



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**IMAGE PROCESSING AND PLC BASED CONVEYOR BELT
SYSTEM FOR INDUSTRIAL AUTOMATION AND CONTROL**

This report submitted in accordance with requirement of the Universiti Teknikal
Malaysia Melaka (UTeM) for the Bachelor Degree of of Electrical Engineering
Technology
(Industrial Automation and Robotics) (Hons.)

by

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I hereby, declared this report entitled “Image Processing and PLC based Conveyor Belt System for Industrial Automation and Control” is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Automation and Robotics) (Hons.). The member of the supervisory is as follow:

.....
(Project Supervisor)

ABSTRACT

This project is to develop a simple teaching tool by using image processing and PLC based conveyor belt system. The system will be able to detect the object patterns that will be captured by a webcam. The project used HALCON software program that will be integrated with a webcam or digital camera. The System will analyze the image then display it on a Graphical User Interface (GUI). The system uses CX Programmer to control the conveyor belt system in transporting the object.

The system is designed to recognize different types of object's pattern and sort the object according their types. System provides a fun and easy way to let students know how an industry sorting process is operated. This system attract students and increase their interest in the field of engineering and technology.

ABSTRAK

Projek ini adalah untuk mereka sebuah alat mengajar yang mudah dengan menggunakan pemprosesan imej dan PLC. Sistem ini akan dapat mengesan corak dan warna objek serta mengisih object yang memenuhi syarat tertentu. Projek ini akan menggunakan program HALCON untuk mengintegrasikan dengan webcam atau kamera digital. Sistem ini akan menganalisis imej dan dipaparkan pada Graphical User Interface (GUI). Sistem ini juga akan menggunakan CX-One untuk mengawal pergerakan system tali sawat.

DEDICATIONS

This is devoted to my father who never stops believing and supporting me throughout my journey in building success and also to my mother who teaches me that nothing comes easy in life.

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LIST OF SYMBOLS AND ABBREVIATIONS

IO	-	Input and Output
T_c	-	cycle time, min/pc;
T_o	-	time of the actual processing or assembly operation, min/pc;
T_h	-	handling time, min/pc;
T_t	-	average tool handling time, min/pc.
R_p	-	hourly production rate, hr/pc;
T_p	-	average processing time, min/pc;
T_B	-	batch processing time, min/pc;
Q	-	batch quantity, pc/batch;
T_{SU}	-	setup time to prepare the machine for the batch, min/batch;
R_p	-	hourly production rate, hr/pc
PC	-	production capacity;
n	-	number of machines;
H_{pc}	-	the number of hours in the period being used to measure production capacity;
R_{pph}	-	average hourly plant production rate;
R_{pij}	-	production rate of machine i when processing part j;
f_{ij}	-	the fraction of time during the period that machine i is processing part style j;
n_{oj}	-	the number of operations required to produce part j;
T_{no}	-	Non-operation time, min
MLT	-	Manufacturing Lead Time
WIP	-	Work-in-Process

-

CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter provides an introduction about this whole project. It starts with general information and background about image processing, problem statement. It will also cover the objective, problem statement and scope for the overall project.

1.1 Project Background

The project is about creating teaching tools for primary and secondary students to learn and know about the systems that used in industry such as sorting process and how it is operated. As we know, the industry is moving towards automation and robotics, lots of labour works and controls are being replaced by using advance system and machine. One of the labour process that have being replace by technology is sorting process. The purpose of the project is to provide a simple and lower cost teaching tools for primary or secondary students to learn about the sorting process in the real industrial. The students can expose earlier to the machines and systems that are using in the real industry. They will know how the sorting process is operated, how the image is process and how the conveyor belt is being control, thus it will increase the interest of the students in the field of engineering and technology.

1.1.1 Image Processing

Image processing is a process or operations that function as to improve, correct, analyze or change the image differing to its original state and to convert it into digital form, in order to get an enhanced image or to extract some useful information from it. Image Processing System includes treating images as two

dimension signal and applying standard processing techniques to obtain the best analysis result. In general, the objective of this process is to transform or analyze an image so that the new information of the image is made obvious. An image processing flow consist of enhancement process, restoration process, analysis, compression process and synthesizing.

1.1.2 History of Image Processing

The history of digital image processing started possibly for the problem of image transmission where it was applied in the newspaper industry. Earlier to this, analog images transported through air or ships which very time consuming and costly. To reduce transmission time, images were being digitized and transmitted through cable electronically. However, these techniques were found to involve loss of significant image information during reconstruction at the receiver end. Hence, suitable processes such as enhancement, restoration, encoding, and compression were developed. Figure 1.1 show a digital picture produced in 1921 from a coded tape by a telegraph printer with special type faces, (McFarlane, 1972).



Figure 1.1 : A digital picture produced in 1921 from a coded tape by a telegraph printer with special type faces, (McFarlane, 1972).

