AUTOMATIC DETECTION USING HUMAN MACHINE INTERFACE (HMI)

ROHAIDAH BINTI MAHIDIN

This Report Is Submitted In Partial Fulfillment Of Requirement For The Bachelor Degree of Electronic Engineering (Industrial Electronic)

Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka

Mei 2011

UNIVERSTI TEKNIKAL MALAYSIA MELAKA

FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN

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Dedicated to my ***lovely husband****,* ***Shaharuddin Bin Nordin****,* ***my parents, Mahidin Bin Seman and Rohani Binti Abdullah, my siblings and my beloved friends.***

ACKNOWLEDGEMENT

To my lovely husband, and also my parent who had relentlessly support me throughout the project and the accomplishment of this thesis. To my group colleague, Encik Zulafandi that helped a lot with his idea and suggestion. Thousands of appreciation to my fellow lecturers, for their willingness to listen, to point out their critique and voice out their comment towards the success of the project. Last but not least, my respected supervisor, Engr. Muzafar for his valuable advice and views. Finally, I would like to express my gratitude to the department that sponsored my study in UTEM, Majlis Amanah Rakyat (MARA). Thank you all.

ABSTRACT

This thesis is about the Automatic Detection Using Human Machine Interface. This system consists of PLC programming network, and how every element merge such as sensor, input and output for every control made in the system called as Human Machine Interface. The flow of the system begins with the detection made by the sensor to quantify the hygiene level of the bottle which runs over in the conveyor system. The first sensor detect the existence of the bottle, second sensor will determine the hygiene level of the bottle with a pre-set mode, third sensor will fill up the bottle with water and the fourth one will detect a full bottle to the next process. PLC that had been programmed with the Ladder Diagram method is built to control every flows of the operation and connected with HMI concept. A Graphic User Interface (GUI) is built to help the observation made throughout the operation. The system operation's is set to operate in dual mode, manual or automatic. This developed project detects the hygiene level of the tested bottles. It suits nicely to be commercialized in a minimum bottles preparation system where each bottles tested to guarantee its quality are clean and safe. In addition, the system can also be used as additional teaching tools for student to elevate their understanding level in the industry including a latest developed technology.

ABSTRAK

Tesis ini adalah mengenai Pengesanan Automatik Menggunakan Human Machine Interface. Sistem ini terdiri daripada rangkaian pengaturcaraan PLC, dan bagaimana setiap elemen digabungkan seperti sensor, masukan dan keluaran bagi setiap kawalan dilakukan didalam system tersebut yang dinamakan sebagai Human Machine Interface. Aliran sistem bermula dengan proses pengesanan yang dilakukan oleh sensor untuk mengukur tahap kebersihan botol yang bergerak diatas system konveyor. Sensor pertama mengesan kehadiran botol, sensor kedua akan menentukan tahap kebersihan botol yang diuji, sensor ketiga akan mengisi botol dengan air dan yang keempat akan mengesan botol penuh untuk proses selanjutnya. PLC yang telah diprogramkan dengan kaedah Ladder Diagram dibina untuk mengawal setiap arus operasi dan dihubungkan dengan konsep HMI. Sebuah Graphic User Interface (GUI) dibina bagi membantu pengamatan seluruh operasi. Operasi system ditetapkan untuk beroperasi dua mode; manual dan automatic. Projek ini dibangunkan mengesan tahap kebersihan botol yang diuji. Ianya sesuai digunakan untuk industri pembotolan air dimana setiap botol diuji untuk memastikan kualiti yang bersih dan selamat. Selain itu, system ini juga boleh digunakan sebagai alat bantu mengajar bagi pelajar untuk meningkatkan tahap pemahaman mereka dalam bidang industri termasuk teknologi yang sedang giat dibangunkan masakini.

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CHAPTER 1

INTRODUCTION

1.0 Background of Study

A programmable logic controller (PLC) or programmable controller is a digital computer used for automation of electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or lighting fixtures. PLCs are used in many industries and machines. Unlike general-purpose computers, the PLC is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery-backed or non-volatile memory. A PLC is an example of a real time system since output results must be produced in response to input conditions within a bounded time, otherwise unintended operation will result. The PLC also can interface with HMI system in order to supervise the system. This thesis presents Automatic Detection Using Human Machine Interface. In this study, the complete display is in the form of graphic user interface [GUI], to perform manual mode and automatic mode of the system implementation. A complete system has been developed and performed the task accordingly.

