They have made the virtual lab for power sytem simulation and the others thing is the compare between use Newton-raphson and Gauss-Seidel method.

By Shannon McCall, Georgia Institute Of Technology, she do An Educational Tools For Load Flow Analysis With Electromechanical Interface. The paper describes a new combination of hardware and software being developed at Georgia Tech as a learning tool for power system steady state analysis

2.4 Conclusion of Reviews

From the studies, researches and software development above, it were obvious that e-learning systems have provided a better strategy and understanding for teaching,

learning, administration and system development. E- learning will become one of the most important means for the education and as a medium delivering knowledge and information, especially for universities and the outside world in the future.

CHAPTER 3

LOAD FLOW ANALYSIS THEORY

3.1 A Brief History Of The Power Flow

A brief history of power flow have been recorded by Fernando L. Alvarado and Robert J. Thomas. It describes how power flow was calculated in beginning introduction of load flow.

Improved economy and reliability were recognized well over half century ago as benefits of using an interconnected network for the transport of electric power. But critical to its realization was (and still is) the ability to predict the voltages and flows on network components. As the networks evolved, the challenge was to develop a tool that would produce this critical information. The load- flow, as the tool came to be known, predicts all flows and voltages in the network when given the status of generators and loads. It is the tools most heavily used by power engineers.

Early load- flows were solved using what were called calculator boards. These boards were a kind of analog computer, in that they emulated a specific system by using a physical lumped- parameter resistor-inductor-capacitor realization of the actual system, the components being connected in the same topology. For a realistic system, these boards filled several rooms, consumed substantial power, and had to be rewired when any modification was desired. As studied often required teams of engineers

working in unison adjusting knobs and settings and reading out results aloud, the need for a flexible alternatives was clear.

Enter the modern digital computer, which, in fact, owes much of the impetus behind its original development to power engineers and their need for a better way to solve load-flows. In the early days of computing, the electric power business was by far the largest commercial user (and even developer) of digital machines. It was not unusual for a utility to spend several million dollars (not adjusted for inflation) on the development of digital hardware and software. While IBM Corp. was advancing mainframe machine architectures, theorists were publishing the first papers on load-flow algorithms.

The earliest algorithms were based on the Gauss- Seidel method, which made it possible, for the first time, to solve the load-flow problem for relatively large systems. It suffered, however, from relatively poor converges characteristics. Then the Newton algorithms was developed to improve the convergences of Gauss- Seidel method, but was initially thought to be impractical for realistically sized systems because of computational problems with large networks. The underlying problem for the iterative Newton method is the solution of a matrix equation of large dimension.

In the 1960's Bill Tinney and his colleagues at the Bonneville Administration observed that, although the main systems matrix was very large, it was also very sparse (meaning it had a very small proportion of nonzero values). This observation gave rise to the development of sparsity methods. The concept made it possible to apply the Newton method to systems of arbitrary size, to attain for the first time both speed and excellent convergence characteristics.

Since the '60s, numerous advances and extensions have been made in load-flow methods. In the early '70s came the fast-decoupled load-flow methods, which enhanced computational speed. Extensions to the load-flow itself included the representations of components such as high- voltages direct- current (HVDC) transmission lines, better

methods for loss calculation, solution of the continuation power flow, and the determination of spot prices of electricity in the presence of constraints – plus, of course, the development of better ways of visualizing and presenting load-flow results.

3.2 Power Flow Solution

In power flow, there were several types to make solution on load flow problem, focusing on determine the voltages magnitude, power flow and losses and others manually. Focused on Newton – raphson and Gauss- Seidel solution which are famously used in settle the problem indicated.

