PLC APPLICATION FOR FLOOD DETECTION AND PROTECTION VIA COMMUNICATION SYSTEM

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This report is submitted in partial fulfillment of the requirements for the award Bachelor of Electronic Engineering (Telecommunication Electronics) with honours.

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka

April 2010

UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
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Signature :

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ACKNOWLEDGEMENTS

With the name of Allah, The Most Gracious and Merciful. Praise to Allah Almighty for giving me the will and strength to go through the industrial training and for giving me opportunity to complete this Final Year Project report successfully.

First and foremost, I would like to express my deepest gratitude and appreciation to my supervisor, Madam Noor Shahida Bt Mohd Kasim for his guidance, advices, supervision and encouragement in making this report. The valuable and useful ideas that he had shared with me during the Final Year Project are very much appreciated.

Secondly, my thanks go to my family for their helps and supports along doing this project. Special thanks also to my friends for their helps and supports in producing this report.

Lastly, I would like to convey my gratitude to other people who directly or indirectly help me in the process of finishing this report.

ABSTRAK

Banjir adalah bencana yang paling kerap berlaku di Malaysia. Bencana ini mengakibatkan kehilangan dalam bentuk harta benda dan nyawa. Sebagai tindak balas prihatin terhadap bencana ini, sebuah prototaip untuk mengesan dan mencegah bencana ini telah direka. Sistem ini merangkumi sistem amaran dan pencegahan. Apabila banjir berlaku, litar pengesan air akan mengesan paras air dan menghantar isyarat kepada "*Programmable Logic Control (PLC)"* yang bertindak sebagai pengawal utama. "*Programmable Logic Control"* akan mengawal setiap bahagian mengenai sistem ini. Isyarat daripada pengesan paras air akan di proses oleh "*Programmable Logic Control"* dan seterusnya menghantar arahan tersebut untuk menghidupkan pam air. Sekiranya paras air meningkat kepada paras dua dan paras tiga, "*Programmable Logic Control"* akan mengaktifkan siren dan juga telefon bimbit di mana dalam projek ini telefon bimbit berfungsi untuk membuat panggilan. Hasil daripada projek ini menunjukkan sistem ini berjaya untuk menghidupkan pam air dan mengaktifkan siren dan juga telefon bimbit sekiranya paras air meningkat.

Kata Kunci: "*Programmable Logic Control (PLC)",* Pengesan Air, Telefon Bimbit, Semboyan.

ABSTRACT

Flood is the most frequent disaster that occurs in Malaysia. This type of disaster causes a lot of damage in term of property and life. In the response to this harmful disaster, the flood detection and protection system is designed. The system consists of warning and protection system. When flood occurs, the water lever sensors sense the water level and send the information to Programmable Logic Controller (PLC) as input variable. PLC as a main control board that control each parts of the flood detection and protection system. Information from water level sensors is processed by PLC and send command signal to the actuator to open the water gate. If flood level continuously increase and reaches level two and level three, the PLC will activate the siren and mobile phone. Where, in this project the mobile phone only has a function for making a dialing. The experimental results show that the flood detection and protection system success to open the water pump and active the siren and mobile phone as soon as the flood level increase.

Keyword: Programmable Logic Control (PLC), Water Sensor, Mobile Phone, Siren.

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TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURES

CHAPTER I

INTRODUCTION

1.1 Project Overview

Flood is the most frequent that occur in our country, Malaysia. Often, we heard about flood occur from television, news paper, radio and many more where this disaster causes a lot of damage in term of property and life. This loss can be reduce and avoided if first move was made before it happened. There are many factors that causing the flood. The factor can be divided by two categories, natural phenomena and human activities. The natural phenomena such as heavy rainfall are the main factor that causing flood. The human factor is also the major problem that contributing flood. The human factor that cause the flood situation comes from uncontrolled development, affect of urbanization, inadequate drainage infrastructure, obstruction in the river by solid waste and garbage and development of flood plains [1]. Most of the victim of flood did not realize when the flood happened because the flood is unexpected phenomena if the public do not alert with the current situation of surroundings and weather.

