UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Design and Modeling of Automated Sorting System in Manufacturing Industry Using Simulation Software

Thesis submitted in accordance with the requirements of the
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By

ZULHASHIKIN BIN TALIB

Faculty of Manufacturing Engineering
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Alamat Tetap:
Ldg. Jeleta Bumi,
Peti Surat 135,
91207, Kunak Sabah.

Tarikh:16/05/2007

Cop Rasmi:
MUHAMAD ARFAUZ BIN A RAHMAN
Pensyarah
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka
Karung Berkunci 1200, Ayer Keroh
75450 Melaka

Tarikh: 24/05/2007

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.....

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.....

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DECLARATION

I hereby, declare this thesis entitled "Simulation Study on Motor Controller via Voice Command" is the results of my own research except as cited in the reference.

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Author's Name : ZULHASHIKIN BIN TALIB

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ABSTRACT

Design the automated sorting system to need the manufacturing industry in many fields is a very complex process. The system needs to develop in order to meet the industry satisfactions. Currently, there are many automated sorting systems for single purpose.
The main contribution of this project is to improve the current parts sorting system in manufacturing industry. The investigation was made in scope of the lacking in current parts sorting system in manufacturing industries. The step of development of the project starts with survey the manufacturing current scenario, analysis the current sorting system, development of concept design and development of the detail design using the engineering software called Automation Studio software. Designed and analyzed the concept design using simulation in order to get the detail results. The detail results shows that the designed system can encounter the problem that current automated sorting faced. The outcomes of this thesis can be used as reference to support in developing the automated sorting systems in future.

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DEDICATION

Specially dedicated to: My Father, Talib bin Kalla, My Mother, Nurung bte Yapa, and Azlan bin Talib who are vere concern, understanding and supporting.

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TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURE

LIST OF ABBREVIATION AND SYMBOLS

CHAPTER 1
GENERAL INTRODUCTION

1.1 Introduction

Sorting systems are required in many industrial fields such as in manufacturing industry to make sure the manufacturing process more efficiently. All sorting processes, although different, generally consist of looking at the objects distributed on a moving conveyor, localizing any single part, recognizing the relevant features that make it acceptable or not and separated the parts depend on their categories.

The automated sorting systems are similar with the manual sorting systems. The different between those two is the automated sorting system is more efficiency and used more technology features in their system than the manual sorting.

1.2 Problem statement

In most industrial situations where a sorting process is needed, a highly structured environment can be found, specifically designed for the optimal exploitation of systems capabilities.

In order to accomplish fully automated parts sorting systems, the following problems have to be faced:

a. Automatic localization of the single parts on the conveyor in presence of contact and/or overlapping.
b. Classification of a wide class of sorting items for which mechanic/magnetic pre-sorting do not suffice.
c. Optimization of the separation strategy in order to upgrade the performance of the system.

1.3 Objectives

The objectives of this project have been identified and must be achieved in order to make the project successful. The objectives are as follows;

a. To evaluate current parts sorting system in manufacturing industry
b. To recommend for improvement of current parts sorting system in manufacturing industry
c. To design and develop a model of a parts sorting system in manufacturing industry using Automation Studio software

1.4 Scopes

In order to producing a successful system, the scopes are very important to make sure the direction of the project development. The scopes of this project are as follows:

a. Manufacturing

Investigation about the sorting system in the manufacturing industry current scenario. In this case, all the critical aspects that involved about sorting system and manufacturing are identified.

b. Identify suitable solution

After the problem has been identified, the suitable solution is needed to overcome the problem that the current manufacturing industry facing. Beside that, the solution must available to apply in manufacturing industry.

c. Evaluation

After the suitable solution has been identified, the evaluation is needed to make sure the solution is very suitable in current manufacturing industry.

d. Design the proposal

The designing phase is to design a system either it prototype or real. The design will be used to make the sketch of the working procedure. Even the specification and the pattern of the automated sorting system is clear, the programming design to control the system must be design according to the work flow. Beside that the location of the components like the sensor and stopper must be define for easy revision and checking. The design can affect all the working sequence of the system and it can be trouble if the design and the sequence of the system not matched.

e. Build the prototype

When all the steps in designing and manufacturing have been identified, the prototype of system should build to make sure the system is really successful or not. This step is important to make sure the systems are suitable for manufacturing industry.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

There several issues regarding to the usage of automated sorting systems in manufacturing industries. These problem occurs because of the sorting systems that been used are really not suitable in manufacturing industry current scenario. Beside that, it happened when the system is not meeting the manufacturing industry desired and needed.

For this purpose, many parties try to develop the automated sorting system that only capable to fulfil the task of manufacturing but also easier to operate and to handle. This sorting system is not only focus on the system but also focus on the part or equipment that been used.

2.2 Automated Sorting System

Sorting procedures are required in many industrial fields, e.g., in manufacturing, where a strict quality control has to be maintained. All sorting processes, although different, generally consist of looking at the objects distributed on a moving conveyor belt, localizing any single item, recognizing the relevant features that make it acceptable or not and, if applicable, gripping it to perform the necessary separation. The two fundamental issues involved in the automation of these processes are therefore:

a. Sensing for detecting and classifying the items, and
b. Gripping for realizing the required separation in the most efficient way.

