

A NEW APPROACH FOR INDUSTRIAL PRODUCT INSPECTION BASED ON
COMPUTER VISION AND IMAGE PROCESSING TECHNIQUE

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INSPECTION BASED ON COMPUTER VISION AND
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ABSTRACT

Product quality inspection is became a major issue in production and industrial. Quality is commonly related with product and it is very important to satisfy the customer's desire. It is important to maintain the product quality before sending to customer. This project presents an automatic system for product inspection based on computer vision and image processing technique. For the proposed system, soft drink beverage is been used as product that to be tested for quality inspection. The offline system was created to inspect the product based on color and level water quality inspection. A technique for classify the color of product in digital color images is analyzed. The system used Otsu' method and quadratic distance classifier to classify the product based on color. For level, the coordinate of image is set to measure the range of water level. All the images for this system has been taken by using digital color camera and save in hard disk for experimental setup. Afterwords, real-time field testing of this system is done by using a web-cam digital camera. Matlab software and its image processing toolbox have been used in the image processing and analysis stage. Graphic User Interface (GUI) for beverage inspection and system by using Matlab software version 7.8.0.347 are achieved. 100% accuracy have been archieved for both offline and online system.

ABSTRAK

Pemeriksaan kualiti produk adalah menjadi isu utama dalam pengeluaran dan industri. Kualiti biasanya berkaitan dengan produk dan ia adalah sangat penting untuk memuaskan keinginan pelanggan. Adalah penting untuk mengekalkan kualiti produk sebelum menghantar kepada pelanggan. Projek ini membentangkan satu sistem automatik untuk pemeriksaan produk berdasarkan visi komputer dan teknik pemprosesan imej. Untuk sistem yang dicadangkan itu, minuman ringan telah digunakan sebagai produk yang akan diuji untuk pemeriksaan kualiti. Sistem luar talian telah dicipta untuk memeriksa produk berdasarkan warna dan paras pemeriksaan kualiti air. Satu teknik untuk mengelaskan warna produk dalam imej warna digital dianalisis. Sistem ini menggunakan Kaedah Otsu' dan kuadratik pengelas jarak untuk mengklasifikasikan produk. Untuk paras, koordinat imej diatur untuk mengukur julat paras air. Semua imej untuk sistem ini telah diambil dengan menggunakan kamera digital warna dan direkodkan dalam cakera keras untuk persediaan eksperimen. Selepas itu, ujian lapangan masa nyata sistem ini dilakukan dengan menggunakan kamera digital web cam. Perisian Matlab dan toolbox pemprosesan imej telah digunakan dalam pemprosesan dan analisis imej pantas. Antara Muka Pengguna Grafik (GUI) untuk pemeriksaan minuman dan sistem dengan menggunakan perisian Matlab versi 7.8.0.347 tercapai. Ketepatan 100 % telah achieved bagi kedua-dua luar talian dan sistem dalam talian.

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LIST OF ABBREVIATION

GUI	-	Graphical User Interface
RGB	-	Red, Green and Blue
HSV	-	Hue, Saturation and Value
ROI	-	Region Of Interest

CHAPTER 1

INTRODUCTION

1.1 Project Background

In industrial nowadays, product inspection is a vital step in the production line process. Because product reliability is most importance, 100 percent inspection of all parts, subassemblies, and finished products is often being attempted. As a result, the inspection process is normally the largest single cost in manufacturing. The most difficult task for inspection is that of inspecting for visual appearance. Visual inspection seeks to identify both functional and defects product. The visual inspection in most manufacturing processes depends mainly on human inspectors whose performance is generally inadequate. The human visual system is adapted to perform in a world of

variety and change, the visual inspection process, on the other hand, requires observing the same type of image repeatedly to inspect the product [1]. Some studies [2]-[5], [6] show that the accuracy of human visual inspection declines with dull, endlessly routine jobs. Slow, expensive, erratic inspection is the result. Automated visual inspection is obviously the alternative to the human inspector. The need for industrial automation and show the general acceptance among manufacturers that automated systems will increase productivity and improve product quality [7], [8].

Nowadays many industries upgraded from human to automated visual inspection to inspect everything from pharmaceutical drugs to textile production. Image processing most common used in an industrial setting is for the automated visual inspection of products leaving a production facility. It is estimated that the majority of products bought on supermarket shelves are inspected using automated “machine vision” based systems prior to dispatch cause to avoid the cost of shipping a faulty or sub-standard item to a supermarket shelf that no-one wants to buy. One of the industry used automated visual inspection is coca-cola for beverage industry [9]. There is dealing with a bottling production line in a facility bottling coca-cola for the domestic market. It has a set of images, taken under near constant factory lighting conditions, of the bottles as they leave the bottling line. The bottling company requires a vision system to automatically identify a number of different faults that may occur during filling, labeling and capping stages of production so that these bottles can be intercepted prior to packaging. Thus, in this project there is dealing with beverage industry to develop algorithm that inspect the quality of beverage product.

