



**FACE GENDER CLASSIFICATION FOR PUBLIC TOILET DOOR USING
CONVOLUTIONAL NEURAL NETWORK**

UNDERGRADUATE THESIS

Submitted as one of the requirements to obtain

Sarjana Komputer (S.Kom.)

By:

ANAESTHASIA PATRICIA

001201900111

**FACULTY OF COMPUTING
INFORMATICS STUDY PROGRAM**

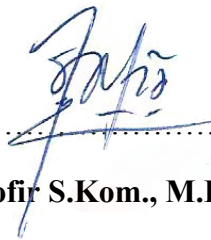
CIKARANG

MARCH, 2023

PANEL OF EXAMINER APPROVAL

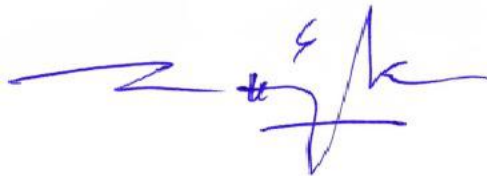
The Panel of Examiners declare that the undergraduate thesis entitled **Face Gender Classification for Public Toilet Door using Convolutional Neural Network** that was submitted by Anaesthasia Patricia majoring in Informatics from the Computing Faculty was assessed and approved to have passed the Oral Examination on March 9th, 2023.

Panel of Examiner



Abdul Ghofir S.Kom., M.Kom.

Chair of Panel Examiner



Dr. Tjong Wan Sen, S.T., M.T.

Examiner I

STATEMENT OF ORIGINALITY

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

Name : Anaesthasia Patricia

Student ID number : 001201900111

Study Program : Information Technology

Faculty : Computing

I hereby declare that my thesis/final project/business plan entitled "**FACE GENDER CLASSIFICATION FOR PUBLIC TOILET DOOR USING CONVOLUTIONAL NEURAL NETWORK**" 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 thesis/final project/business plan, 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, February 27, 2023



(Anaesthasia Patricia)

SCIENTIFIC PUBLICATION APPROVAL FOR ACADEMIC INTEREST

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

Name : Anaesthasia Patricia

Student ID Number : 001201900111

Study program : Information Technology

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:

FACE GENDER CLASSIFICATION FOR PUBLIC TOILET DOOR USING CONVOLUTIONAL NEURAL NETWORK

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 is an obligation from President University to mention my name as the copyright owner of my final report.

This statement I made in truth.

Cikarang, February 27, 2023



(Anaesthasia Patricia)

ADVISOR APPROVAL FOR JOURNAL/INSTITUTION'S REPOSITORY

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

Name : Rusdianto Roestam
ID number : 20170800704
Study program : Information Technology
Faculty : Computing

declare that following thesis:

Title of thesis : Face Gender Classification for Public Toilet Door using
Convolutional Neural Network

Thesis author : Anaesthasia Patricia

Student ID number : 001201900111

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

Cikarang, February 27, 2023



(Rusdianto Roestam)

SIMILARITY INDEX REPORT

Face Gender Classification for Public Toilet Door using Convolutional Neural Network

ORIGINALITY REPORT

14%

SIMILARITY INDEX

12%

INTERNET SOURCES

8%

PUBLICATIONS

0%

STUDENT PAPERS

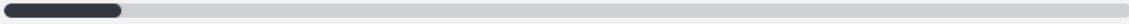
PRIMARY SOURCES

1	repository.president.ac.id Internet Source	4%
2	ntnuopen.ntnu.no Internet Source	1%
3	Samira Pouyanfar, Saad Sadiq, Yilin Yan, Haiman Tian et al. "A Survey on Deep Learning", ACM Computing Surveys, 2018 Publication	1%
4	ojs.polmed.ac.id Internet Source	1%
5	viblo.asia Internet Source	1%
6	Konstantina Malamousi, Konstantinos Delibasis, Bryan Allcock, Spyros Kamnis. "Digital transformation of thermal and cold spray processes with emphasis on machine learning", Surface and Coatings Technology, 2022 Publication	<1%

GPT ZERO CHECK

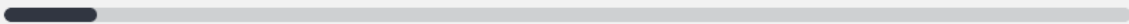
Stats

Average Perplexity Score: 103.457



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

Burstiness Score: 81.674



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

Your sentence with the highest perplexity, *"The explanation for each phase of the FDD methodo"*, has a perplexity of: 406

ABSTRACT

Safety and comfort in using public facilities, especially public toilets, are crucial because the needs of each gender, male and female, are different in using the public toilet. Because of this issue, a face gender classification system was developed to detect the faces of user candidates before entering a public toilet. Public toilet users must match the gender of the toilet so that the public toilet is safe and comfortable to use. The Convolutional Neural Networks (CNN) algorithm is proposed to solve the problem by implementing this algorithm for the face gender recognition system to detect toilet users' face gender. The face gender recognition system will be implemented in the public toilet door through Arduino Uno as the microcontroller. The Arduino Uno is connected to a web camera to detect the user candidate's face and the motor servo controls the door movement whether or not the user is allowed to enter the toilet. This final project case will implement a female public toilet so that only female users are allowed to enter the toilet.

