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INEXPENSIVE PLC OUTPUT PORT EXPANSION USING MICROCONTROLLER

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This report is submitted in partial fulfillment of the requirements for the award of Bachelor of Electronic Engineering (Industrial Electronics) With Honours

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I dedicate this to both of my beloved parents, friends and electronic engineering education

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ABSTRACT

The main objective of this project is to expand PLC output port using a microcontroller (PIC). Both of these items have a same concept which is to become a controller from the instruction given to it. PLC is a digital computer used for automation of industrial processes and it is designed for multiple inputs and output such as arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. PIC Microcontrollers however is a computer system that is fabricated in single integrated chip. PLC however has very limited input and output. To add the input and output to a PLC, a PIC is needed. The way that both these things will interface will be determined during this research. The project start with designing the PLC and PIC program that produces of 16 outputs. The next step is to design hardware as an interface device. Then for the final step, both programs will be added with a few instructions to ensure both devices will be interface properly even though there is a modification done on it.

ABSTRAK

Projek ini bertujuan untuk menambah keluaran PLC menggunakan kawalan mikro. Kedua-duanya mempunyai fungsi yang sama iaitu pengawal kepada arahan yang diberikan. PLC adalah computer digital yang banyak digunakan dalam industri pemprosesan and ia di reka untuk menjalankan pelbagai arahan. Kawalan mikro PLC pula adalah komputer mini yang di muatkan dalam satu litar kecil. Namun PLC mempunyai keluaran yang minima. Projek ini bertujuan untuk mengatasi masalah keluaran PLC yang terhad dengan menggabungkan dua unit pengawal. Beberapa kaedah telah di kaji dan projek ini adalah relevan untuk di jalankan.

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CHAPTER I

INTRODUCTION

1.1 Introduction of the Project

PLC is a digital computer used for automation of industrial processes, such as control of machinery on factory assembly lines. The PLC is designed for multiple inputs and outputs arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. This project aims to expand PLC port inexpensively using microcontroller while maintaining standard PLC input properties and functionality.

PIC Microcontroller however is a computer system that is fabricated in single integrated chip. A PIC consists of a Central Processing Unit (CPU), memory modules and several input and output peripherals. In short, both PLC and PIC are able to be control elements for machines. PLC however has limited input and output, thus the limitation of instruction and direction given to it. To add the input and output to a PLC, a PIC is needed. The project is about interfacing PIC with PLC.

In this case, more output will be provided to the PLC. The way that both these things will interface will be determined during this research. As a component PLC attachment project, the project furnishes a user instruction manual.

1.2 Objectives of the Project

By the end of the project, the project should be able to handle more outputs correctly using the PIC without adding more PLC ports which are costly. In industrial process, the involvement of machines and robots are very common. This machinery uses a lot of PLC as means to control them. So when the need of work instruction to control the machine the extra instruction cannot be given since the port itself is insufficient to accept such instructions.

Then, this project is to ensure that the input data is compatible with the output data. PIC and PLC are able to connect with each other such as can send and receive data efficiently. The data signal from both PIC and PLC are difference. The problem may occur while receiving and transmitting the signal. The difference between data signal and operational voltage between PLC and PIC will be diminished. So, at the end of this project is to solve the entire problem that existed.

To choose the best method to produce the stable system that can interface both of them. In the process of choosing the best method, all the resources knowledge obtains will be taken into consideration.

1.3 Statement of the Project

PLC has very limited input and output, thus the limitation of instruction and direction given to it. PLCs typically use 16-bit signed binary processors. The PLC has only 16 input and output ports that makes it very limited to certain processes. PLCs were usually configured with only a few analog control loops. Certain processes require hundreds or thousands of loops.

This is where the problem occurs. Input and output ports need to be added for it to receive and produce more output as more instructions are given. Interfacing PLC and PIC needs a lot of things figured out. Things like discrete signals sent to PLC with voltage of 24 V DC I/O, while PIC only needs 5 V DC I/O. With different activation voltages, both PLC and PIC must interact and able to send and receive data from each other.

