

Prototype development of Face Recognition Door Lock Access Authorization Control and Management System

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Abstract: This system is a design and development prototype of facial recognition door lock access system. Facial recognition technology is an Artificial Intelligent (AI) technology that capable of matching human digital face from the database records. A database is used to store digital images of users' faces that will use to authenticate user IDs to increase system security from compromising its confidentiality, integrity, and accessibility. The system design has equipped with a non-physical key which makes it very efficient for preventing theft and burglary cases from happening. The system is quite complicated in nature however with the use of non-physical type keys like this can also make it easy for valid users to be authenticated and could enter the properties. This study therefore will discuss the designs and development of the door lock facial recognition access authorization system. The methodology that has been used is the waterfall model and the development software is Thonny Python IDE. This study was tested on residential area users, and the results showed that 95 percent of the respondents agreed that the system has the ability to prevent theft and burglary. Although the system uses AI as the key feature, it still has some minor drawbacks where it takes a little more time to run the face recognition authentication processes. However, this system has the potential to be install into any residential or property which will improve it security system and most conveniently the access control system uses simple devices like Raspberry pi.

Keywords: Artificial Intelligent, Facial Recognition System, Door Access Control System, Security System, Non-Physical Key

1. Introduction

In recent years, crime and burglary have become inequality and crime in residential areas. In 2018, there were 17.68 cases of theft reported in Malaysia [1]. As a result, there is a need to build highly

secure and smart door lock system. Door control access system can be protect our homes from theft and burglary.

In this era of technology, traditional door lock such as padlocks and keys are outdated. It is because it does not guarantee strict security to the occupants of the house. In addition, thieves are easy to open by using tools such as hammers, wires and master keys.

Door control access system is the security system that protect our home from criminal activities such as home theft, spy and robbery. To overcome the limitations of mechanical locks and keys, this system employs an electronic central door and access system that employs a computer [2]. This system very important for hight security and easily accessible by host.

There are several common door control access systems such as the metric Bio Access Control System with fingerprint access, key card system, and keypad lock. However, this type of door lock access system has some shortcomings that cause its security features to be lower than face recognition systems [3]. Face recognition has been done in this study using the OpenCV platform and its inherent libraries to produce code that performs correct and dependable facial recognition with innovative and efficient hardware utilization [3].

In this study, door lock face recognition access authorization for door control and management system is recommended for high security of residential area for users for each case of burglary, theft and so on. in addition, users can use it quickly and easily compared to traditional keys. Objective of this study is to develop anti-theft security systems that are easy to carry, high efficiency, low cost, and easy to operate. The methodology of this study is to use the waterfall model method. The scope of this study is focused on how face recognition and door lock access control can be developed and applied in residential areas to reduce burglary cases. The Raspberry Pi and Raspberry Pi programming software were used to build the system's hardware and software. Python, MySQL, and PHP are the programming languages utilized. Based on a survey of consumers in a residential areas, over 95 percent agreed that the system has the ability to prevent theft and burglary. This will become a new innovation in today's technology if it can be welcomed by the community in Malaysia.

2. Materials and Methods

2.1 Materials

In this study, door lock face recognition access authorization for door control and management system have used some hardware and software to run this study. Extensive research has been conducted in this meticulous task to make sure the product functions well. Before this process is taken into consideration, this study functionality has first to be understood. Hence, the function of each hardware and software is also detailed show in **Table 1**.

Table 1: Hardware and software

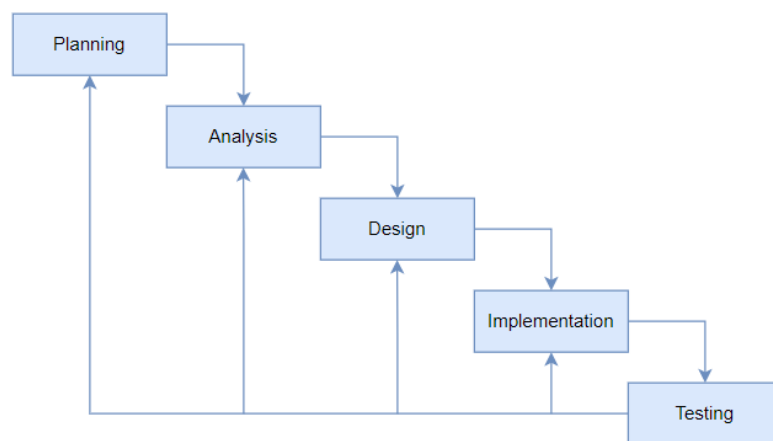
Hardware and software	Function	Hardware and software	Function
Raspberry Pi 3 B	Function as a computer but it called a Single Board Computer and it can use to develop a program [4].	Relay	To use low-voltage signal aid to operate a high-voltage circuit.
Key switch	To open doors that can only be used by security guards.	Coloured Led (red and green)	Works to emit light and convert electric current into light.
Cable jumper male to male, and cable jumper male to female	To connect electronic components other than Raspberry Pi to the	Adapter 12 volt	To convert AC current into DC current with a certain voltage as required.

