SAWN TIMBER DEFECT IDENTIFICATION SYSTEM

HAU TZE MIN

BORANG PENGESAHAN STATUS TESIS*

JUDUL: **Sawn Timber Defect Identification System**

SESI PENGAJIAN: **2017/2018**

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SAWN TIMBER DEFECT IDENTIFICATION SYSTEM

HAU TZE MIN

This report is submitted in partial fulfilment of the requirement for the Bachelor in Computer Science (Software Development)

FACULTY OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2017

DECLARATION

I hereby declare that this project report entitled

SAWN TIMBER DEFECT IDENTIFICATION SYSTEM

Is written by me and is my own effort that no part has been plagiarized without citations.

STUDENT : _____ DATE: 25.8.2017
(HAU TZE MIN)

SUPERVISOR: _____ DATE: 25.8.2017
(DR UMMI RABA'AH BINTI HASHIM)

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STUDENT : _____ DATE: _____
(HAU TZE MIN)

SUPERVISOR: _____ DATE: _____
(DR UMMI RABA'AH BINTI HASHIM)

DEDICATION

This work is dedicated to my beloved parents who guidance me on this journey and made education a priority for my siblings and I.

ACKNOWLEDGEMENT

I would like to say millions thanks to my supervisor, Dr Ummi Raba'ah binti Hashim for her sincere, expert and valuable guidance. I am grateful to her for her professional guidance.

I would like to thanks my parents for their encouragement and financial support during this project.

I would also like to thanks my senior and course mate who had giving me advices and helping me during this project.

ABSTRACT

Automated inspection of timber defect has shown to be of great importance in the wood industry. Due to the decreasing forest resources and increasing cost of timber, the application of automated vision inspection is seen as a solution to optimize resources and save production cost, while maintaining the output of products with reliable quality. This project aims to investigate suitable algorithm and develop a tool for identification of timber defects on timber images. The prototype will be tested against 8 types of natural defect commonly found on tropical timber. This project is a standalone system that will be develop using MATLAB. There are 3 phases in the methodology of this project. The first phase will focus on study and investigate the suitable algorithm of defect identification while in phase 2 we will develop a system based on Matlab. In phase 3, we will test our system using the data obtained from timber defect image database developed by Computation Intelligence and Technology Lab, UTeM (Hashim, 2015). The objective of this project is to investigate the suitable algorithm for defect detection as well as develop the system. Then, we will test the system againts types of defect and multiple species. The goal of this project is to develop a timber surface defect identification system which is capable of identifiying different types of timber defect on multiple species. This project has promising impact in quality control process of wood based industry with contribution to the automated visual inspection (AVI) domain.

ABSTRAK

Pemeriksaan kecacatan kayu secara automatik telah menunjukkan yang sangat penting dalam industri kayu. Disebabkan sumber hutan yang semakin berkurang dan kos kayu yang semakin meningkat, penggunaan pemeriksaan visi automatik dilihat sebagai penyelesaian untuk mengoptimumkan sumber dan menjimatkan kos pengeluaran, sambil mengekalkan keluaran produk dengan kualiti yang boleh dipercayai. Projek ini bertujuan untuk menyiasat algoritma yang sesuai dan membangunkan alat untuk mengenalpasti kecacatan kayu pada imej kayu. Prototaip ini akan diuji terhadap 8 jenis kecacatan semula jadi yang terdapat pada kayu tropika. Projek ini merupakan sistem yang berdiri sendiri yang akan dibangunkan menggunakan MATLAB. Terdapat 3 fasa dalam metodologi projek ini. Fasa pertama akan memberi tumpuan kepada kajian dan menyiasat algoritma pengenalan kecacatan yang sesuai manakala dalam fasa 2 kita akan membangunkan sistem berdasarkan Matlab. Dalam fasa 3, kami akan menguji sistem kami menggunakan data yang diperolehi daripada pangkalan data imej kecacatan kayu yang dibangunkan oleh Makmal Kecerdasan dan Teknologi Pengkomputeran, UTeM (Hashim, 2015). Objektif projek ini adalah untuk menyiasat algoritma yang sesuai untuk pengesanan kecacatan serta membangunkan sistem. Kemudian, kami akan menguji sistem dengan jenis kecacatan dan pelbagai spesies. Matlamat projek ini adalah untuk membangunkan sistem pengenalan kecacatan permukaan kayu yang mampu mengenal pasti pelbagai jenis kecacatan kayu pada pelbagai spesies. Projek ini mempunyai kesan yang menjanjikan dalam proses kawalan mutu industri berasaskan kayu dengan sumbangan kepada domain pemeriksaan visual automatik (AVI).

