

**REAL TIME IDENTIFICATION PROCESSING
FOR SECURITY SYSTEM**

By

Rex Henderson Agandhi
22052009

MASTER'S DEGREE
in

MECHANICAL ENGINEERING-MECHATRONICS
FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY

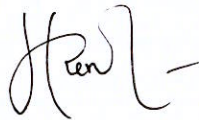


SWISS GERMAN UNIVERSITY
The Prominence Tower
Jalan Jalur Sutera Barat No. 15, Alam Sutera
Tangerang, Banten 15143 - Indonesia

Revision after the Thesis Defence on January 22, 2024

STATEMENT BY THE AUTHOR

I hereby declare that this submission is my own work and to the best of my knowledge, it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.



Rex Henderson Agandhi

Student

01 - 02 - 2024

Date

Approved by:

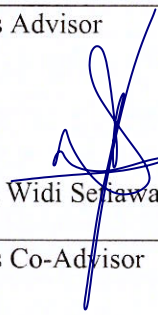


Assoc. Prof. Dr. Ir. Henry Nasution, S.T., M.T,
IPP

Thesis Advisor

01 Feb 2024

Date



Dr. Ir. Widi Setiawan

Thesis Co-Advisor

01 Feb 2024

Date

Dr. Ir. Maulahikmah Galinium, S.Kom., M.Sc.

Dean

Date

Rex Henderson Agandhi

ABSTRACT

REAL TIME IDENTIFICATION PROCESSING FOR SECURITY SYSTEM

By

Rex Henderson Agandhi
Dr. Ir. Henry Nasution, M. T., IPP, Advisor
Dr. Widi Setiawan, M.Sc., Co-Advisor

SWISS GERMAN UNIVERSITY

We created a comprehensive smart access control system within an Anaconda environment, using an Arduino UNO as the system's actuator. The main hardware components of the system are a laptop, an RFID reader, a webcam, an Arduino UNO, and a micro-servo SG90. The objective is to guarantee secure access to a limited area by verifying the individual's identification using facial recognition and subsequently validating the unique identifier (UID) of RFID cards or tags. The DeepFace module, employing facial recognition technology, will verify the identification of the individual entering the premises. The webcam captures a real-time view, while the micro-servo SG90 replicates the functioning of the door lock. Moreover, the LED indicator will offer visual signals. The system demonstrates its capability to authenticate people by utilizing a database consisting of only two images for verification. Additionally, it employs RFID identification as an additional measure to enhance security.

Keywords: Smart access control system, Security system, Face Recognition, RFID, Two-step access verification, Hardware integration, Software programming, DeepFace.

© Copyright 2024
by Rex Henderson Agandhi
All rights reserved.

DEDICATION

I dedicate this works for the future of my university and the country I loved: Indonesia

ACKNOWLEDGEMENTS

My parents and the rest of my family have encouraged me to pursue greater knowledge and provided me with inspiration and fortitude, making this research dedicated to them. Additionally, I would like to thank Dr. Ir. Henry Nasution, M. T., IPP, as my advisor, who has always supported and advised me on this thesis, as well as Dr. Ir. Widi Setiawan, as my co-advisor, who has always inspired me to solve numerous problems in this study. Sir Dena Hendriana, B.Sc., S.M., Sc.D., who always assists me with my studies, as well as all the lecturers who assisted me while I was a student at the Swiss-German University, deserve special mention.

TABLE OF CONTENTS

	Page
STATEMENT BY THE AUTHOR	2
ABSTRACT	3
DEDICATION	5
ACKNOWLEDGEMENTS	6
TABLE OF CONTENTS	7
LIST OF FIGURES.....	9
LIST OF TABLES	10
Chapter 1 - INTRODUCTION.....	11
1.1 Background.....	11
1.2 Research problem	13
1.3 Research objective	13
1.4 Significance of study	13
1.5 Research question	13
1.6 Expected result.....	14
1.7 Hypothesis	14
Chapter 2 - LITERATURE REVIEW	15
2.1 Theoretical Perspectives	15
2.1.1 Residential area.....	15
2.1.2 Access Control: Access Card	16
2.1.3 Anaconda.....	20
2.1.4 Machine Learning.....	22
2.1.5 DeepFace	25
2.1.6 Cosine Similarity and Euclidan Distance	31
2.2 Previous Studies.....	36
Chapter 3 – RESEARCH METHODS	38
3.1 Research Framework	38
3.2 Structure of the System.....	39
3.3 Scope of Research.....	40
3.4 Materials and Equipment	40
3.5 Design of Experiment	41
3.5.1 Data collection of images for face recognition database	41
3.5.2 Face recognition	42
3.5.3 RFID reader system	46

3.5.4 Setup.....	46
3.6 Component and Circuit Testing.....	48
Chapter 4 – RESULTS AND DISCUSSIONS.....	50
4.1 RFID reader	50
4.2 Face verification	54
4.3 Implementation conditions.....	62
Chapter 5 – CONCLUSIONS AND RECOMMENDATIONS	65
5.1 Conclusion	65
5.1 Recommendations.....	65
REFERENCES.....	66
APPENDICES.....	69
CURRICULUM VITAE	84

LIST OF FIGURES

Figures	Page
Figure 2.1 Fishbone Diagram	16
Figure 2.2 Smart Card Access	17
Figure 2.3 Example of Access Control System Components	18
Figure 2.4 RFID Basic System	20
Figure 2.5 Analogy of Artifical Neural Network (ANN)	23
Figure 2.6 Basic Architecture of Convolutional Neural Network (CNN)	24
Figure 2.7 DeepFace face recognition models	26
Figure 2.8 Cosine Similarity Formula	31
Figure 2.9 Sample Vectors	32
Figure 2.10 New vector to draw a triangle	32
Figure 2.11 Finding vector length	34
Figure 2.12 Euclidan distance	35
Figure 3.1 Research Framework.....	38
Figure 3.2 Structure of the System	39
Figure 3.3 Face recognition database: without glasses (left) and with glasses (right).....	42
Figure 3.4 Base image (left), alignment = false (middle), alignment = true (right)	43
Figure 3.5 Common steps of face recognition.....	45
Figure 3.6 RFID flow diagram	46
Figure 3.7 System setup	47
Figure 3.8 System wiring diagram	47
Figure 3.9 Verified result (top left and top right), not verified result (middle bottom)	49
Figure 4.1 Wiring diagram for circuit testing using the Arduino.	50
Figure 4.2 The system is asking to scan the card.	51
Figure 4.3 When ID card data matches the database and gives access rights.....	51
Figure 4.4 When data is rejected, and access denied.....	52
Figure 4.5 Distribution (left), Threshold (right)	56
Figure 4.6 Face verification result with image using mask.	56
Figure 4.7 Face verification result with image using glasses.	57
Figure 4.8 Face verification result when facing sideways.....	58
Figure 4.9 Face verification result in different lighting condition.....	59
Figure 4.10 Face verification result using different database (glasses)	60
Figure 4.11 Face verification result in obstructed view (left) and facing sideways (right).	61
Figure 4.12 How the system responds.....	62

LIST OF TABLES

Table	Page
Table 2.1 Matrix of Previous Studies	36
Table 3.1 Material and Equipment List.....	40
Table 3.2 Testing result of RFID range.....	48
Table 3.3 RFID angle test result.....	48