Solenoid lock	breadboard or to the Raspberry Pi itself. It's essentially an electronic lock for a standard cabinet, safe, or door [5].	Webcam	Capture a picture or video of a person, when the person is in front of the camera
Sensor ultrasonic HC-SR04	To open the door from while on the inside.	Power jack female	The DC Female jack is a connector that has a hole that can be connected to adapter 12 Volt.
Breadboard	Is a special construction basic board for electronic prototype.	Buzzer	Used for immediate or alarm, buzzer sound, alarm sound, and various other sounds [6].
Keypad	Used to enter a password.	Thonny python IDE	Perform programming code and the download process to the Raspberry Pi 3 B.

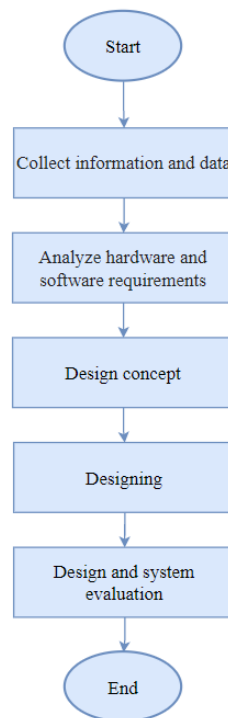
2.2 Methods

This study methodology is waterfall model, flow chart and system design, it is divided into two stages, namely the initial stage and the final stage. At this initial stage, we get ideas through a search on the internet and do direct observations on the door locks used at home and conduct research directly to get the best and thoughtful problems and ideas in planning this study.

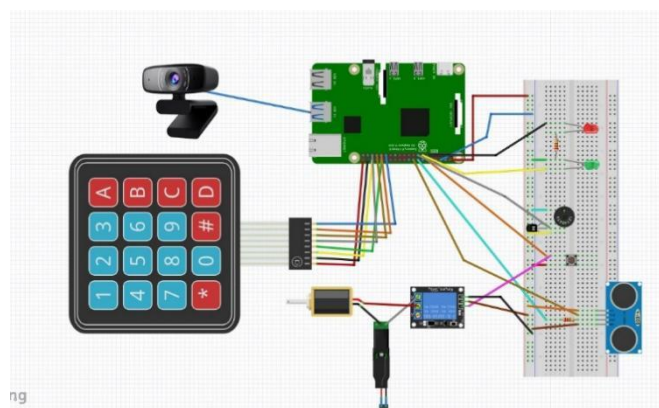
The diagrams below show the waterfall models are used in assisting the development process of this system in **Figure 1 (a)** and the flow chart diagram is to show the flow of this study in **Figure 1 (b)**. In addition, the system design it is to show a sketch of the circuit of this study is shown in **Figure 1(c)**. The development of this system begins by planning in the form of the system to be developed, its development methods, equipment setting and software development and finally testing shown in the model waterfall diagram below.



(a)



(b)



(c)

Figure 1: (a) Waterfall model [7], (b) Flow Chart [8], (c) System Design [9]

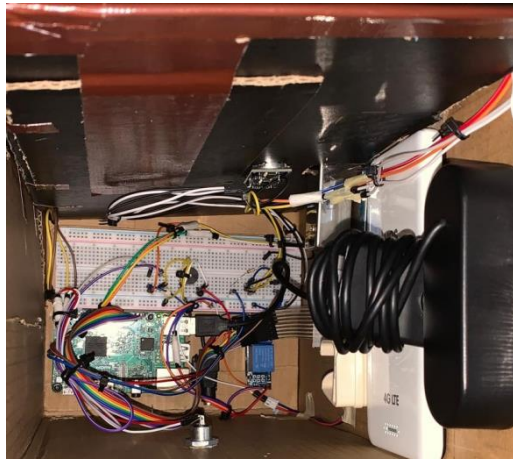
2.3 Programming language

We used Python programming language for face recognition, matrix keypad, sensor, emergency key to unlock solenoid lock. In the meantime, we also used a database to store incoming user data. Apart from that, face recognition, we have used the OpenCV module.