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Introduction

1.1 Project Background

The timber production has encouraging patterns recently. According to the statistic from Malaysian Timber Industry Board (MITB), over RM 20 billion of timber production has been exported from Malaysia in December 2016. The highest export major of timber products is wooden furniture which exceeds RM 742.40 million. This aggressive number of exportation shows that there has a high demand of timber products in Malaysian wood industry. MTIB also believe that the exportation of timber from Malaysia can achieve a target of RM 53 billion by the year 2020. Hence, the reliable of quality control procedure is very important procedure that needs to provide to support the increasing rate of the timber production. The use of Automated Visual Inspection (AVI) has developed for quality control process in production process.

Automated Vision Inspection is the automation of visual inspection process in manufacturing which could achieve through the integration of component such as material handling, image acquisition, defect detection, defect type identification, timber cutting optimization and timber grading or sorting. The Automated Visual Inspection has been developed to meet the expanding need in manufacturing environment and faster the production rate to raise the

interest in automating the visual inspection process. As the visual inspection is done by human, it is prone to error due to limitation of human capability. Human will easily get tired and stress after long working hours reviewing the same object repeatedly to identify the defect part of the timber that may contribute a low efficiency and accuracy of the inspection process which led to low quality of timber product.

The goal of this project is to propose a timber surface defect identification approach that capable to identify the defect type of timber with focus on species independent processing. This project will bring the impact in the quality control process of wood-based industry with contribute to AVI domain.

1.2 Problem Statement

Manual inspection processes of timber defect identification are less reliable in the industry. It is because of the visual inspection is done by human that might to have error due to the limited capability in handling a long period of inspection and it also a time consuming. Human easily get tired, stressed and distracted while having high rates of production and repetitive work. This will led to the lower accuracy of inspection grading after a long inspection. To carter the increasing demand in Malaysia wood industry, this problem will affect the production of timber products as well as its quality. Hence, an automated visual inspection of timber surface will be developed to enable higher inspection accuracy.

1.3 Objective

The goal of this project is to develop a timber surface defect identification system which able to identify different type of timber defects on multiple species. The objectives of this project are:

- To investigate and study the appropriate algorithm for defect identification on timber surface
- To develop timber defect identification system
- To test the system against many types of defect.
- To test the system against multiple species of wood.

1.4 Project Scope

This project is built using MATLAB R2010a. This system is created for recreation purpose. In real application, image of timber surface is examined specifically while moving the timber into the cutting machine. This system is able to detect and identify the different type of defect on multiple species. Image of timber will be loaded by user and the system will detect and identify the defect part on the surface of the timber.

1.5 Project Significant

Sawn Timber Defect Identification is the system that able to detect and identify different type of defect on multiple species. This system will increase the accuracy of defect identification and decrease time consuming on human visual inspection. As a high demand of timber production in Malaysia wood industry, defect identification of timber surface is an important aspect to reduce wastage.

As the automated visual inspection is being used, there will be a reduction of time in visual inspection of identifying the defect part in production of timber. By using this system, the use of worker for visual inspection and the cost of hiring worker will be reduced.

This system is able to detect and identify different type of defect on multiple species. It helps on visual inspection with highest production and good quality control.

1.6 Expected Output

The goal of this project is to develop a timber surface defect identification system which is capable of identifying different types of timber defect on multiple species. This project has promising impact in quality control process of wood based industry with contribution to the automated visual in inspection (AVI) domain.

1.7 Conclusion

This chapter discuss about the background of the project that will be developed. Sawn Timber Defect Identification System is a system that automates the process of visual inspection of identifying the defect type of timber surface.

This system is able to identify the different type of defect on multiple species. As the current process of visual inspection is done by human, it is prone to error due to the limitation of human capabilities. Human will easily get tired and stress after long working hours reviewing the same object repeatedly to identify the defect part of the timber. It may contribute a low efficiency and accuracy of the inspection process which led to low quality of timber product. Hence, this system is to develop a timber surface defect identification approach

that capable to identify the defect type of timber with focus on species independent processing.

The next chapter will discuss about the literature review and project methodology. The related research and study will be discusses as well as the project methodology used to develop the system.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter discusses about the literature review of the system. The literature review focus on the research that related to the project. This literature review helps reader to convey the knowledge and also established the ideas. The chapter begins with a facts and findings which will discuss about the overview of timber process, Malaysian timber species, timber defects and automated vision inspection (AVI) of timber.