Keyword — Face Recognition, Convolutional Neural Network, Arduino Uno

ACKNOWLEDGEMENTS

I hereby dedicate this final project to those who supported and guided me in the development process. I would like to express my deepest gratitude to:

1. My Lord, Jesus Christ enabled me to complete my final project with His love and grace.
2. My family for the support, love, help, prayers, and encouragement for me.
3. Mr. Rusdianto Roestam, my final project advisor, for guidance, suggestions, and inputs during the development and preparation process of the final project.
4. All Information Technology lecturers and staffs who have educated, provided knowledge during lectures, and always help during my time in university.
5. All my friends who always support, encourage and help each other to survive in university life.
6. My seniors who help me and give me survival tips during my study in Information Technology major.
7. Myself, for always try to work hard and never give up on the process of developing and preparing this final project.

TABLE OF CONTENTS

ABSTRACT	i
DEDICATION	ii
ACKNOWLEDGEMENTS.....	iii
TABLE OF CONTENTS	iv
LIST OF TABLES.....	vii
LIST OF FIGURE	viii
CHAPTER I INTRODUCTION.....	17
1.1 BACKGROUND	17
1.2 PROBLEM STATEMENT.....	2
1.3 FINAL PROJECT OBJECTIVES	3
1.4 SCOPE AND LIMITATIONS.....	3
1.5 FINAL PROJECT METHODOLOGY	3
1.6 FINAL PROJECT OUTLINE	5
CHAPTER II LITERATURE REVIEW.....	8
2.1 THEORETICAL FRAMEWORK	8
2.1.1 Deep Learning	8
2.1.2 Convolutional Neural Network (CNN).....	9
2.1.3 Face Recognition	11
2.1.4 Python	11
2.1.5 Arduino Uno.....	12
2.1.6 USB Cable.....	12
2.1.7 Servo	13
2.1.8 Web Camera.....	14
2.1.9 Gender.....	15
2.1.10 Public Toilet	15
2.2 RELATED WORK	15
2.2.1 Opening Doors Using Face Recognition Based on the IoT	16
2.2.2 Face ID.....	16
CHAPTER III SYSTEM ANALYSIS	18
3.1 SYSTEM OVERVIEW	18
3.2 FUNCTIONAL ANALYSIS	18
3.3 DEVELOPMENT PROCESS ANALYSIS.....	19
3.3.1 Image Data Collection	19
3.3.2 Technique and Algorithm Acquisition	19

3.3.3 System Development	19
3.4 HARDWARE AND SOFTWARE REQUIREMENTS	20
3.5 USE CASE DIAGRAM	22
3.6 USE CASE NARRATIVE	22
3.7 SWIM-LANE DIAGRAM	26
CHAPTER IV SYSTEM DESIGN	29
4.1 USER INTERFACE	29
4.2 CIRCUIT DESIGN	30
4.3 PHYSICAL DESIGN	31
4.4 DATASET OVERVIEW	33
CHAPTER V SYSTEM IMPLEMENTATION	34
5.1 USER INTERFACE IMPLEMENTATION	34
5.2 CIRCUIT IMPLEMENTATION	35
5.3 CODE STRUCTURES	36
5.3.1 Import Python Libraries	36
5.3.2 Load and Processing Dataset	37
5.3.3 Data Splitting	37
5.3.4 CNN Algorithm Implementation for Face Gender Recognition Model ...	38
5.3.5 Data Training Plot and Results	42
5.3.6 Face Recognition	43
5.3.7 Connect to Arduino Uno	48
5.3.8 Controlling the Door by Servo	49
5.3.9 Pseudocode	50
CHAPTER VI SYSTEM TESTING	52
6.1 TESTING ENVIRONMENT	52
6.2 TESTING SCENARIO	52
6.2.1 Recognize Female Face	52
6.2.2 Recognize Female Wear Hijab Face	54
6.2.3 Recognize Male Face	56
6.2.4 Recognize Female Students Face	57
6.2.5 Recognize Male Students Face	61
6.3 LIMITATION	66
CHAPTER VII CONCLUSION AND FUTURE WORK	67
7.1 CONCLUSION	67
7.2 FUTURE WORK	68
7.2.1 Add More Types of People	68

7.2.2 Retraining Gender Recognition Model.....	68
7.2.3 Add New Feature.....	68
7.2.4 Add Male Toilet	68
REFERENCES	69

LIST OF TABLES

Table 2.1 Features Comparison between This Final Project and Related Works	17
Table 3.1 Function Description	18
Table 3.2 Use Case Narrative for Data Splitting	23
Table 3.3 Use Case Narrative for Data Training	23
Table 3.4 Use Case Narrative for Data Testing	24
Table 3.5 Detect the User's Face	25
Table 4.1 Elements in Public Toilet Miniature Explanation	29
Table 4.2 Software Requirements	31
Table 4.3 Hardware Requirements	32
Table 6.1 Recognize Female Face Evaluation	53
Table 6.2 Recognize Female Wear Hijab Face Evaluation	54
Table 6.3 Recognize Male Face Evaluation	56
Table 6.4 Recognize Female Students Face Evaluation	58
Table 6.5 Recognize Male Students Face Evaluation	61
Table 6.6 Limitation of Testing Scenario	66

