



EyeSee: Real-Time Object Detection Application for the Visually Impaired Using TensorFlow Lite and EfficientDet with Convolutional Neural Networks

UNDERGRADUATE THESIS

**Submitted as one of the requirements to obtain
Sarjana Komputer (S.Kom)**

By:

CINDY ZULANI

001202000137

FACULTY OF COMPUTING

INFORMATICS STUDY PROGRAM

CIKARANG

May, 2023

Copyright By
Cindy Zulani
2023

**EyeSee: Real-Time Object Detection Application for the Visually
Impaired Using TensorFlow Lite and EfficientDet with
Convolutional Neural Networks**

By

Cindy Zulani
001202000137

Approved:



Cutifa Safitri, Ph.D.
Thesis Advisor



Cutifa Safitri, Ph.D.
Program Head of Informatics



Rila Mandala, Ph.D.
Dean of Faculty of Computing

STATEMENT OF ORIGINALITY

In my capacity as an active student at President University and as the author of the final project stated below:

Name : Cindy Zulani
Student ID number : 001202000137
Study Program : Informatics
Faculty : Computer Science

I hereby declare that my final project entitled "**EyeSee: Real-Time Object Detection Application for the Visually Impaired Using TensorFlow Lite and EfficientDet with Convolutional Neural Networks**" is to the best of my knowledge and belief, an original piece of work based on sound academic principles. If there is any plagiarism detected in this final project, I am willing to be personally responsible for the consequences of these acts of plagiarism and will accept the sanctions against these acts in accordance with the rules and policies of President University.

I also declare that this work, either in whole or in part, has not been submitted to another university to obtain a degree.

Cikarang, May 2023



Cindy Zulani

SCIENTIFIC PUBLICATION APPROVAL FOR ACADEMIC INTEREST

As an academic community member of the President's University, I, the undersigned:

Name : Cindy Zulani
Student ID number : 001202000137
Study program : Informatics

for the purpose of development of science and technology, certify, and approve to give President University a non-exclusive royalty-free right upon my final report with the title:

“EyeSee: Real-Time Object Detection Application for the Visually Impaired Using TensorFlow Lite and EfficientDet with Convolutional Neural Networks”

With this non-exclusive royalty-free right, President University is entitled to converse, to convert, to manage in a database, to maintain, and to publish my final report. There are to be done with the obligation from President University to mention my name as the copyright owner of my final report.

This statement I made in truth.

Cikarang, May 2023



Cindy Zulani

**ADVISOR APPROVAL FOR JOURNAL/INSTITUTION'S
REPOSITORY**

As an academic community member of the President's University, I, the undersigned:

Name : Cutifa Safitri
ID number : 20190900815
Study program : Informatics
Faculty : Computing

declare that following final project:

Title of final project : **EyeSee: Real-Time Object Detection Application for the Visually Impaired Using TensorFlow Lite and EfficientDet with Convolutional Neural Networks**

Final project author : Cindy Zulani
Student ID number : 001202000137

will be published in journal / institution's repository / proceeding / unpublished.

Cikarang, May 2023



Cutifa Safitri

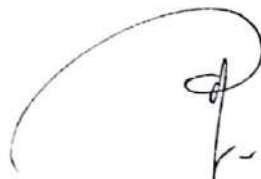
PANEL OF EXAMINER APPROVAL

The Panel of Examiners declare that the undergraduate thesis entitled

EyeSee: Real-Time Object Detection Application for the Visually Impaired Using TensorFlow Lite and EfficientDet with Convolutional Neural Network.


that was submitted by Cindy Zulani majoring in Informatics from the Faculty of Computing was assessed and approved to have passed the Oral Examination on May 18, 2023.

Panel of Examiner



Rosalina, S.Kom., M.Kom.

Chair of Panel Examiner



Abdul Ghofir, S.Kom., M.Kom.

Examiner I



Cutifa Safitri, Ph. D.

