



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DEVELOPMENT OF CUSTOMIZED HMI CONTROL SYSTEM
FOR MAP 202**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree of Electronics Engineering Technology (Industrial Electronics) (Hons.)

by

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DECLARATION

I hereby, declared this report entitled “Development of Customized HMI Control System for MAP 202” is the results of my own research except the works that have been cited clearly in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor's Degree of Electronics Engineering Technology (Industrial Electronics) (Hons.). The member of the supervisory is as follow:

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Mr Shamsul Fakhar bin Abd Gani

ABSTRAK

MAP 202 merupakan sistem pengendalian yang mampu mengawal proses. Dengan menggunakan sistem ini, teknik-teknik pengendalian boleh dipelajari dalam siri peralatan latihan dengan mengeluarkan semula sistem pengendalian yang selalu digunakan. Stesen MAP 202 terdiri daripada sistem latihan untuk mempelajari tentang aplikasi pengendalian utama yang digunakan dalam teknologi elektro-pneumatik. Proses pergerakan ambil dan letak boleh dilakukan dengan menggunakan penggenggam vakum. Sistem pengendalian ini terdiri daripada teknologi perindustrian seperti pneumatik, elektro pneumatik, 'Programmable Logic Controller' (PLC), pengesanan dan lain-lain. Peralatan ini dicipta dan dibangunkan untuk kemahiran pengambil alihan profesional seperti analisis, pemasangan, diagnosis dan membaiki kerosakan, tafsiran dan huraian dokumentasi dan pengaturcaraan PLC. Untuk projek ini, sistem ini akan dinaik taraf dengan membangunkan sistem kawalan baru yang dinamakan 'Human Machine Interface' (HMI) yang boleh menggantikan papan kekunci semasa di stesen. Terlebih dahulu, strategi kawalan yang sewajarnya perlu dibuat berdasarkan bagaimana stesen tersebut beroperasi dengan menggunakan perisian CX-Programmer. Kemudian, akan paparan antara muka direka bentuk dengan menggunakan NB-Designer. Setelah paparan antara muka direka, strategi kawalan akan disepadukan dengan HMI dengan menangani atau mendaftarkan suis yang muncul di antara muka dengan alamat masukan dan keluaran yang dibuat pada strategi kawalan.

ABSTRACT

MAP 202 is a handling system that is able to control the process. By using this system, the handling techniques can be studied in a series of training equipment which reproduces the most common handling applications in an industrial environment. The MAP 202 station consists training systems to learn about the main handling applications used in electro-pneumatic technology. A simple pick and place movement process can be carried out by using vacuum grippers. This handling systems consist of industrial technologies such as pneumatics, electro pneumatics, programmable logic controller (PLC), sensors, etc. This is equipment devised and developed for the acquisition of the following professional skills such as analysis, assembly, diagnosis and repair breakdown, interpretation and elaboration of documentation and PLC programming. For this project, this system will be upgraded by develop a new control system named Human Machine Interface (HMI) that can replace current keypad on the station. Firstly, a proper control strategy need to be made based on how the station operates by using CX-Programmer software. Then, interface will be designed by using NB-Designer. Once the interface was designed, the control strategy will be integrated with the HMI by addressing the button appear on interface with the address from input and output made on control strategy.

DEDICATION

I dedicated my project work to my family and friends. A special gratitude to my beloved parents, Mr. Yukhanis b. Amir and Mrs. Hafizah binti Hambali for their moral support that I need when I was doing this project.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

GRAFCET	-	Graphe Fonctionnel de Commande Etapes-Transitions
HMI	-	Human Machine Interface
NC	-	Normally closed
NEMA	-	the National Electrical Manufacturing Association
NO	-	Normally open
PC	-	Personal Computer
PLC	-	Programmable Logic Controller

CHAPTER 1

INTRODUCTION

1.1 Project Introduction

Generally, the control system of an automation plant is a brain for their whole operation. Control system consists of collection of electronic devices and equipment to ensure the purpose of obtaining desired output with desired performance of a process or a manufacturing activity. As a result of rapid advancement of technology, a complicated control task can be accomplished with a highly automated control system, which may in form of Programmable Logic Controller (PLC) or possibly a host computer. (James, 2010)

