

UNIVERSITI TEKNOLOGI MARA

**WOOD SPECIES
RECOGNITION USING
CNN**

MOHAMMAD OTHMAN BIN NORHAIZA

**BACHELOR OF COMPUTER SCIENCE
(HONS.)**

JANUARY 2024

ACKNOWLEDGMENT

Firstly, Thanks to Allah, the Almighty for His graces and blessing, this study case would not have been possible. I want to thank my family for giving so much support throughout this semester. I have gone through ups and downs with my family being my biggest supporter to gain motivation for finishing this semester.

I would also like to thank my supervisor Dr Mohamad Faizal Ab Jabal for his support and words of encouragement. I received a lot of guidance, and his time and effort assisted me in completing this study. Besides, I would like to express my appreciation to Madam Ummu Fatimah binti Mohd Bahrin who is my lecturer for CSP600 and CSP650 for sharing her knowledge with me, motivating, and supporting me throughout the semester. Last but not least, I could not have undertaken this journey without the support and help of my friends.

ABSTRACT

This study aims to develop an automated wood species recognition model using Convolutional Neural Networks (CNNs) based on macroscopic wood images. CNNs, known for their effectiveness in image recognition, leverage transfer learning to address limited training data challenges. The study pursues three objectives: feature extraction using CNNs, developing a wood species recognition system, and evaluating CNN model accuracy. Accurate wood identification is crucial for quality control, combating illegal logging, and regulatory compliance. Computer vision, particularly CNNs, offer automated solutions, surpassing labour-intensive traditional methods. The proposed CNN model utilises RGB images for feature extraction and transfer learning for efficient training on limited datasets. Evaluation compares two CNN models, Xception and VGG-16, with Xception demonstrating superior accuracy, precision, and F1-score. The research addresses wood species identification challenges, enhancing industry efficiency. Limitations include dataset size, environmental variability during image capture, and hardware constraints. Future work suggests dataset expansion, consideration of environmental factors, exploration of advanced techniques, and hardware infrastructure upgrades for scalability. Continuous refinement of wood species recognition systems is essential to meet evolving industry demands.

TABLE OF CONTENTS

CONTENT

SUPERVISOR APPROVAL	ii
STUDENT DECLARATION	iii
ACKNOWLEDGMENT	iv
ABSTRACT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF ABBREVIATIONS	xii
CHAPTER ONE: INTRODUCTION	2
1.1 Background Study	2
1.2 Problem Statement	3
1.3 Research Question	5
1.4 Objective	5
1.5 Project Scope	6
1.6 Project Significant	6
1.7 Conclusion	7
CHAPTER TWO: LITERATURE REVIEW	9
2.1 Artificial Intelligence	9
2.2 Wood Features	10
2.2.1 Grain Pattern	12
2.2.2 Texture	12
2.2.3 Colour	13
2.3 Algorithm	15
2.3.1 Convolutional Neural Network	15
2.3.2 Support Vector Machine (SVM)	17
2.3.3 Convolutional Neural Networks (CNNs) and Support Vector Machine for Wood Species Recognition	19
2.4 Datasets	20

2.5	Implementation Convolutional Neural Network Algorithm in Various Problem	22
2.6	Similar works	27
2.7	Summary	31
CHAPTER THREE: METHODOLOGY		32
3.1	Research Framework Methodology	32
3.1.1	Research Framework	33
3.1.2	Research Methodology	34
3.2	Preliminary Study	36
3.2.1	Literature Study	37
3.2.2	Data Collection	38
3.2.3	Data Pre-Processing	40
3.3	Design and Implementation Phase	41
3.3.1	Prototype Architecture	41
3.3.2	Xception Architecture	43
3.3.3	Flowchart	46
3.3.4	Interface Design	48
3.3.5	Pseudocode of Selected Algorithm	50
3.3.6	Prototype Implementation	51
3.4	Performance Evaluation	52
3.4.1	Confusion Matrix	52
3.4.2	Accuracy, Precision, Recall, F1 Score	53
3.5	Gantt Chart	55
3.6	Conclusion	56
CHAPTER FOUR: RESULT AND FINDINGS		58
4.1	Conceptual Framework	58
4.2	Result for Objective 1	59
4.2.1	Analysis of Literature Review on CNN	59
4.2.2	Image Pre-processing	61
4.3	Result for Objective 2	65
4.3.1	CNN Implementation	65
4.3.2	Prototype Interface	71
4.3.3	Functionality Testing	73
4.4	Result for Objective 3	76
4.4.1	CNN Model Evaluation	76