Advisor

PLAGIARISM CHECK RESULT

Cindy Zulani Ch All

ORIGINALITY REPORT

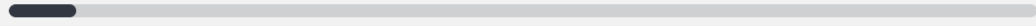
13% SIMILARITY INDEX	9% INTERNET SOURCES	4% PUBLICATIONS	7% STUDENT PAPERS
--------------------------------	-------------------------------	---------------------------	-----------------------------

PRIMARY SOURCES

1	www.tensorflow.org Internet Source	1%
2	Submitted to National Institute of Technology Jamshedpur Student Paper	1%
3	www.coursehero.com Internet Source	<1%
4	www.scirp.org Internet Source	<1%
5	Submitted to British University in Egypt Student Paper	<1%
6	www.geeksforgeeks.org Internet Source	<1%
7	Submitted to University of Essex Student Paper	<1%
8	dspace.univ-ouargla.dz Internet Source	<1%
9	repositorio.yachaytech.edu.ec Internet Source	<1%

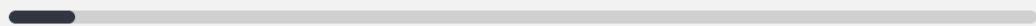
AI-BASED INDEX REPORT

Average Perplexity Score: 65.061



A document's perplexity is a measurement of the randomness of the text

Burstiness Score: 64.170



A document's burstiness is a measurement of the variation in perplexity

Your sentence with the highest perplexity, "CNNs are deep learning model that is trained using sizable labeled image datasets with specified ground truth bounding boxes and class labels.", has a perplexity of: 343

ABSTRACT

A real-time object detection mobile application for visually impaired individuals using TensorFlow Lite aims to detect objects and Indonesian currency while providing language selection and other supporting features. Deep learning models for object detection, particularly Convolutional Neural Networks, have been an active field in computer vision research for many years. However, developing object detection applications for mobile devices with limited computational power might be challenging. The solution presented in this report utilizes TensorFlow Lite, a lightweight variant of TensorFlow created for mobile and embedded devices. The application uses EfficientDet, a highly efficient object detection model that enables scaling of network width, depth, and resolution in a balanced manner, resulting in improved accuracy and efficiency. The implementation of the application using TensorFlow Lite and EfficientDet has resulted in a highly precise and reliable object detection model suitable for mobile devices. The application also includes additional features to improve usability, such as Indonesian currency detection. The future work for this application includes improving the Indonesian currency detection feature, expanding language options, and training custom models for specific objects or features. This application has the potential to significantly improve the daily experiences of visually impaired people and enhance their independence.

Keywords—*Object Detection, Convolutional Neural Networks, TensorFlow Lite, Real-Time, Visual Impairment*

DEDICATION

For myself and my family.

ACKNOWLEDGEMENT

1. I want to express my sincere gratitude to the following people for support me to finish this final project:
2. I want to thank Allah SWT sincerely for His blessings and direction during this final project. His constant love and support have given me courage and strength.
3. Myself, I am proud of the effort and commitment I put into this final project.
4. My advisor, Ms. Cutifa Safitri, Ph.D., for her invaluable guidance and support throughout the process. Her expertise and dedication were instrumental in making this final project a success.
5. My family for their encouragement and understanding during this challenging time. Their unwavering support is a constant source of inspiration and motivation.
6. My team, Accommodation Product and Connectivity, for their patience and unwavering support during my internship. Balancing work and study has been a challenge, but my team's understanding and flexibility have allowed me to succeed in both academics and internship.

TABLE OF CONTENTS

ABSTRACT.....	i
DEDICATION.....	ii
ACKNOWLEDGEMENT.....	iii
TABLE OF CONTENTS.....	iv
LIST OF TABLES.....	ix
LIST OF EQUATIONS.....	x
LIST OF FIGURES.....	xi
CHAPTER I INTRODUCTION.....	1
1.1 Background.....	1
1.2 Problem Statement.....	2
1.3 Objectives.....	3
1.4 Scope and Limitations.....	4
Scope.....	4
Limitations.....	5
1.5 Project Methodology.....	5
1.6 Final Project Outline.....	6
CHAPTER II LITERATURE REVIEW.....	9
2.1 Object Detection.....	9
2.2 How Object Detection Works.....	10
2.3 Measuring Accuracy and Optimizing Performance of Model.....	20
2.4 TensorFlow.....	21
2.5 Remarks.....	27
CHAPTER III SYSTEM ANALYSIS.....	28

3.1	System Overview	28
3.2	Function Analysis	28
3.3	Use Case Diagram.....	30
3.4	Use Case Narrative	31
3.5	Swim Lane Diagram	36
	Swim Lane Diagram for Object Detection	36
	Swim Lane Diagram for Currency Detection	37
	Swim Lane Diagram for About Page.....	38
	Swim Lane Diagram for Help Page	39
	Hardware Requirement	39
	Software Requirement	40
	CHAPTER IV SYSTEM DESIGN.....	41
4.1	User Interface Design	41
	Object Detection Menu	41
	Currency Detection Menu.....	42
	About Page.....	44
	Help Page	45
4.2	Class Diagram.....	46
	CHAPTER V SYSTEM IMPLEMENTATION	47
5.1	User Interface.....	47
	Splash Screen	47
	Permission.....	48
	Language Selection.....	48
	Object detection	49
	Currency Detection	51
	About Page.....	52
	Help Page	53

