FACE RECOGNITION SMART DOOR LOCK SECURITY SYSTEM USING HAAR CASCADE ALGORITHM AND LOCAL BINARY PATTERNS ALGORITHM

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BORANG PENGESAHAN STATUS LAPORAN

JUDUL: FACE RECOGNITION SMART DOOR LOCK SECURITY SYSTEM USING HAAR CASCADE ALGORITHM AND LOCAL BINARY PATTERNS ALGORITHM

SESI PENGAJIAN: 2020 / 2021

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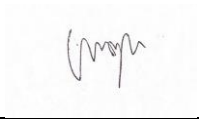

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FACE RECOGNITION SMART DOOR LOCK SECURITY SYSTEM USING HAAR CASCADE ALGORITHM AND LOCAL BINARY PATTERNS ALGORITHM

MAH KIM FONG

This report is submitted in partial fulfillment of the requirements for the Bachelor of [Computer Science (Computer Networking)] with Honours.

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
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2021

DECLARATION

I hereby declare that this project report entitled

FACE RECOGNITION SMART DOOR LOCK SECURITY SYSTEM USING HAAR CASCADE ALGORITHM AND LOCAL BINARY PATTERNS ALGORITHM

is written by me and is my own effort and that no part has been plagiarized without citations.

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I hereby declare that I have read this project report and found this project report is sufficient in term of the scope and quality for the award of Bachelor of [Computer Science (Computer Networking)] with Honours.

SUPERVISOR : _____ Date : 8.9.2021
(TS. DR. NORHARYATI HARUM)

DEDICATION

This project is dedicated to my beloved parents, Mr. Mah Ang Lai, and Mrs. Lily Yoo who have been giving me support and encourage me throughout this project. I would like to thank for my supervisor, Ts. Dr. Norharyati Harum for giving me guidance to complete this project. Finally, I would like to thank to my friends who providing me a lot of comments and suggestions when I faced some problems.

ACKNOWLEDGEMENTS

I would like to thank my supervisor, Ts. Dr. Norharyati Harum for giving assistant to complete this project successfully.

I would also like to thank my beloved parents who have been giving me support and motivation throughout my project. They motivate and encourage me throughout my projects.

I also like to special thanks to all my friends and lecturers from Faculty of Information and Communication Technology (FTMK), UTeM for their knowledge sharing through this project until I finished this project.

ABSTRACT

This project is about the smart door lock security system using face recognition approach using Haar Cascade Algorithm and Local Binary Patterns (LBP) Algorithm. Different kind of smart door lock has been launched to the market in the recent years but it still needs a lot of improvement from the security aspect. The place is insecure since everyone can access the simple door lock only with door locker or padlock, or smart door lock using other approach such as fingerprint, RFID, and password easily. Therefore, face recognition approach is needed to make it more secure and convenience. The face recognition smart door lock security system will detect and recognize the face appear to the door using Haar Cascade Algorithm and Local Binary Patterns (LBP) Algorithm on Raspberry Pi. Only the person with the face who matched with the dataset in face database can unlock and access the door. Else, a notification will be sent to the owner through Telegram with Wi-Fi to alert owner about the stranger.

ABSTRAK

Projek ini adalah mengenai sistem keselamatan kunci pintu pintar menggunakan pendekatan pengecaman wajah menggunakan Algoritma Haar Cascade Algorithm dan Local Binary Patterns (LBP). Jenis kunci pintu pintar yang berbeza telah dilancarkan ke pasaran dalam beberapa tahun kebelakangan ini tetapi ia masih memerlukan banyak peningkatan dari aspek keselamatan. Sesuatu tempat akan jadi tidak selamat kerana semua orang dapat mengakses kunci pintu yang mudah hanya dengan loker pintu atau kunci, atau kunci pintu pintar menggunakan pendekatan lain seperti cap jari, RFID, dan kata laluan dengan mudah. Oleh itu, pendekatan pengecaman wajah diperlukan untuk menjadikannya lebih selamat dan selesa. Sistem keselamatan kunci pintu pintar pengenalan wajah akan mengesan dan mengenali wajah yang muncul di pintu menggunakan Algoritma Haar Cascade dan Algoritma Corak Binari Tempatan (LBP) pada Raspberry Pi. Hanya orang dengan wajah yang sepadan dengan set data dalam pangkalan data wajah yang dapat membuka kunci dan mengakses pintu. Jika tidak, pemberitahuan akan dikirimkan kepada pemilik melalui Telegram dengan Wi-Fi untuk memberi tahu pemilik mengenai orang asing yang dikesan.

