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FINAL YEAR PROJECT REPORT

DEVELOPMENT OF HUMAN MACHINE INTERFACE (HMI) AND INTERFACING
FOR LOW VOLTAGE DISTRIBUTION AUTOMATION SYSTEM (DAS)

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**DEVELOPMENT OF HUMAN MACHINE INTERFACE (HMI) AND
INTERFACING FOR LOW VOLTAGE DISTRIBUTION AUTOMATION
SYSTEM (DAS)**

Submitted By:

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A progress report submitted in partial fulfilment of the requirement for the degree of
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(UTeM)

2014

I declare that this report entitle “**Development of Human Machine Interface (HMI) And Interfacing for Low Voltage Distribution Automation System (DAS)**” 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 candidate of any other degree.

Signature :

Name : MOHAMMAD HARIZ BIN ZARIR

Date :

Dedicated, in thankful appreciation for support, encouragement and understandings

To:

My supervisor, Prof Madya Mohd Ariff bin Mat Hanafiah

My beloved father and mother, Zarir Bin Ahmad and Nasiah Binti Nasro

My family members and all friends

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ABSTRACT

In this technology era, the need of electricity is beyond the demand. Such this requirement is to be fulfilled every time. This is because the power distribution system is one of the most important parts of a power system in the delivering electricity to consumers. Therefore, in this study, the Distribution Automation System (DAS) technique was used to solve the problems experienced by the 415/240V low voltage distribution system due to the line under repair or fault. The development of the Human Machine Interface (HMI) and the Interfacing in this project will help to detect and identify fault and restore the system back. Thus, all the equipment can be controlled and monitored remotely.

ABSTRAK

Dalam era teknologi ini, keperluan tenaga elektrik adalah di luar permintaan. Seperti keperluan ini adalah yang perlu dipenuhi setiap masa. Ini adalah kerana sistem pengagihan kuasa adalah salah satu bahagian yang paling penting dalam sistem kuasa dalam penghantaran elektrik kepada pengguna. Oleh itu, dalam kajian ini, teknik Sistem Pengagihan Automasi (DAS) telah digunakan untuk menyelesaikan masalah-masalah yang dialami oleh 415/240V sistem pengagihan voltan rendah seperti wayar sedang diperbaiki atau bersalah. Pembangunan Antara Muka Manusia Mesin (HMI) dan perhubungan dalam kehendak projek ini membantu untuk mengesan dan mengenal pasti kerosakan dan memulihkan sistem semula. Oleh itu, semua peralatan boleh dikawal dan dipantau dari jauh.

MOTIVATION

This project is expected to contribute some improvements to the distribution network management field and also deal with fault occurrence efficiency on the distribution side. By conducting this project, it enables the student to learn about power system management. Besides, it provides a clearer understanding on how to develop the Human Machine Interface (HMI) based on student creativity. The developments of prototype for LV substation panel also give extra knowledge how the substation operates and how to control it. Other than that, this work can be a guideline for the student if want to involve in power system management in future.

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CHAPTER 1

INTRODUCTION

1.1 Project Background

An electrical power system is a network of electrical components that consist of generation, transmission and distribution. These three major part also known as the grid. Each grid may have minor differences between countries due to geographical factors, demand variances, region and etc. These power grids typically transmits electricity in three levels of voltage which are High Voltage (100,000 Volts upwards), Medium Voltage (1000 Volts to 100,000 Volts) and Low Voltage (1 to 1000 Volts). The generation gains its electricity from the power plant system. For the transmission system, it carries the power from the generating centres to the load and the distribution system feeds the power to the consumer [1].

The Distribution Automation System or known as DAS is a complete automation of all controllable equipment and functions in this distribution power system. It enables to remotely monitor, control and regulate the distribution assets and network using connectivity from the substation of the consumer and the distributed resources. This system also optimizes the flow of electricity from the utility to the consumers, and to ensure the system operates efficiently and reliably.

1.2 Problem Statement

A major requirement of the electricity supply systems is high supply reliability for the consumer which is mainly determined by the distribution network. But the disruption on the low voltage downstream 415/240V system such as overloading, line under repair or other fault will cause the interruptions of electricity supply to the customers. Thus, the technicians has to manually locate the faulty point before restore it back and this tedious work may last for extended periods of time.

Considering the extensive size of the network, all problems can be effectively solved. This system of monitoring and controlling of electric distribution networks is known as Distribution Automation System (DAS). Thus, by creating the Human Machine Interface (HMI) and Interfacing between the control room and distribution substation, fault identification, fault clearing task and system restoration of low voltage downstream 415/240V can be done easily using DAS solution technique. Therefore, all faults that occur on the distribution line can be controlled and monitored in order to enhance supply reliability and quicker response to satisfy the customers.