1.1.3 Component of Image Processing

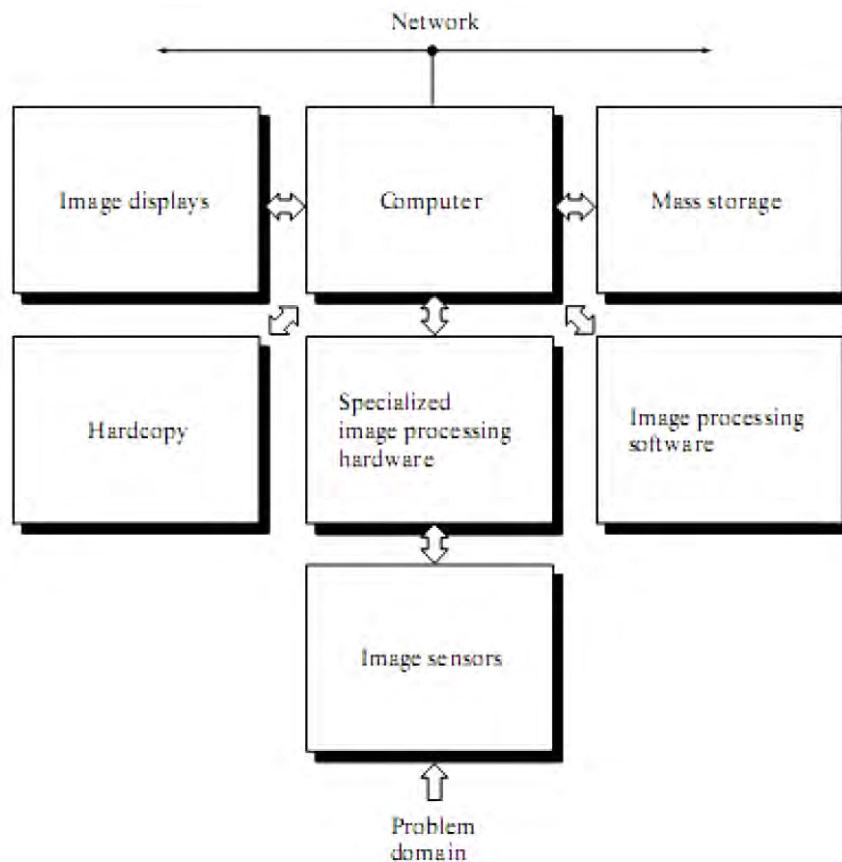


Figure 1.2 : Component of Digital Image Processing System

With reference to sensing, two elements are required to acquire digital images. The first element is a physical device that is sensitive to the energy radiated by the object we wish to image. The second is called a digitizer, is a device for converting the output of the physical sensing device into digital form. For example, in a digital video camera, the sensors produce an electrical output proportional to light intensity. The digitizer converts these outputs to digital data. Specialized image processing hardware usually consists of the digitizer plus hardware that performs other primitive operations, such as an arithmetic logic unit (ALU), which performs arithmetic and logical operations in parallel on entire images. This type of hardware sometimes is called a front-end subsystem.

The computer in an image processing system is a general-purpose computer and can range from a PC to a supercomputer. In dedicated applications, sometimes

specially designed computers are used to achieve a required level of performance. Software for image processing consists of specialized modules that perform specific tasks. A well-designed package also includes the capability for the user to write code that, as a minimum, utilizes the specialized modules. Mass storage capability is very important in image processing application as it provide storage space to store data. Image displays in Digital Image Processing System is mainly colour TV monitors that display images. As for hardcopy devices, they are used for recording images include laser printers, film cameras, inkjet units and CD-RO.