1.2 Problem Statement

Flood in Malaysia are regular natural disaster which happen nearly every year during the monsoon season. Given Malaysia's geographical location, most floods that occur are a natural result of cyclical monsoon during the tropical wet season that are characteristic by heavy and regular rainfall. That is the major cause of flooding in Malaysia. Other than that, this flood problem is probability occur to residents whose lives at flooding area [2]. In fact, it is become dangerous to whole resident in the area especially to children and sometime cause death [3]. Besides, it will cause big detriment such as assets destroyed, maintenance cost for electrical equipment and so on [3]. It is also contribute traffic jam for closing the main road where the flood reached at high level [4].

Nowadays, many effort and method has been taken to solve this flood problem such as Project SMART in Kuala Lumpur [5], "Pelan Induk Tebatan Banjir (PITB)"[5] and so on. This effort is good to overcome this flood problem to protect death, detriment and many more when the wet season is coming. So to avoid this problem, this project will do to detect the flood level and prevent it from becomes worst. The project title is "PLC Application for Flood Detection and Protection via Communication System" which it is combination of PLC and communication systems.

1.3 Project Objective

This project is done to achieve the following objectives:

i. To produce a water pump system using PLCs.
ii. To send warning signal to the police station using dialing technique.
iii. To detect flood level using water level sensor.
iv. To give warning signal to all resident using a loud siren through a speaker.
v. To make an underground conduit system which through out the flood to a suitable area.

1.4 Project Scopes

The project scope is to detect and protect the disaster problems to all residents whose lives at lower area and beside a river. The purpose of this project is to use the PLCs as the main controller to control the water pump. In this project, water pump is used to flow out the flood through the underground conduit or pipe to the stagnant area such as flood stagnant reservoir. The water level sensor gives signal of the flood level at the control area. There are three levels, which is level 1 for safety condition, level two for careful condition and level three for dangerous condition.

In this project, mobile phone is applied to make a dialing to another phone where at placed in police station that has been setting into the mobile phone memory. When the PLC receive signal from water level sensor and it sense as a second level, PLC active the mobile phone. Then if water level increase into dangerous level, PLC will active the siren to giving warning to people.

1.5 Project Requirement

To build this project, the combination of software and hardware are required. There are the importance parts to make the project successful operate. The listed of project requirement are shows in Table 1.1 below:

Table 1.1: The listed of project requirement.

Category	Types
i. Software	i. PLC's software
ii. Hardware	i. PLC system ii. Water pump (aquarium) iii. Mobile phone iv. Water level sensor v. Siren

1.6 Expected Result

When the flood coming to attack one area, especially for residents whose lives at lower area and beside a river, the project will be able to detect it instantly and effectively. Furthermore, the detection system is also reliable in term the alertness and able to distinguish hoax. That is because, this system will be built at suitable spot and it will control and surveyed.

Another expected result from this project is, the system will operate systematically after the detection of the flood. After it detect, the system will active the water gate to throw out the flood. Furthermore, this system is a efficiency detected the flood level and then automatically connect to the mobile phone and make the dialing to alert and inform the authority exactly what condition in that area. The alarm system also active and will emit a loud siren through a speaker to alert all the resident area where the flood reached at dangerous level.

Other than that, the circuit will be working as a desire sequence corresponding to the level of water during the system is activated and make the system operate very efficient.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

A programmable logic controller (PLC) is an industrially hardened computer-based unit that performs discrete or continuous control functions in a variety of processing plant and factory environments. Originally intended as relay replacement equipment for the automotive industry, the PLC is now used in virtually every industry imaginable. Though they were commonly referred to as PCs before 1980, PLC became the accepted abbreviation for programmable logic controllers, as the term "PC" became synonymous with personal computers in recent decades [7].

PLCs are produced and sold worldwide as stand-alone equipment by several major control equipment manufacturers. In addition, a variety of more specialized companies produce PLCs for original equipment manufacturer (OEM) applications. Typically, PLC vendors can supply large volumes of application notes for their products. Most major PLC vendors also publish detailed articles about applications in technical journals and prepare papers for engineering societies and industrial symposia on control, automation, and so forth. Each manufacturer's software package usually has its own application programming techniques. Vendors also are a valuable source of "how to" information, providing training courses in their local office or at the factory as well as actual hands on experience to help users gain familiarity with the PLC. Most vendors offer an applications or programming manual

that provides insight on how to use available programming features. Of course, familiarity with one brand of PLC generally helps the engineer learn to use other brands quickly.