2.4 Model development and model equipment

In the model development and equipment section of this model, there are several diagrams that will be shown. The following are diagrams showing the equipment and models developed in this implemented study. **Figure 2 (a)** shows the circuit assembly picture is viewed from the top view of the model. For **Figure 2 (b)** it shows a picture of door access control system for security guards during an emergency that can be used by security guards only. In **Figure 2 (c)** it also shows a picture of the door access control system for the user to enter the house if the user does not use face recognition. Next, **Figure 2 (d)** also shows a picture of the door access control system for the occupants of the house who

are inside the house. In **Figure 3 (a)** it shows a circuit diagram between the solenoid lock, button, and buzzer circuit. In **Figure 3 (b)** also this diagram shows a picture of an LED for a solenoid lock circuit. **Figure 3 (c)** picture showing the matrix keyboard circuit for the second option for users entering the home. Next, **Figure 3 (d)** It shows the Ultrasonic sensor circuit for occupation of the house.



(a)



(b)

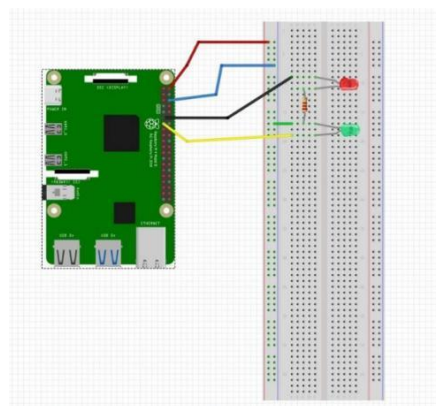
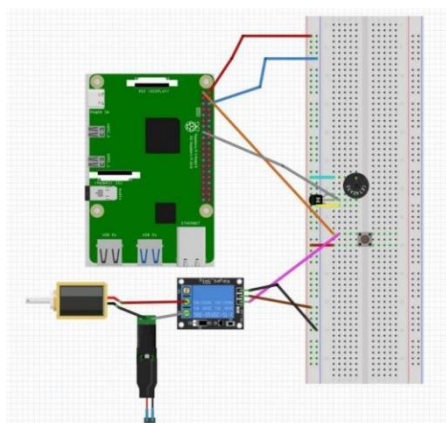


(c)



(d)

Figure 2: (a) Circuit figure, (b) Emergency key, (c) Door access control system, (d) The interior of the house



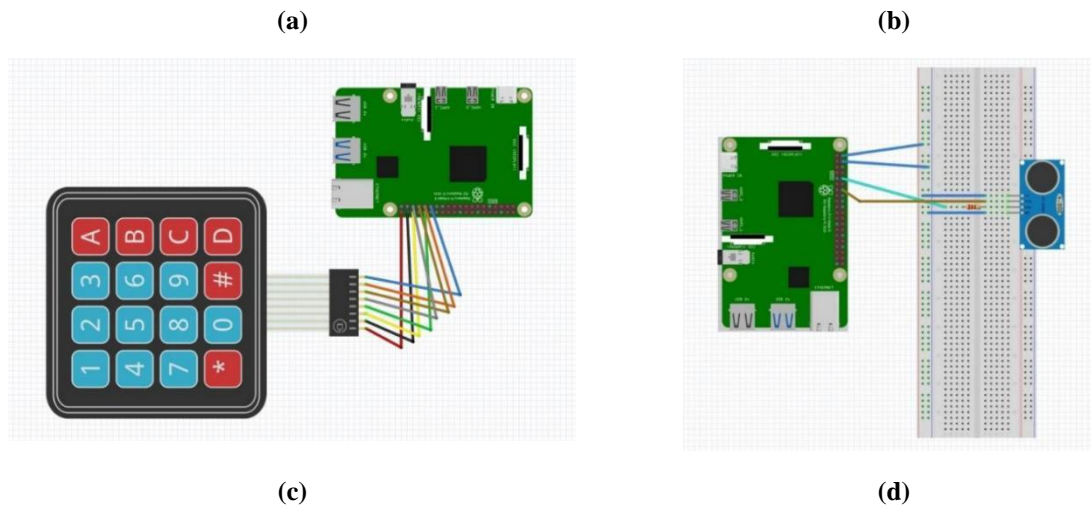


Figure 3: (a) Solenoid lock circuit, button and buzzer circuit, (b) LED for solenoid lock circuit, (c) Matrix keyboard circuit, (d) Ultrasonic sensor circuit

3. Results and Discussion

Based on the research and implementation on this application we can deduce the number and analysis that participated in answering our research questions. Below **Table 2** shows the frequency and percentage of respondents by gender who have answered the questionnaire provided.