1.1 Objectives

The followings are the objective of the project;

a) To develop a mini simulation model of Automatic Detection Using Human Machine Interface in the industrial control.
b) To design a graphic user interface that will facilitate in monitoring the process of the system.
c) To demonstrate how the HMI applications can be used in the industry.
d) To apply the knowledge in the manufacturing, instrumentation and control application.

1.2 Problem statement

Nowadays, industry manufacturing brought widespread use of tools and machines to workplace and grown in number and complexity day by day. The tools and machinery mainly controlled by the PLC. The switch and actuators are controlled manually, semi-automatic or fully automatic from the input through to the output. To reduce the complexity of connection or wiring between the input and output, also to ensure the safety and easier in monitoring process, a technology called as Human Machine Interface (HMI) was introduced to set the convenience and easier to used. The technology that applied touch screen display was built to control the flow of information from the machine to the user and from the user to the machine. A display called as Graphic User Interface (GUI) which was built in to interface the program from the PLC to the HMI. In the area of current drinking water bottling, the bottle are recycled is sent to the manufacturer for the process of refilling water. Cleanliness bottles are inspected at random. To ensure the cleanliness and high quality, each bottle should be inspected. The inspected process used laser sensor to detect the bottle.

1.3 Scope of work

This project involves the study on knowledge acquisition of interfacing among HMI, PLC and Hardware. This project will design the GUI for HMI system. The project achievement is to design a graphic user interface that will facilitate in monitoring the process of the system and to demonstrate how the HMI applications can be used in the industry. PLC programming and Graphic User Interface development will not covered in this paper.

1.4 Methodology

Several steps have been taken in order to implement the study. The designs are employed to this project due to automatic detection using human interface. For better understanding the research methodology is shown in Figure 1.1. The study involved the followings:-

