

TABLE OF CONTENTS

S1 RESEARCH PROPOSAL	I
APPROVAL PAGE	II
STATEMENT	III
TABLE OF CONTENTS	IV
LIST OF TABLES	VII
LIST OF FIGURES	VIII
ABSTRACT	XI
INTISARI	XII
CHAPTER I: INTRODUCTION	1
1.1 Background	1
1.2 Research Problem	3
1.3 Research Scope	4
1.4 Research Objective	5
1.5 Research Benefit	5
1.6 Research Methodology	5
1.7 Writing System	7
CHAPTER II: LITERATURE REVIEW	10
CHAPTER III: THEORETICAL BASIS	16
3.1 Convolutional Neural Network (CNN)	16
3.2 Gamma Correction	20
3.3 Noise Reduction Filter	20
3.4 Subsampling	22
3.5 Batch Size	23
3.6 Data Augmentation	23
3.7 K-Fold Cross Validation	25

3.8 Transfer Learning	25
3.9 InceptionV3	26
3.10 ResNet	27
3.11 DenseNet121	29
3.12 Ensemble Learning Method	31
3.13 Hyperparameter Tuning	32
3.14 Learning Rate	33
3.15 Optimiser	34
3.16 Confusion Matrix	34
3.17 Performance Evaluation	35
3.18 Retinal Diseases	36
3.19 Optical Coherence Tomography (OCT)	39
CHAPTER IV: RESEARCH METHODOLOGY	41
4.1 Research Description	41
4.2 Problem Analysis	41
4.3 Analysis Based on Previous Research	44
4.4 Research Dataset	46
4.5 Research Stages	47
4.6 Algorithm Design Structure	50
CHAPTER V: IMPLEMENTATION	52
5.1 Implementation Tools	52
5.2 Library Preparation	52
5.3 Dataset Preparation	53
5.4 Data Augmentation and Image Enhancement	54
5.5 Create Subsets	61
5.6 Preparing Pretrained Models for Training	63

5.7 Finding an Optimal Learning Rate	65
5.8 Defining a Train Function	68
5.9 Integrating a K-Fold Cross Validation	70
5.10 Training Each of the Models	74
5.11 Defining and Implementing the Evaluation and Confusion Matrix for Each Model	75
CHAPTER VI: RESULTS AND DISCUSSIONS	80
6.1 Results and Analysis of the Speckle Denoise Filters	80
6.2 Results and Analysis of the Effects of using Translations	82
6.3 Learning Rate for Each of the Pretrained Models	85
6.4 Results and Analysis of Sampling the Dataset for Each Model	86
6.5 Evaluation Performance for Each Model at Different Sampling Rates	91
CHAPTER VII: CONCLUSION AND SUGGESTION	96
7.1 Conclusion	96
7.2 Suggestion	97
REFERENCES	98

LIST OF TABLES

Table 2.1 A comparison of each research.	13
Table 5.1 Details of the Implementation Tools.	52
Table 6.1 Performance of training with no filter.	80
Table 6.2 Performance of training with the median filter.	81
Table 6.3 Performance of training with the Wiener filter.	81
Table 6.4 Performance of training with the combined filter.	82
Table 6.5 Performance of training with translation.	83
Table 6.6 Performance of training with constrained translation.	83
Table 6.7 Performance of training with no translation.	83
Table 6.8 Performance of training ResNet50 with 5,415 images.	87
Table 6.9 Performance of training InceptionV3 with 5,415 images.	87
Table 6.10 Performance of training DenseNet121 with 5,415 images.	88
Table 6.11 Performance of training ensemble model with 5,415 images.	88
Table 6.12 Performance of training ResNet50 with 10,830 images.	89
Table 6.13 Performance of training InceptionV3 with 10,830 images.	89
Table 6.14 Performance of training DenseNet121 with 10,830 images.	90
Table 6.15 Performance of training ensemble model with 10,830 images.	90
Table 6.16 Performance of the evaluation with 5,415 images.	92
Table 6.17 Performance of the evaluation with 10,830 images.	93

LIST OF FIGURES

Figure 3.1 Example of applying 2-D convolution to a single kernel (Goodfellow et al., 2018)	16
Figure 3.2 Example of Max Pooling using a 2x2 filter and 2x2 stride (Phoenix, 2018)	18
Figure 3.3 A simple CNN Architecture (Kumar, 2023)	19
Figure 3.4 Example of an ultrasound image where the right has been filtered (Jaybhay & Shastri, 2015)	21
Figure 3.5 Performance of subsampling methods based on their accuracy (Zhang et al., 2023)	22
Figure 3.6 Different batch sizes trained on CIFAR-10 (Runze Lin, 2022)	23
Figure 3.7 Structural Diagram of the InceptionV3 (Wang et al., 2019)	27
Figure 3.8 A ResNet block (Howard & Gugger, 2021)	28
Figure 3.9 Differences between ResNet's block structures (He et al., 2016)	29
Figure 3.10 Differences between DenseNet's architectures (Huang et al., 2017)	30
Figure 3.11 The flow diagram of the ensemble learning method (Sulistya et al., 2023)	31
Figure 3.12 Example of applying a learning rate finder to a model, where the red dot signifies the optimal learning rate. (Howard & Gugger, 2021)	34
Figure 3.13 An example of a confusion matrix on a model classifying a bear. (Howard & Gugger, 2021)	35
Figure 3.14 Example of an OCT image of a retina with DME. (Kermany et al., 2018)	37
Figure 3.15 Example of an OCT image of a retina with DMD. (Kermany et al., 2018)	38
Figure 3.16 Example of an OCT image of a retina with CNV. (Kermany et al., 2018)	39
Figure 3.17 Example of an OCT image of a retina. (Kermany et al., 2018)	40
Figure 4.1 Comparisons of the retinal diseases. (Kermany et al., 2018)	42
Figure 4.2 The retinal disease images. (Kermany et al., 2018)	47
Figure 4.3 Algorithm Design Structure	50

Figure 5.1 List of libraries used	53
Figure 5.2 Layout path of the dataset folders	54
Figure 5.3 Importing data	54
Figure 5.4 Data transformations dictionary	55
Figure 5.5 Gamma correction function	56
Figure 5.6 Filter application functions	57
Figure 5.7 Pseudocode of the median filter transformation class	58
Figure 5.8 Pseudocode of the Wiener filter transformation class	58
Figure 5.9 Pseudocode of the combined filter transformation class	59
Figure 5.10 The training execution	60
Figure 5.11 Create a subset	62
Figure 5.12 Pseudocode of ResNet50 custom class	63
Figure 5.13 Pseudocode of InceptionV3 custom class	64
Figure 5.14 Pseudocode of DenseNet121 custom class	64
Figure 5.15 Pseudocode of ensemble custom class	65
Figure 5.16 Pseudocode of the learning rate finder function	66
Figure 5.17 Device Variable	67
Figure 5.18 Running the learning rate finder function	68
Figure 5.19 Pseudocode of the training function	68
Figure 5.20 Pseudocode of the K-Fold cross-validation function	71
Figure 5.21 Variable initialization	74
Figure 5.22 Training each model	75
Figure 5.23 Pseudocode of the evaluation function	76
Figure 5.24 Class names extraction	78
Figure 5.25 Utilizing the evaluation function	79
Figure 6.1 Learning rate for each model	86

Figure 6.2 Confusion matrix of the models with 5,415 images	92
Figure 6.3 Confusion matrix of the models with 10,830 images	94
Figure 6.4 Similarity between the retinal diseases. (Kermany et al., 2018)	95