



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**SHAPE BASED MATCHING: GLUING DEFECT USING
GAUSSIAN FILTERING**

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

by

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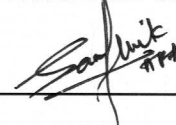
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ABSTRAK


Projek penyelidikan ini adalah berkaitan dengan aplikasi sistem penglihatan yang melibatkan proses pemprosesan imej atau produk bagi mengenal pasti kawasan yang mempunyai kecacatan pada permukaan sesuatu produk atau imej. Kajian ini juga mencadangkan tentang satu teknik pengesanan kecacatan dan klasifikasi yang berkesan untuk mengesan kategori kecacatan pada sesuatu produk seperti jurang , gelembung , dan kecacatan tepi untuk memastikan kualiti produk dapat dihasilkan dengan lebih baik sewaktu proses pembuatan dan juga kadar pengeluaran dalam perindustrian automasi. Dalam menentukan pemprosesan produk yang lebih baik , kaedah penapisan Gaussian telah diguna pakai kerana kaedah ini digunakan secara meluas dalam pemprosesan imej kerana ia mampu melicinkan tekstur untuk segmentasi imej , membuang bunyi bising sambil memelihara kelebihan, dan menyimpan lebih banyak butiran tekstur. Fokus utama kajian ini adalah membentuk ciri-ciri yang hampir sama di mana ia berasaskan keutamaan kepada mengenal pasti kecacatan yang berlaku pada produk dengan mencari objek yang berdasarkan imej tunggal dan mengesan mereka dengan melakukan ketepatan piksel sub. Algoritma ini terdiri daripada dua fasa di mana fasa yang pertama ialah fasa melatih dan fasa yang kedua ialah pengiktirafan. Dalam projek ini, teknik mengaplikasikan kaedah ROI telah dibincangkan dan terdapat dua bentuk dimensi (2D) telah dipilih sebagai maklumat lebar (x- koordinat) dan panjang (y - koordinat).

ABSTRACT

This research project is regarding the application of vision algorithm which is related with the images processing process in order to identify defectives area of a product. This paper proposes an efficient defect detection and classification technique to detect a class of defects in gluing application such as gap, bubble, bumper, and edge defect that can have ensured the better quality of product in manufacturing process as well as production rate in industrial automation for gluing process. In determining better image processing, Gaussian filtering method is proposed because this filter is widely used in image processing as it can be used to smooth textures for image segmentation, removing noise, and keep more texture details. The main focus of this paper is on the shape based matching properties method where it mainly focus on identifying defects that occur on the product by finding the object based on the single image and locate them with sub pixel accuracy. The algorithm consists of two phases which are training phase and the recognition phase. In this project, creating of region of interest in important region of object is discussed and two-dimensional (2D) shape matching was chosen to be used to provide information of width (x-coordinate) and length (y-coordinate).

DECLARATION

I hereby, declared this report entitled “Shape Based Matching: Gluing Defect Using Gaussian Filtering” is the results of my own research except as cited in references.

Signature : 

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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 Engineering Technology (Industrial Application & Robotics) with Honours. The member of the supervisory is as follow:



.....

(Project Supervisor)

DEDICATION

Specially dedicated to my family

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LIST OF ABBREVIATIONS AND SYMBOLS

SBM	=	Shape-Based Matching
ROI	=	Region of Interest
HALCON	=	Machine Vision Software
2D	=	Two Dimensional
GUI	=	Graphical User Interface
VB	=	Visual Basic
FMS	=	Flexible Manufacturing System
DSM	=	Defect Shape Matching
DIM	=	Defect Inspection Method
MDF	=	Modified Direction Feature
RGB	=	Red, Green, Blue

CHAPTER 1

INTRODUCTION

Machine vision is a highly technology machine used in industrial application nowadays especially in automation industry. Machine vision is the technology and methods used to provide imaging-based automatic inspection, process control, and robot guidance in industry. Machine vision system plays a vital role in manufacturing application because it offers many competitive advantages as it inspect the good quality of production, reducing noise, reducing costs, and ensuring level of customer satisfaction. Because of these advantages, machine vision has become a key technology in the area of manufacturing and quality control due to the increasing quality demands of manufacturers and customers. Machine vision also called as industrial vision or vision systems where it is primarily focused on computer vision in the context of industrial manufacturing processes likes counting objects on a conveyor, reading serial numbers, and searching for surface defects.

