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Signature :
Supervisor's Name : PN. ALIZA BINTI CHE AMRAN
Date :

PORTABLE DRAGON FRUIT GRADE SORTER- HUMAN MACHINE INTERFACE
DESIGN

NUR AZLINA BINTI JAMIL

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Faculty of Electrical Engineering
Universiti Teknikal Malaysia Melaka

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“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 : NUR AZLINA BINTI JAMIL
Date :

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ABSTRACT

This project is about to design and develop a Portable Dragon Fruit Grade Sorter programming via Microsoft Visual Basic 6.0. This machine will able to sort the dragon fruits according to their standards, grade and size using a sensor. Sorting and grading process are based on various criteria such as weight, shape and size. Dragon fruit has five different grades which are AA, A, B, C and D. The sensors will detect the different sizes of the dragon fruits and the sorting mechanism of the machine will sort the fruits at the end of process. Input/Output Module (PLC Keyence) will be used to interface between Grade Sorter Machine and Visual Basic and the output from Visual Basic will be transmitted via Parallel Port DB25 to the Input/output Module (PLC Keyence). While, the signal from Input/Output Module will be transmitted through wiring to the Grade Sorter Machine. This machine sorter is no longer operated manually but fully control by computer. So it will save time and energy for user to control this machine. The programming of the Machine Grade Sorter allows user to control motor, set date and time, and display all indicator lamps by using computer. Moreover, Visual Basic programming that writes is more flexible to make it user friendly and the graphics are more interesting. The significant of this programming will help user to control machine sorter easily.

ABSTRAK

Projek ini dilaksanakan bertujuan untuk merekabentuk dan membangunkan aturcara Mesin Pengasing Gred Buah Naga Mudah Alih menggunakan perisian *Microsoft Visual Basic 6.0*. Mesin ini menggunakan pengesan yang berupaya mengasingkan buah naga berdasarkan kepada piawai, gred dan saiz buah tersebut. Proses mengasing dan menggred adalah berasaskan kepada kepelbagaian kriteria seperti berat, bentuk dan saiz. Buah naga mempunyai lima gred yang berbeza iaitu AA, A, B, C and D. Pengesan tersebut akan mengesan buah naga mengikut saiz yang berbeza dan mekanisma pengasing pada mesin tersebut akan mengasingkan buah naga di akhir proses. Modul Kemasukan/Keluaran (*PLC Keyence*) akan digunakan sebagai pengantara muka di antara Mesin Pengasing Gred dan *Visual Basic*, dan isyarat keluaran daripada *Visual Basic* akan dihantar ke Modul Kemasukan/Keluaran (*PLC Keyence*) melalui Pot Selari *DB25*. Sementara itu, isyarat dari Modul Kemasukan/Keluaran akan dihantar melalui pendawaian ke Mesin Pengasing Gred. Mesin pengasing ini tidak lagi dijalankan secara manual tetapi akan dikawal sepenuhnya oleh komputer. Jadi, proses ini akan menjimatkan masa dan tenaga pengguna untuk mengawal mesin ini. Aturcara Mesin Pengasing Gred ini membolehkan pengguna untuk mengawal motor, menetapkan tarikh dan masa, dan memaparkan semua lampu penunjuk menggunakan komputer. Tambahan pula, aturcara *Visual Basic* yang dilaksanakan adalah lebih fleksibel untuk menjadikan mesra pengguna dan grafik yang direkabentuk juga adalah menarik. Kepentingan aturcara ini adalah dapat membantu pengguna untuk mengawal mesin pengasing ini dengan mudah.

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CHAPTER I

INTRODUCTION

1.1 Introduction

Before continue with this project, the concept of sorting process and how it works must be understood. Currently, there are a lot of sorting process with different specification.