To study about control system and PLC, MAP 200 that produced by SMC International Training have selected as training kit so people can learn how to control the station. The study of the handling techniques in a series of training equipment which reproduces the most common handling applications in an industrial environment using electro pneumatic technology. MAP 202 is a Cartesian handling device with two shafts which can move the part from one position to another while holding it using set of three vacuum pads. This control system can be develop by exploring MAP 202 automation machine and implementing the programmable logic controller and electro pneumatic technology. The control system of this machine can be upgraded by implementation of Human Machine Interface which known as touch screen technology to control the machine. Therefore, in this research, the enhancement of control system is applied to MAP 202 Station.

1.2 Problem Statement

Computer always been a choice when it comes to control and monitor process purposes. It can directly interact what is displayed by user with touch pad or mouse controller. Nowadays, in industry or other several situations, using mouse system do not allow fast responds or gratify interaction to user because it will slow down the time operation of a process.

The MAP 202 supports the study of handling techniques. This machine can only be handled by using push buttons for automatic and manual operation. This project to develop the control system of MAP 202 by using Human Machine Interface by improve it to latest technology applied in industry. By implementing it, the station is easier to control.

1.3 Project Objectives

The objectives of this project are as follow:

1. To design and develop control strategy to control MAP 202 station.
2. To develop Human Machine Interface (HMI) that can integrate with MAP 202 station.
3. To implement the control system and HMI on MAP 202 station.

1.4 Project Scope

The project scope is all about how to arrange all tasks in order to achieve all project objectives. This project to develop a new control system on MAP 202 which is Human Machine Interface (HMI). HMI refers to user interface in manufacturing or process control system. It includes the electronic part required to signal and control the state of industrial automation equipment. The project work scope that will be included in this project are:

1.4.1 Familiarization on MAP 202 Station

Study and familiarize about MAP 202 station from SMC International Training. As the project is focusing on how to enhance the control system for this station, so a proper smooth operation must be done first. Study and analyze the design technique of the operation need to plan by using GRAFCET and ladder diagram was constructed using CX-Programmer.

1.4.2 Study on how to design touch screen interface

To replace current controller which is built in with the station, a customized HMI needs to be designed. The controller user interface is designed by using NB-Designer.

1.4.3 Integration between controller and MAP 202 Station

Study and develop on how to communicate between control system and MAP 202 station.

1.5 Project Methodology

The methodology of this project are following as below:

1. Project planning

Meeting up with supervisor to proper planning and guidance for PSM I and duration of each task to be completed should be noted on Gantt chart and follow it to achieve objective of this project.

2. Familiarizing MAP 202

Research for MAP 202 station to gain more knowledge about it so it is easier to familiarize on how it operates and what types of technology will be used. The control strategy must be properly planning for smooth operation.

3. Researching HMI

Same as familiarize MAP 202, where the proper understandings are needed to design interface to implement the control system on MAP 202.

4. Implementing HMI

Once the research is understood, the implementation process can be started based on knowledge gained. Touch screen will replace current control keypad system as a new control system.

5. Troubleshooting the program

If there are any mistake happen, troubleshooting process must be done to solve the problem. It is important so system can run in exact specifications. This troubleshooting process is carried out along with develop, design and test performance process.

1.6 Project Outline

Chapter 1 : Cover the overview of the project. This chapter will be including the introduction of the project, problem statements of the project, the project objective, scope of the project, methodology review and project outline.

Chapter 2 : This part is the medium to get information in order to develop the project. In this chapter, the background of the project and the theory of each component is explained. The information is from the reference book, websites, articles and some related interview with the lecturer,

including the differentiation of project of previous researchers. It is mostly about the MAP 202 station, Programmable Logic Controller (PLC), GRAFCET, pneumatic technology and sensors used.