1.4 Scope of the Project

The project will concentrate on the OMRON PLC. This PLC will be researched and programmed as part of the project. The programming software that will be used is the CX Programmer, or in other words the grafcet. The project will be focused on designing the programmed PLC to produce the 24V bulb light in accordance with the command given to it. The bulb light is determined by the program made by the grafcet. The PIC will be programmed to execute the command.

From PLC, three output lines will be used. These lines produced 24V signal and will be isolated using 24V relay. The programmed PIC will receive 5V signal and the expanded output will be showed through the bulb. These 24V bulbs will light once according to the command that have been choosing at PLC.

PIC 16F877A have 5 groups I/O ports, means that the I/O can be configure and multiple output can be produced. Those 3 line inputs will be connected to the pin 8,

9, 10 at port E. Then the output configured at pin 33 to 40 or port B. In terms of I/O, the outputs have been expanded into 8 lines by using 3 input lines only.

The main idea is to add more output ports to PLC via PIC since ports from PLC are very limited. If the PLC needs more output, the PLC will send a data to the PIC that will operate the PIC. PIC then will resend the data and provide more output to the PLC without compromising the previous data input to the PLC.

1.5 Project Methodology

Firstly, the methodology starts from searching information about the project. After retrieving information about the project, the information is discussed with supervisor for any ideas direction and focus consult action on related problem. The background study continuous and all theoretical data involved in this project are researched. After that the scope for the system and project layout are prepared. After that, survey and preparing component is involved. Next is to, design the real hardware and circuit and implement the hardware. When finish that part, try to running the project. If the project is running, then prepare for full report, but if not, must troubleshoot again and do the process before.

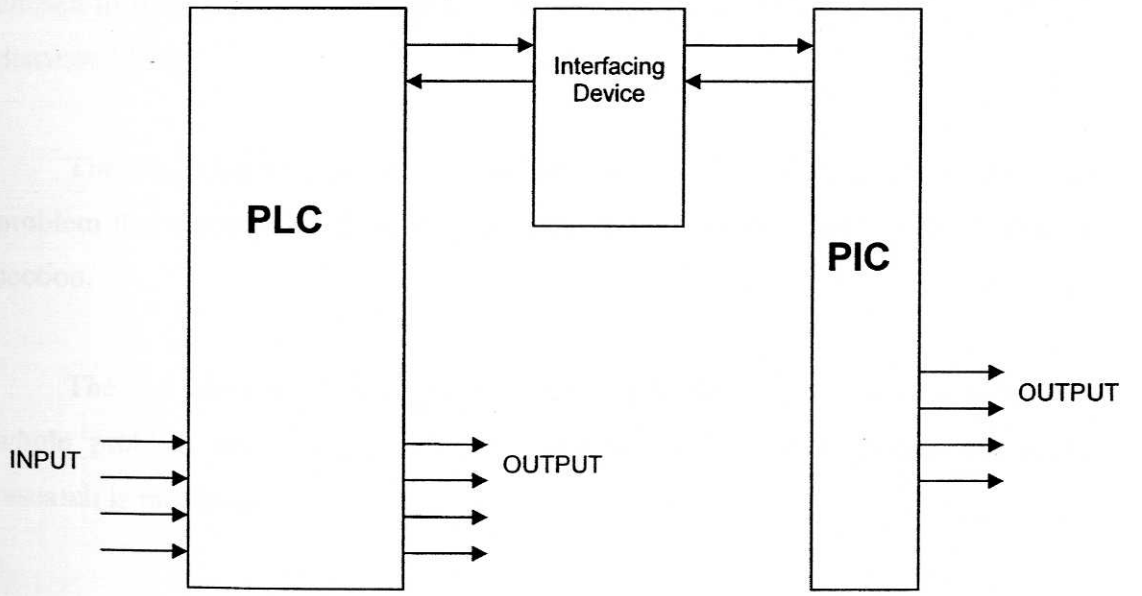

Figure 1.5: PLC and PIC Connection Layout

1.6 Thesis Synopsis

The thesis contains five chapters that explain details about this project. The first chapter is introduction, to explain overall concept like objective, scope of project and thesis synopsis. Every part will be discussed clearly part by part. The objective is about why this project was created and the significance of this project with industries. In scope part, kind of this system will do when it fully finished and task would this system do when it assembles and lastly for thesis scope is to give some summary for the whole report.