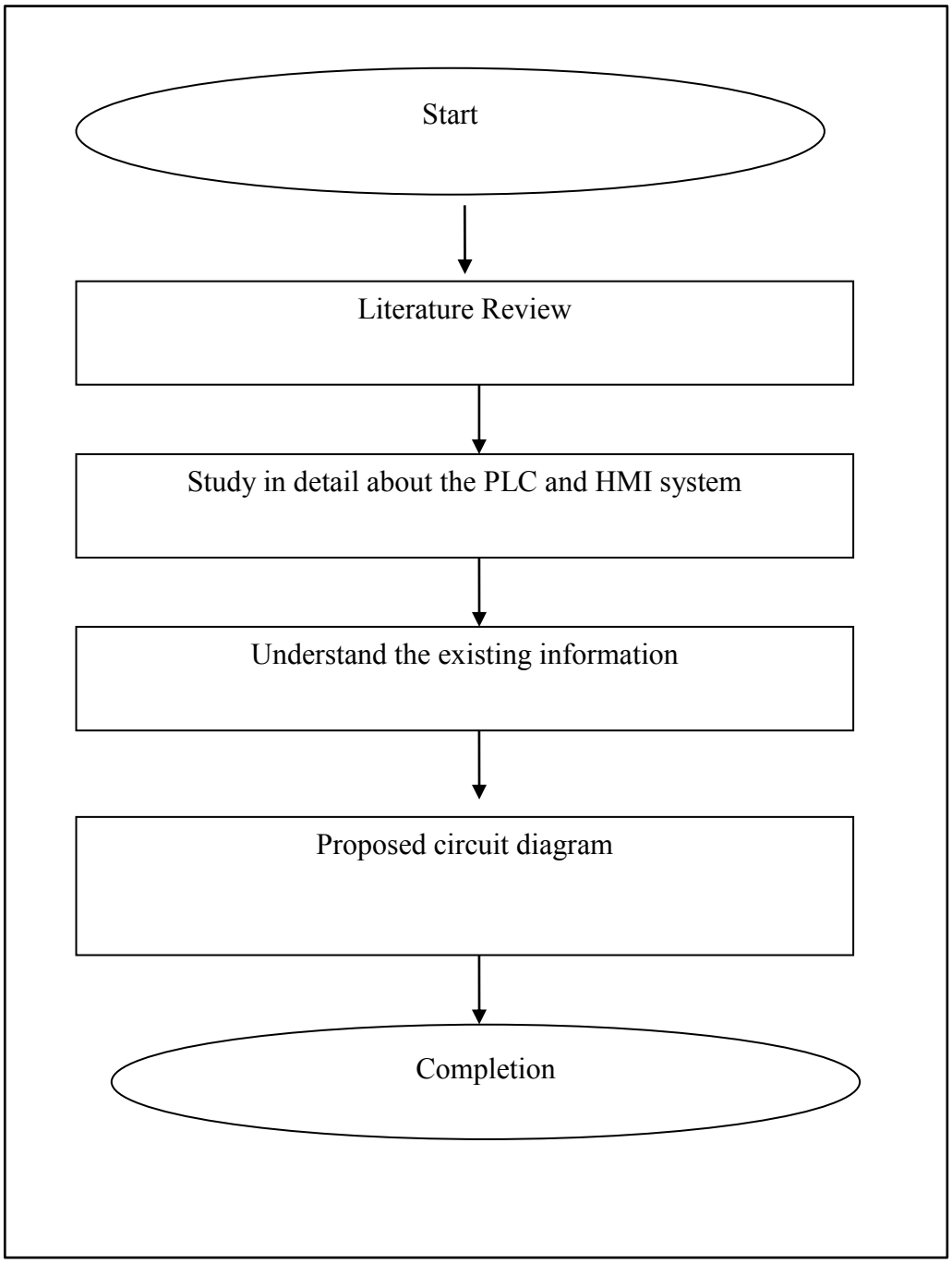

Figure 1.1: Research Methodology

No.	Activity	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
1	Meeting supervisor														
2	Project initiation and title														
3	Proposal review and approval														
4	Knowledge acquisition														
5	Seek product price and specification														
6	Development system set-up														
7	Ladder diagram development														
8	Presentation preparation														
9	Presentation review														

Figure 1.2: Gantt chart Project 1

No.	Activity	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10	W 11	W 12	W 13	W 14
1	Hardware development & installation														
2	Testing and commissioning wiring														
3	PLC installation and Input and Output Wiring														
4	Testing and commissioning of I/O and PLC program														
5	Experimentation and data collection														
6	Thesis preparation														
7	Project submission & final presentation														

Figure 1.3: Gantt chart Project 2

1.5 Organization of the Thesis

This thesis consists of five chapters including this introduction follow the university thesis standard which including objectives, scope of the works, problem statement and methodology. In second chapter present the literature review of introduction and uses of the equipment used in this project; PLC, HMI, GUI and sensors.

Presents the study which includes most of the related research methodology and process of the experiment detailed will be present at chapter three. Meanwhile the chapter four focused on presenting the results and discussions of the project. The discussion focused on the analyses with referring to the results obtained.

Beside that chapter five present the result, analysis, discussion and the conclusions of the topics with regards to this topics and the future development of the experiments.

CHAPTER 2

LITERATURE REVIEW

2.0 Programmable Logic Controller System

PLC programs are typically written in a special application on a personal computer, and then downloaded by a direct-connection cable or over a network to the PLC. The program is stored in the PLC either in battery-backed-up RAM or some other non-volatile flash memory. Often, a single PLC can be programmed to replace thousands of relays. Figure 2.1 illustrates the block diagram for a general PLC system.