2.2 History About PLC

Bedford Associates, the forerunner of Modicon, designed the first PLC in 1968 for the Hydramatic Division of General Motors Corporation to eliminate costly scrapping of assembly line relays during model changeovers and to replace unreliable electromechanical relays. The objectives of the program were to [7]:

i. Extend the advantages of static circuits to 90% of the machines in the plant.
ii. Reduce machine downtime related to controls problems.
iii. Provide for future expansion.
iv. Include full logic capabilities, except for data reduction functions.

Richard Morley, a Bedford engineer, is credited with the original PLC design and the creation of ladder logic programming. Morley says the diagrams on which ladder logic is based, however, probably originated in Germany years before to describe relay circuitry. Describing the technology of the day, Morley explains:

"Automatic control of industrial metalworking and assembly operations in 1969 were mostly by relays and clock-driven electromechanical devices. Relays ran hot and tended to beat themselves to death with their persistent 60-cycle hum and contact arcings. Electromechanical timers/sequencers were much like enlarged music box mechanisms and were maintenance headaches [7].

2.3 PLC Structures

The hardware of a PLC consists of a microprocessor based CPU, a memory, input and output ports where signals can be received such as from switches and sensors, and sent to actuators, for example to motors or valves. A PLC is equipped with an operating system that allows to load and run programs and perform self-checks. Traditionally, the PLC operating system must respond to interrupts and must be real time. In Figure 2.1 illustrate that, the basic of PLC architecture where consist CPU, power supply, memory, I/O system and output and input devices [7].

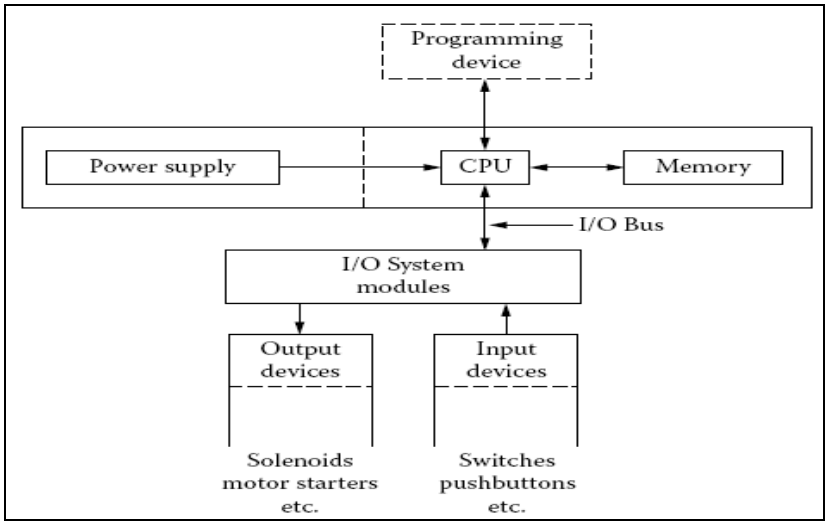

Figure 2.1: PLC Architecture.

A PLC is a sequential device that performs one task after another. Figure 2.2 shows how a conventional PLC system operates. There are three major tasks of a PLC perform, in the following order:

i. Task 1: Read inputs. PLC checks status of its inputs to see if they are on or off and updates its memory with their current value.
ii. Task 2: Program execution. PLC executes program instructions one by one sequentially and stores the results of program execution in the memory for use later in task 3.
iii. Task 3: Write outputs. PLC updates status of its outputs based on the results of program execution stored in task 2.

After PLC executes task 3 it goes back to execute task 1 again. The total time taken by a PLC to perform these three tasks is called the PLC scan time. Scan time depends on CPU clock speed, user program length, and number of I/O. Typically scan time is in milliseconds. The smaller scan time, the faster the updates of the I/O and the program execution [8]. Figure 2.2 below shows the typical modular of PLC system.