The second chapter will discuss about the previous research and information related to the project. Every fact and information found from any resources will be observed and debated to choose the best method for the project. In other word, this chapter is about theoretical part and study about the concept of this project until the best method found.

The third chapter discusses about the component that being used in this research. The software involved also will be described in this chapter.

The fourth chapter discuss about the techniques and method that have been chosen in second chapter elaborated in details. All the method used in this project is discussed here.

The next chapter concentrates on the results and discussion. Then, the entire problem that occurred since starting this research will be discussed in the discussion section.

The last chapter of this report is the conclusion and recommendation. The whole problem and solution will be concluded and recommendation for future research is mentioned.

CHAPTER II

LITERATURE REVIEW

2.0 Literature Review

Previously, there few researches have been done about this interface device. The research has the same concept but use different methods.

In 1989, Deborah L. Blocker and David G. Green from University of Alabama Birmingham, Alabama, did a research on *'Software Control Interface to a Programmable Logic Controller'*. This system was designed to allow a program development on the Prime 6350 computer system and program execution on a personal computer which is connected to the programmable logic controller.

The method of this project is concentrated on Software Relay Control System (SORCON) Interface and PLC. The software system involved a Prime 550 minicomputer and a time-sharing LSI-11/23 computer. The hardware consisted of 16 input converters and 16 output switches. The LSI-11/23 computers used a DRV-11 Parallel Line Interface Module to read inputs and control outputs.

The second version of SORCON consisted of a microprocessor-based programmable logic controller which was designed to replace the task of the LSI-11/23 computer executing the SORCON software. This system used a 6809 microprocessor, a 6850 Asynchronous Communication Interface Adapter (ACIA) and a 6821 Peripheral Interface Adapter (PIA).

Then in 2000, Lei Lin and Houjun Wang from University of Electronics Science and Technology, Chengdu, China did a research on *'Technique of Real-time Communication between Programmable Logic Controller and Microcomputer'*. The research studied about the problem communication between PLC and microcomputer.

They used a technique of interconnect communication between PLC and microcomputer, while combining the PLC and upper microcomputer to be a distributed control systems. This project concentrated on C++ programming technique for the REALCOM (real-time communication) between PLC and PC. They used the OMRON C200SH PLC as a front-end controlling.

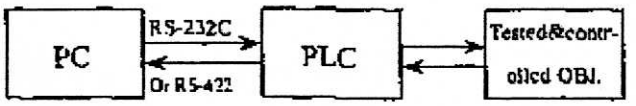

Figure 2.0: PC and PIC Communication System

When designing the PLC& REALCOM program and using the technique, the differences between reception/transmission mode and communication verification mode would bring some differences to the practical design. Then, concrete analysis is imperative, although the design principles and techniques are similar.

Based on both research above, it is be proven that the PLC can be interfacing with the PIC. PIC is actually as a mini computer which can be used to give and receive and transmit the command.

CHAPTER III

COMPONENT OVERVIEW

3.0 Component Used

3.1.1 Programmable Logic Controller (PLC)

A programmable controller is a digital electronic apparatus with a programmable memory for storing instruction to implement specific function, such as logic, sequencing, timing, counting, arithmetic to control machines and processes. In general control system is a collection of electronic device and equipment which are in place to ensure the stability, accuracy and smooth transition of process of a manufacturing activity.

It takes any form and varies in scale of implementation, from power plant to semiconductor machines. As a result of rapid advancement of technology, complicated control task accomplished with a highly automated control system, which may be in form of PLC and possibly a host computer. Beside signal interfacing to the field devices (such as operator panel, motor, sensor, switches, solenoid and etc, capabilities in network communication enable big scale implementation and process co-ordination besides providing greater flexibility in realizing distributed control system. Every single element in control system plays an important role regardless of size.

The PLC was choosing because of the feature which more rugged and has noise immune capabilities. Moreover the PLC is modular approach in construction,