" I admit that to have read this report and it has followed the scope and quality in partial fulfillment of requirements for the degree of Bachelor of Electrical Engineering (Power Electronic and Drive)"

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Date :.....4TH MAY 2007 .....

AN AUTOMATED SYNCHRONISING SYSTEM FOR ELECTRICAL MACHINE LABORATORY (PART 2)

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This Report Is Submitted In Partial Fulfillment of Requirements for the Degree of Bachelor in Electrical Engineering (Power Electronic and Drive)

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 excerpts that have been cited clearly in the references"

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This dedicated to my beloved father and mother

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ABSTRACT

"An Automated Synchronizing System For Electrical Machine Laboratory (Part 2)" project starts with learning all the process in this project and focusing more about Vrms, phase difference and signal conditioning. At the same time, this project will also help student for deeper understand about the synchronizing requirement for the 3-phase synchronous system and able to observe in real time reading for the frequency waveform, phase sequence, Vrms, phase difference another synchronization phenomena. Actually, this project is divided in two parts which are hardware development and software development. Signal conditioning is also used to obtain the suitable output which to be connected to input of data acquisition card (DAQ). For the software part, LabVIEW software is used to program and display the output (result) virtually on the computer and control the system. And it also able to trigger the hardware synchronous switch to turn on once the systems achieve the synchronization requirement. In addition, this project consists of synchronous generator and DC motor as the prime mover. As a final result, this project is expected to be an important exposure to the student on the conditions required for the synchronisation process.

ABSTRAK

Projek *"Sistem Segerak Automatik Untuk Mesin Elektrik Di Makmal (Bahagian 2)"* bermula dengan memahami keseluruhan proses dalam projek ini dan ia lebih memfokuskan berkenaan Vrms, perbezaan fasa dan rupabentuk isyarat. Pada masa yang sama projek ini juga akan membantu pelajar untuk lebih memahami secara mendalam tentang apa yang diperlukan dalam proses persegerakkan bagi talian tiga fasa untuk sistem segerak. Selain itu ia mampu memberi bacaan secara langsung pada masa itu juga untuk gelombang frekuensi, turutan fasa, Vrms, perbezaan fasa dan lain-lain dalam suatu fenomena persegerakkan. Sebenarnya projek ini terbahagi dalam dua bahagian iaitu bahagian pembangunan perkakasan dan pembangunan perisian. Sistem rupabentuk isyarat juga digunakan bagi memperolehi keluaran yang sesuai yang mana perlu bagi penyambungan pada masukan *data acquisition card (DAQ)*. Untuk bahagian perisian, *LabVIEW software* digunakan sebagai aturcara untuk memaparkan keluaran sebenar pada komputer dan mengawal sistem tersebut. Dan ia juga mampu memicu suis perkakasan segerak bagi menghidupkan sesuatu sistem itu untuk mencapai keperluan persegerakkan. Tambahan juga, projek ini mengandungi penjana segerak dan motor DC sebagai penggerak primer. Bagi keputusan akhir, projek in adalah penting untuk pendedahan kepada pelajar tentang syarat yang diperlukan bagi proses persegerakkan.

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LIST OF ABBREVIATIONS

TNB	-	Tenaga Nasional Berhad
VI	-	Virtual Instrument
LabVIEW	-	Laboratory Virtual Instrument Engineering Workbench
DAQ	-	Data Acquisition Board/Card
Vrms	-	Voltage of Roots Mean Square
NI	-	National Instrument
RPM	-	Radian Per Minutes
PSM 1	-	Projek Sarjana Muda 1
PSM 2	-	Projek Sarjana Muda 2
I/O	-	Input / Output
DC	-	Direct Current
PC	-	Personal Computer
LED	-	Light Emitting Diode
TTL	-	Transistor-Transistor Logic

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CHAPTER 1

INTRODUCTION

In today's educational institute, especially in electrical engineering subject, students are often required to conduct practical experiments in the laboratory. The practical experiment will employ equipment under test, such as the three-phase induction motor, synchronous generator and others are connected to three-phase mains. Obviously, three phase current and voltages are parameter of interest in the experiment. In order to obtain the parameters, one must measure it [1].