TABLE OF CONTENTS

PAGE

LIST OF TABLES

PAGE

LIST OF FIGURES

PAGE

LIST OF ABBREVIATIONS

Wi-Fi	**-**	**Wireless Fidelity**
RFID	**-**	**Radio Frequency Identification**
FYP	**-**	**Final Year Project**
OpenCV	**-**	**Open Source Computer Vision Library**
LBP	**-**	**Local Binary Patterns**
IoT	**-**	**Internet of Things**
IEEE	**-**	**Institute of Electrical and Electronics Engineers**
SDLC	**-**	**Software Development Life Cycle**
V	**-**	**Volt**
LED	**-**	**Light Emitting Diode**
TV	**-**	**Television**
GUI	**-**	**Graphical User Interface**
GPIO	**-**	**General Purpose Input/Output**
USB	**-**	**Universal Serial Bus**
HDMI	**-**	**High-Definition Multimedia Interface**
DC	**-**	**Direct Current**
OS	**-**	**Operating System**
IDE	**-**	**Integrated Development Environment**
SUS	**-**	**System Usability Scale**

CHAPTER 1: INTRODUCTION

1.1 Introduction

Nowadays, there are various kind of smart home security devices exist on the market and sometimes it can be overwhelming. One of these devices is smart door lock. A smart door lock is a replacement for simple door lock with only door locker or padlock. It is a door locks without using the physical key. It needs Bluetooth or Wi-Fi connection for it to works. There are many types of smart door lock system implemented using different approach available on the market such as fingerprint, password, face recognition or RFID based door lock (Al-Tuma, K. A. H (2019)). Different kinds of smart door lock provide its user with different advantages. In this project, face recognition approach is used to develop a face recognition smart door lock security system.

Our face is the unique biometric characteristic to an individual to recognize a person. With the advancement of technology, many systems are implemented with the face recognition approach. To identify a person, the face captured are matched with the face image stored in the database. The face recognition approach has widely used in various field such as forensic and security. Nowadays, the simple door lock with only door locker or padlock, or smart door lock using other approach such as fingerprint, RFID and password that install on the premise such as home or office still need a lot of improvement from the aspect of security and convenience of the owner. This is because the door lock is not secure enough to protect the user and it will also cause many inconveniences for the owner in their life indirectly. Therefore, the face

recognition smart door lock security system is primarily driven by the growing need for effective solutions in increasing the security and convenience of the user.

OpenCV is a free and open source software library for programming functions especially for machine learning, image processing, and computer vision. It is originally created at Intel by Gary Bradsky, and later maintained by Willow Garage with Gary Bradsky and Vadim Pisarevsky (Kulhary, R (2021); OpenCV (2021)). It was built so that the computer vision applications have a common infrastructure and provide an acceleration to the use of machine perception in the commercial products. OpenCV consists of C++, Python, Java and MATLAB interfaces and it supports most of the common operating system such as Windows, Linux, Android, and Mac OS. It also provides many algorithms in the library such as Haar Cascade Algorithm and LBP Algorithm in OpenCV (Emami, S., Suciu, V.(2012)). The development of OpenCV has enabled computer vision field to keep growing rapidly. This is because OpenCV has prepared the computer vision and machine learning infrastructure that was previously unavailable in many research labs for many people no matter students or professionals. This will increase their productivity in computer vision field since they are able to develop different project and do the research mainly on real-time vision more efficiently.

The demand and application of face recognition smart door lock security system keeps growing rapidly due to the outbreak of COVID-19. This is because the pandemic has surged the demand for touch-free smart door lock security system (Fortune Business Insights 2021; Transparency Market Research 2020). By installing or implementing face recognition smart door lock security system, it provides many conveniences to the user. Instead of worrying about the security aspect and inconveniences caused by the simple door lock with only door locker or padlock, or smart door lock using other approach such as fingerprint, RFID, and password, installing a face recognition door lock system would be the effective solution.

1.2 Problem Background

Nowadays, many people pursue for high efficiency and quality life. They keep finding the solution to make their life better. The implementation of face recognition

smart door lock security system using Haar Cascade Algorithm and LBP Algorithm in their premise is one of the examples of the solution. Development of face recognition door lock system not only able to improve the quality of life of the user, but it also makes the premises or places of the user more secure. Although we are used to the simple door lock only with door locker or padlock, or smart door lock using other approach such as fingerprint, RFID, and password, but these approaches have many disadvantages.