3.2.1 Newton- Raphson Power Flow Solution

For large power systems, the Newton- Raphson method is found to be more efficient and practical. The number of iteration to obtain a solution is independent of the system size, but more functional evolutions are required at each iteration. Since the power flow problem real power and voltage magnitude are specified for the voltage-controlled buses, the power flow is formulated in polar form.

$$I_i = \sum_{j=1}^{n} |Y_{ij}||V_j| \angle \theta_{ij} + \delta_j \qquad (3.1)$$

3.2.2 Step Using Newton- Raphson

1) Obtain the Y bus
2) Identify your Newton Raphson equation

$$\Delta c^{(k)} = i^{(k)} - \Delta x^{(k)} \qquad (3.2)$$

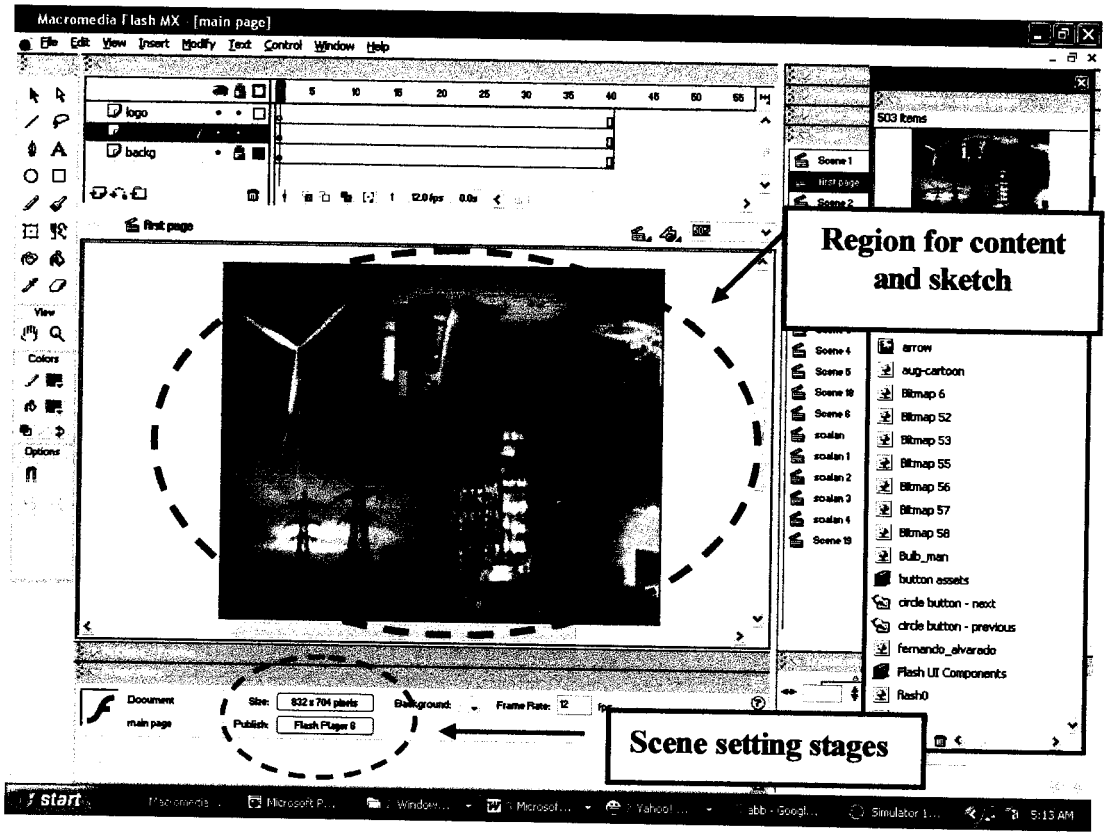

Figure 5.1 : The setting stages and sketched content

5.1.3 Implement The Suitable Colour and Graphic

The next phase is to identify a suitable colour and graphic based on the project topic and then implement into the scene. For example, the operations of generator, transmission line, load and busbars need the symbols or graphic that represent them in attractive ways. For this example, the picture of factory has been decided to represent the load. Background colour or graphic should be decided, as the scene can look more elegant or beautiful suitable with the content.