Basically, this project is focused on developing a portable dragon fruit grade sorter. The tasks are divided into three parts. So, this project consists of three students. The first part is assigned to design a power supply and structure of the machine. But for the second part is to do an automation task using Programmable Logic Controller (PLC) and my part is to design a Graphical User Interface (GUI) for this project. In this project, the sorter machine is controlled using a computer. This machine will able to sort the dragon fruits according to their standards, grade and size using a sensor. Dragon fruit has five different grades which are AA, A, B, C and D. The sensors will detect the different sizes of the dragon fruits and the sorting mechanism of the machine will sort the fruits at the end of process. The Parallel Port DB25 is used to interface between the computer and the hardware (sorter machine) through an Input/Output Module (PLC Keyence). The parallel port will transfer signal from the computer to the I/O module and give command to start the machine.

1.2 Problem Statement(s)

In present, the grade sorter machine is popular done in manually which is faster and cheaper. Yet, the process is difficult to be controlled and hard to be monitored and since grading is done by visual inspection, it could lead to human errors. Thus, the best solution for this problem is to design Human Machine Interface (HMI) for the grade sorter machine. This software can control the system and monitor the process easily through communication between computer (Visual Basic) with the machine via an Input/Output Module using parallel port. The program can store all data of the system such as date and time, so it can record the number of fruits sorted and many more. Beside that, Human Machine Interface (HMI) saves time and energy for user to control the machine.

1.3 Project Objectives

There are four objectives of this project to make it successful. There are:

i. (Group Work)

1. To develop a portable dragon fruit grade sorter
2. To examine and test the sorter machine with the software, Visual Basic and PLC controller.

ii. (Individual Work)

1. To develop a suitable and user friendly software, Visual Basic (VB) to control sorter machine
2. To communicate machine sorter to PC through input/output module via parallel port

1.4 Scope of Work

In this project, we have a limitation task that we call scope of work. For this project, the scopes of work are:

- i Design and develop communication between PC and PLC using PC parallel port.
- ii Develop software (Visual Basic) to control the sorter machine via parallel port.
- iii Interface between PC with sorter machine through I/O Module (PLC Keyence).

CHAPTER II

LITERATURE REVIEW

2.1 Overview

A literature review is an evaluative report of information found that related to the selected area of study. This review will describe the summaries, evaluate and clarify of this literature. It should give a theoretical base for the research and help to determine the nature for this research. In this section, it will be discussing about the theory and concepts that is accordingly to the project in details. Also, it will inform about the perspective and method that have been using in this project. It is also discuss previous researches and work based on previous generation of sorting system. Through the literature review for this project, it can identify and evaluate technical issues about sorting system reliability.

2.2 Sorting System

Nowadays we already have a lot of technologies of sorting system. So, there are some research about the types of sorter machine to be used as a guideline in developed the machine for this project. Here, got few last technologies that people out there use for their sorter machine [8]:

2.2.1 Apples Sorter machine

Increasingly, Compac's many grading and packing technologies are the chosen solution for Apple pack houses around the world. The reason is accurate box weights (with less fruit give-away) plus easy to use and accurate color grading software that is being used commercially for 6 or more color grades.

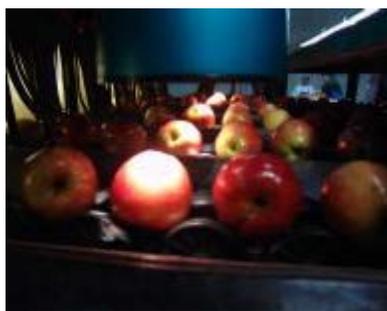
Compac sorters are designed for performance. At speeds of up to 12 fruit per second, gentle handling is maintained and throughput exceeding 10 bins or 200 x 18kg cartons per hour, per lane is common. Compac grading systems can sort apples by weight, color, internal characteristics and blemish.

Compac InVision 5000 color sorting system is the most accurate and easy to use Apple color sorting system available. The system literally learns from other fruit, can be fine tuned easily off-line as our fruit change and easily copes with dark colors, subtle browns, soft pinks and stripes commonly found in new varieties of Apples.

Compac weight sizing provides accurate fruit sizing and when combined with the unique Pack Weight Optimizer feature in Compac Sizer software, can provide accurate box weights consistently all day, every day.