1.1 Background

In this research, the most important application used to recognize gluing defect is by applying the shape-based matching algorithms using HALCON as Machine vision software. This algorithm is mainly focus in identifying defects that occur on the product by finding the object based on the single image and locate them with sub pixel accuracy. There are two common similarities that involved between a basic shape based matching algorithm and the detail programming language used by

HALCON, first is three basic framework of the processes involved which are image acquisition, pre-processing, and feature extraction or selection and second is the two phases required for shape matching which are the training phase and the recognition phase.

At the training phase, after all the training parameters are determine by the user, shape detection library is applied to extract the shape of the glue defect and these shapes are then saved as a template that will be used for the recognition phase. This step is known as template creation. Then, at recognition system, images are then fed to the system to be matched against the template that was created in the training phase. Here, is the basic framework for defect matching using shape based matching (SBM) algorithm in Figure 1.1:

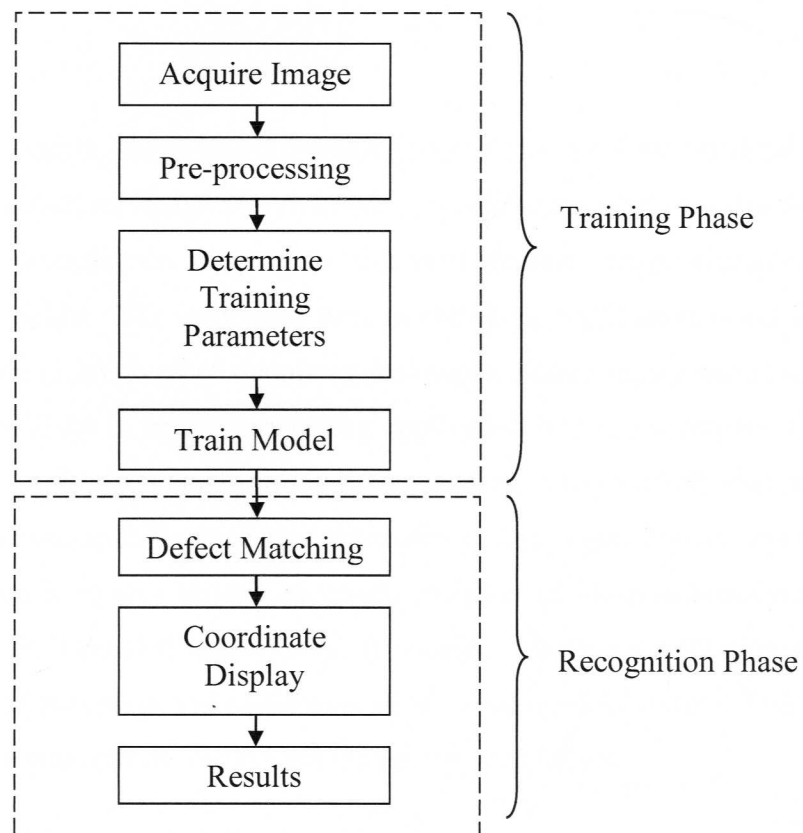


Figure 1.1: Basic Process of Shape- Based Matching using HALCON

1. **Acquired Image** – Process of obtaining the image by captured image using a camera.

2. **Pre-processing** – Pre-processing is needed to modify the image so that the further process can be simplified for acquiring a better solution in time consuming. Common pre-processing includes image filter and also image enhancement.
3. **Determine Training Parameters** – The essential parameters required are identified and created as a unique parameter for identifying certain image.
4. **Train Model** – The model are created based on the parameter develop in step 3, the speed of the process can be improved by creating Region of Interest (ROI) and also using image pyramid level. ROI create a region where as only focus on the main of interest needs to create an image as a model.
5. **Defect Matching** – Comparing defect image with the process image pixels by pixels by referring to template image that has been saved in the memory.
6. **Coordinate Display** – Display the value of object coordinates that are required.
7. **Results** – The results can be shown in sentences or images according to requirement.

