

VISION SYSTEM BASED RUST (REJECT) DETECTION

SUHADILLA BINTI ZAINAL

**This report is submitted in partial fulfillment of requirements for the award of
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UNIVERSITI TEKNIKAL MALAYSIA MELAKA
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PROJEK SARJANA MUDA II

Tajuk Projek : VISION SYSTEM BASED RUST (REJECT) DETECTION

Sesi Pengajian :

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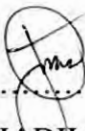

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KHAIRUL AZHA BIN A. AZIZ
Jurutera Pengajar
Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka (UTeM)
Karung Berkunci No 1752
Pejabat Pos Durian Tunggal
76109 Durian Tunggal, Melaka

Tarikh: 30 APRIL 2010

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“I hereby declare that this report is the result of my own work except for quotes as cited in the references.”

Signature : 

Author : SUHADILLA BINTI ZAINAL

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Signature : 

Supervisor's Name : MR KHAIRUL AZHA BIN A. AZIZ

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ABSTRACT

The Vision System Based Rust (reject) Detection Machine project is to develop a system that can identify the availability of rust on a certain product using vision based system. The main function of this product is to detect the product with rust. This project is focusing in color image processing that developed using Matlab software. The software will process the picture that has been captured by webcam which is a vision system. In the color image processing process, the software will able to classify and compared each color in the picture of can that has been captured and determined whether the can rejected or acceptable. For example, this system used in a industry at a production line and camera will be situated at four edge of can to capture can image. Then this image will be process through Matlab according to coding that has been designed.

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The Vision System Based Rust (reject) Detection Machine project is to develop a system that can identify the availability of rust on a certain product using vision based system. The main function of this product is to detect the product with rust. This project is focusing in color image processing that developed using Matlab software. The software will process the picture that has been captured by webcam which is a vision system. In the color image processing process, the software will able to classify and compared each color in the picture of can that has been captured and determined whether the can rejected or acceptable. For example, this system used in a industry at a production line and camera will be situated at four edge of can to capture can image. Then this image will be process through Matlab according to coding that has been designed.

ABSTRAK

Projek Mesin Pengesan Karat Menggunakan Berasaskan Penglihatan adalah projek yang mempunyai kebolehan mengesan karat pada suatu produk. Kegunaan utama projek ini adalah untuk mengesan karat pada sesuatu produk. Projek ini fokus kepada cara memproses warna gambar. Dalam projek ini, pengaturcaraan Matlab telah digunakan untuk bahagian memproses warna dalam gambar. Pengaturcaraan Matlab akan memproses warna imej yang telah di tangkap menggunakan kamera. Di dalam proses imej ini, pengaturcaraan ini akan mengasingkan warna mengikut kelas tersendiri and membandingkan warna yang ada pada imej yang diambil. Seperti contoh, ia boleh digunakan di industri di baris produksi. Empat buah kamera diletakkan pada sudut supaya dan imej yang diambil dhantar kepada Matlab untuk pemprosesan imej. Imej tersebut akan diprosess mengikut pengaturcaraan yang telah dihasilkan.

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CHAPTER I

INTRODUCTION

In this chapter the project overview will briefly discuss. The objectives, scope and thesis outline will be presented in this chapter

1.1 PROJECT BACKGROUND

In this thesis, the main focus for this project is the color image processing that developed by using Matlab. Matlab was used because it's full with toolbox, simulink, state flow and can adept from the source code in internet example signal processing, control system and other which easy to learn. In this color image processing, can be subdivide it into three principle areas color transformations (color mapping), spatial processing of individual color planes and color vector processing. Image understanding requires segmenting a scene into a set of meaningful regions. I have study color classification for partitioning a natural color image into a set of perceptually uniform color regions. The algorithm accepts high resolution color as input and yields a new representation of the data in the form of small set of spatial regions, each described by a single color value. This ability can be useful for essential problems of color image analysis, including image segmentation and image representation. Interest focuses recently on color image segmentation which is invariant to shading and highlight effects. This project start with a product that been captured by webcam and the webcam will send the data to Matlab software and

through Matlab, the image being processed and determine the product rejected or accepted.