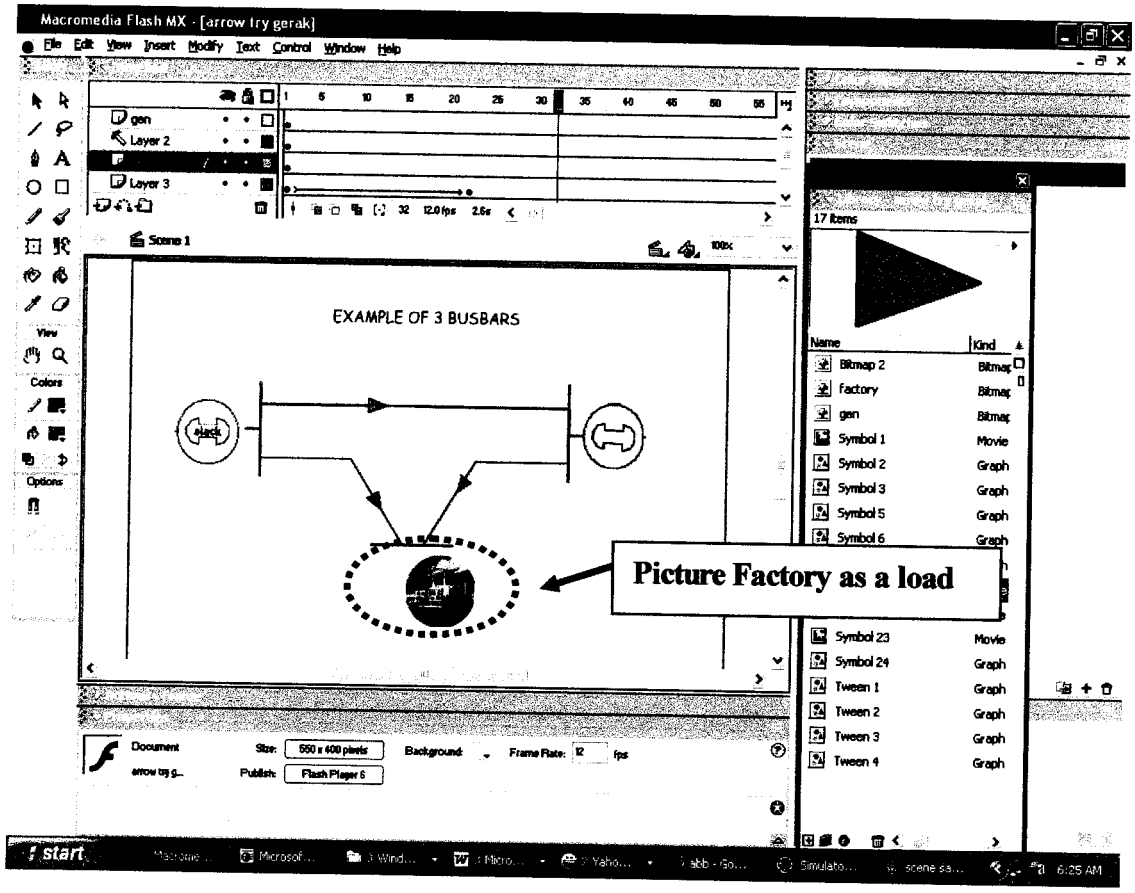

Figure 5.2 : Implement suitable graphic and colour

5.1.4 Develop Proper Animation

After implementing a suitable graphic, the next phase that must be done is to decide the proper animation for content. This animation offer interactive looking for the content of the project. User can easily understand the text of the content which has been explained with proper animation. For this example, the animations of arrows that move along the transmission line represent the Active Power, P and Reactive Power, Q has been decided. This animation explains the basic operation of load flow analysis.

