# VISION CHECKING SYSTEM FOR LABELLING INSPECTION

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"I hereby acknowledge that the scope and quality of this thesis is qualified for the award of the Bachelor Degree of Electrical Engineering (Electronics)"

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## ABSTRACT

This project is to present the efficient vision checking system for labeling inspection. But in this daily life, most of the factory and production produces a lot of product with error on the labeling due to the human inspection. In this project, the system is to detect the labeling error due to the printing problem. The method being used in this project is a digital image processing which is Image Subtraction Operation. The picture was processing by converting an original picture, obtained by taking a photograph of the good product and also the reject one into the gray scale format. The simulation of this inspection will be done by using the Matlab software. The system will judge a pass or rejection of the inspection target sample based on the generated inspection picture and the statistical value of the subtraction image. From the analysis of the results it shows that there are 50 original images and 50 defect images. Then, the system can be categories as an efficient system.

# ABSTRAK

Projek ini bertujuan untuk mencipta sistem pengesahan semakan label produk yang cekap dan efisyen. Namun, pada masa kini, sebahagian besar kilang dan pengeluaran menghasilkan banyak produk dengan kesalahan pada label kerana semakan label yang dilakukan oleh penglihatan manusia. Dalam projek ini, sistem ini adalah untuk mengesan kesalahan pelabelan akibat dari masalah pencetakan. Kaedah yang digunakan dalam projek ini adalah pemprosesan gambar digital terdiri daripada dua teknik iaitu Operasi Pengurangan Pixel Gambar. Gambar yang diambil akan diproses dengan mengubah gambar asal yang diperolehi dengan mengambil gambar produk yang baik dan juga gambar yang mengandungi kerosakan ke format skala intensiti. Simulasi pemeriksaan ini akan dilakukan dengan menggunakan perisian Matlab. Sistem ini akan dapat membezakan antara produk yang baik dan rosak hasil daripada gambar yg telah dibezakan dan nilai statistik gambar yang telah menjalani Operasi Pengurangan Pixel Gambar. Daripada keputusan yang terhasil, ianya dianalisis dan menunjukkan bahawa terdapat 50 gambar produk yang baik dan 50 lagi gambar produk yang rosak. Sistem ini boleh dikategorikan sebagai sistem yang efisyen.

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# CHAPTER 1

# INTRODUCTION

## 1.1 Vision Checking System

In industry today, quality goals are tightening, production throughputs are increasing and the demand for productivity improvements continue. To ensure that the products are made to specification and meet customer expectations, the need for reliable automated inspection during manufacture is extremely important. The vision checking system is used to detect the labelling error due to the printing problem. This system will improve the quality inspection process and reduce the related manpower since most of the companies in industry are using a manpower which is an operator.

Traditionally, visual inspection and quality control are performed by human experts. Although humans can do the job better than machines in many cases, they are slower than the machines and get tired quickly. Moreover, human experts are difficult to find or maintain in an industry, require training and their skills may take time to develop. There are also cases were inspection ends to be tedious or difficult, even for the best trained experts. In certain applications, precise information must be quickly.

Machine vision provides innovative solutions in the direction of industrial automation. A plethora of industrial activities have benefits from the application of machine vision technology on manufacturing processes. These activities include, among others, delicate electronics component manufacturing, quality textile production metal product finishing, glass manufacturing, machine parts, printing products and granite quality inspection, integrated circuits(IC) manufacturing and many others. Machine vision technology improves productivity and quality management and provides a competitive advantage to industries that employ this technology.

Vision checking system is defined as a technique and method to check the quality of product. It is used to detect the defects of labelling that is printed on the surface of the casing. The examples of defects that I have to detect are such as scratch, crack, blemishes, unclear text, and improper text printing, lost part of printing, text with several dots. When there is a defects detected, the vision checking system will give an alert to the printing station about to error to stop the printing operation. So that it will reduce the production of reject product.