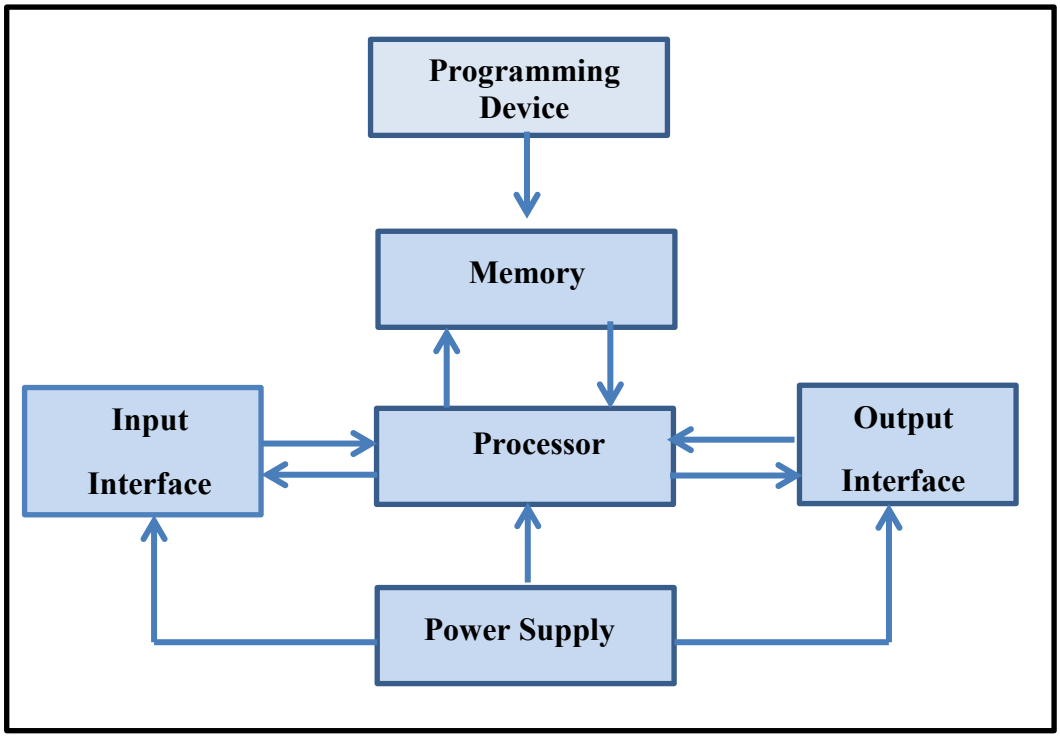

Figure 2.1: The PLC System

PLCs can be programmed using standards-based programming languages. A graphical programming notation called Sequential Function Charts is available on certain programmable controllers. Initially most PLC's utilized Ladder Logic Diagram Programming, a model which emulated electromechanical control panel devices (such as the contact and coils of relays) which PLC's replaced. This model remains common today.

IEC 61131-3 currently defines five programming languages for programmable control systems: FBD (Function block diagram), LD (Ladder diagram), ST (Structured text, similar to the Pascal programming language), IL (Instruction list, similar to assembly language) and SFC (Sequential function chart). The first PLCs were programmed with a technique that was based on relay logic wiring schematics. These techniques emphasize logical organization of operations. While the fundamental concepts of PLC programming are common to all manufacturers, differences in I/O addressing, memory organization and instruction sets mean that PLC programs are never perfectly interchangeable between different makers. Even within the same product line of a single manufacturer, different models may not be directly compatible [4].

2.1 Human Machine Interface (HMI)

With Human machine interface (HMI) software, the operators can manage their industrial and process control machinery using a computer-based graphical user interface (GUI). The human machine interface or HMI is the computer in which the software is installed. Basically, there are two types of HMI: supervisory and machine level. The first type i.e. supervisory level is designed for room control environments and used for system control and data acquisition (SCADA), referring to process control application that collects data from sensors on the shop floor and channeled the information to a central computer for further processing. The latter types i.e. machine level HMI uses embedded, machine-level devices within the production facility itself. Even though most human machine interface (HMI) software is designed to operate either supervisory or machine level, there is also applications that

suits for both types. Those software applications are more expensive, but the benefits will eliminate redundancies and cut down long-term costs.

An analysis of products specifications and features are vital on selecting human machine interface (HMI) software. Besides that, other important considerations are; system architectures, standards and platforms; ease of implementation, administration, and use; performance, scalability, and integration; and total costs and pricing. Some human machine interface (HMI) software provides data logging, alarms, security, forecasting, operations planning and control (OPC), and ActiveX technologies. Others support data migration from legacy systems. Communication on multiple networks can support up to four channels. Supported networks include ControlNet and DeviceNet. ControlNet is a real-time, control-layer network that provides high-speed transport of both time-critical I/O data and messaging data. DeviceNet is designed to connect industrial devices such as limit switches, photoelectric cells, valve manifolds, motor starters, drives, and operator displays to programmable logic controllers (PLC) and personal computers (PC).