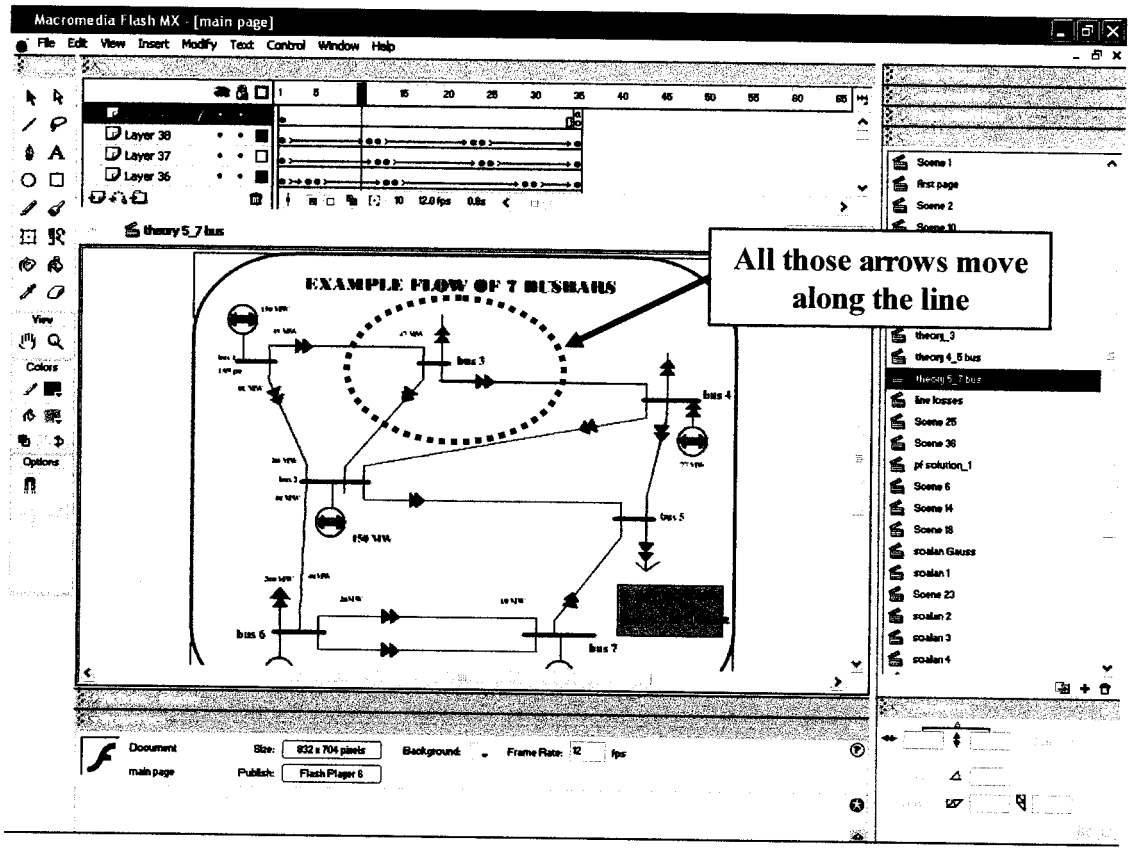

Figure 5.3: Developing a proper animation

5.1.5 Building Navigation

The next phase is developing the navigation, navigation in this flash are important aspect which it plays the main role to move to another scene or content. The navigation has been made up and set up by assigned a script that will play a frame or external movie clip into a button. As the objective of project which requires this project software to be user- friendly software, this navigation would help to achieve the objective. The navigation can helped user easily to navigate the control of the software; as example user can easily go to main menu or sub menu by clicking the navigation button. Actually there a few button that was imported from the internet to give the best motion instead of the bttuon library which have been provided in Macromedia Flash MX.