1.1.4 Fundamental Steps in Digital Image Processing

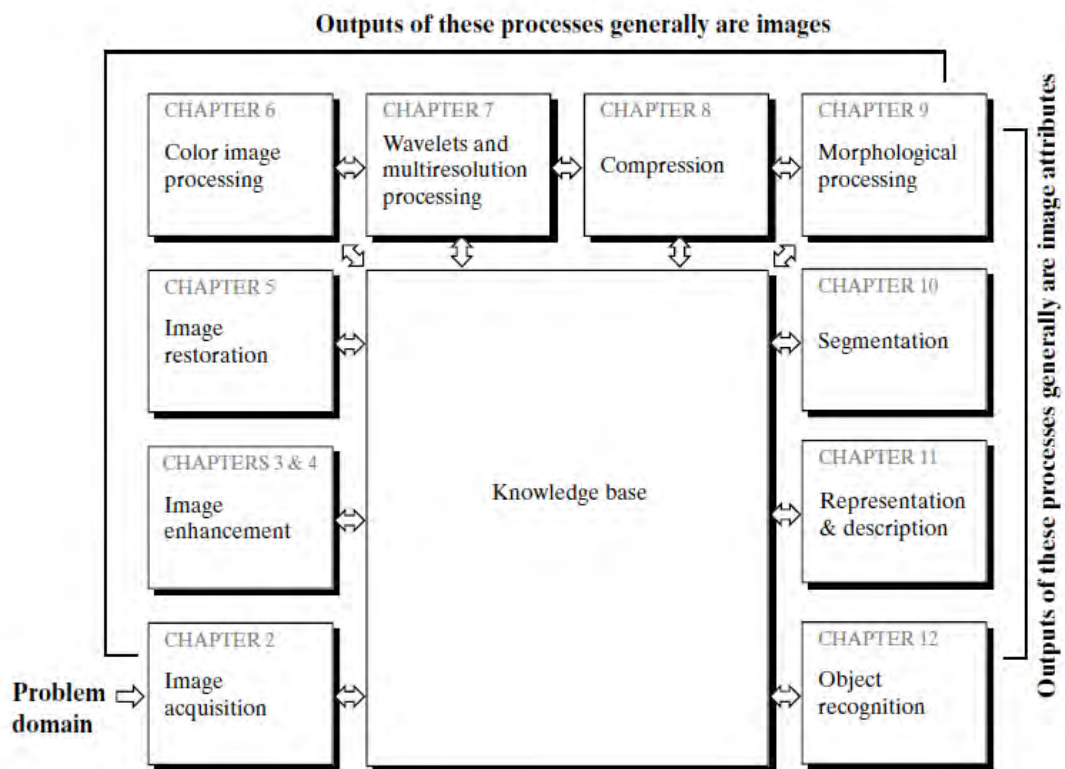


Figure 1.3 : Fundamental Steps in Digital Image Processing

Step 1. Image Acquisition: In this step, the image is captured (such as a monochrome or color TV camera) and digitized, an analog-to-digital converter (ADC) will digitizes the output if the output of the camera or sensor is not already in digital form.

Step 2. Image Enhancement: It is the process of manipulating an image so that the result is more suitable than the original for specific applications. Enhancement techniques are so varied, and use so many different image processing approaches.

Step 3. Image Restoration: Image Restoration improving the appearance of the image and tend to be mathematical or probabilities models of image degradation.

Step 4. Color Image Processing: Use the color of the image to extract features of interest in an image.

Step 5. Wavelets: Used in image data compression and pyramidal representation.

Step 6. Compression: Techniques Compression for reducing the storage required to save an image and reducing the size of the image to transmit it ("JPEG Standard"), with suitable bandwidth required for transmission.

Step 7. Morphological Processing: Morphological Processing are the **tools** for extracting image' components that are useful in the representation and description of shape.

Step 8. Image Segmentation: Computer tries to separate objects from the image background. There are 3 kinds of Segmentation kinds: Autonomous Segmentation, Rugged Segmentation (long process to get successful solution) and Erratic Segmentation.

Step 9. Representation and Description: Representation makes a decision whether the data should be represented as a boundary or as a complete region

Step 10. Recognition and Interpretation: Recognition is the process that assigns label to an object based on the information provided by its descriptors.

Step 11. Knowledge base: controls the interaction between modules. The knowledge about a problem is coded into an image processing system in the form of a Knowledge base.

1.2 Problem Statement

In the era of technology, industry are now using advance system and machine to do the labour works and controls such as automated sorting process to replace labour sorting process. However, students did not have the chance to know or expose to it during their early education and the types of teaching kits in the market are still not

enough. Furthermore, schools did not have suitable teaching kits to let the students to expose to the field of engineering and technologies.

1.3 Project Objectives

The objectives of this project are:

- i. Develop a teaching tool to let students expose earlier to the system that used in industry.
- ii. Demonstrate how the image is processed and how to determined the type of object.
- iii. Demonstrate conveyor system and how to control it.

1.4 Problem Scope

The goal of this project is to develop simple teaching tools for primary or secondary students to learn about the sorting process in the real industrial. The final prototype will be consists of a conveyor system, a PC and a webcam while for the software, HALCON is used.

- Detect the colour of the object (red and green) by using HALCON.
- Detect the contour of the object (pyramid and cuboid) by using HALCON.
- Sorting the object using PLC CP1E for teaching purpose.

1.5 Project Outline

The report of this project is divided into three chapters which began with the introduction, literature review and methodology. The first chapter is about the introduction towards image processing, the problem statement of the project, the objectives and also the scope of this project. The introduction includes the basic

knowledge and information about image processing such as the definition of image processing, the levels of image processing and the examples of the application of image filtering.

In Chapter 2, several references on previous research from various sources such as books, journals, Internet and previous projects about the application of image filtering was explained. In addition to that, several explanation on the types of image filtering techniques were also included.

Next, Chapter 3 explains about the method used in this project, from the beginning to the end of obtaining the results of the experiments done.

Chapter 4 comprises of the results and the brief explanations on the experiments are shown in the result section while the explanations about the image filtering functions regarding the experiments are shown in the discussion section.

Finally, Chapter 5 includes of conclusion and future works of the project.