In machine vision system, shape based matching algorithms has 7 fundamental steps which is image acquisition, image pre-processing, image segmentation, extraction of low-level feature, grouping or mapping to high level feature, image classification, and image interpretation. The important part in matching application is on image segmentation which is involved of denoising technique. Image segmentation also is the most important tasks in image processing application because it having a wide range application in image visualisation, image coding, image synthesis, pattern recognition, rendering, and displacement estimation. The segmentation procedure brings the process a long way toward successful solution of imaging problems that require objects to be identified individually. By having, image segmentation it will lead to smoothen of the image for easier execution in recognition system. The weak segmentation algorithms almost always guarantee eventual failure.

In determining a better image processing, an additional method by using Gaussian filtering is proposed to detect a class of defects in gluing application. Gaussian filter is a fundamental process that is used in almost every computer vision application and it also widely used in image processing. Gaussian filter is a specialized filter known for its blurring and noise reducing capabilities. It also commonly applied for noise

smoothing, noise suppressing in image and signal processing, reduce the loss of original information in image processing, preserving edge, keep more texture details and producing realistic lighting.

For this project, two dimensional (2D) shape matching was chosen to be used to provide information of width (x-coordinate) and length (y-coordinate). There are four defect types detection that are available in this research which are gap, bubble, bumper, and edge defect. In this research, the characteristics of each defect will be described based on the appearance and shape of defects that occurs in gluing process. To get a precise operation when applying gluing application, the point of each defect coordinates must be accurate to minimize error of the system.

1.2 Research Methodology

The method that used to start this project is by doing more research about this project to gain the idea how to produce the tested model. Then, followed by creating the model and draw a line on the cupboard by using a glue method. Lastly, recognize the defect to identify the type of defect through HALCON application as Machine Vision software that used for shape based matching process (Haniff et al., 2011).

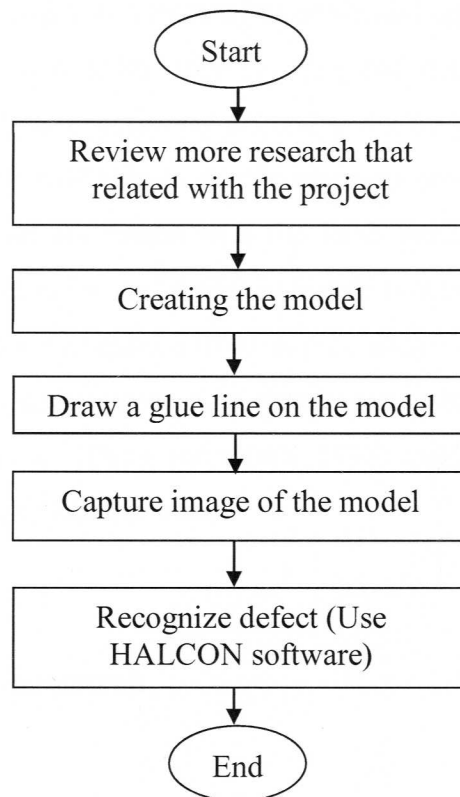


Figure 1.2: Flowchart of Research Methodology

1.3 Problem Statement

Nowadays, in manufacturing industry there are so many problems involving defect inspection. Defect detection and noise is very important to guarantee the quality of image processing. The image can be affected by noise and defect because it causes negative effect on the image processing (Peng, 2009a). In order to serve a good quality of product, inspection and checking method is needed to find the defected product. So, it is necessary to remove the noise and defect to conserve the image information as much as possible such as edge and the texture to achieve a good image processing without excessively distorting the original image. By recognizing the pattern of defect, it will help to decide recovery process in industrial sector, so the defected product do not mixed with the fresh product. Today, there are many methods used to reduce noise and defect in image processing but in this research an adaptive Gaussian filter was chosen to overcome noise reduction and edge detection to determine the better image processing, improving its blurring preserving edge, and noise reducing capabilities (Deng and Cahill, 1993) and at the same time to enhance the performance of the defect detection.