In order to make an effective vision checking system, I need to consider the lighting of this system. Defects can be obtained when located close to a light transition. Quantifying this proximity condition is irrelevant for the purpose of defect characterization, because defect signatures are always functioning of their location with respect to light transition. The best detection of defects is reached when defects are tangent to light transition.

## 1.2 MATLAB

MATLAB is a general purpose programming language. When it is used to process images one generally writes function files, or script files to perform the operations. These files form a formal record of the processing used and ensures that the final results can be tested. MATLAB provides many functions for image processing and other tasks. Most of these functions are written in the MATLAB language and are publicly readable as plain text files. Thus the implementation details of these functions are accessible and open to scrutiny.

The simulation of the defects will be done by using MATLAB software. In this project, there are two major techniques used which are image comparison operation and image subtraction operation. According to Ismail Ibrahim, image comparison operation is the simplest approach; consist of comparing both images pixel-by-pixel. While for the image subtraction operation, it is another method to develop the proposed algorithm. It is to produce positive pixel image. Besides, by using MATLAB software, I need to obtain the result of defect detection by using the range value of mean of image subtraction. It is important to do a decision between good and reject product. Another type of result representation of this simulation is by using histogram equalization in MATLAB software.

## 1.3 Objectives

This project aims is to produce an efficient and effective vision checking system to detect error and defects for labelling inspection in factory. On the other hand, it is also to maximize the quality of inspection for the production. If the vision checking system can successfully done, thus it can be implement in the production so that it will reduce manpower to do the inspection. At the end of this project, it will check and found out whether the objectives have been achieved or not.

## 1.4 Project Scope

The related scopes of this project are Image processing. It is focused on how to detect the defects in the labelling. The scopes of the project are;

(i) The learning of vision checking system to detect the labelling error and defects of product.
(ii) To apply the system by using MATLAB software (image processing)
(iii) Implementation of GUI to interface the system with offline mode.

## 1.5 Problem Statement

Detection of labelling error is not consistent due to human factor. Since most of the company is still used a manpower which is an operator to do the inspection. As we know, human vision is limited and not consistent enough to do the inspection accurately. Thus, this project is to apply the vision checking system that is more effective in order to do the labelling inspection.

Besides, misused and wasting product will affect the company's profit. Every day, the company will produce about 500,000 products and if there is a lot of defects product produce, it will give a lot of loss. Hence, this project is effectively used in the production in order to reduce the defects of the product.

## 1.6 THESIS ORGANIZATION

This thesis consists of five chapters. For Chapter 1, it discuss about overview of project, objective research, and scope of project, problem statement and thesis organization.

Chapter 2 contains a detailed description of Vision Checking System. It will explain about the concept of vision system and also the Image Processing.

Chapter 3 includes the research methodology. This chapter explained on how the system was designed and the operation of the system.

Chapter 4 will discuss about the result obtained and also the discussion. By using the MATLAB software the simulation will be done and it will analyze the data to get the result. The discussion is based on the result that is obtained before.

Chapter 5 will discuss on development of GUI software. This chapter will explain on how the GUI can be interface with the system.

Finally, in Chapter 6, it will be the conclusions for this project. This chapter also discusses about the recommendation for the project and for the future development. But for this draft 1, the content is only from Chapter 1 till Chapter 3 due to the result that is not finished yet.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Image Processing Algorithm

The vision checking system that has been developed consists of two major components covering the opto-mechanical and algorithmically aspects of the system. Ovidiu Ghita [1] found that first component addresses issues including the mechanical implementation and interfacing the inspection system with the development of a fast image processing procedure able to identify visual defects present on the slate surface.

The aims of using automated visual inspection are to classify products for quality so that defective units may be rejected, to measure some properties of the product with a view to controlling the production process, and to gather statistics on the efficiency of the production process by using image processing algorithm that is applied to detect the visual defects. [1]

Based on Raafat and Taboun, [2] they used a gradient-based calculation algorithm for image segmentation and defect detection. His system started with finding the edge of an inspected bottle to segment the object region and then checked every column of pixels with more than a predefined threshold of pixels to detect cracks.