- Chapter 3 : It will cover all the methodology and a project implementation process to make the project is done successfully. This chapter also explains the procedures that have been taken during the project implementation. The methodology of the thesis is consisting of the hardware and software of the project. Then, it is about the designing the control strategy and touch screen interface and finally about implementing HMI into MAP 202 station
- Chapter 4 : This is the important chapter of this project report. This chapter contains the development and implementation of the whole project. It also contains the results gained and the discussion of the project.
- Chapter 5 : This chapter is the final chapter in the report. In this chapter, it will be including the conclusion and suggestions about this project.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will describes more on literature review that can gives more understanding and better visualization of this whole project operation, input and output and devices used. A fully explanations on MAP 202 handling system will be explained to give whole overview of the functionality of this station to the users. The components handling process of MAP 202 station will be analyzed in depth including the actuators and sensor that will be involved in the station operation. The sequence of control by using GRAFCET will be also elaborated in this chapter. Furthermore, ladder diagram that was built using software and the design of touch screen interface which is HMI will be explained in detail.

By using CX-Programmer software in personal computer, the ladder diagram is constructed before it was transferred to Programmable Logic Controller (PLC) unit that was attached on MAP 202 station. After ladder diagram was done, the interface for new control system is designed using NB-Designer software and then communicate this new control system to MAP 202 station. The project overview is shown as Figure 2.1 in next page.

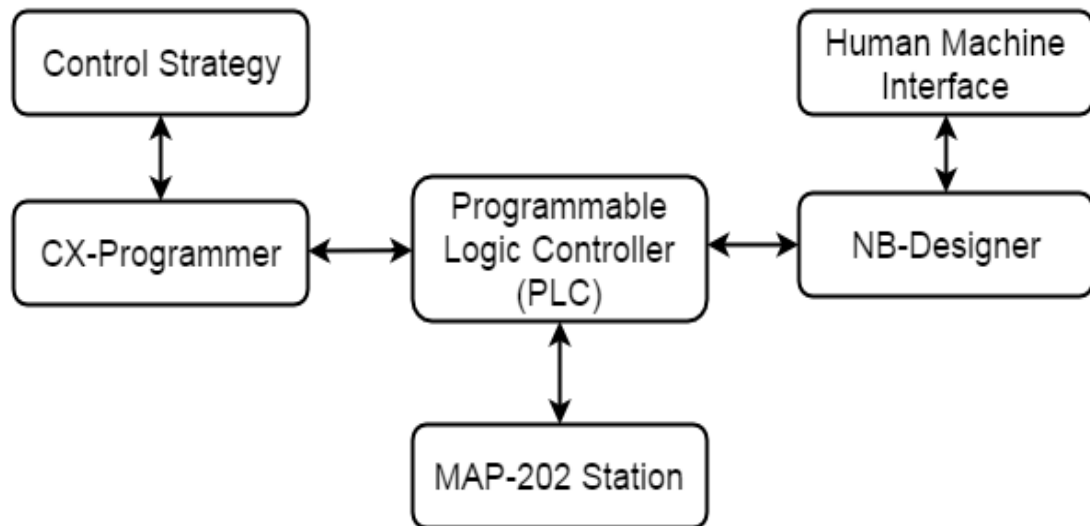


Figure 2.1: Project Overview

2.2 MAP 202 Handling System

MAP is a series of products for simple PLC control and fault finding. MAP 202 is from the MAP 200 Handling system series. MAP 202 Station is a vacuum-held handling device with two shafts which moves a part from one position to another by holding it with a set of three vacuum pads. As shown as Figure 2.2, the dimension of this station is about 740x400x445mm and the weight is approximately around 20kg. As the air treatment unit, this station equip with filter with pressure regulator, pressure gauge, throttle, drain valve and also supply pneumatic pressure around 0.6MPa to actuate the actuator that using air pressure. (Technical Description MAP 202, 2015)

To make this station functional, a 100-240Vac or 24Vdc (60W) power source was supplied. For the current controller, there are keypads to start and stop push buttons. Besides that, it also has automatic-manual selector to choose whether to run this station on automatic mode or manual mode.