1.2 Problem Statement

The global beverage manufacturing and packaging industry is one of the most efficient processes in the world. Because of the enormous scale of the current beverage

industry, American, European and Asian beverage manufacturers are becoming increasingly better equipped at manufacturing and packaging beverages at high speeds.

Today's current market demands are creating challenges for production schedules and are applying pressures for quality standards like never before. Ensuring the quality of products before they reach the retailer's shelf or the consumer is now more important than ever. Now top beverage manufacturers are starting to implement vision inspection programs.

A vision inspection program can be a valuable tool for a wide range of beverage manufacturers. The ability of vision inspection to detect and prevent defective product packaging from being distributed to consumers is invaluable. In recent years, retailers and consumers have become much less tolerant of with poor packaging quality that results in either health risks or increased retailer costs because of manual inspection by human. If a vision inspection program is correctly implemented and managed, it can become a powerful tool to reduce rework and help safeguard brand from recalls, increase retailer confidence, protect consumers from defective products.

Based on the manual inspection and quality of product issue, this project is conducted to design the quality inspection for beverage product so that later it can be used for automation process. In developing the quality inspection algorithm, new features will be constructed to carry out two processes of the beverage quality inspection. Those processes are classification of good or reject beverage product based on color concentration and level of beverage in bottle.

1.3 Objective

The objective of this project is:

1. To automate the beverage product quality inspection process. However, the automation process covers a wide range of work, which can be generally categorized into software design and hardware design. In this project, the work focused on the development of beverage product quality inspection algorithm implemented in software.
2. To design algorithms to classify the color concentration of beverage and level of beverage in the bottle.
3. To design GUI for color and level quality inspection. The design GUI will complete the system for software.

1.4 Scope

As this project is aiming on designing the algorithms for automated visual quality inspection of beverage product, hence an offline system is considered. By applying the offline system, input images to the system (beverage product image) are captured using digital color camera at indoor environment and store them in a computer hard drive. There are 246 samples used for this work. In this work, algorithm development in software design not focusing on hardware design. The matlab software used to process the sample image as computational tools. This work will classify the sample beverage product based on two conditions which are pass or reject products based on color concentration and level. Only focus on six color of product which are green, red, oren, sarsi, purple and zapple. Figure 1.1 below show the sample of products



Figure 1.1: Six types of product

1.5 Research Methodology

- Data collection: For sample of product, images were taken by using digital color camera and web-cam.
- Analysis of color: Color was analysis by using RGB component, HSV component, Saturation component, Otsu' method.
- Classification color concentration is using Quadratic Distance Classifier.
- Level of water: Level of water in bottle image is set by range of water level which is pass, overfill and underfill. For range of level, two point coordinate was set, if water level between two point level is pass, if above two point level is overfill and if level below two point level is underfill.
- GUI was design using user interface available in matlab software.

1.6 Thesis Organization

This report contains five chapters. The summary of each chapter will be explained as follow.

Chapter 1 will describe about introduction of the automated visual system quality inspection, problem statement that describe the reason for developing the project, objective of the project, scope of work, significant study of the project and thesis organization.

Chapter 2 is about review on previous research by other researcher in foreign country. Various methods and approaches that related to our project have been discussed and reviewed.

Chapter 3 explains about method that will be used in this project. RGB and HSV color model, Otsu method and Quadratic distance classifier will be applied in this project.

Chapter 4 explains about result of the simulation from the 6 type of soft drink. Next, results will be analyzed to classify the reject soft drink based on the concentration and level.

Chapter 5 shows overall conclusion for the project. There are some issues in recommendation or suggestion rises about this field of study of project is discussed in this chapter.

CHAPTER 2

LITERITURE REVIEW

2.1 Introduction

This chapter consists of color system that will be discussed, quality inspection system, platform for automated quality inspection and classification system.

2.2 Color System

This subsection will be discussed about color system, color model and RGB color system.

2.2.1 Color models

The purpose of a color model (also called color space or color system) is to facilitate the specification of colors in some standard, generally accepted way. In essence, a color model is a specification of a coordinate system and a subspace within that system where each color is represented by a single point. Most color models in use today are oriented either toward hardware (such as for color monitors and printers) or toward applications where color manipulations is a goal (such as in the creation of color graphics for animation). In terms of digital image processing, the hardware-oriented models most commonly used in practice are the RGB (red, green, blue) model for color monitors and a broad class of color video cameras [10].

2.2.2 RGB Color System

In the RGB model, each color appears in its primary spectral components of red, green, blue. This model is based on a Cartesian coordinate system. The color subspace of interest is the cube shown in Figure 2.1, in which RGB primary values are at three corners; secondary colors cyan, magenta, and yellow are at three corners; black is at