MATLAB is always a good way to test algorithms and processing before getting into the actual implementation in C. It features a lot of pre-built functions which makes it much easier to implement very fast your algorithm and test it in a visual. It's a high level signal processing language. MATLAB is a scientific programming language and provides strong mathematical and numerical support for the implementation of advanced algorithms. It is for this reason that MATLAB is widely used by the image processing and computer vision community. 12 New algorithms are very likely to be implemented first in MATLAB; indeed they may only be available in MATLAB. [2]

From [3], due to the important of defect classification operation, a set of new algorithms for PCB defect classification are proposed by using some well-known conventional methods, such as image difference, image subtraction, image addition, and image comparison, for the classification of six different defects, namely, missing hole, wrong size hole, short-circuit, under etch, open-circuit, and breakout, successfully.

From ref [4], automated post-sawing inspection system (APSIS) is used for detecting defects on the wafer. By adopting the reference method, some features extracted from the reference image are used to compare with an inspecting image. The experiment results showed that the recognition rate of sawing defect and pad defect was 99.0% and 98.0%, respectively. This paper proposes an algorithm, APSIS, for the automated post-sawing inspection of defects in an IC encapsulation facility. APSIS involves the application of computer vision technique and development image processing algorithms to identify and classify defects.

The basic principle of image processing method here applies the image-to-image reference approach, i.e., the golden-part reference. Most vision-based inspection techniques fall into one of two approaches, the design-rule checking and

the image-to-image reference. [4] The design-rule checking approach detects the defects with the generic rules on the part. It has the advantage that no alignment is necessary and the system is flexible, but it is time consuming. No commercial wafer inspection system is based on this approach.

Moganti et al. [7] proposed three categories of inspection algorithm: referential approaches, non- referential approaches, and hybrid approaches. The reference approaches is performed, by doing a comparison between the template PCB image and tested PCB image. There are two major techniques; image comparison techniques and model based inspection.

## 2.2 Visual defect recognition

Dirt spots and patches, weaving faults, missing or torn fibres, and certain errors of the label patterns are detected. They used a Bi-I system which is a compact, standalone, and high-speed vision system based on the Cellular Visual Microprocessor technology. For each label, errors and their types have been determined and these reference data were compared to the algorithm response. Both false positive (a good label is classified as a wrong one) and false negative (a wrong label is classified as a good one) classification errors were evaluated. The information is very useful in order to do the decision. From the result that we obtained at the output, we can see the choice of the product whether to classify the product as reject or good. [2][5]

Many important applications of vision are used in manufacturing processes. The processes start from inspection work, measurement and then some assembly operations. [3] One of these applications is the automatic visual inspection of printed circuit boards (PCB). In this research, image understanding is a vital part in the

inspection of PCBs in order to detect the defects and then classified them to several group. Defect classification operation is an essential part in this research because it is capable to identify the source of these defects.

According to [6], In Computer Vision applications, there often exist the need to extract features to facilitate the process of analysis and recognition. If we have the knowledge of those key features, it can quickly perform analysis and recognition by only processing those important components. And can also easily improve the accuracy and robustness for analysis and recognition by emphasizing those key features. In this dissertation, the authors focus on the topic of automatically extracting key features for analysis and recognition in Computer Vision applications.

Many existing PCB inspection systems just concentrated on defects detection, as reported in [7]. Defects detection did not provide satisfactory information for repairing and quality control work, since the type of detected defects cannot be clearly identified. Based on this incapability of defects detection, defect classification operation is needed in PCB inspection. Therefore, an accurate defect classification procedure is essential especially for an on-line inspection system during PCB production process. [8]

The requirements for the design and development of a successful machine vision system vary depending on the application domain and are related to the tasks to be accomplished, environment, speed, etc. [10] For example, in machine vision inspection applications, the system must be able to differentiate between acceptable and unacceptable variations or defects in products. The system need to recognize the defects on the product itself. Once it can recognize the defects, then it will make a decision whether the product is good or bad. The important attributes of an industrial machine vision inspection system such as, flexibility, efficiency in performance, speed and cost, reliability and robustness. In order to design a system that maintains

these attributes it is important to clearly define its required outputs and the available inputs.

