PORTABLE HONEY ORANGE FRUIT SORTER (PROTOTYPE AND POWER SUPPLY DESIGN)

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May 2009

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This Report Is Submitted In Partial Fulfillment of Requirements for the Degree of Bachelor in Electrical Engineering (Power and Drive)

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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 :.....LIM PEI FERN.....

Date :.....13/5/09.....

Special dedication to my loving parent, all my siblings, my supervisor En.Fazlli bin Patkar and to my dearest friends.

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ABSTRACT

Mainly this project is to produce the Portable Honey Orange Fruit Sorter machine in low cost but still effective. An adaptor is needed to be developed to supply the system from 240Vac to the desired input value for the PLC Keyence (24V), motor (12V), sensors (12V) and external circuit that are used to connect the computer port to PLC Keyence or PIC controller (5V). Also, a 13V and 5A regulated power supply also needed to be constructed to operate the motor. For the power supply design, linear regulated power supply is a suitable choice since it is able to rectifier 240V AC main electricity to a suitable voltage supply, 5V,12V and 24V DC. A linear power supply exhibits low ripple and noise, tolerates ambient temperature changes, and is highly reliable due to its circuit simplicity.

ABSTRAK

Matlamat projek ini adalah untuk menghasilkan suatu mesin yang dapat mengasingkan saiz buah limau hijau yang murah dan effeisen. Bekalan kuasa elektrik yang dapat menghasilkan keluaran voltan sebanyak 24V bagi PLC Keyence, 12V bagi alat pengesan dan 5V bagi litar sambungan computer dengan PLC Keyence atau alat kawalan PIC perlu dibina. Bagi mengoperasikan motor, bekalan kuasa elektrik yang dapat megeluarkan voltan sebanyak 13V dan 5A arus juga perlu dibina. Bekalan kuasa elektrik yang linear telah dipilih bagi projek ini memandangkan bekalan kuasa elektrik jenis ini agak mudah dibina, mengurangkan tahap kebisingan dan tahan lama.

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PLC	- Programmable Logic Controller
PIC	- Peripheral Interface Controller
HMI	- Human machine interface
cm	- Centimeters
mm	- millimeters
AC	- Alternating current
DC	- Direct current
EMI	- Electro-magnetic interference
V	- Voltage
A	- Ampere

CHAPTER 1

INTRODUCTION

1.1 Introduction

Honey orange is one of the popular citrus species cultivated by small holder farmers along the coastal and midland areas in Malaysia. However, there are many variations in fruit type, with quite noticeable differences in fruit size and shape, thickness of rind and sweetness. The fruit is well accepted as a dessert fruit and the market for it is good. Fruits are round in shape and 5-10 cm wide, with skin shiny and greenish yellow. The skin is thin and peeling easily. The flesh is juicy, pale orange in color and sweet.

Honey orange as shown in Figure 1.1 are adapted to grow under all climatic conditions where frost is not a limiting factor. It can survive in areas with temperature between 23 - 38C, and annual rainfall of not more than 900mm.

Figure 1.1: Honey oranges

Figure 1.2: Honey oranges orchard

Figure 1.3: Honey oranges packing style

Honey orange in Figure 1.3 can be grown on a variety of soils ranging from sandy to soils with high clay content as shown in Figure 1.2. However, the best soil is medium textured soil of alluvial origin, uniform, reasonably deep and fertile, having good internal drainage.

Honey oranges have different sizes. Table 1.1 shows the different grades of the honey orange fruit.

Table 1.1: Difference types of honey orange fruit ranges and sizes

Size	Range (cm)
S	4.5-5.5
M	5.6-7.0
L	7.1-8.5

1.2 Problem Statement

While large scale operations may benefit from investing in costly handling and high-tech machinery, often these options are not practical for small-scale handlers. Instead, simple and low cost technologies often can be more appropriate for small volume, limited resource commercial operations, farmers involved in direct marketing, as well as for suppliers to

export in developing countries. Besides, local conditions for small-scale handlers may include labor surpluses, lack of credit for investment in post harvest technology. Therefore, these simple technologies have the potential of meeting the special needs of small-scale marketers. Furthermore, it is a good starting point for low input or small scale handlers to try the practices and compare them to their current practice. The machine is designed to suit the local conditions or materials available.