Apple weighing



Measured for Taste



Baggers interfaced to 4 lanes

Figure 2.1: Apples Sorting Systems

2.2.2 Citrus Sorter Machine

Citrus are sorting by weight, diameter, color, and blemish. This sorting systems can also sort Oranges by density; particularly important for identifying frost-damaged Oranges. Density is also use for Lemons to detect internal disorders and with Mandarins to separate loose skin or puffy fruit. One machine will handle nearly all citrus varieties.

InVision 9000 can detect and grade on minor to major defects which range from skin blemishes, insect damage, mis-shappen fruit to physical damage. Physical damage (included punctures, cuts and bruising) can be a significant percentage of over all defects. These are often difficult to pick up with human eye but can cause fruit break down in the market.

The grading systems using the sizer electronics and an InVision optical grading system, can calculate the density of citrus. This is performed using accurate diameter readings as well as accurate weight readings for each fruit. Density sorting is also successfully being used to remove puffy (loose skin) Mandarins and internal breakdown in Lemons.



Density grading Citrus



Citrus blemish



40 lanes grading defects from Citrus

Figure 2.2: Citrus Sorting Systems

2.2.3 Potatoes Sorter Machine

The Compac Potato solution offers quality grading, sizing and distribution systems all in one efficient and reliable unit. Using Compac's accurate weight and InVision 9000 blemish system, sorting for external quality, size, shape, color and individual weight is all achieved prior to any human contact. This system provides accurate shape sorting for produce. InVision captures multiple images of each fruit at standard production speeds of up to 15 fruit per second. These images are analyzed with multiple measurements taken from each image, allowing shape sorting to improve the look and consistency of produce when packed.

Compac's patented carrier, combined with durable electronics and software controls, provide high volume throughput and the flexibility needed to meet the requirements. Assuming an average size of 150 grams (approx 5.5ozs) per Potato, each lane of a sizer can process an average of 3.5 metric tons (3.8 U.S. tons) per hour.

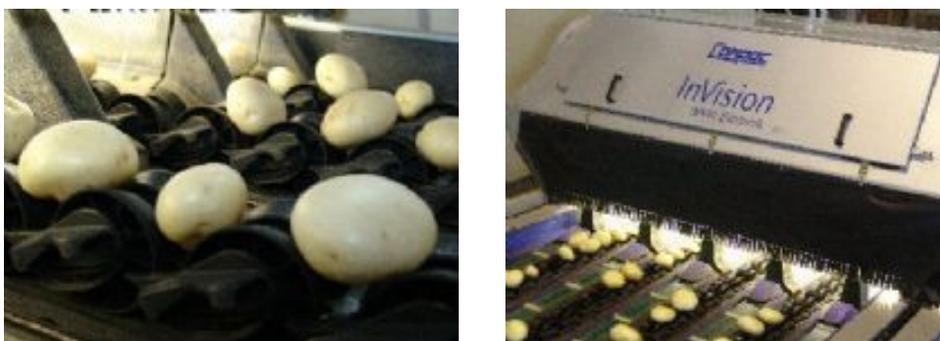


Figure 2.3: Shape Grading Potatoes

2.3 Sorter Control Software

There are several development software's were developed to control a sorter machine to perform its specific application. The types of software that been used in controlling sorter machines are:

2.3.1 Microsoft Visual Basic 6.0

A programming language such as Visual Basic is used to translate instructions as humans understand them into the steps that the computer can comprehend and follow. 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. A programmer can put together an application using the components provided with Visual Basic itself [2].

Visual Basic is so powerful because it took a complex technology and made it easier to use through a graphical inter face. 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.

2.3.2 AutomGen7.0

AutomGen software is based on the idea of a project. A project groups together the elements that compose an application. The browser displays all the project elements such as sheets, symbols, configuration, IRIS objects and many more in a tree format. "Beginner" modes make it possible to start using AutomGen in a "simplified"

configuration, with a reduced number of options in the menus and simplified palettes. This mode is especially suited to user using AutomGen for the first time. Expert mode offers all of the applications [7].