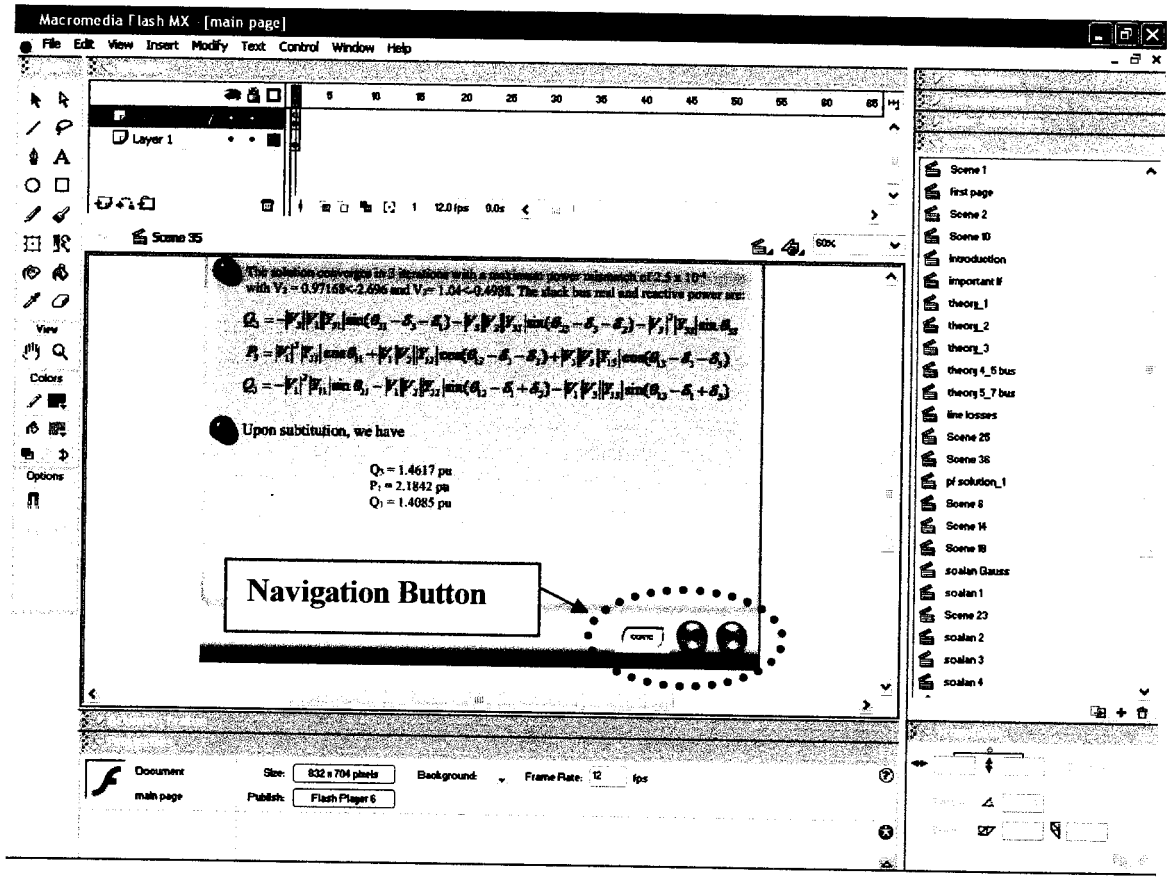

Figure 5.4: Building a navigation button

5.1.6 Test Movie

This the last phase requires to test a movie of the scene that already been developed. At this phase if problem occurs, such as the animation won't animate or navigation can't be link other frame or external movie clip, analyzing the problem frames must be done. For this, refer to the actions toolbars and identify the problem frame must be done. If this problems happen, the actions toolbars must be referred to identify the problems within the action script. Usually Macromedia Flash MX will identify and show the error within the action the action script. After the problems have been fixed, the scenes will start over again for the contents when the test movie is running.