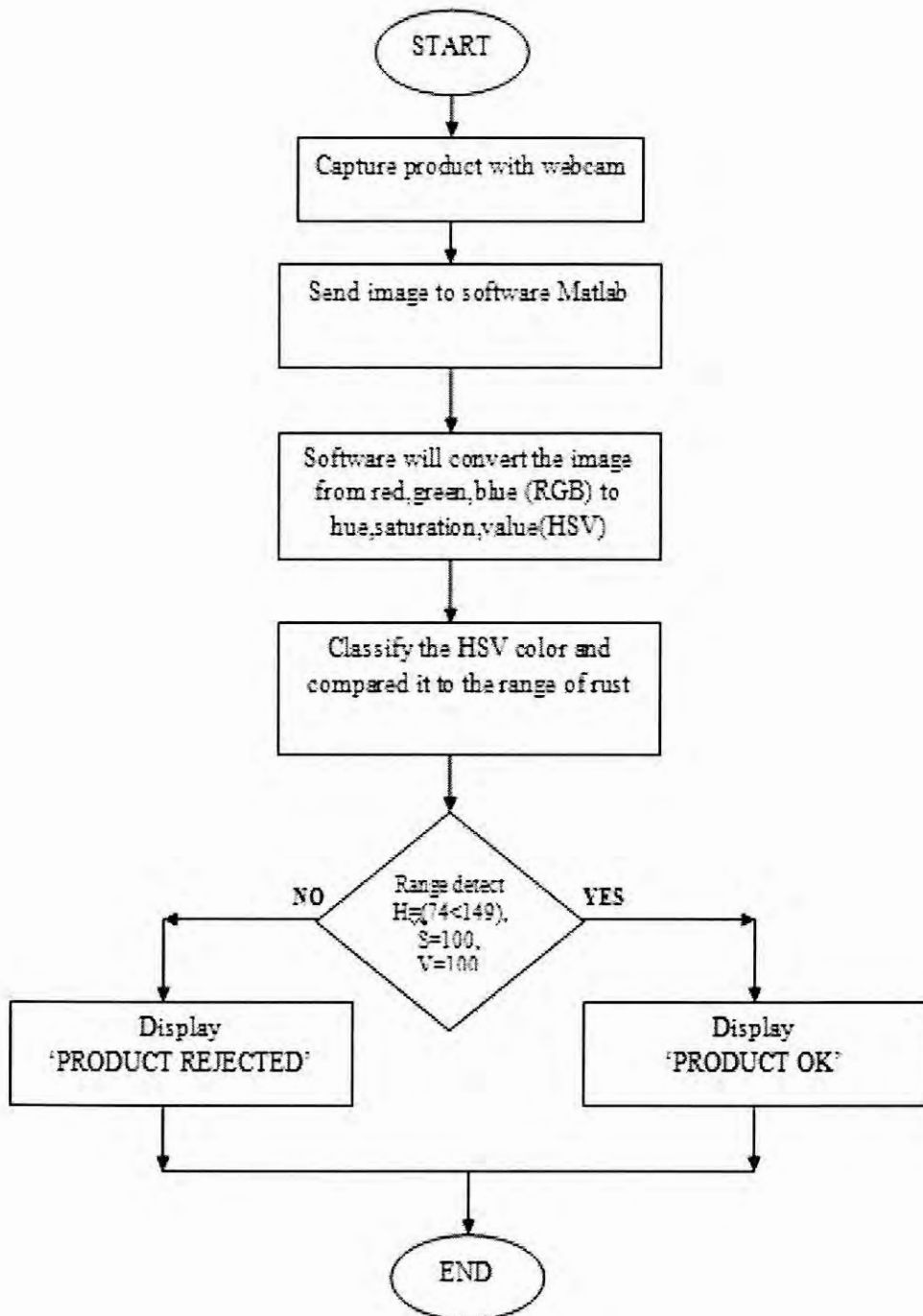


Figure 1.1: Flow chart for overall project

Figure above explained the process for the entire of project. The project starts with the image product that will be captured by webcam. The image that has been

captured had been saving as .jpeg format. After that, the image will be send into software Matlab to be analyzed. In this color image processing, the image will process into several type of color and the product color will be classified according to the range that has been determined. As an output, the software will display the product whether it rejected or acceptable. If the product rejected it means that the product has rust and if the product accepted it means that the product is non-rust product.