2.2 Facts and Findings

This section will discuss about the domain of this system. The section included overview of the timber process, Malaysian timber species, timber defect, and automated visual inspection (AVI) of timber and neural network.

2.2.1 Overview of Timber Process

Timber is defined as the wood that cut into various sizes to be used as building material and in carpentry. Woods from the timber are classified into four categories which are heavy hardwoods, medium hardwoods, light hardwoods and softwood. The classification is based on its average density and durability (MITB, 2000). There are different stages of processing to turn trees into timber. In Figure 2.1, the first stage is timber harvesting or felling where the trees are cut down or fell in the permitted forest area. After the felling stage, the logs are sent to the sawmill to be processed into timber. In the sawmill, the barks on the logs are removed in the debarking process. Then the logs are sawed into different ways based on log size, shapes and defects to optimize the number of timber produced.

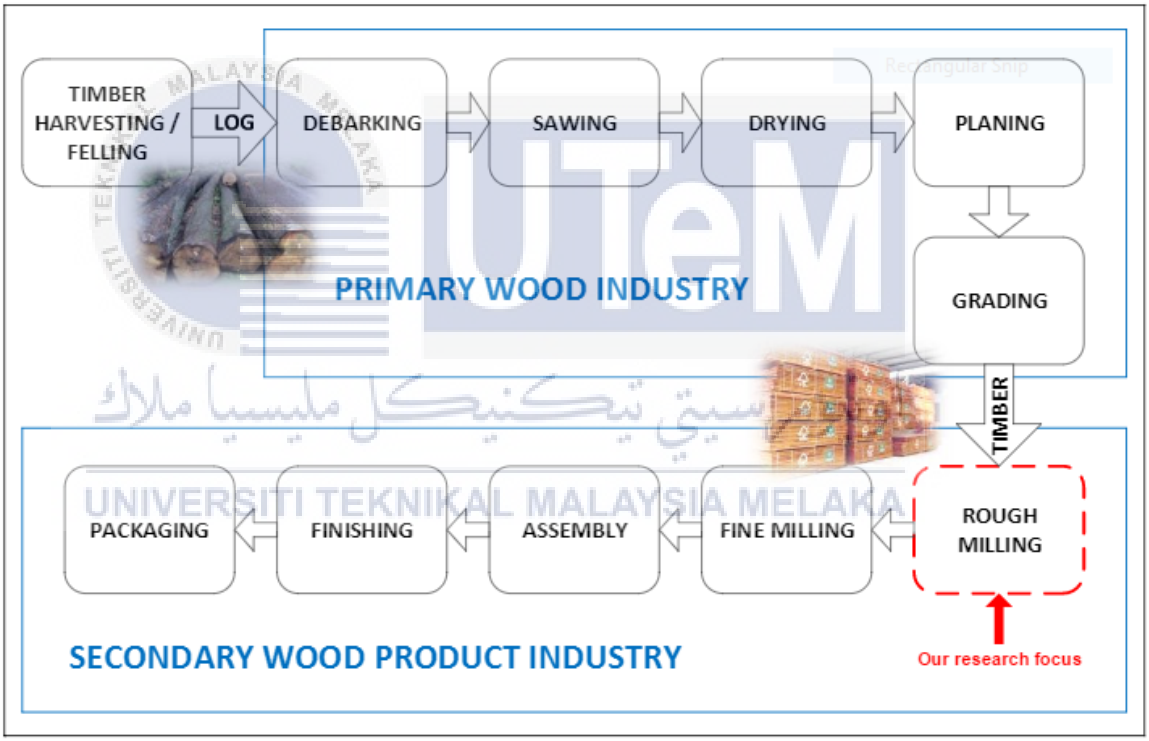

Figure 2.1**:** Timber Process (Hashim, 2015)

There have various ways to saw the logs into timber as show in the figure 2.2. Generally, the outer part of the logs is cut into a thinner piece of timber, followed by thicker pieces. Usually, the larger pieces of timber are cut from the centre of the logs. After the sawing stage is drying process by using either air dried or kiln dried. Drying process brings down the moisture content of the timber to prevent decay and allow the timber to shrink. Then the timber is arranged in closed area where the air is

heated and circulated in kiln while dried the timber is arranged with spaces between pieces to allow the circulation of the air in air dried. Next, the timber is planned into smooth the surface and edges during the planning stage. The timber will be packed according to wood types, moisture content and sizes before proceed to grading stage.