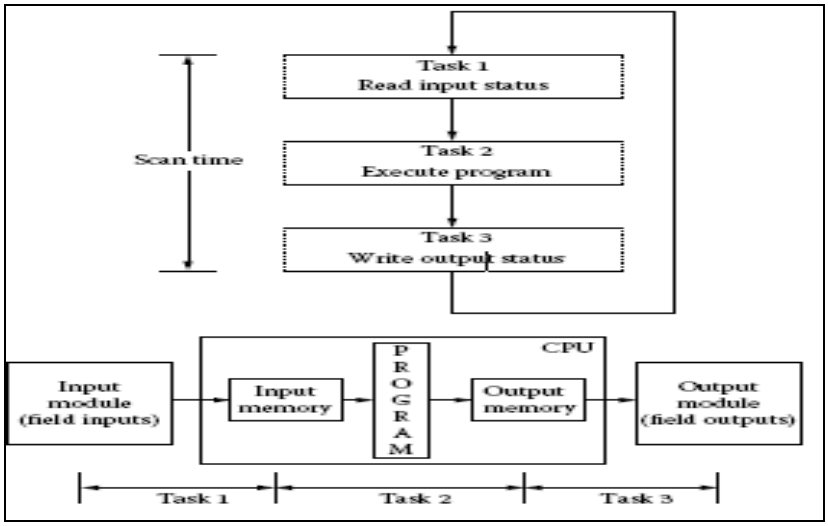

Figure 2.2: Typical Modular PLC Systems.

2.3.1 Central Processing Unit

The central processing unit (CPU) is the part of a programmable controller that retrieves, decodes, stores, and processes information. It also executes the control program stored in the PLCs memory. In essence, the CPU is the brains of a programmable controller. It functions much the same way the CPU of a regular computer does, except that it uses special instructions and coding to perform its functions. The CPU has three parts:

i. The processor,
ii. The memory system,
iii. The power supply.

The processor is the section of the CPU that codes, decodes, and computes data. The memory system is the section of the CPU that stores both the control program and data from the equipment connected to the PLC. The power supply is the section that provides the PLC with the voltage and current it needs to operate [9].

2.3.2 The Input/ Output System

The input/output (I/O) system is the section of a PLC to which all of the field devices are connected. If the CPU can be thought of as the brains of a PLC, then the I/O system can be thought of as the arms and legs [9]. Figure 2.3 below reveal the Input/ Output system in PLC.

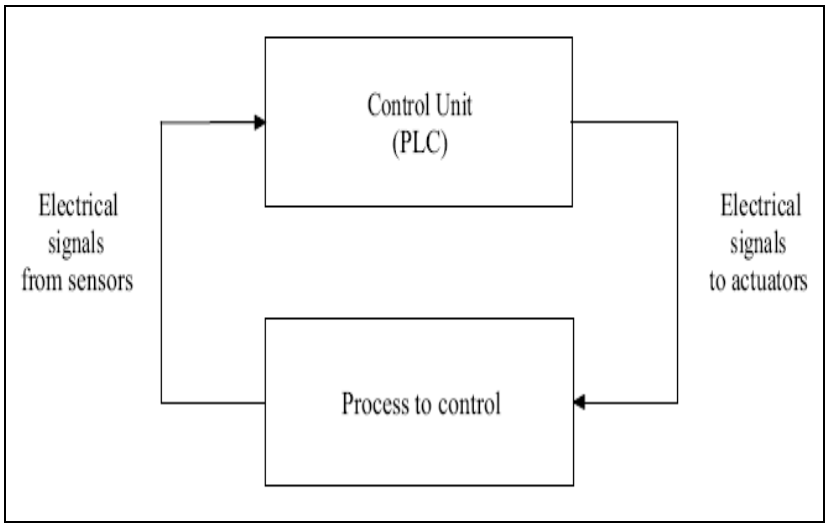

Figure 2.3: The Input/ Output System.

The I/O system is an actual physically carries out the control commands from the program stored in the PLCs memory. The I/O system consists of two main parts:

i. the rack
ii. I/O modules

The rack is an enclosure with slots in it that is connected to the CPU. I/O modules are devices with connection terminals to which the field devices are wired. Together, the rack and the I/O modules form the interface between the field devices

and the PLC. When set up properly, each I/O module is both securely wired to its corresponding field devices and securely installed in a slot in the rack. This creates the physical connection between the field equipment and the PLC. In some small PLCs, the rack and the I/O modules come pre-packaged as one unit. All of the field devices connected to a PLC can be classified in one of two categories:

i. Inputs.
ii. Outputs.