In this project, LabVIEW is used to develop the front panel- based automated system to display three-phase output voltage (Vrms) and phase differences in electrical machine. This project contains two parts, which are hardware and software development. For hardware part, the generator and DC motor are using as prime mover to generate power for three phases output, and then compare them with TNB main supply.

With the use of LabVIEW, students can see real-time effects of an experimental variable on the real power, reactive power and phasor quantities and the spectral representation of AC signals. For example, we can immediately see the result of the loading a motor, changing supply voltage or changing a connection [5].

So, in this case if students have any knowledge about this software, they just spend a small portion of time to get something related with the situation. In addition, student will familiar and know-how to use those new method. Even in modern generation now, they already alert with the situation and at the same time can solve the problem.

1.1 Project Objective

The objective of this project is:

i) To construct the signal conditioning hardware and collect data of output parameters and at the same time calculation is carried out in software for other needed parameters like three-phases output voltage (Vrms), Phase differences, Frequency and Phase sequence.

ii) To create and develop an interface panel for electrical measurement using LabVIEW software.

iii) To show the process for determination of phase differences and Vrms using LabVIEW software during the process of synchronization between TNB main and synchronous generator.

iv) To expose and help student to understand the synchronizing process for the synchronous generator and TNB main in LabVIEW graphical user interface.

v) To develop drive circuit for control stepper motor.

vi) For the last, this project is expected to become an automatic synchronous switch when the all the parameter is match to synchronization.

1.1 Project Scope

The scope of this project is:

i) To generate drive with control of field current of synchronous generator.

ii) To do an analysis for the parameter by using the LabVIEW software and able to transfer the collected data and result of analysis in graphical user interface to observe real time Vrms waveform and phase difference at synchronisation process.

iii) To construct the signal conditioning hardware to match output which to be connected to input of the data acquisition card (DAQ).

1.3 Problem Statement

Actually, for this project the problem coming from the less of knowledge about how to use LabVIEW software and at the same time do not know to create graphical user interface. To understand and familiar with all part in this project is obviously taken a longer time. For new engineering students, becomes so hard for them to understand how to use and try to continue the experiment.

In another part, some problems associated with the signal conditioning of the electric drives, such as the high voltage interface and noise isolation. For this purpose, dielectric isolation or optocouplers are extensively used [6], [7] and [8]. Also, the computer-based data acquisition (DAQ) systems make use of relatively simple interface circuits.

However , most DAQ boards have few input channels, and furthermore if differential voltages are sampled, this number of channels is halved. These limitations prevent commercially available DAQ products to be connected to high voltage devices such as ac induction motors.

To overcome this problem, the circuits proposed in this study allow the high voltages and currents as well as RPM data to be interface to a DAQ board. In this project, the interface intended for ac applications convert signals into RMS, thus reducing the software complexity and the additional computer processing requirement.

Finally, the problem coming from unsuccessful to develop output signal from stepper motor drive and try some other alternative way to solve the problem. However, the result is slightly differ with the one from theory.

1.4 Project Planning

Figure 1.1 show the flow chart of project planning for the PSM 1. The number of weeks in each project need to be completed is representing by the gantt chart. Table 1.1 shows the gantt chart and figure 1.2 shows the flow chart of PSM 2 project planning.

