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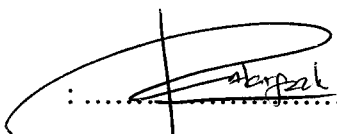
Portable honey orange fruit grade sorter machine (human
machine interface design) / Muhammad Amzari Najmi.

**PORTABLE HONEY ORANGE FRUIT GRADE SORTER
MACHINE
(HUMAN MACHINE INTERFACE DESIGN)**

MUHAMMAD AMZARI BIN NAJMI

MAY 2009

“I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Power Electronic and Drive).”

Signature : 

Supervisor's Name : MR. FAZLLI BIN PATKAR

Date : 12/5/2007

**PORTABLE HONEY ORANGE FRUIT GRADE SORTER MACHINE
- HUMAN MACHINE INTERFACE DESIGN**


MUHAMMAD AMZARI BIN NAJMI

**This Report is submitted in Partial Fulfillment of Requirements for The Degree of
Bachelor in Electrical Engineering (Power Electronic and Drive)**

**Faculty of Electrical Engineering
Universiti Teknikal Malaysia Melaka**

MAY 2009

“I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in the references.”

Signature : 

Name : MUHAMMAD AMZARI BIN NAJMI

Date : 12.05.2009

Dedicated especially to my father
and my beloved mother

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First and foremost, I thank to Allah the Almighty for blessing me to complete my Final Year Project 2. I would like to enlarge my appreciation to Mr. Fazlli Bin Patkar because of the kindness heart to accept me as one of the student under her supervision. Special thanks also dedicated to her for all comments, idea, and a guideline begin from the first day I start this project.

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ABSTRAK

Projek ini adalah berkenaan dengan merembentuk Perantara Manusia dan Mesin untuk Mesin Pengasing Gred Buah Limau Madu Mudah Alih menggunakan perisian *Visual Basic 6.0*. Ianya termasuklah merembentuk sistem pemantauan untuk pengendali yang mengendalikan mesin tersebut. Perantara Manusia dan Mesin ini membolehkan pengguna mengawal sistem mesin pengasing dan membenarkan sistem ini bertindakbalas dengan pengguna. Perantara Manusia dan Mesin ini juga berfungsi sebagai alat perantara kepada komputer peribadi dan pengguna. Sementara itu, isyarat dari Modul Masukan/Keluaran akan dihantar melalui kabel kepada Mesin Pengasing Gred. Mesin pengasing ini, tidak lagi dikendalikan secara manual tetapi dikawal sepenuhnya oleh komputer. Oleh itu, ianya menjimatkan masa dan tenaga pengendali untuk mengawal mesin ini. Pengaturcaraan Mesin Pengasing Gred ini membolehkan pengguna untuk mengawal motor, menetapkan tarikh dan masa, serta memaparkan semua lampu penunjuk menggunakan komputer. Pengaturcaraan *Visual Basic* adalah lebih fleksibel, mesra pengguna dan grafik yang dirembentuk lebih menarik dengan menggunakan fungsi-fungsi Perantara Grafik dan Pengguna. Kepentingan pengaturcaraan ini adalah bagi membantu pengguna mengawal mesin pengasing dengan mudah.

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LIST OF ABBREVIATION

BASIC	-	Beginner's All-Purpose Symbolic Instruction Code
CPU	-	Central Processing Unit
DC	-	Direct Current
GUI	-	Graphical User Interface
HMI	-	Human Machine Interface
IC	-	Integrated Circuit
I/O	-	Input/Output
LED	-	Light Emitting Diode
LS	-	Limit Switch
NC	-	Normally Closed
NO	-	Normally Opened
PLC	-	Programmable Logic Control
PIC	-	Programmable Interface Controller
PC	-	Personal Computer
RAD	-	Rapid Application Development
SCADA	-	Supervisory Control and Data Acquisition
SPC	-	Statistical Process Control
UPH	-	Unit per Hour
VB	-	Visual Basic

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CHAPTER 1

INTRODUCTION

1.1 Introduction

A Fruit Grade Sorter System is a system that sort fruit by its size. There are a lot of Fruit Grade Sorter System types available in market. They are manual, semi-automatic and fully-automatic operation. In manual operation, sorting and recording process has been done in manual operation. Users need to sort fruits into their size by using naked eye inspection and place into box by hand. User also has to count the quantity of fruits and record in manual. In semi-automatic operation, the fruits will be sort by machine. The machine is able to grad and sort the fruits in automatic operation. But the user still needs to record the quantity of fruits by manual. In fully-automatic operation, the sorting process is fully operated by machine. The machine is able to be controlled and monitored by computer. The computer also able records the quantity of fruits by automatic operation. Here, user just operates the sorting process from computer.