The actuators for this station are two dual rod cylinder and three vacuum pads with one vacuum ejector. Besides, it also equips with one double solenoid valve and two single solenoid valves for solenoid valve block. To connect the process between steps of process, four end of stroke reed type switches are used as sensor of this station. (SMC International Training Catalogue)

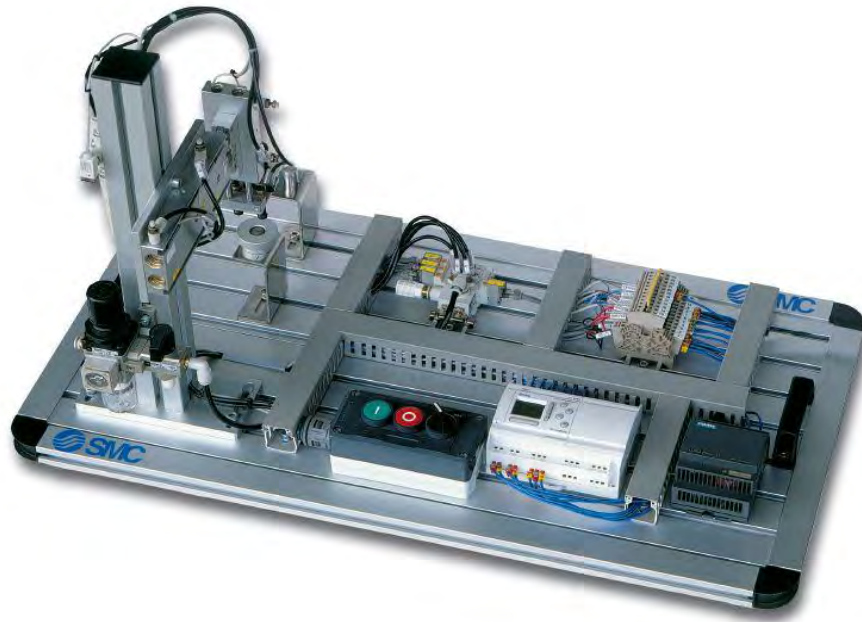


Figure 2.2: Layout of MAP 202

2.3 Programmable Logic Controller (PLC)

The National Electrical Manufacturing Association (NEMA) defines a PLC as a programmable logic controller is a digital electronic apparatus that has programmable memory to store instructions to implement specific functions. PLC also defines as a specialized electronic device based on one or more microprocessors that are used to control industrial machinery. The definitions state that PLCs are industrial computers designed to operate in the harsh physical and electrical noise environments present in production plants (James A Rehg, 2009). The functions of PLC are for logic, sequencing, timing, counting and arithmetic to control machines and processes. The role of the PLC is commonly regarded as the heart of the control system.

Before the first introduction of PLC by Richard E. Morley in 1969, logic control was implemented by hard-wired logic. Electromagnetic relays, pneumatic relays, and electronic gates and flip-flop were used. Wiring had to be removed and replaced to provide a new control scheme. With these technologies, complex problems are difficult to handle, and a logic controller is difficult to modify.

The PLC provides an easy way to reprogram the wiring rather than actually rewiring the control system. Table 2.1 shows the advantages of PLC against hard wired logic that used before PLC.

Table 2.1: Differentiation between Hard Wired Logic and PLC

	Hard Wired Logic	Programmable Logic Controller (PLC)
Controlled Device	Specific Purpose	General Purpose
Control Scale	Small or medium	Medium or large
Delivery Period	Several days	Almost immediate
Maintenance	Difficult	Easy
Reliability	Depends on design and manufacture	Very high
Economic Efficiency	Advantage on small scale operation	Advantage on small, medium and large scale operation

The specific features of PLC:-

1. Has noise immune capabilities and more rugged
2. Easy to replace or add units of construction
3. Standard signal level and input output connection
4. Programming language using ladder diagram is easy to understand
5. Easy to program and reprogram
6. Low cost production equipment

2.3.1 Ladder Diagram Programming

Ladder Diagram is a type of graphic language for automatic control systems it had been used for a long period since World War II. Until today, it is the oldest and