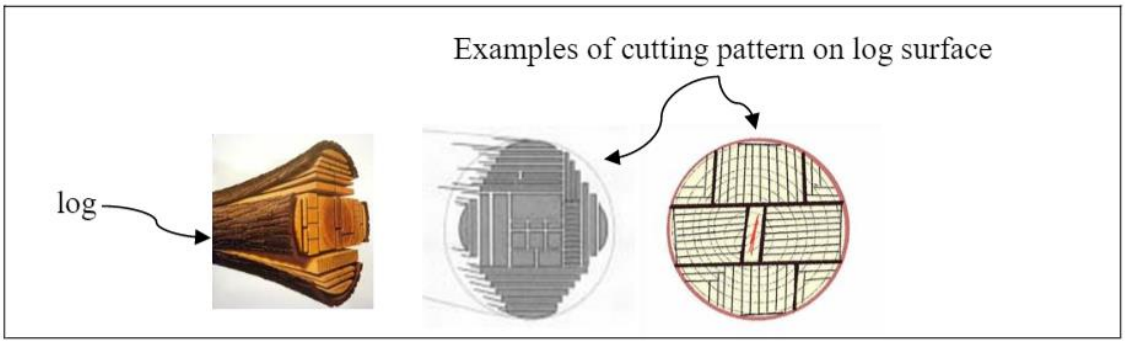

Figure 2.2 Log cutting pattern (Hashim, 2015)

Grading stage needs a grader who is certified to examine the timber pieces visually and competent to grade the timber after attending a grading authority course. The timber defect present will be visually inspected to ensure the quality of timber pieces is determined by the frequency and distribution of the defects and the timber dimension (Buehlmann et al., 2011). Currently, the grading authority in Malaysia is the Malaysian Timber Industry Board under the Ministry of Plantation Industries and Commodities (Lew, 1981). The timber will grade accordingly to Malaysian Grading Rules (MGR).

After grading process, a buyer will choose the appropriate grade according to desired application. The grading process is not compulsory and it is an optional quality control procedure depending on understanding achieved between the buyer and seller. (Hashim, 2015). This quality control procedure will ensure the buyer buys the appropriate grading and high quality of timber.

The sawmill will then distributed the timber to secondary wood product industry where the timber will be made into products such as furniture and construction material. Before the timber becomes the final products, the timber will undergo various processes. The first stage is molding process where sawn timber is molded and then cut into the required size of component. To ensure the highest yield and reduce wastage, the timber will be visually inspected for defects during the process. The defected part will be cut and send to sorted process where it shall be

repair, discarded or recycle for other purposes. There is various stage of quality control that involves detection and identification of timber defect from sawmill to secondary wood industry.

2.2. 2 Malaysian Timber Species

Hardwood and softwood are distinct by botanical convention. Malaysian timbers are categorized into four categories which are heavy hardwood, medium hardwood, light hardwood and softwood. Hardwoods are classified based on wood density at 15% moisture content. However, heavy hardwood places the durability measure with higher priority than density. Some of the average medium density species are placed in heavy hardwood category instead of medium category because of having higher durability. The table below shows list of Malaysia timber classification based on density:

Table 2.1: List of Malaysian timber classification based on density (MTIB, 2000)

Classification	Density Range (15% moisture content)
Heavy Hardwood	800-1120 kg/m^3
Medium Hardwood	720-880 kg/m^3
Light Hardwood	400-720 kg/m^3
Softwood	Botanical distinction

Hardwood timber species is used for visual inspection purpose for this project such as rubberwood, merbau, meranti, and kembang semangkok (KSK). These four types of timber species have very different of characteristic that can be detailed with the color difference between heartwood and sapwood, nature of grains as well as texture. Thus, these timber species gives a good test on the reliability of the system with the variation of characteristic.

2.2. 3 Timber Defects

Wood defect can be classified as mechanical defects and natural defects. Mechanical defects occur during the processing or manufacturing of timber such as sawing, drying and molding processes. While natural defect is a biological defect caused during growth of a tree. There has no wood that free from defects completely (Hashim, 2015). Depending on grading rules, defects can categories as permissible and non-permissible.

The characteristic of defect is commonly similar even from different species. These defections affect the aesthetic value, appearance and strength of the wood. Therefore, the identification of timber defect is very important process to maintain the quality of final products. This project will focus on the natural defect based on the study by Hashim, 2015. Table 2.2 below shows that the list of common timber defect.