For the power supply design, it is necessary to choose the best, stable and inexpensive power supply. But, the problem encountered here is which type of power supply has to be chosen between the linear regulated power supply and switched-mode regulated power supply. Because of its emphasis on efficiency, switched-mode power supply design minimizes the use of certain components such as resistors and uses components that are ideally lossless such as switches capacitors, inductors and transformers. The primary design problem is how to interconnect these components and control the switches so the desired results are obtained. The secondary design problem is to select, design, or overcome the performance characteristics of less than ideal components. Besides that, it is also difficult to stabilize and keep oscillating.

Linear power supply though more bulky and less efficient has some advantages too when compared with the switched mode power supply. Generally the control of the linear power supply circuit is much simpler than that of switched-mode power supply circuit. Since there is no high frequency switching, the switching related electro-magnetic interference (EMI) is practically absent in linear power supply but is some concern in switched-mode power supply circuit. Also, as far as output voltage regulation is concerned the linear power supply is superior to switched-mode power supply. A linear power supply also exhibits low ripple and noise, tolerates ambient temperature changes, and is highly reliable due to its circuit simplicity.

After consider the pros and cons for both of the power supplies, the linear power supply is being chosen since it meet all the specifications of this project as the linear power supply circuit is much simpler and the multiple output voltage controlled is fixed , stable and easy to be control compared to switched-mode power supply.

1.3 Objectives

1. To assemble the machine parts into one system
2. To design and develop an adaptor to provide supply to the system
3. To produce a cost effective sorter machine

1.4 Scope

In this project, the scope is based on three main parts. The first part is to propose the best design for the Portable Honey Orange Fruit Sorter Machine. Then, the following part is to design and assemble the machine parts into one system using the Solid Works software and prepare engineering drawing. The final step is to design and develop adaptors to supply the system from 240Vac to the desired input values, which are 5V, 12V and 24V for the PLC Keyence (24V), motor (12V), sensors (12V) and external circuit that is used to connect the computer port to PLC Keyence or PIC controller (5V).

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review is the method for collecting information regarding the machine, and the result based on the information will be analysis and examine for the purpose to know the benefit or the scarcity of the machine. The information from the technical journal, references books, internet searches and ideas from discussion among team members, supervisor and some guideline from the experienced person about the design machine and the power supply will be used to implement and develop the fruit sorting machine. In this section, it will be discuss 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. The information for this project is as below:

2.2 Introduction of fruit sorting and grading system.

Preparation for marketing fruits begins with harvesting. Then the fruits need to be hauled at packinghouse. At packing house operation, the workers will unload products from loaded field containers onto a conveyor or into a water dump for conveying into a packinghouse. After the fruits have gone through the cleaning, coating, and drying process, it is carried to a sorting area for the inspection. Along the sorting conveyor, workers inspect each fruit, remove defective fruit or unwanted items, and redirect different grades of fruit as required.

Commonly, a roller conveyor is used to rotate the fruit for overall surface inspection. At this stage workers perform sorting operations that machines are not capable of doing.

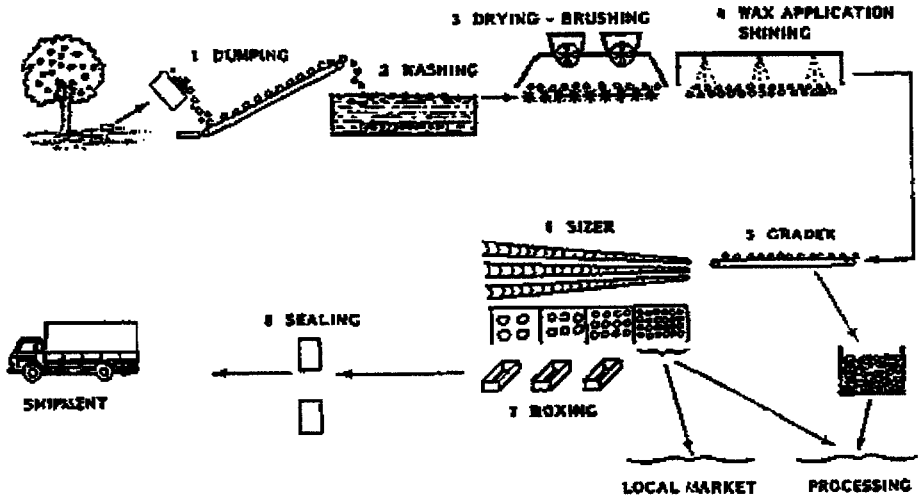

Figure 2.1: Packinghouse operation system

In large packinghouse operations as shown in Figure 2.1, sorting machines using machine vision are installed to sort fruit into different grades based on weight, dimensional size, color, shape, limited defects, and other parameters. A typical machine vision fruit sorting system is shown in Figure 2.2 below:

Figure 2.2: Fruit sorting machine vision

On the roller conveyers, fruit are cingulated into pockets so they can be handled individually. Usually the fruit is rotated on rollers while passing through a vision chamber. Inside the chamber, video cameras take one or more images of each fruit. Linked to each

camera, a computer embedded with a digital image processor instantly processes the images. This information is combined with information from other sensors, in many cases weight, and each individual fruit is assigned a grade based on this information compared against the sorting parameters specified by the operator. A typical user control console of a vision system is shown in Figure 2.3 below.

Figure 2.3: User control console

After grading the fruit is transported by a mechanical sorting machine that discharges the fruit at many different locations along its length. The "drop" location for each individual fruit is determined by the operator based on its assigned grade and where in the packinghouse it is to be packed. When a fruit reaches its assigned location it is removed from the sorting machine by some methods. Generally the fruit is carried in a pocket or holder which can hinge down backwards, hinge down to the side, or tilt up to make the fruit fall out. In some cases an ejector is used to knock the fruit out. It then falls onto a conveyer which carries the fruit to its packing location. The mechanisms for releasing are carefully engineered to minimize damage to the fruit. Typically, soft pads, brushes, and/or ramps are also used to reduce the impact of fruit to each other and to the collection conveyer. The computer controlled sorting machines give the packinghouse the flexibility to sort fruit to meet many different customer requirements.

2.3 Latest Technology in Sorting Fruit Process

Nowadays, there are many high technology machines in sorting variety fruits. The machine sorts the fruits by weight, size, color, shape, density, blemish or defects, taste, internal characteristics and etc.

2.3.1 Machine vision system for on-line sorting and grading of fruits like apples

CEERI Centre, Chennai conducted various studies on many images and the development of algorithms have culminated into an on-line product to sort and grade fruits like apples with funding support from Department of Food Processing Industries, Ministry of Agriculture, Govt. of India, New Delhi. This development will help the farming community to increase value additions to their produce.

The developed system consists of conveyor assembly, diffused uniform illumination system, CCD cameras and image processing algorithms. The system has been developed for sorting and grading of fruits like apple and the same can be used/extended to fruits like orange, mango, grape, tomato, etc., The system can perform complex color, size and shape based classification, comparable with human vision but with far greater speed, repeatability and reliability. Similar kind of technology/ instrument is available only in USA. (See Figure 2.4)

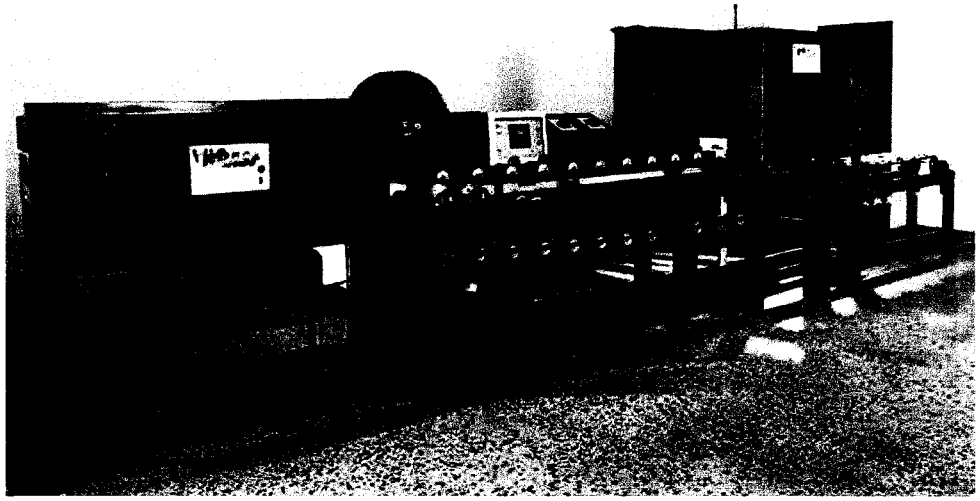

Figure 2.4: Machine vision system for on-line sorting and grading of fruits like Apples