1.2 OBJECTIVES

The main objective of this project is to design and develop software to detect rust by using image color processing system. The objective can be summarized as below:

- i. Is to develop a system that can identify the availability of rust on product using vision based system.
- ii. By using Matlab as a translator for image and color.
- iii. Understand the type and range of each color either RGB, HSV and others.

1.3 PROBLEM STATEMENT

This project is chosen because it could detect the rust and shorten worker time to check each product. Apart from that, this project also reduces cost in aspect man power because it uses computer system. Other from that, the vision based system is one of the high technology in system and as a develop country we did not want to miss to use this system.

1.4 SCOPES

This project more into software, Matlab has been used as an interface between webcam and software and also as image processing. Webcam used as a medium to captured an image product and transfer it to image processing part. In image processing, color image are represented by a 3-dimesional array .The image has been separate in different color such as RGB and HSV. Then from the range that has determined, it will display whether it rusty product or not.

1.5 REPORT STRUCTURE

Chapter one briefly introduces the overall of the project title; The Vision System Based Rust (reject) Detection Machine. The introduction consists of overview, objective, problem statement, scope of work and structure report.

Meanwhile chapter two discuss about the background of study related to software that been used. Literature review will produce overall about the colour image processing and the research throughout the Matlab software.

Chapter three will explain about the project methodology. Project methodology give details about the method used to solve the project problem. The method used such as collecting data method, process and analysis data method, modelling and etc.

Chapter four consists of result and discussion of the project, finding and analysis throughout the research and project development.

Lastly, chapter five is the project conclusion. This chapter rounds up the attained achievement of the whole project and reserves suggestions for possible future researches.

CHAPTER II

LITERATURE REVIEW

2.1 VISION BASED SYSTEM

2.1.1 What is Computer Vision?

Computer vision is the science and technology of machines that see. As a scientific discipline, computer vision is concerned with the theory for building artificial systems that obtain information from images. The image data can take many forms, such as a video sequence, views from multiple cameras, or multi-dimensional data from a medical scanner.

As a technological discipline, computer vision seeks to apply the theories and models of computer vision to the construction of computer vision systems. Examples of applications of computer vision systems include systems for:

- Controlling processes (e.g. an industrial robot or an autonomous vehicle).
- Detecting events (e.g. for visual surveillance or people counting).
- Organizing information (e.g. for indexing databases of images and image sequences).
- Modeling objects or environments (e.g. industrial inspection, medical image analysis or topographical modeling).
- Interaction (e.g. as the input to a device for computer-human interaction).

Computer vision can also be described as a complement (but not necessarily the opposite) of biological vision. In biological vision, the visual perception of humans and various animals are studied, resulting in models of how these systems operate in terms of physiological processes. Computer vision, on the other hand, studies and describes artificial vision systems that are implemented in software and/or hardware. Interdisciplinary exchange between biological and computer vision has proven increasingly fruitful for both fields. Sub-domains of computer vision include scene reconstruction, event detection, tracking, object recognition, learning, indexing, motion estimation, and image restoration.

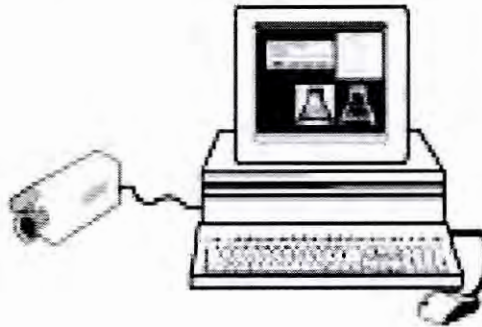


Figure 2.1.1: Example of computer vision

2.1.1.1 Computer vision systems

The organization of a computer vision system is highly application dependent. Some systems are stand-alone applications which solve a specific measurement or detection problem, while other constitute a sub-system of a larger design which, for example, also contains sub-systems for control of mechanical actuators, planning, information databases, man-machine interfaces, etc. The specific implementation of a computer vision system also depends on if its functionality is pre-specified or if some part of it can be learned or modified during operation. There are, however, typical functions which are found in many computer vision systems.