1.3 Objectives

The main objectives of this project are:

- 1) To develop a Human Machine Interface (HMI) for Low Voltage Distribution Automation System (DAS) by using InduSoft Web Studio (IWS).
- 2) To implement I-7188EG controller which acts as Interfacing for the Low Voltage Distribution Automation System (DAS).
- 3) To develop a prototype of a real Low Voltage Distribution Automation System (DAS).

1.4 Scope of Research

The research architecture of Distribution Automation System (DAS) consists of three major parts. The first part involves the study of Human Machine Interface (HMI) which run under the Microsoft Window (XP or above version) platform using InduSoft software. This part provides monitoring for the substation remotely. The second part consists of I-7188EG controller embedded Ethernet. This controller acts as the Interfacing for the DAS. The logic programming will be downloaded into the controller by using IsaGRAF software. This controller is used to handle all the control function between the HMI and substation. Last part is the study of the control circuit in the substation panel that will be used as the I/O modules for the controller.

1.5 Contribution of Project

This project is expected to contribute some improvement to the distribution network management field and also deals with fault occurrence efficiency on the distribution side. By utilizing this system, the effect of fault occurs of 415/240V can be minimized. Besides, it will provide a clearer understanding to the power utility company about the process and the advantages of the Distribution Automation System (DAS). Other than that, this work can be a guideline for other researcher who wants to make improvements of this project in the future.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

In this chapter, it will explain more on the theory and basic concept that have been used to achieve the project objectives. To achieve all the goal, several numbers of studies has been conducted which covered the software and hardware part. Besides, the information about previous work also had been mentioned in this chapter. Thus, this chapter is very important in order to provide a clearer understanding about the system.

2.2 Project Background

2.2.1 Low Voltage Distribution System

In general, Low Voltage (LV) Distribution System refers to an electricity supply with a rating from 1 to 1000 Volts. It serves at the last stage of electric power system as a sources of energy supply for the consumer side. The LV receives power supply after passing through the substations that step-down the Medium Voltage (MV) from 11 kV to 415 Volts. From that, three-phase system (415 Volts) and single-phase system (120/240 Volts) is produced

for the uses of consumer. Figure 2.1 below is shown the overall process of electrical power system from the first stage to the last stage.

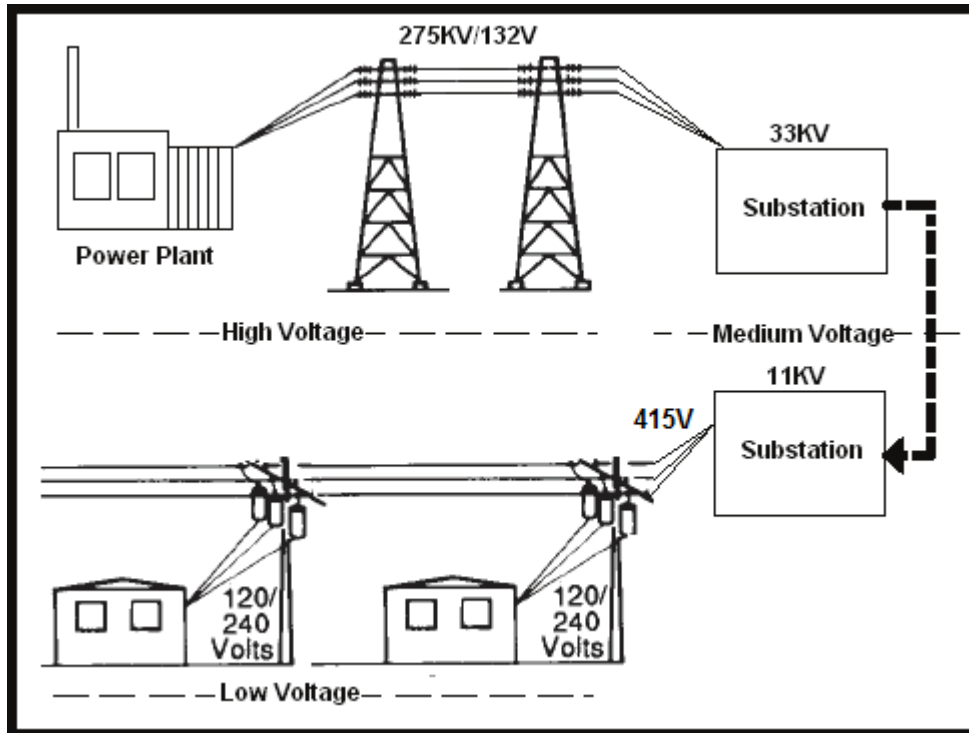


Figure 2.1: Typical Power Production and Distribution Process.

2.2.2 Distribution Automation System (DAS)

2.2.2.1 Introduction of DAS

Distribution Automation System (DAS) is the complete automation of all controllable equipment and functions in the distribution power system. It is basically a system that allows for automatically monitor, computerized control of a utility's distribution facility with little or no human intervention [1]. The main purpose of the distribution automation system is to improve the efficiency of the supply restoration time under unplanned outage condition.