2.3.3 V10 Control Software

Compac Sizer V10 is a simple to use, high performance software engine to add more power to a new sorting system. This control software provides user-friendly, flexible information feedback and advanced diagnostic systems. Its development has been based on hundreds of constructive requests and suggestions from experienced operators. Besides, this software also has advantages such as performance data clearly displayed for quick reference, any number of sizes, grades or qualities can be sorted, customizable production graph illustrating daily or hourly packing performance at a glance, customizable Graphical User Interface and so on.

2.3.4 EXACT Sorter Control

EXACT is an Equinox software product designed for controlling the process of sorting a quantity of the same items represented as distribution to a certain number of stores/customers. The EXACT system can be installed on any sorter type that Equinox's StarSort system can control. Currently EXACT is and continues to be installed on hang, flat and tilted tray sorters all around the world. EXACT controls the distribution process at a high software level by providing the user interface to the Equinox StarSort sorter control system for the sorter's operators. StarSort is an integrated hardware and software system that controls Material Handling Equipment (MHE) in distribution centers such as conveyors, merges, carton, trolley and piece sorters and many other types of equipment. EXACT also ensures the automatic distribution process control on the sorter by communicating with StarSort via TCP/IP messages.

2.3.5 M90/M91: Micro PLC with Text HMI

The M90/M91 is an innovative micro-PLC (Programmable Logic Controller) with a built-in operating panel. The operating panel offers an LCD that can display two 16-character text lines, and a keypad (one line in the M90 models). The M90/M91™ series offers a variety of onboard I/O configurations, including direct temperature and weight measurement inputs; the configuration can be expanded by adding I/O Expansion Modules. The M90/M91 is the perfect control solution for small-to-medium applications such as water treatment, automated machines, and process control.

PLC/HMI integrated devices:

- save customers' programming time, wiring, and cabinet space
- cut budget by reducing requirements for additional hardware
- prevent customer from wasting time setting up Panel-PLC communication

2.3.6 HyperTerminal

HyperTerminal is a program that can be use to connect to other computers, Telnet sites, bulletin board systems (BBSs), online services, and host computers. HyperTerminal connections are made using a modem, a null modem cable (used to emulate modem communication), or an Ethernet connection.

HyperTerminal has capabilities beyond making connections to other computers. It can, for example, transfer large files from a computer onto portable computer using a serial port rather than requiring user to set up their portable computer on a network. It can help debug source code from a remote terminal. It can also communicate with many older, character-based computers.

HyperTerminal records the messages passed to and from the computer or service on the other end of connection. It can therefore serve as a valuable troubleshooting tool

when setting up and using your modem. To make sure that the modem is connected properly or to view modem's settings, user can send commands through HyperTerminal and check the results. HyperTerminal also has scroll functionality that enables to view received text that has scrolled off the screen.

2.3.7 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 memory management. The most advanced LabVIEW development systems offer the possibility of building stand-alone

applications. Furthermore, it is possible to create distributed applications which communicate by a client/server scheme, and thus is easier to implement due to the inherently parallel nature of *G*-code.

To maintain clean and legible user VI interfaces its best to keep these tips in mind: Keep panels simple and clean, keep a consistent style, clean up wires where ever possible, use proper terminology when labeling controls and indicators.

2.3.8 CitectSCADA

CitectSCADA is a HMI / SCADA software package supporting an extrem wide range of Schneider Electric and 3rd party PLCs (using vender's OPC driver or its own *native* drivers) and a big collection of symbols of industrial equipments for drawing the application scenes made by Citect with a design-time HMI/GUI construction tool (called *Citect Graphics Builder*) and a run-time application logics expressed in the Cicode programming language [9].

CitectSCADA is a fully integrated Human Machine Interface (HMI) / SCADA solution that enables customers to increase return on assets by delivering a highly scalable, reliable control and monitoring system. Easy-to-use configuration tools and powerful features enable user to quickly develop and deploy solutions for any size application.

A system with a primary function of collecting information (data) and providing an interface to control specific equipment such as Programmable Logic Controllers (PLCs), Remote Terminal Units (RTUs) etc.