LIST OF FIGURES

Figure 1.1 Feature Driven Development Phases	5
Figure 2.1 The Simple CNN Architecture	10
Figure 2.2 Arduino Uno	12
Figure 2.3 USB 2.0 Cable for Arduino	13
Figure 2.4 Servo SG90	13
Figure 2.5 Internal Webcam	14
Figure 2.6 External Webcam	15
Figure 3.1 Use Case Diagram	22
Figure 3.2 Swim-Lane Diagram for Data Splitting	26
Figure 3.3 Swim-Lane Diagram for Data Training	27
Figure 3.4 Swim-Lane Diagram for Data Testing	27
Figure 3.5 Swim-Lane Diagram for Detect the User's Face (Female)	27
Figure 3.6 Swim-Lane Diagram for Detect the User's Face (Male)	28
Figure 4.1 Public Toilet Miniature User Interface Design	29
Figure 4.2 Public Toilet Miniature Circuit Design	30
Figure 4.3 Circuit Design Implementation to the Toilet Miniature	31
Figure 5.1 Public Toilet Miniature User Interface Implementation	34
Figure 5.2 Public Toilet Miniature Circuit Implementation from Top Side	35
Figure 5.3 Public Toilet Miniature Circuit Implementation from Back Side	35
Figure 5.4 Python Libraries Implemented in train.py	36
Figure 5.5 Python Libraries Implemented in detect_gender_webcam.py	36
Figure 5.6 Python Libraries Implemented in arduino_control.py	36
Figure 5.7 Load and Processing Images Files Steps	37
Figure 5.8 Data Splitting into Train and Test	37
Figure 5.9 First Step of Build the Face Gender Recognition Model	38
Figure 5.10 Implementation of Convolutional, Pooling, and Additional Layers	39
Figure 5.11 Implementation of Flatten, Dense, Additional Layers & Return Model	39
Figure 5.12 Image Dimension Initial Parameter	40
Figure 5.13 Build and Compile the Model	40
Figure 5.14 Train the Model	41
Figure 5.15 Save the Model	41
Figure 5.16 Create and Save Data Training Loss and Accuracy Plot	42
Figure 5.17 Accuracy Formula	42
Figure 5.18 Data Training Loss and Accuracy Results	43
Figure 5.19 Gender Recognition Model Load to detect_face_gender.py	43
Figure 5.20 Open Camera Detection	44
Figure 5.21 Create Face Recognition Region	44
Figure 5.22 Preprocessing and Apply Model	45

Figure 5.23 Female Prediction Number Result	45
Figure 5.24 Male Prediction Number Result	46
Figure 5.25 Gender Label	46
Figure 5.26 Gender Label Output.....	47
Figure 5.27 Confidence Percentage Formula.....	47
Figure 5.28 Import doorControl Function	47
Figure 5.29 Gender Classification for Control Toilet Door.....	47
Figure 5.30 StandardFirmata Implementation to toilet_door.ino.....	48
Figure 5.31 Importing pyFirmata and Connect to Arduino Uno	49
Figure 5.32 Arrange Door Angle Rotation Movement.....	49
Figure 5.33 Start and Close Door Servo Rotation Degree.....	50
Figure 5.34 Open Door Servo Rotation Degree.....	50
Figure 6.1 Female Face Recognition Result	53
Figure 6.2 Toilet Door Opens from Female Face Recognition Result	54
Figure 6.3 Female Wearing Hijab Face Recognition Result	55
Figure 6.4 Toilet Door Closes from Female Wear Hijab Face Recognition Result..	55
Figure 6.5 Male Face Recognition Result	56
Figure 6.6 Toilet Door Closes from Male Face Recognition Result	57
Figure 6.7 Fitri Anggraini Face Recognition Result	58
Figure 6.8 Toilet Door Opens from Fitri Anggraini Face Recognition Result	59
Figure 6.9 Callista Dominique Face Recognition Result	59
Figure 6.10 Toilet Door Opens from Callista Dominique Face Recognition Result	60
Figure 6.11 Mirah Amai Face Recognition Result.....	60
Figure 6.12 Toilet Door Opens from Mirah Amai Face Recognition Result	61
Figure 6.13 Leonardo Alfroni Face Recognition Results	62
Figure 6.14 Toilet Door Closes from Leonardo Alfroni Face Recognition Results .	63
Figure 6.15 Edward Hidayat Face Recognition Results	63
Figure 6.16 Toilet Door Closes from Edward Hidayat Face Recognition Results ...	64
Figure 6.17 Feliks Manihar Face Recognition Results.....	64
Figure 6.18 Toilet Door Closes from Feliks Manihar Face Recognition Results	65