1.4 Objectives of Research

The objectives of this research are:

1. To ensure an efficient defect detection and classification technique that can be able to identify quality of the product.
2. To classify types of defect that might be occurred in gluing process.
3. To test efficiency of Gaussian filter as one of the effective methods in preserving edge and reducing noise from the image.

1.5 Contributions of Research

The contributions in this research are mainly to increase flexibility and adaptability of the vision system to perform a good quality of product. In order to serve a better quality of production, the inspection and checking method is needed to find defected product in gluing application.

1. Capabilities of user define ROI creations replacing standard dedicated feature extraction methods that is unique because every solutions is different based on the problems and user requirements.
2. The implementation of inspection system that consume to detect whether the object gluing perfectly or error occurred in gluing line with providing additional data including x and y coordinates for gluing process in (2D) version.
3. The implementation of this vision system using Graphical User Interface (GUI) allows everyone to be able to use it even without immense knowledge of the vision background.

1.6 Scope of Research

The scope of this research is focus on Shape- Based Matching algorithm by using Gaussian Filtering in producing repetitive type of image to recognize defective area of product after finish performing a gluing process.

1. The vision system will focusing on recognizing 2D objects in image processing by using camera application.
2. Build a vision system based on shape based matching algorithm and inspection of defects application to find out image defect.
3. Use Gaussian filter method to reduce noise and edge preserving on the image to enhance the performance of defect detection.
4. Create the special region of defect by using Region of Interest (ROI) to form a better quality of the image.

CHAPTER 2

LITERATURE REVIEW

In this section, the literatures are differentiated from two points of view. One is on the vision system and another is on the industrial applications, which focus mainly on defect detection and the methods of Gaussian filtering in automation industry.

2.1 Literature Review

This part will discuss about all the research that had been done before developing a gluing application in detecting defect detection and its classification. Basically, all the research are based on the Machine Vision system where it focus on the process of applying the inspection and checking method in automatic inspection for manufacturing industry in order to perform a good quality of production.

2.1.1 Machine Vision

The first literature review was entitled as “Flexible approach for Region of Interest Creation for Shape-Based Matching in Vision System” by (Teck et al., 2009a) where it gives a lot of idea in implementation Region of Interest in this research. This paper focused on the development of an adaptive training phase of the vision system. The

multiple selective ROI can help the user to decide on the criteria that user required from the combination of different ROI as one object or each ROI as separate object. The creation of Flexible Region of Interest (ROI) provides better application that extracts the main features of the image that will be used as matching template. Most important thing, the data extraction through this creates a unique data for each model defects that easily to identify defects in matching application. The better creation of ROI gives better processing time in this system as it reduce the size of the image according to the needs of the system that required only certain part of the image.

Besides that, the other literature review that being revised in this project was entitled as “HALCON Application for Shape-Based Matching” (Xu et al., 2008b) that discussed mostly about the process involved in basic shape based matching with additional of extended Region of Interest (ROI) that available in HALCON software. This software can be used to construct most reliable application known as shape based matching application where it fulfills its main task in finding the object based on single model image and locates them with sub pixel accuracy. First, before matching process takes place, the object must be specified and created object as a model in training phase. Then, the model being used in order to find and localized an object including optimizing the outcome of the matching by minimizing the search space of the object. This unique algorithm helps in handling the changes in illumination, clutter, various in size of object, and also affect in position and rotation of the object. Not only that, this algorithm may affect the relative movement of parts of the template. So, the result shown that shape based matching algorithms with additional ROI that available in HALCON is a powerful tool for various machine vision tasks.

Human inspection is a traditional method that can cause misjudgment. This research entitled as “Quality Inspection of Engraved Image Using Shape- Based Matching Approach” by (Ahmad et al., 2011) used flexible manufacturing system (FMS) as an advanced manufacturing technology system because it has the capabilities on producing new diversity of products in a short time and efficient in recognizing the object presence. The method of colour and gray scale charged couple device cameras are used in this research to acquire engraved image for different kind of environment.