Inputs are devices that supply a signal/data to a PLC. Typical examples of inputs are push buttons, switches, and measurement devices. Outputs are devices that await a signal/data from the PLC to perform their control functions. Lights, horns, motors, and valves are all good examples of output devices [9].

2.4 PLC Programming

Ladder logic is one of the most popular and widely used programming languages by electricians and programmers, since it emulates the old relay-based ladder logic structure [8].

2.4.1 Ladder Logic Structure

As ladder logic is an extension of the relay logic, it makes sense to see how the ladder logic and relay logic structures are analogous to each other. Also, a basic understanding of Boolean logic will help in writing ladder logic, since many times a control scheme is first developed using Boolean logic and then converted into ladder logic in PLC. In relay logic, the lines L1 and L2 represent the power applied to the relay circuit. Start pushbutton is normally open type and stop pushbutton is normally closed type. When the start pushbutton is pressed, the start pushbutton's contact closes, the current flows through start and stop pushbuttons' contacts to the relay coil, and it energizes the relay coil. The contact of the relay coil gets closed and provides an alternate current path to the relay coil, thus keeping it energized. When

the stop pushbutton is pressed, the stop pushbutton's contact opens, the current path to the relay is opened, the relay gets de-energized, and the relay contact opens. The motor runs as long as the motor relay stays energized. In Boolean logic, the start pushbutton and motor relay contact are represented as inputs to the OR logic block, output of the OR logic block and stop pushbutton are represented as inputs to the AND logic block, and motor relay coil is represented as output of the AND logic block. Normally closed stop pushbutton is shown by inverting the stop input (logical 1). When the start pushbutton is pressed (logical 1), output of the OR block becomes logical 1. With both inputs of the AND block being logical 1, output of the AND block becomes logical 1 and turns the motor relay on. Status of motor relay is fed back to the OR block to keep its output on. Motor relay turns off as soon as the stop button is pressed. In PLC ladder logic, two vertical lines represent virtual power lines, and the actual electrical current is replaced by logical path. A horizontal line represents a logical rung Inputs are shown near the left vertical line and outputs are shown near the right vertical line on a rung. When the inputs have logical 1 or TRUE state, logical path to the outputs completes, and outputs get logical 1 or TRUE state [8]. Figure 2.4 below shows the three types logic can be represented which is in Relay logic, Boolean logic and PLC logic.

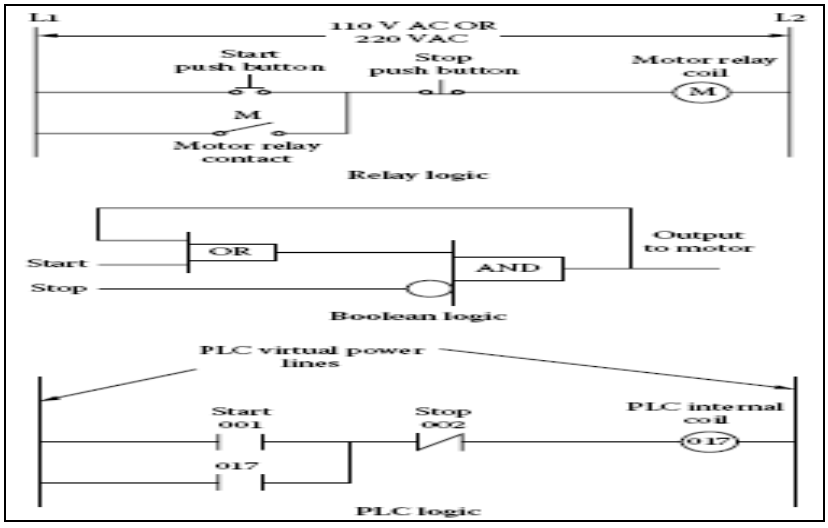

Figure 2.4: Figure of Three Types Logic Representation.