

**UNIVERSITI TEKNOLOGI MARA**

**AUTOMATED VISION  
RECOGNITION FOR CLASSIFYING  
NUTRIENT DEFICIENCIES BASED  
OF ELAEIS GUINEENSIS LEAF**

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Thesis submitted in fulfillment  
of the requirements for the degree of  
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## **AUTHOR'S DECLARATION**

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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## ABSTRACT

Automated vision recognition has been widely implemented for various fields such as automobiles, manufacturing, medical, agricultural sector, etc. However, automation recognition specifically in oil palm or scientifically known as *Elaeis Guineensis* industry is still lacking. To the best of our knowledge, automatic detection device for nutrition-lacking disease based on appearance of symptoms on leaf surfaces is unavailable since at present, the disease is inspected by human experts depending on the knowledge and experience possessed. Hence, this thesis proposed to automate the nutritional disease detection due to nutritional deficiencies namely nitrogen, potassium and magnesium instead of manual visual recognition. This is because automation process is necessary to lessen error and reduce cost due to human experts as well as to increase speed of disease detection. Generally, the proposed automation disease detection of oil palm involves three modules namely feature extraction based on image processing technique, statistical analysis as feature selection and classification based on artificial intelligence. Firstly, the diseased-frond leaf surface image is captured at ambient environment. This uncontrolled processing environment approach implemented for disease detection based on leaf surface appearance is considered new and can be regarded as significant contribution in this research field. Next, the captured leaf image is transmitted to the host computer database for further processing. Further, the processor formulates its judgment through machine learning that is able to infer decision similar to human thinking. Here, the performances of several machine learning classifiers are compared. Once the processing stage is completed, the image will be retrieved online through the portable device of Apple's Operating System (iOS) (ipod/iphone/ipad tablet) technology. Results demonstrated that support vector machine (SVM) of radial basis function (RBF) outperformed other classifiers in recognizing the disease types from the leaf surface. Furthermore, it was also found that SVM-RBF is the most suitable method for classifying the disease in terms of accuracy and processing speed. Feature selection via Analysis of Variance (ANOVA) and Multiple Comparison Procedure (MCP) enhanced classifier prediction capability, thus resemble original features as closest as possible without compromising the accuracy rate. Results revealed that higher recognition rates attained with classification based on SVM-RBF along with appropriate feature selection that yields accuracy from 91.11% to 91.81%.

# TABLE OF CONTENTS

	<b>Page</b>
<b>AUTHOR'S DECLARATION</b>	ii
<b>ABSTRACT</b>	iii
<b>ACKNOWLEDGEMENTS</b>	iv
<b>LIST OF TABLES</b>	xi
<b>LIST OF FIGURES</b>	xiv
<b>LIST OF ABBREVIATIONS</b>	xx
<b>CHAPTER ONE : INTRODUCTION</b>	22
1.1 Introduction	22
1.2 Problem Statement	24
1.3 Objectives of Research	25
1.4 Scope and Relevancy	26
1.5 Organization of the Thesis	26
<b>CHAPTER TWO : REVIEW OF LITERATURE</b>	29
2.1 Introduction	29
2.2 Nutritional Disorders	29
2.3 Fertilization of Plants	32
2.4 Diagnostic Tools for Deficiencies Detection	34
2.5 Literature of Disease Recognition in Imaging and AI Application	35
2.6 Review of Literature by Other Researcher	37
2.7 Overview of Image Processing Technique	40
2.7.1 Colour-space	41
2.7.2 Lab Colour Space	42
2.7.3 YCbCr Colour Space	43
2.7.4 Thresholding	43
2.8 Statistics Background Overview	44
2.8.1 Data Distribution	45

2.8.2	Statistics Inference	46
2.8.3	Hypothesis Testing	47
2.8.4	Interpretation of P-value	49
2.8.5	Test of Normality	49
2.8.6	Graphical Data Representation: Normality Plot	51
2.9	Artificial Neural Network (ANN) Overview	54
2.9.1	Normalization	55
2.10	Introductory Approach for Computerizing Oil Palm Disease Recognition	56
2.11	Summary	57

### **CHAPTER THREE : EXPERIMENTAL SETUP FOR AUTOMATIC LEAF**

	<b>DETECTION</b>	58
3.1	Introduction	58
3.2	Challenges and Difficulties	58
3.2.1	Uncontrolled Illumination Trait for Processing the Diseased- Image on Database	58
3.2.2	Background Removal	60
3.3	Image acquisition	61
3.4	Database Collection	63
3.5	Calibration of Light Intensity, Analysis and Discussions	64
3.6	Summary	71

### **CHAPTER FOUR : FEATURE EXTRACTION FOR DISEASES**

	<b>IDENTIFICATION</b>	72
4.1	Introduction	72
4.2	Image Pre-processing	72
4.2.1	Image Binarization	73
4.2.2	Filter	74
4.2.3	Image Enhancement	74
4.3	Segmentation of Crop's Disease Spot	75
4.4	Feature Extraction for Oil Palm	76
4.4.1	Colour as Features to be Extracted	77
4.4.1.1	Mean Intensity	79
4.4.1.2	Total Mean	79