First, security is always the top concern for every individual. A secure and safe premises or home is the necessity of every individual especially those who are working or outstation most of the time. Due to the simplicity of the door lock, the risk for home invasion crimes to be occurred will be increased because the premise owner or the homeowner left their home unattended most of the time. The place is insecure since no matter owner or stranger can access the simple door lock only with door locker or padlock, or smart door lock using other approach such as fingerprint, RFID, and password easily. For example, if owner install the simple door lock, other people such as burglar can break into the house easily because the door lock are installed without user authentication and authorization or using weak authentication method. This will put the owner or the property of the owner in potentially dangerous situation.

In addition, the door lock with physical key makes the user's life inconvenient. As we know, the physical key can be unique keys for a door lock and for different door locks, it has different keys. The user must grab a bunch of keys when they want to go out. This will cause the user to face the possibility of the physical key being lost, misplaced, or stolen. They will be unable to unlock the door because they must find the key, get a new key, or even replace the whole locking mechanism. This will waste their time and thus decrease their efficiency in their daily life. Moreover, they must worry about their place situation when they are working or outstation during daytime, and their own safety during the night time because burglary and robbery seemed to peak when nobody at home or when the homeowner has slept. They will be unable to enjoy life events and even sleep peacefully. As a result, their quality of life will be affected.

Next, most of door lock system especially simple door lock are unable to notify user when stranger or intruder detected. The user is unable to keep track of surroundings of their premise and allocate the stranger that step in front of the door. When there are intruders try to access into their place, even though intruders are detected from the system, they do not know about it since no notification are sent to notify the user. This will cause them unable to protect themselves or protect their properties because they are not notified about the situation occurred and cannot act immediately.

1.3 Problem Statement (PS)

The place is insecure since no matter owner or stranger can access the simple door lock only with door locker or padlock, or smart door lock using other approach such as fingerprint, RFID, and password easily. If owner install the simple door lock only with door locker or padlock, or smart door lock using other approach such as fingerprint, RFID and password, other people such as burglar can break into the house easily because the door lock are installed without user authentication and authorization or using weak authentication method. This will put the owner or the property of the owner in potentially dangerous situation. In addition, the door lock with physical key makes the user's life inconvenient. The user must grab a bunch of keys when they want to go out. This will cause the user to face the possibility of the physical key being lost, misplaced, or stolen. They are unable to unlock the door because they must find the key, get a new key, or even replace the whole locking mechanism. It is getting worst if the lost key was found by other people because this will increase the possibility that the intruders to break into their house. Moreover, most of door lock system will not notify user when stranger or intruder detected. The user is unable to keep track of surroundings of their premise and allocate the stranger that step in front of the door. When there are intruders try to access into their place, even though intruders are detected from the system, they do not know about it since no notification are sent to notify the user.

Table 1.1: Problem Statement

PS	Problem Statement
PS1	The place is insecure since no matter owner or stranger can access the simple door lock only with door locker or padlock, or smart door lock using other approach such as fingerprint, RFID and password easily.

1.4 Project Question (PQ)

There are many questions that can relate with face recognition smart door lock security system. The project objectives will answer these questions. These questions are related to the problem statement as stated Table 1.1.

Table 1.2: Problem Question

PS	PQ	Problem Question
PS1	PQ1	How to make the place more secure?
	PQ2	What is the approach used to detect the stranger or intruders?
	PQ3	How to notify user when stranger or intruder detected?

1.5 Project Objective (PO)

This project will develop a face recognition smart door lock system using Haar Cascade Algorithm and LBP Algorithm to detect stranger or intruders and notify user through Telegram when strangers or intruders detected.

Table 1.3: Project Objective

PS	PQ	PO	Project Objective
PS1	PQ1	PO1	Develop a face recognition smart door lock security system.

	PQ2	PO2	Detect the strangers or intruders through face recognition approach which using Haar Cascade Algorithm and LBP Algorithm
	PQ3	PO3	Notify user through Telegram when strangers or intruders detected.

1.6 Proposed System

For this project, a face recognition smart door lock security system will be implemented using Haar Cascade Algorithm and LBP Algorithm. First, the face image will be captured and save as data sets. Secondly, to enable machine learning, the image will be trained to the Haar Cascade Algorithm so that the system can detect the face and save it to the face database. Then, when the face is captured by the webcam, the system will try to compare and match the face detected from webcam with the image in face database using LBP Algorithm. As the result, if the face detected from the webcam is matched with the face image in database, the solenoid door lock will be unlocked. Otherwise, a notification to inform the user about the existence of stranger will be sent through Telegram. The face detection process is using Haar Cascade Algorithm while face recognition process is using LBP Algorithm.