There are a lot of fully-automatic Fruit Grade Sorter Systems with different specifications and types. The Fruit Grade Sorter System classified the fruits according to their size, color, and weight, but most of the system still using manual operation to operate the sorter machine. They use human as operator to operate the machine and manual recording system to record the quantity of fruits those have been sorted. Nowadays, the manual fruit sizing are not effective anymore and the fruit industries has change to use the fully automatic grade sorting system. But the small fruit industries in Malaysia are lacking of funds. This happens because sorting systems are not designed by local company, so the price of the machine is more expensive. These create a critical situation for small fruit industries in Malaysia since the price

is not appropriate with their production efficiencies. Before this, there is no technology to design a low cost fruit and fully control grading sorter machine equipped with computer aid especially for small fruit industries in Malaysia. Thus, this project tries to take this opportunity to build up and design a sorter machine for the small fruit industry in Malaysia located in area Selama, Perak.

This project focuses on developing a Portable Honey Orange Fruit Grade Sorter Machine. The project are divided into four different task where each part is assigned to four different students. The first task is to design a power supply and structure of the machine. The second task is to design an automation process of the machine by using Programmable Logic Controller (PLC), while the third task is to complete the same task by using Programmable Intelligent Controller (PIC). The last part of this project is to design a Human Machine Interface (HMI) for the machine.

This report covers the last task of this project (HMI design). Basically, this task consists of designing a Graphical User Interface (GUI) and building an interface between the GUI and the machine through a PLC. The sorter machine is able to be controlled and monitored through a computer. The machine is able to sort the honey orange fruits according to their standards grade and size using a mechanical design based on a sizing hole on a conveyer. Honey orange fruit has 3 different grades which are small (S), medium (M), and large (L). The sorter machine consists of a components such as a DC motor, limit switches and indicator lamps. The structure of the machine was designed by the other team member. The finalized design is as shown in Figure 1.1.

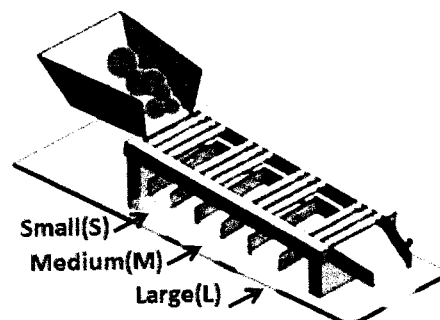


Figure 1.1: Sorter Machine Structure

For this project, the sorter machine will be controlled using a computer. It able to sort the honey orange fruits according to their grades. The sensors will detect the honey lemon fruits and the sorting machine will sort the fruits into grade box. The Parallel Port DB25 is used to interface between the computer and the sorter machine through an Input and Output Module Interface Circuit. The parallel port will transfer signal from the computer to the Input and Output Module Interface Circuit and pass the signal to PLC to start the machine. The PLC Keyence has limited input and output points which are 10 inputs and 6 outputs [1]. Figure 1.2 below shows the block diagram of this project design.

