

CONTENTS

APPROVAL PAGE

SELF DECLARATION AGAINST PLAGIARISM

ABSTRACT	iv
ACKNOWLEDGEMENTS	v
PREFACE	vii
CONTENTS	viii
LIST OF FIGURES	xii
LIST OF TABLES	xiv
LIST OF ABBREVIATION	xv
LIST OF SYMBOL	xvi
ACHIEVEMENT	xviii
1 INTRODUCTION	1
1.1 Background	1
1.2 State of the Art	4
1.3 Research Problem	5
1.4 Research Objective	5
1.5 Research Methodology	5
1.6 Scope of Work	6
1.7 Timeline	7
2 BASIC CONCEPTS	8
2.1 Fundamentals of Convolutional Neural Networks (CNNs)	8
2.1.1 Convolution Layer	9
2.1.2 Activation Function	11
2.1.3 Pooling Layer	12

2.1.4	Flatten Operation	13
2.1.5	Fully Connected Layer	14
2.2	Transfer Learning and Fine-Tuning	15
2.2.1	Transfer Learning Concept	15
2.2.2	Transfer Learning Strategies	15
2.2.3	Mathematical Perspective	15
2.2.4	Benefits of Transfer Learning	16
2.2.5	Fine-Tuning Illustration	16
2.2.6	Related Works and Applications	16
2.3	Pre-trained CNN Models	17
2.3.1	InceptionV3	17
2.3.2	Xception	18
2.3.3	MobileNetV2	19
2.3.4	ResNet152V2	19
2.3.5	DenseNet201	20
2.4	Plant Leaf Condition Classification	21
2.5	Related Works	22

3 PROPOSED APPROACH: TRANSFER LEARNING AND FINE-TUNING OF PRE-TRAINED CNN MODELS

3.1	Research Framework	23
3.2	Dataset Description	25
3.2.1	Class Distribution	25
3.2.2	Visual Diversity and Annotation	25
3.2.3	Hierarchical Class Structure	27
3.2.4	Image Preprocessing	28
3.2.5	Importance and Reliability	28
3.3	Dataset Splitting	29
3.4	Data Preprocessing and Augmentation	29
3.5	Pre-trained CNN Models	32
3.6	Transfer Learning and Fine-Tuning Strategy	32
3.7	Training and Validation Setup	34
3.8	Evaluation Metrics	35
3.8.1	Accuracy	35
3.8.2	Precision	36
3.8.3	Recall	36
3.8.4	F1-Score	36
3.8.5	Confusion Matrix	36

3.8.6	ROC-AUC	37
4	EXPERIMENTAL RESULTS AND PERFORMANCE EVALUATION	38
4.1	Overview of Experiment Execution	38
4.2	InceptionV3 Result Analysis	39
4.2.1	Feature Extraction Phase	40
4.2.2	Fine-Tuning Phase	40
4.2.3	Classification Report	40
4.2.4	Learning Curve Analysis	40
4.2.5	ROC-AUC Analysis	42
4.2.6	Performance Summary	44
4.3	Xception Result Analysis	44
4.3.1	Feature Extraction Phase	44
4.3.2	Fine-Tuning Phase	45
4.3.3	Classification Report	45
4.3.4	Learning Curve Analysis	45
4.3.5	Confusion Matrix Analysis	46
4.3.6	ROC-AUC Analysis	47
4.3.7	Performance Summary	48
4.4	MobileNetV2 Result Analysis	48
4.4.1	Feature Extraction Phase	48
4.4.2	Fine-Tuning Phase	49
4.4.3	Classification Report	49
4.4.4	Learning Curve Analysis	50
4.4.5	Confusion Matrix	51
4.4.6	ROC-AUC Analysis	52
4.4.7	Performance Summary	52
4.5	ResNet152V2 Result Analysis	53
4.5.1	Feature Extraction Phase	53
4.5.2	Fine-Tuning Phase	53
4.5.3	Classification Performance	54
4.5.4	Learning Curve Analysis	54
4.5.5	Confusion Matrix Analysis	55
4.5.6	ROC-AUC Analysis	56
4.5.7	Performance Summary	56
4.6	DenseNet201 Result Analysis	58
4.6.1	Feature Extraction Phase	58
4.6.2	Fine-Tuning Phase	58

4.6.3	Classification Report	58
4.6.4	Learning Curve Analysis	59
4.6.5	Confusion Matrix Analysis	59
4.6.6	ROC-AUC Analysis	60
4.6.7	Performance Summary	61
4.7	Performance Comparison	63
4.7.1	Accuracy and Loss Comparison	63
4.7.2	Macro Precision, Recall, and F1-Score Analysis	63
4.7.3	Learning Curve Trends	65
4.7.4	Confusion Matrix and Error Analysis	66
4.7.5	ROC-AUC Evaluation	68
4.7.5.1	Analysis and Observations	68
4.7.5.2	Implications of ROC-AUC	69
4.7.6	Model Architecture and Hyperparameter Comparison	69
4.7.6.1	Architectural Trade-Offs and Performance Implications	70
4.7.6.2	Model Suitability for Deployment	70
4.7.7	Model Performance and Class-Wise Strength Analysis	71
4.7.8	Comparison with Previous Studies on Lemongrass Leaf Classification	72
4.7.8.1	Implications and Generalization	75
4.7.8.2	Conclusion	75
4.8	Discussion and Interpretation	75
4.8.1	Strengths of the Proposed Approach	75
4.8.2	Limitations and Possible Bias	76
4.8.3	Potential for Deployment in Agriculture	76
4.9	Summary	77
5	CONCLUSION AND FUTURE WORK	78
5.1	Conclusion	78
5.2	Limitations	78
5.3	Future Work	79
REFERENCES		80