In most industrial situations where a sorting process is needed, a highly structured environment can be found, specifically designed for the optimal exploitation of robots capabilities. In particular:

i. The position of any item is exactly known (or, at least, the items are separated).
ii. A small number of physical and/or geometrical parameters is relevant for sorting purposes.
iii. The relevant parameters vary in a restricted range of values.
iv. The items flow is controlled, so that the load variations are limited and the robots always work in conditions of nearly maximum efficiency.

Under the strong assumptions at points 1, 2 and 3, a variety of localization and/or identification techniques have been proposed in the literature most of them consist of using 2D Vision techniques to separate the objects from the known belt background (when needed) and/or to get some of their geometrical parameters (typically: length, width, or shape parameters). When other parameters than geometrical ones are relevant for sorting, specific sensors are employed. As regards the gripping efficiency, due to the assumption at point 4, it is not even an issue in most sorting processes.

A completely different situation characterizes the sorting systems, where items of many different kinds (plastic, metals, composite, etc.), together with some other undesired materials, have to be separated into homogeneous fractions that will undergo the same recycling process [6]. Here:

i. The shape and position of any item is unknown.
ii. The items on the belt may be in contact or even overlapping.
iii. Their physical and geometrical characteristics vary in a wide range.
iv. The items flow can be just characterized in statistical terms and its parameters typically have a high variance.

Due to these conditions, that violate all assumptions at points 1-4, thus making standard automatic techniques inapplicable, this sorting process has not yet been automated: actually, after some mechanical and magnetic pre-sorting, the process has to be completed manually by human operators, with serious risks for their health.

2.3 Sorting Methods

There are several methods used to facilitate a sort. The optimum configuration depends on the quantity of sort destinations, the volume of product to be shipped, the size and sensitivity of the product, and window of time available to perform the sort. Three basic sorting methods are batch sorting, continuous batch sorting and multiple batch sorting.

2.3.1 Batch Sorting (Wave Sorting)

In wave sorting or a batch sort, inventory is picked in bulk to fill the orders for each specific time period, or wave. The product is then induced automatically or manually utilizing two to three employees into any one of sorting appropriately chosen for the products.

When the quotation of the order received, a runner(s) would then go to the appropriate storage areas to gather the bulk requirement for each product necessary to complete the requirements of the cutoff. The collected product is then brought to the sorter for distribution to each designated drop according to the order requirement. Once the product has been fully induced all the orders are complete and the next wave is ready for induction.

The sorter comes with an option to verify that the product is dropped to the correct location and to match all products dropped against the order. Deficiencies could be reported to the operator for completion or override before proceeding to the next wave. An automated take-away and replenishment system may also be installed to reduce downtime when transitioning between waves.

2.3.2 Continuous wave sorting

Another method is to sort on a continuous basis rather than in waves. In this case, the sorter is always running and continuously being reconfigured for the next drop after the previous order has been completed and removed.

This method requires more sophisticated software and controls, as well as an automated take-away and replenishment system described above to ensure the uninterrupted flow through the sorter. All methods require that all products be bar-coded for identification.

2.3.3 Multiple Batch Sorting

This mode of operation is similar to the batch mode in that product is brought to the sorter in groups or batches (waves). However, it differs from the wave sorting in that there are multiple batches or waves configured on the sorter at the same time.

Using an example of two batches (waves) on a straight or in-line sorter, one batch (wave) could be configured on one side of the sorter and the second on the other side. One batch or wave of bulk product is brought to the sorter at a time so that one side of the sorter can finish its sort before the other one begins. This method allows the sorter to work continuously since product is always being loaded. Transition time between waves is almost entirely eliminated making more efficient use of the equipment.

This method is employed when it is important to get a greater throughput from the equipment and the sorter is large enough to create efficient bulk pulls of batches or waves for partial segments of the sorter.

2.4 Application of Automated Sorting Systems

According to Batchelor BG, Braggins DW (1992) in their article, industrial applications require some sort of automated visual processing and the classification of items placed on a moving conveyor. A typical process comprises of:

i. Looking at the items on the conveyor via some type of sensor such as a camera
ii. Localizing any single item
iii. Classifying the item based on a set of features such as shape
iv. Performing the necessary action depending on the classifications made.

According to the H. I-sil Bozma, H.ulya Yal-cin (2002) in their journal explains about a Visual classification setup in an industrial setting typical setup. The Figure 2.1 shows the typical setup about visual classification.

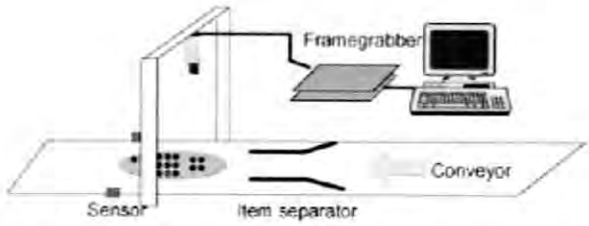

Figure 2.1: Visual classification setup in an industrial setting

From figure 2.1, the authors explain how to detect the items at random positioned and oriented on a conveyor. A camera located above the conveyor views the items orthographically.

In their journal also brief about an automated remote controller sorting system has been developed for a TV manufacturing plant as shown in figure 2.2. There are five different types of remote controllers with about ten different colours. Each type of remote controller can be distinguished based only on the outer shape. In this application, all the different types of remote controllers are being manufactured on