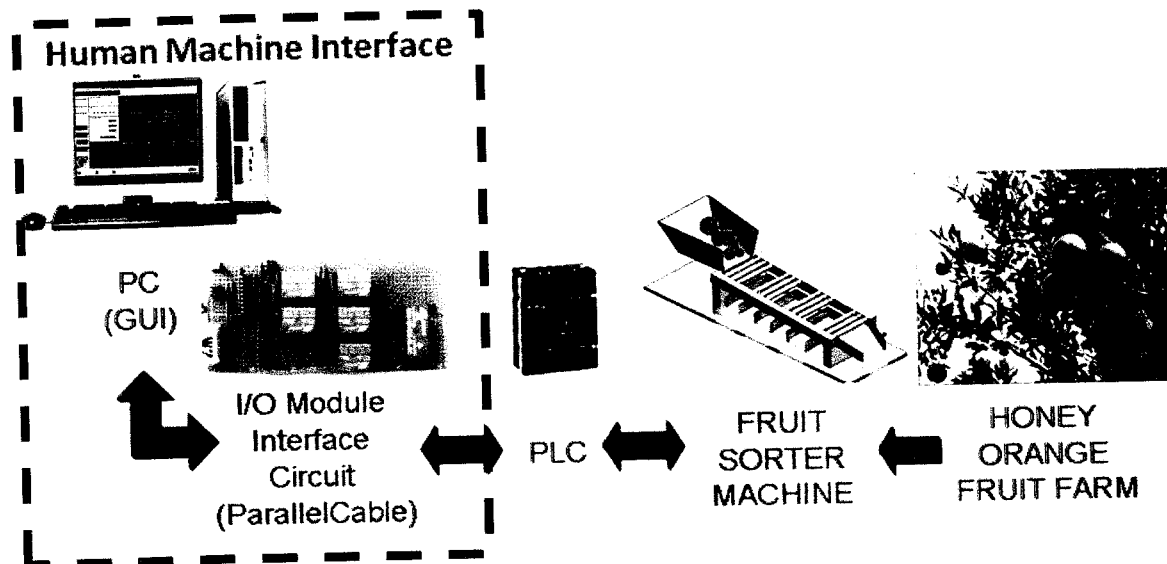


Figure 1.2: Project Block Diagram

Microsoft Visual Basic 6.0 software is used to design the Graphical User Interface (GUI) for the sorter machine. It allows user to control the process of the machine directly from the GUI. The GUI is users friendly and it helps user to control the machine easily and it can display the quantity of the fruits for each grades. The GUI also being integrated with database system which is created using a Microsoft Access. The purpose of database system is to save all the data for the daily quantity of the fruits and the machine sorter capacity.

1.2 Problem Statements

Nowadays in small fruit industries, the process of fruit grade sorter machine is done using semi-automatic process which still needs a human as an operator to operate the sorter machine. It includes the visual inspection by human and it may lead to human errors. The users of sorter machine also need to manually record the daily capacity or the unit per hour (UPH) of the sorter machine. It shows the semi-automatic sorter machine is not effective compared to the fully automatic sorter machine. The fully automatic sorter machine is able to control and monitor the sorting process using a computer. The users can just click on a mouse to start or stop the sorter machine. It is also able to record the daily capacity or the unit per hour (UPH) of the sorter machine automatically in the database system. But, the price of the automatic sorter machine is too expensive and it is not effective for the small fruit industry in Malaysia.

1.3 Project Objectives

Thus, the objectives of this project are:

- 1) To develop a low cost monitoring and controlling system of sorter machine by implementing the Human Machine Interface (HMI) Technology.
- 2) To control the system and monitor the process easily through communication between computer (Visual Basic) and the machine via an Input and Output Module using parallel port.
- 3) To allows the users to control the machine with Graphic User Interface (GUI).
- 4) To improve the recording system in recording the capacity of the sorter machine with automatic database system.

1.4 Project Scope

In this project, the scopes of work are:

- 1) Design and develop communication protocol between Computer and PLC using Computer Parallel Port.
- 2) Interface between Computer and sorter machine through I/O Module on PLC Keyence.
- 3) Develop the Graphical User Interface (GUI) using Microsoft Visual Basic 6.0 to control and monitor the sorter machine.
- 4) Develop a simple database system (Data Logging) for sorter machine.

1.5 Literature Review

This section discusses the theory and concepts of this project in details. Also, it informs about the method that have been used in this project. Besides that, it also discusses about the software that has been used on previous generation of sorting system. Below are the parts that are discussed in literature review:

- 1) Human machine interface Software
- 2) System Configuration

1.5.1 Human Machine Interface (HMI) Software

Human Machine Interface is the intelligent technology to increase the effectiveness of controlling and monitoring device or machine especially in production industrial field. The benefits of using HMI are described by Sakamura.K (1992) [2]. Currently, there are many types of HMI design that has been used in industry and there are several software that can be used for designing and developing the HMI. Below are the some of HMI software.

1.5.1.1 Microsoft Visual Basic 6.0

Visual Basic is a popular programming language for designing HMI. It is use a simple command that is similar to human language. So the visual basic programmer just need to understand how to use the command for executes the instruction steps. Visual Basic was derived from BASIC (Beginner's All-Purpose Symbolic Instruction Code) and enables the Rapid Application Development (RAD) of graphical user interface (GUI) applications, access to databases, and creation of ActiveX controls and objects.