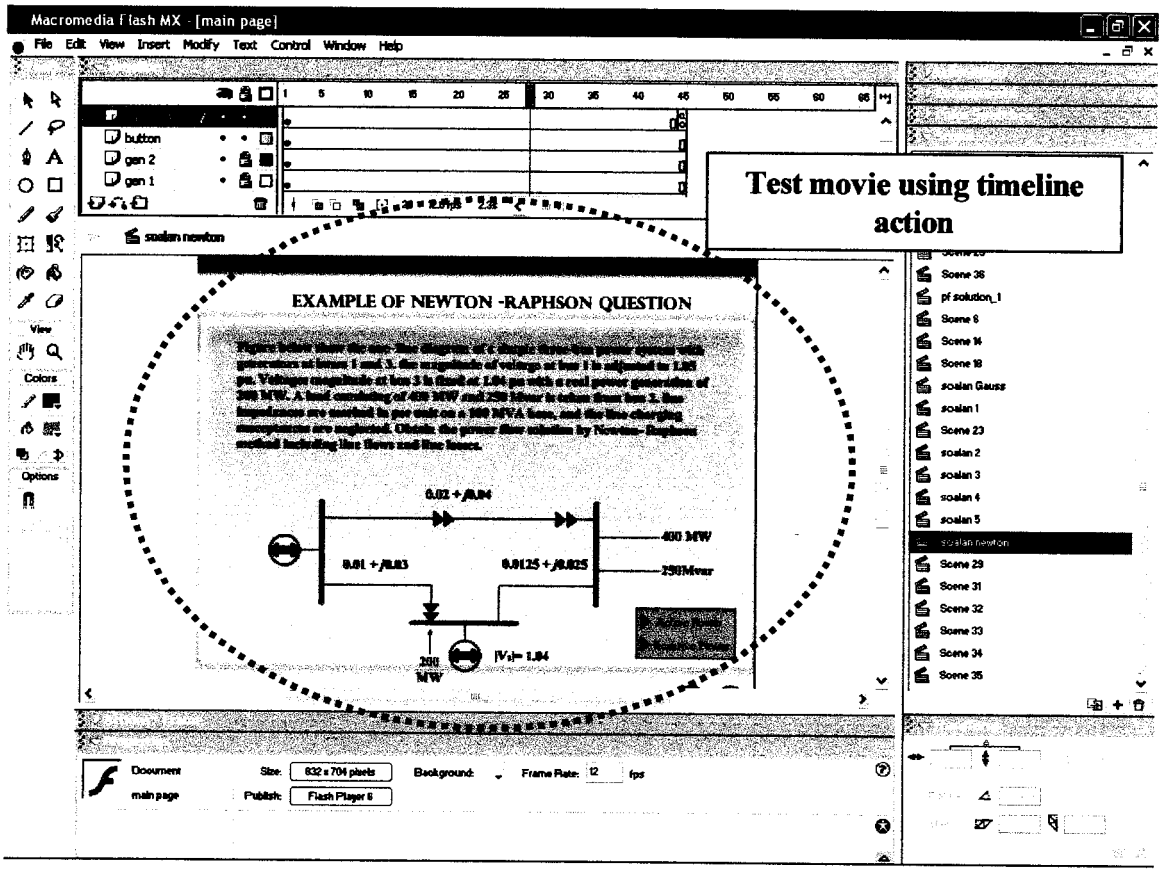

Figure 5.5: Testing a movie

CHAPTER 6

PROJECT RESULTS

6.1 Introduction

In brief, e- learning is the the delivery of education through the application of information technology. Most people are familiar with the phrase e- learning as distance based learning, primarily using the Internet. Actually, it can also be implemented using 'offline' software and hardware such as CD- ROM based courses, technology based learning material.

Most schools, college and other educational institutions are strong recommend of this type of learning (both 'online' using the Internet and 'offline' using the computers). Actually this ways of learning can also be implemented in a business/ commercial environment and can have many benefits for both employer and employee in terms of improving existing skills and learning new ones.

One of the key factors in helping this type of learning t become so widely used is the ability to communicate rapidly to other people by using e-mail, instant messaging program, shared electronic workspace such as virtual whiteboard and other interactive communication technologies.

6.2 Target Audience

For An Interactive Learning Oon Load Flow Analysis (ILoLA),a few target audiences have been listed out.

i. Instructors and students
ii. Engineers and technicians

6.2.1 Instructors and students

This e- learning is used for instructors to guide and to teach the learner a new way to study. This facility can be used together with the use of e-mail for the learner to interact with the instructor. Meanwhile for the students, this e- learning can help those who feel shy about speaking up in a lecture hall or classroom may be more likely to ask their questions in this environment.

6.2.2 Engineers and technicians

E- learning helps engineers and technicians to learn something new fast and directly. Also with the e- learning, time and money can be saved by the company with travel expanses may be spent just on getting the company's e- learning program up and running.

6.3 Project Results

Here are some screenshot showing the results that have been achieved throughout this project development.