5.2	Application Details	54
	Project Dependencies.....	54
	Model and Dataset	55
	Prepare Data for the Model.....	60
	Model Output.....	64
	Language Selection.....	65
	Translate Detected Object.....	72
	Text-to-Speech.....	74
	CHAPTER VI SYSTEM TESTING.....	79
6.1	Testing Environment.....	79
	Language Selection Testing Scenario.....	79
	Speech Recognition Testing Scenario	79
	Object Detection Testing Scenario	80
	Currency Detection Testing Scenario	80
	Translation Testing Scenario	81
	Text to Speech Testing Scenario.....	81
	Auto Flashlight Testing Scenario.....	82
6.2	Testing Summary	83
	CHAPTER VII CONCLUSION AND FUTURE WORKS	85
7.1	Conclusion	85
7.2	Future Works	86
	REFERENCES	89

LIST OF TABLES

Table 1. Comparison Table.....	27
Table 2. Table of Function Description	29
Table 3. Use Case Narrative for “Select Language” Use Case.....	31
Table 4. Use Case Narrative for “Object Detection” Use Case.....	32
Table 5. Use Case Narrative for “Currency Detection” Use Case.....	34
Table 6. Use Case Narrative for “Auto Flashlight” Use Case	35
Table 7. Label Description from Figure 4. 1	42
Table 8 Label Description from Figure 4. 2	43
Table 9. Label Description from Figure 4. 3	44
Table 10. Label Description from Figure 4. 4	45
Table 11. Accuracy Evaluation.....	59
Table 12. Language Selection Testing Scenario	79
Table 13. Speech Recognition Testing Scenario	79
Table 14. Object Detection Testing Scenario	80
Table 15. Currency Detection Testing Scenario	80
Table 16. Translation Testing Scenario	81
Table 17. Text to Speech Testing Scenario	81
Table 18. Auto Flashlight Testing Scenario	82

LIST OF EQUATIONS

Equation 1. Formula for Convolutional Layer.....	16
Equation 2. Padding Layer Formula	17
Equation 3. Hidden Layer	19
Equation 4. Output Layer.....	19

LIST OF FIGURES

Figure 1. 1 Rapid Application Development (RAD).....	6
Figure 2. 1 Example of Object Detection	10
Figure 2. 2 Labeled Images for Cat Detection.....	11
Figure 2. 3 Architecture of CNNs.....	14
Figure 2. 4 Convolution Operation	16
Figure 2. 5 Pooling Operation.....	17
Figure 2. 6 Fully Connected Layer	18
Figure 2. 7 TensorFlow Lite Object Detection	23
Figure 3. 1 Use Case Diagram	31
Figure 3. 2 Swim Lane Diagram of Object Detection	37
Figure 3. 3 Swim Lane Diagram of Currency Detection	38
Figure 3. 4 Swim Lane Diagram of About Page.....	39
Figure 3. 5 Hardware and Software Requirement	39
Figure 4. 1 Object Detection Menu.....	42
Figure 4. 2 Currency Detection Menu	43
Figure 4. 3 About Page	44
Figure 4. 4 Help Page.....	45
Figure 4. 5 Class Diagram of The Application	46
Figure 5. 1 Splash Screen.....	47
Figure 5. 2 Video and Audio Recording Permission	48
Figure 5. 3 Language Selection	49
Figure 5. 4 Object Detection in English and Indonesian	51
Figure 5. 5 Indonesian Currency Detection	52
Figure 5. 6 About Page	53
Figure 5. 7 Help Page.....	54
Figure 5. 8 Project Dependencies	55
Figure 5. 9 Object Detection Models.....	56
Figure 5. 10 Download EfficientDet-Lite0 Model	57
Figure 5. 11 Dataset in CSV Format.....	58
Figure 5. 12 Build ImageAnalysis Object.....	61

Figure 5. 13 Configure Image Analyzer to Detect Objects	62
Figure 5. 14 Preprocess Image Data	63
Figure 5. 15 Convert and Prepare Image Data.....	64
Figure 5. 16 Interface Output.....	65
Figure 5. 17 Ask the Language Preferred	67
Figure 5. 18 Answer the Language Preferred	72
Figure 5. 19 Set-up Translation Language.....	73
Figure 5. 20 Translation Process.....	74
Figure 5. 21 Text-to-Speech	75
Figure 5. 22 Object Overlay Display Handler	77