Visual Basic is so powerful because it took a complex technology and made it easier to use through a graphical interface. In a visual programming environment, it can quickly design the windows that the user sees by drawing and arranging them just as lay out elements for a newspaper. In a text-based programming system, it can control the user inter face through program language commands. Besides, the visual programming method is easier for newcomers to learn and requires less time to maintain. For this project, Visual Basic is choosen as HMI software for GUI design. It is according to Parijat Inc. (2006), Visual Basic programming is more flexible, user friendly and the graphics are more interesting by using Graphical User Interface (GUI) function [3].

1.5.1.2 FactoryLink 7.5

FactoryLink 7.5 also called FactoryLink SCADA (Supervisory Control and Data Acquisition) software. It is been used in HMI design for controlling and monitoring for complex production line system. This software is compatible to use for automation controls, Statistical Process Control (SPC), OPC Server and OPC Client. Currently, the FactoryLink is popular used in manufacturing, building management and automations, utilities and for some typical applications.

1.5.1.3 RSLinx

RSLinx is a useful software for HMI application and it is developed by Rockwell Automation Company. RSLinx is a complete communication server for plant floor device connection. There are many types of application included in RSLinx such as RSLogix, RSView32, client application software, and data collection and analysis. By using The RSLinx HMI software, users can communicate with machine from anywhere. It provides a user friendly graphical interface for control and monitor the machine operation. Basically, this software uses some hardware for completing the communication such as PCMCIA, serial port, and PC-Based Network Card.

1.5.1.4 In-Touch 10.0

In-Touch 10.0 software is the other software that are currently used for HMI application. This software comes out with the latest technology and graphic design. It provides the amazing graphic capabilities, incredible power and flexibility for Graphical User Interface (GUI) view. These capabilities make this software really easy to use by any workers either operators or engineers.

In-Touch 10.0 already established as the world's favorite HMI, it is used in over one-third of the world's plants, in virtually every country and industry. In-Touch 10.0 software raises the bar for excellence with a host of features and capabilities, including:

- 1) Vibrant, resolution-independent ArcestrA® graphic capabilities, for realism, clarity and attention
- 2) Versatile, user-friendly, multi-user development and editing environment for collaborative engineering productivity
- 3) Powerful self contained ArcestrA graphical symbols with integrated scripting and connectivity to preserve engineering effort through re-use and standardization

- 4) Unprecedented power and flexibility with comprehensive scripting and graphical animation capabilities. In-Touch 10.0 software enables software engineers as well as non-programmers and novices to quickly customize application functions
- 5) Complete control with the Development Studio, provides a single consistent environment for centralized management and remote deployment of HMI applications everywhere, including the new Compact Panels
- 6) Comprehensive library of pre-built, eye-popping graphical symbols and faceplates
- 7) Built-in features for consistent handling and visualization of data quality

1.5.1.5 LabVIEW

LabVIEW is a program used to automate testing and data gathering. It is basically a graphical programming language in which the user can set up the program to manipulate and store data. LabVIEW ties the creation of user interfaces (called front panels) into the development cycle. LabVIEW programs/subroutines are called virtual instruments (VIs). Each VI has three components: a block diagram, a front panel and a connector pane. The latter may represent the VI as a subVI in block diagrams of calling VIs. Controls and indicators on the front panel allow an operator to input data into or extract data from a running virtual instrument. However, the front panel can also serve as a programmatic interface. Thus a virtual instrument can either be run as a program, with the front panel serving as a user interface, or, when dropped as a node onto the block diagram, the front panel defines the inputs and outputs for the given node through the connector pane. This implies each VI can be easily tested before being embedded as a subroutine into a larger program.

The graphical approach also allows non-programmers to build programs by simply dragging and dropping virtual representations of the lab equipment with which they are already familiar. The LabVIEW programming environment, with the included examples and the documentation, makes it simpler to create small applications. This is a benefit on one side but there is also a certain danger of underestimating the expertise needed for good quality "G" programming. For complex algorithms or large-scale code it is important that the programmer possess an extensive knowledge of the special LabVIEW syntax and the topology of its