From the ref [11], to design an intelligent inspection system for seals, three key types of knowledge have to be obtained. The first is the types of seal defects and the areas where they occur. The second is heuristics about defect size and shape. The third is knowledge about the effect of each defect type on the functionality of the seals. This knowledge allows a provisional specification to be drawn up for the system hardware required, including details of the vision system, cameras, lighting and seal positioning system.

## 2.3 Light Transition

In order to make an effective vision checking system, it needs to consider the lighting of this system. Defects can be obtained when located close to a light transition. Quantifying this proximity condition is irrelevant for the purpose of defect characterization, because defect signatures are always functioning of their location with respect to light transition. The best detection of defects is reached when defects are tangent to light transition. Besides, by using MATLAB software, it needs to obtain the result of defect detection by applying neural network in order to do a decision between good and reject product.

A vision system capable of imaging, detecting, and characterizing defects on to highly reflective, non-plane surfaces, is presented in this paper. They found that the vision system comprises an innovative lighting solution to reveal defects onto highly reflective non-plane surfaces. Their lighting system allows imaging defects on various-shaped objects. The vision system measures the defect size to make a decision on the product rejection. The used of lighting solution presented in the paper uses the

principle of inspecting the reflection of the lighting system onto the objects surface leading to production of almost-segmented images, in which defects are clearly separated from the flawless background. After imaging defects, their detection is achieved by running simplistic image processing methods. [9]

Besides, in this project, a data has been taken to be use in MATLAB software by capturing the image at FKEE lab. It is because the lighting in the lab is suitable with the factory environment which is pendaflour lighting. So, the data can be easily analyze and reduce noise in the data taken. Light transition is a very important aspect in order to detect defects on the product's surface. Robust performance is difficult to achieve. High recognition and classification rates are obtained only under certain conditions of good lighting and low noise. Finally, an industrial vision system must be fast and cost efficient. [10]

Based on D.T. Pham research [11], Valve-stem seals are moulded from a black rubber compound with a matt surface finish, and it is essential to have good lighting to acquire satisfactory images (Bachelor et al, 1985; Davies, 1990). The majority of surface defects consist of excess rubber above the expected surface contour (e.g., a blister), missing rubber below it (e.g., a flow mark) or a combination of the two (e.g., a pitted or dirty area). To obtain the best images of these types of flaw, the best illumination was found, experimentally, to be 20° to the tangent of the surface. The lighting is presented in this paper which discusses how ultra bright light-emitting diodes (LEDs) have been employed as a useful source of illumination.

## 2.4 Industrial Vision System

Recently interests in building automatic processing and analysis systems for visual inspection tasks used in an industrial environment are increasing. [2] Within the next decade, as much as 90% of all industrial visual inspection tasks might be performed by computer vision systems. Several visual inspection systems for glass/bottle quality inspection and defect classification have been reported with different feature extraction approaches and classification techniques.

Computer vision inspection systems are widely used for on-line inspection and quality control to improve the finished product quality and lower the costs. In this study, a novel system for wine glass defect inspection has been presented. To make an acceptance/rejection decision, these features are fed to a conventional back propagation classifier. The proposed inspection system has been implemented and tested with some wineglass samples. [2]

In order to achieve high quality of the production process, each sheet is inspected by especially trained staff. [5] This kind of inspection is very flexible but it is tedious and leads to unstable and irreproducible results. Based on the experience in quality inspection, the ARC Seibersdorf Research Team set the goal to design an automated sheet inspection system (SIS), in which the front and rear side of the sheet are quality-inspected in a fully automatic mode using image processing methods. This paper presents a novel test facility for quality inspection of these sheets, called sheet inspection system (SIS).

The SIS-Stamp has been developed in the ARC Seibersdorf Research GmbH. Intended customers are printing houses specialized in stamps, which emphasize high