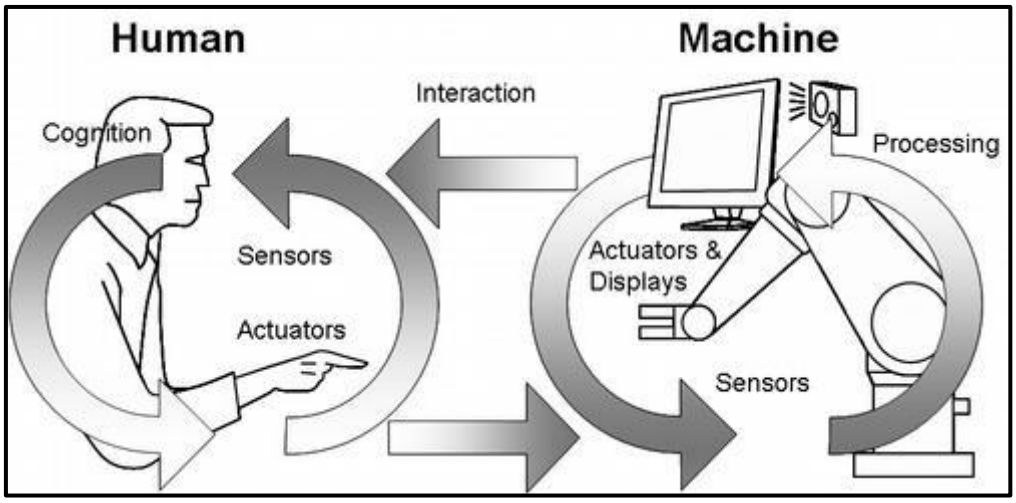

Figure 2.2: The interaction between human and machine

2.2 Graphic User Interface

Graphic User Interface (GUI) is one model of interaction between human and computer. Currently, it is almost software manufacturer trying to make GUI more attractive so that users will also be interested in using the software. It is demanded of the GUI is no longer user friendly but also usability. Usability has 3 aspects;

a) Learnability – easy for new user to be able to use the system effectively and achieve the most optimal performance.
b) Flexibility – variation method/model for users and system in the exchange of information.
c) Effectiveness/robustness – level of support provided for users to achieve their goals with success and provide an assessment of behavior that is directed by a goal.

The third aspect above is if attained, will give the value of attitude (comfort for the user). Evaluation of GUI views of the principle of user friendly and usability can be done by looking at how the development of the GUI from time to time.

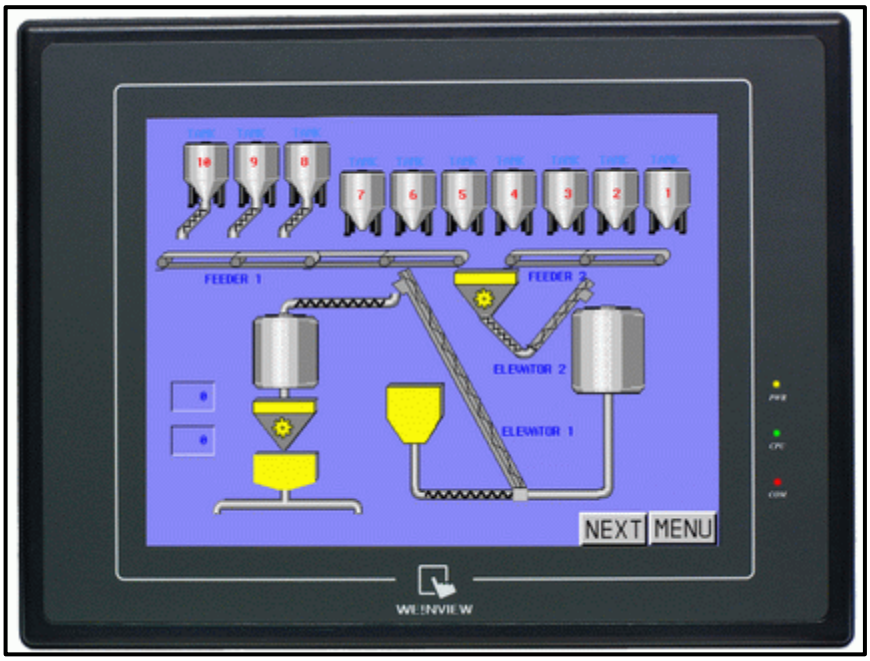

Figure 2.3: The Graphic User Interface

2.3 Sensors

In relation to electronic systems, sensors and transducers can generally be viewed as a device that functionality changing of a physical quantity into electrical quantity so that the output can be processed by electric circuits or digital systems. Today, almost all modern equipment has in it. In environmental control systems and robotics, sensors provide functions like the eyes, ears, nose, and tongue which will then be state electronic device that wrapped tightly to protect from the effects of vibration, fluid, chemical, and corrosive excessive.

Classification Sensor

In general, based on function and usage sensors can be grouped into 3 parts:

a) thermal sensor (thermal)
b) mechanical sensors
c) optical sensor (light)

Thermal sensor is a sensor used to detect changing in heat or temperature at one dimensional object or a particular spatial dimension. For example, bimetallic, thermistor, thermocouple, RTD, photo transistor, photodiode, photo multiplier, photovoltaic, infrared pyrometer and etc.

Mechanical sensor is a sensor that detects changes in mechanical motion, such as displacement or shift or position, straight and circular motion, pressure, flow, level etc.

Example; strain gage, deferential linear variable transformer (LVDT), proximity,potentiometers, load cells, Bourdon tube, etc.

Optic or light sensors are sensors that detect changes in light from the light source, light reflection or refraction of light that hit object. Example: photo cell, photo transistor, photo diode etc.

Figure 2.4: Varieties of sensors