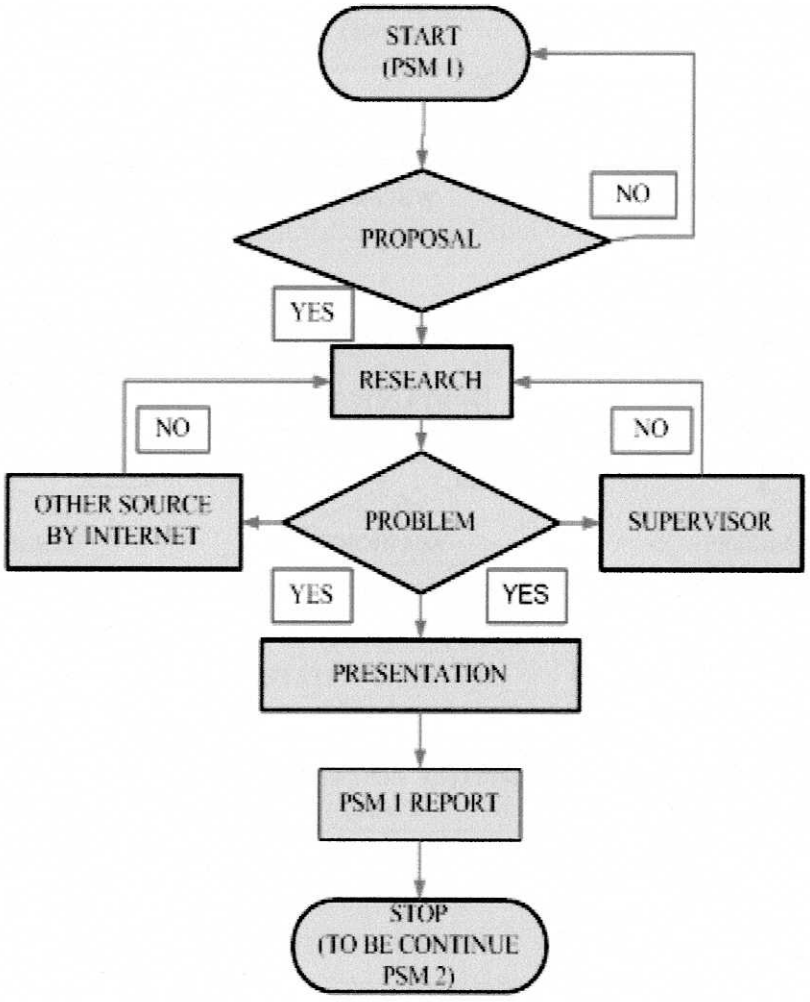

Figure 1.1 : Flow chart of PSM 1 project planning

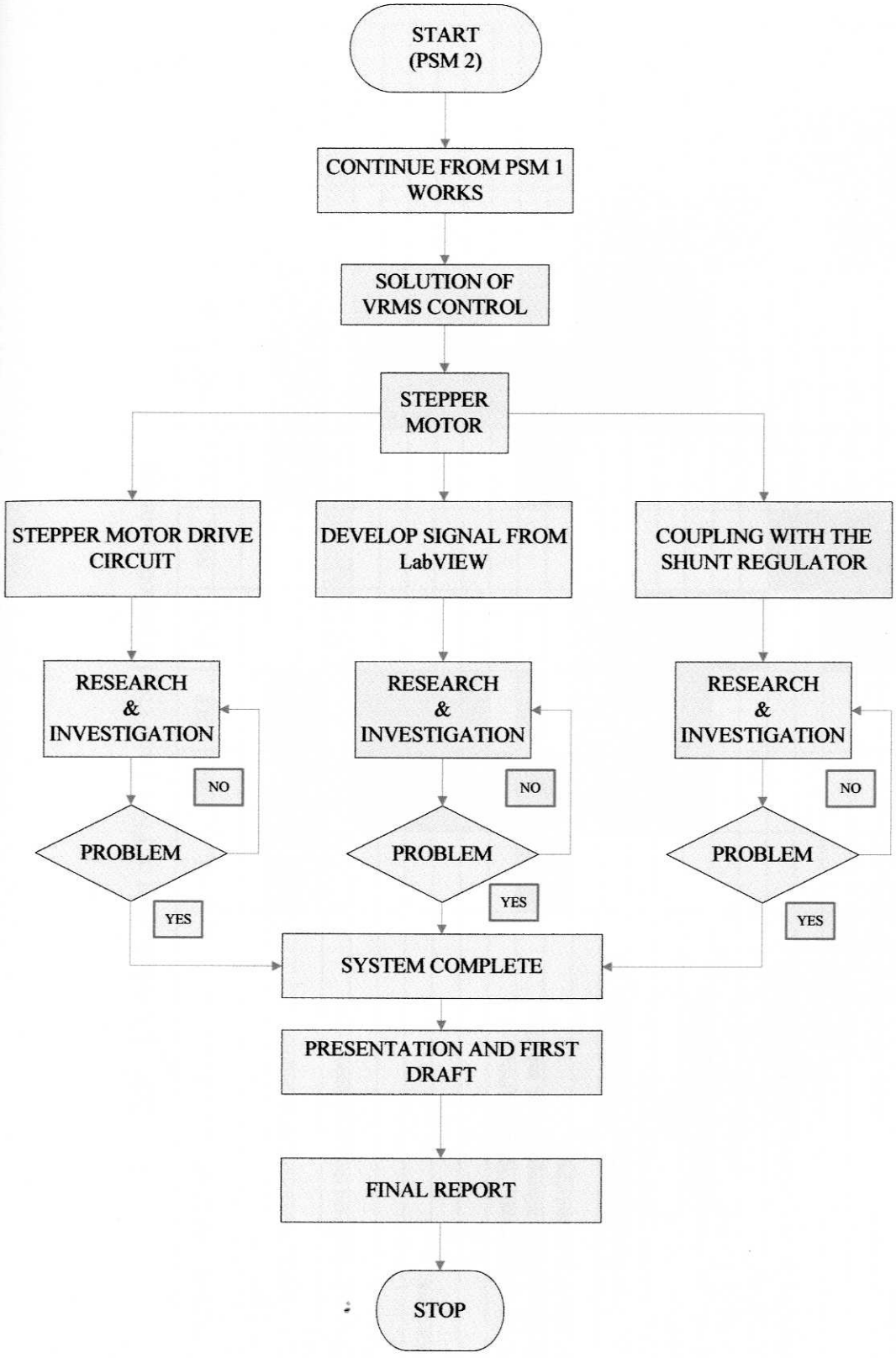

Figure 1.2: Flow chart of PSM 2 project planning

1.5 Gantt Chart

Table 1.1: Gantt chart of PSM 1 and PSM 2 project planning

PROJECT'S ACTIVITIES / MONTH (2006 / 2007)	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAC	APR	MAY
Simple briefing for project / Select of the title											
Clear about the project overview - Hardware & Software - Block diagram											
Survey hardware and equipment											
Study and learn about LabVIEW - try to understand about synchronous system											
Do a block diagram hardware											
Design circuit diagram											
Prepare for PSM 1 and PSM 2 proposal											
Do a block diagram software											
Design Software Architecture											
Submit the proposal project & Borang Pemantauan PSM 1-1 and PSM 2-1											
Survey component & purchase component (Transformers, Mosfet, and others)											
Awaiting arrival of component (Stepper motor and others)											
Start to develop hardware											
Start to develop software & Submit the Borang Pemantauan PSM 1-2 and PSM 2-2											
Do a wiring block diagram , wiring schematic (single line diagram)											
Hardware & software - individual command test											
Continued for Wiring/testing the Borang Pemantauan PSM 1-3 and PSM 2-3											
Prepare for first draft report for PSM 1 and PSM 2											
Submit the PSM 1 and PSM 2 first report											
Prepare for presentation and submit the Borang Pemantauan PSM 1-4 and PSM 2-4											
Presentation week											
Information collection											
Result collection											
Demonstration collection and testing											
Prepare for final report for PSM 1 and PSM 2											