Table 2: Frequency and percentage of respondents by gender

Gender	Frequency	Percentage
Male	32	83%
Female	15	17%
Total	47	100%

In **Figure 4 (a)** shows the gender percentage of respondents and the picture of **Figure 4 (b)** shows the age percentage of respondents

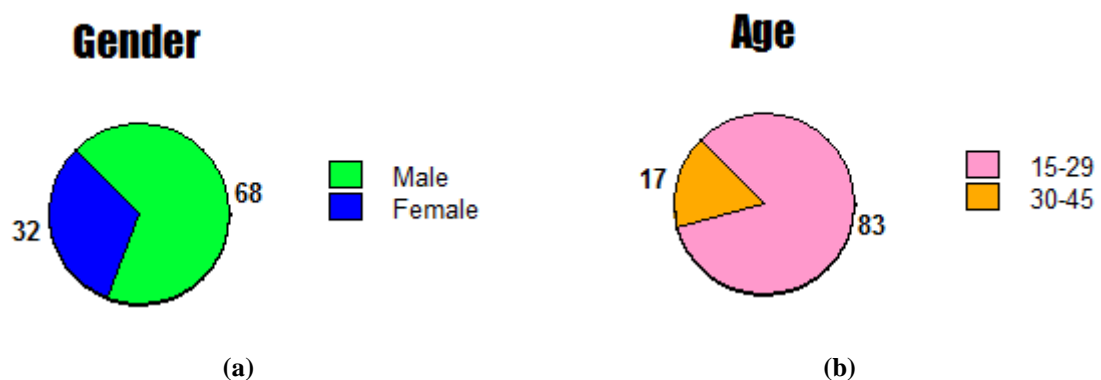


Figure 4: (a) Gender Percentage of respondents, (b) Age Percentage of Respondents

Table 3 shows the statement of questions asked to respondents through a questionnaire. This question is posed by covering in relation to this study, is it suitable for this system to be developed. Respondents were given a choice of answers namely yes or no and multiple questions namely a, b, and c.

Table 3: Questions were given in a questionnaire focused on facial recognition

Item	Question	Yes	No
1	What the door access is used in your home? The answer is Locked Door	47	0
2	Do you feel the security of your home is secured by using the door access you chose in question 1?	42	5
3	Has the residential area in your home ever been entered by thieves, robbers and others?	29	18
4	What the door access are you referring to to further tighten the security of the residential area? The answer is Face Recognition	41	6
5	Do you agree with facial recognition as a replacement for your home door?	42	5
6	Tick your answer from question 5 ? The answer is improve the security of your home	44	3
7	Do you feel this face recognition is systematic?	46	1
8	Do you agree that facial recognition is used throughout Malaysia?	36	11

This system is developed specifically for users who want to increase their door control access from any threats from irresponsible parties. With the convenience of this facial recognition system, users can increase the security of their homes and buildings. It can alleviate the problems faced by users as this system will not allow false face recognition identities to unlock the door. This system is very efficient and simple, and effective in solving community safety problems in a particular house and building. The equipment is by using a Raspberry and with a simple program can solve user problems easily.

Without this system users face various security problems including problems such as loss of life, loss of valuables, lack of access to security doors, and so on. Lastly, the most important thing is that with this system their time can be managed more efficiently. **Table 4** compares the old system and the system we developed.

Table 4: Comparison of the old system and the system we developed

Comparison	The Locked Door	Facial Recognition
Construction cost	Requires a low cost to build a locked door access control	Requires a cost relatively high to build a prototype of door access control by face recognition
Maintenance	Take that time long to maintain	Can be maintained with easy because of the components readily available and the use of simple coding
Construction period	Requires a period of time which is quite a long time for build it because construction of its design which is complicated	Requires a period of time which is a little because the construction is quite simple
LCD Display	Unavailable	Available
Security Access	Less Secure	More Secure
Systematic	Less Systematic	More Systematic

4. Conclusion

This study makes house door locks more systematic and its security more secure than using manual door locks system, especially in areas that are often experienced with thieves and robberies. Thus with the installation of this system, it provides convenience and increases the security into a higher level. While it is also very helpful to consumers to facilitate their daily life. In addition, the system we produce is regarded as sophisticated and high quality and has the potential to be developed and mass-produced

in the future. This is because it has been researched in detail during the development of the system and we found that this innovation, implementation, and productions are appropriate throughout the country. In addition, the system also has a lower cost as compared to other systems. Finally, our system maintenance method is also employed in more stringent ways through multiple authentication levels for stronger safety measures while considering user ergonomics. This, in turn, could improve security more and reduce thief and robbery cases from occurring. In the future, a voice assistant can be added as a way to improve the system as well in line with user demands and requirements.

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