6.3.1 Introduction

In this chapter, it discussed about the uses and important of load flow analysis.

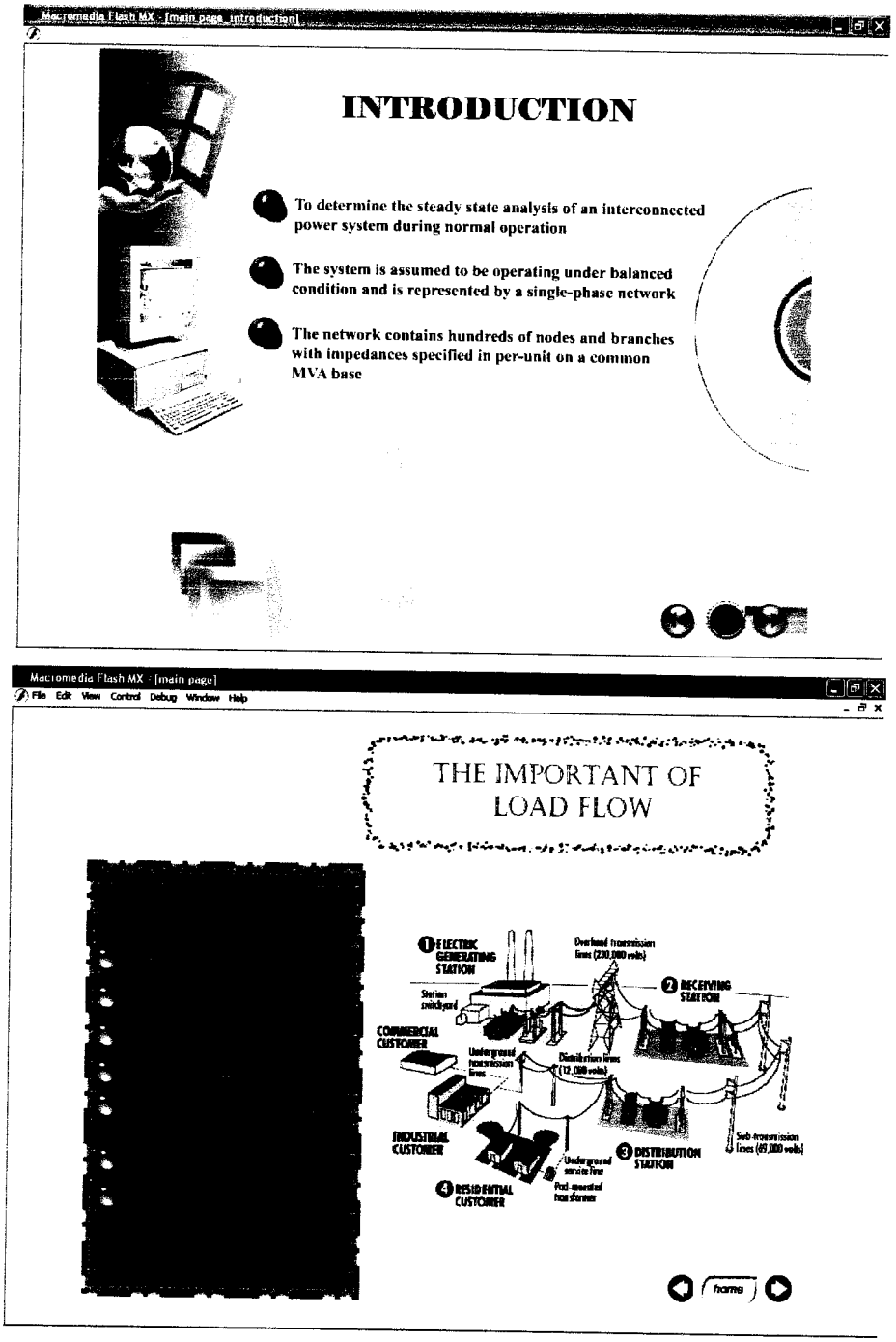

Figure 6.1 : The screenshot of the introduction of load flow analysis