- **Image acquisition:** A digital image is produced by one or several image sensors, which, besides various types of light-sensitive cameras, include

range sensors, tomography devices, radar, ultra-sonic cameras, etc. Depending on the type of sensor, the resulting image data is an ordinary 2D image, a 3D volume, or an image sequence. The pixel values typically correspond to light intensity in one or several spectral bands (gray images or color images), but can also be related to various physical measures, such as depth, absorption or reflectance of sonic or electromagnetic waves, or nuclear magnetic resonance.

- **Pre-processing:** Before a computer vision method can be applied to image data in order to extract some specific piece of information, it is usually necessary to process the data in order to assure that it satisfies certain assumptions implied by the method. Examples are
 - Re-sampling in order to assure that the image coordinate system is correct.
 - Noise reduction in order to assure that sensor noise does not introduce false information.
 - Contrast enhancement to assure that relevant information can be detected.
 - Scale-space representation to enhance image structures at locally appropriate scales.
- **Feature extraction:** Image features at various levels of complexity are extracted from the image data. Typical examples of such features are :
 - Lines, edges and ridges.
 - Localized interest points such as corners, blobs or points.
 - More complex features may be related to texture, shape or motion.
- **Detection/Segmentation:** At some point in the processing a decision is made about which image points or regions of the image are relevant for further processing. Examples are
 - Selection of a specific set of interest points
 - Segmentation of one or multiple image regions which contain a specific object of interest.
- **High-level processing:** At this step the input is typically a small set of data, for example a set of points or an image region which is assumed to contain a specific object. The remaining processing deals with, for example:

- Verification that the data satisfy model-based and application specific assumptions.
- Estimation of application specific parameters, such as object poses or objects size.
- Classifying a detected object into different categories.

2.2 IMAGE PROCESSING

2.2.1 Scene Illuminant Classification

Knowledge of the scene illuminant spectral power distribution is useful for many imaging applications. However, accurate spectral characterization of the illuminant is impossible because the input device acquires only three spectral samples. In such applications it is sensible to set a more limited objective of classifying the illuminant as belonging to one of several likely types, such as incandescent light and D65.

We propose an illuminant classification algorithm by color temperature. Our illumination classification is to restrict the estimation to a set of blackbody radiators, say spaced every 500 degrees Kelvin. Color temperature classification provides simple specification of many common light sources. This illuminant classification is useful in many applications, including photography, color imaging, printing, and room lighting.



Figure 2.2.1: Image scale of color temperature

A correlation method is used to classify the illumination color temperature. The image pixel values for a given image are compared with the reference gamuts of

several different illuminants. The color temperature is then estimated by finding the best match between the number of pixels and the reference gamuts.

2.2.2 Color Classification and Segmentation of Images

Image understanding requires segmenting a scene into a set of meaningful regions. We study color classification for partitioning a natural color image into a set of perceptually uniform color regions. The algorithm accepts high resolution color as input and yields a new representation of the data in the form of small set of spatial regions, each described by a single color value. This ability can be useful for essential problems of color image analysis, including image segmentation and image representation. Our interest focuses recently on color image segmentation which is invariant to shading and highlight effects.



Figure 2.2.2: a) original; b) on color difference; c) On hue difference

2.2.3 Analysis of Highlight, Shading, and Interreflection

Real images exhibit rich and complex structure, whose nature is determined by the physical and geometric properties of illumination, reflection, and imaging. In fact, when multiple objects of inhomogeneous dielectric materials are put close, we observe not only object colors, but also highlights and mirror-like interreflection from the smooth surfaces.

These reflection effects often make image segmentation difficult. However, such singular parts in an image can provide useful features for scene understanding because those include the secondary illumination effects. For instance, the illumination color can be estimated from a small highlight area in a given image with a sufficient accuracy, without using a standard white reference.