Submit the final report for PSM 1 and PSM 2											

1.6 Literature Study

Increasing automation of electric power system has led to the development of fully automatic synchronization, which still generates great interest, despite a rich literature in the subject and numerous patents. Proper execution of automatic synchronization determines the accuracy and reliability of the electric power system.

Automatic synchronizers manufactured by numerous producers all over the world must be tested. Widespread use of computers for control and adjustment in power plants and stations makes it reasonable to use them also for the tasks, which have been done by the automatic synchronizers. This involves the development of new measuring and computing algorithms, which will allow the computer to execute directly the testing process.

This project presents a simulator used for these reasons and gives some results of experimental research with the simulator. In this project also, LabVIEW software is utilized as the one of application to manipulate input from the user interface or other sources and display that information or move it to other files or other computer. So, in this part some information about the LabVIEW will be discussed.

1.6.1 What is Labview?

LabVIEW is short for Laboratory Virtual Instrument Engineering Workbench. It is powerful and flexible instrumentation and analysis software development application created by the folks at National Instruments company. LabVIEW is the leading graphical development environment for science and engineering with built-in functionality for simulation, data acquisition, instrument control, measurement analysis, and data presentation.

LabVIEW is a graphical programming language that uses icons instead of lines of text to create applications. In contrast to text-based programming language,