In this system, the electrical parameters and other various quantities are recorded and then have been feed using a data acquisition device called RTU. These quantities are

transmitted to a central computer control through a communication medium. The acquired data is processed and displayed using a Graphic User Interface (GUI). In the event of a system quantity crossing a pre-defined threshold, an alarm is generated. The necessary action will then be determined by the computer and the command will then be sent to the RTU to be executed[1]. Based on Figure 2.2 below, the interconnection of distribution, control and communication system for Distribution Automation System (DAS) is shown.

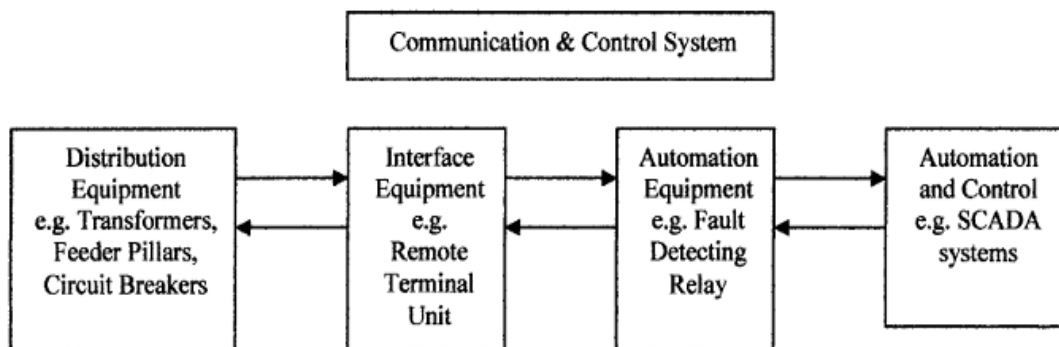


Figure 2.2: Interconnection of Distribution, Control and Communication System[1].

2.2.2.2 The Advantage of DAS

In this millennium age, distribution automation system (DAS) seems to be the best choice to be added to every distribution network. Especially when the system needs for controlling and monitoring from far placed. DAS also gives a big advantage to the utility company in managing the distribution system. There are as follows:

- Increase the distribution reliability by improving the operations and maintenance work.
- Give faster disturbance analysis and fault location.
- Provide asset monitoring for aging infrastructure and avoid asset from overloading.

2.2.3 Human Machine Interface (HMI)

Human Machine Interface (HMI) is a medium that acts as a user interface which allow the user to interact with the machine in a graphical way. It provides a monitoring, controlling and managing a system process. Thus, the user can view all the status and data just from the monitor of the computer instead going directly to the system.

There have several types of HMI software that is currently used in the market. The Table 2.1 describes the details for all the types of HMI that commonly used.

Table 2.1: Type of HMI.

Type	Details
InduSoft Web Studio (IWS)	<ul style="list-style-type: none"> - Enable to build full-featured Supervisory Control and Data Acquisition (SCADA) or HMI applications for industrial automation. - Using build-in language which easier to use.
Visual Basic (VB)	<ul style="list-style-type: none"> - A program that creates an application using the components provided but required higher understanding in programming language.
LabVIEW	<ul style="list-style-type: none"> - System-design platform and development environment for a visual programming language.

2.2.4 Communication Network

Communication network is divided into two groups. There are wired and wireless network. For wired network, it uses cable as a connection medium. Fiber-optic cable, power line carrier (PLC) and coaxial metallic cable are several types of wired network. While wireless network is generally implemented and administered using radio communication. Wireless network also has several types which are a Wireless Personal Area Network (WPAN), Wireless Local Area Network (WLAN), Wireless Metropolitan Area Network (WMAN) and Wireless Wide Area Network (WWAN). Table 2.2 below will describe the advantages and disadvantages of Wired and Wireless network.

Table 2.2: Advantages and disadvantages of Wired and Wireless network.

Type	Advantage	Disadvantage
Wired Network	<ul style="list-style-type: none"> - Ethernet cables, hubs and switches are very inexpensive. - Some connection sharing software packages are free. - Extremely reliable. - Wired LANs offer superior performance. 	<ul style="list-style-type: none"> - Need to run cables in difficult environments through walls, floors and ceilings. - Network cables can disconnect or become faulty consequently causing the connection to fail.
Wireless Network	<ul style="list-style-type: none"> - Mobile computers do not need to be tied to an Ethernet cable and can roam freely within the WLAN range. - It is relatively easy to set up a WAP and configure a WNIC using a wireless connection utility. 	<ul style="list-style-type: none"> - The potential for radio interference due to weather, other wireless devices, or obstructions like walls. - If one major section breaks down, for example the Router, the whole network will be affected.