We are interested in estimating reflection components from a single color image of closely apposed object surfaces. The reflection components correspond to the illumination color, two object colors, and the body interreflection color between two surfaces. A chromaticity plane is proposed for analyzing the highlight and interreflection effects.

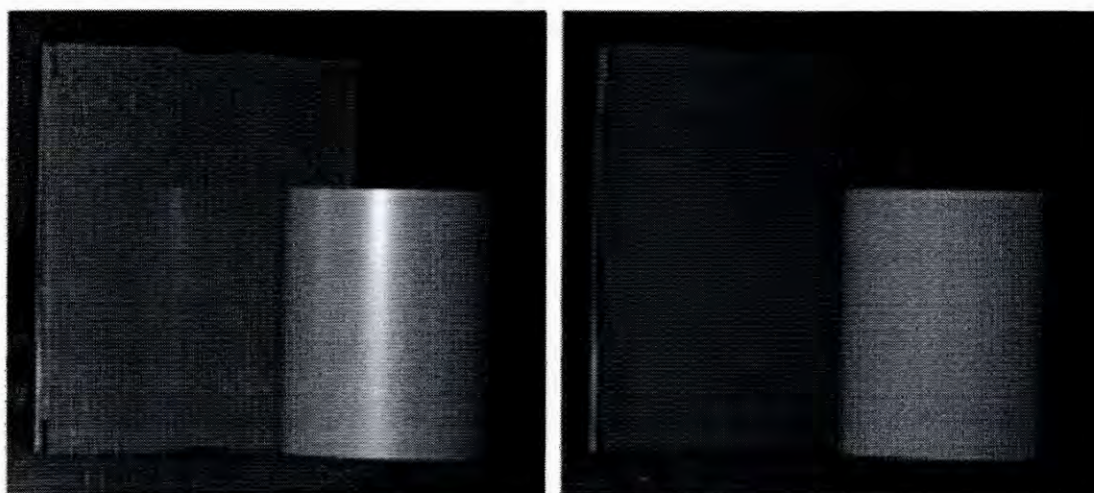


Figure 2.2.3: a) Original image; b) Component image of object

2.2.4 RGB Color

The RGB color model is an additive color model in which red, green, and blue light are added together in various ways to reproduce a broad array of colors. The name of the model comes from the initials of the three additive primary colors, red, green, and blue. The main purpose of the RGB color model is for the sensing, representation, and display of images in electronic systems, such as televisions and computers, though it has also been used in conventional photography. Before the

electronic age, the RGB color model already had a solid theory behind it, based in human perception of colors.

RGB is a device-dependent color space: different devices detect or reproduce a given RGB value differently, since the color elements (such as phosphors or dyes) and their response to the individual R, G, and B levels vary from manufacturer to manufacturer, or even in the same device over time. Thus an RGB value does not define the same color across devices without some kind of color management.

Typical RGB input devices are color TV and video cameras, image scanners, and digital cameras. Typical RGB output devices are TV sets of various technologies (CRT, LCD, plasma, etc.), computer and mobile phone displays, video projectors, multicolor LED displays, and large screens as JumboTron, etc. Color printers, on the other hand, are not RGB devices, but subtractive color devices (typically CMYK color model).

2.2.4.1 Additive Primary Color

To form a color with RGB, three colored light beams (one red, one green, and one blue) must be superimposed (for example by emission from a black screen, or by reflection from a white screen). Each of the three beams is called a component of that color, and each of them can have an arbitrary intensity, from fully off to fully on, in the mixture. The RGB color model is additive in the sense that the three light beams are added together, and their light spectra add, wavelength for wavelength, to make the final color's spectrum.

Zero intensity for each component gives the darkest color (no light, considered the black), and full intensity of each gives a white; the quality of this white depends on the nature of the primary light sources, but if they are properly balanced, the result is a neutral white matching the system's white point. When the intensities for all the components are the same, the result is a shade of gray, darker or lighter depending on the intensity. When the intensities are different, the result is a colorized hue, more or less saturated depending on the difference of the strongest and weakest of the intensities of the primary colors employed.