

ARDUINO BASED LOCKER SYSTEM WITH IMAGE CAPTURE

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ARDUINO BASED LOCKER SYSTEM WITH IMAGE CAPTURE

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PROJEK SARJANA MUDA II**

Tajuk Projek : ARDUINO BASED LOCKER SYSTEM WITH IMAGE CAPTURE

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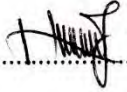
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ABSTRACT

Locker is a very common thing that can be found all over the UTeM area. It is simply provides a storage with security for people to keep their things. However, the conventional lockers that can be seen in Public are lack of security where it can be easily open by using multipurpose key. Hence, this project had been proposed in order to improve the security. This project required a computer, camera and also Arduino Uno as to control the locker. A H-bridge circuit and relay board is being use in order to control the movement of CD rom and locker. This project is only applicable for UTeM student in the university area. This system will have required UTeM student card in order to register the locker. The system will extract user information from the student card instead of manual register by the user. This system improved the register process where it will be faster and help to improve the security as it required student card and password will be applied for each locker by the user. Besides that, SMS notification to the user if there is someone trying to break into it. With the help of this project, the productivity will be improved as there are no operator is required and the security will be improved.

ABSTRAK

Loker merupakan satu benda yang biasa boleh dilihat di mana-mana tempat. Ia menyediakan tempat menyimpan dengan keselamatan untuk orang ramai bagi menyimpan barang mereka. Walaubagaimanapun, loker konvensional yang terdapat di tempat awam adalah kekurangan keselamatan dimana ia boleh dibuka dengan mudah dengan menggunakan kekunci pelbagai guna. Oleh itu, tujuan projek ini adalah untuk meningkatkan keselamatan barangan pengguna. Projek ini memerlukan komputer, kamera dan juga Arduino Uno untuk mengawal loker. Papan litar H-Bridge dan relay telah digunakan untuk mengawal pergerakan motor CD dan loker. Projek ini hanya boleh digunakan oleh pelajar UTeM di kawasan universiti. Sistem ini memerlukan kad pelajar UTeM untuk mendaftar loker. Sistem akan mengekstrak maklumat pengguna dari kad pelajar dan bukannya daftar manual oleh pengguna. Dengan bantuan sistem, proses daftaran akan lebih cepat dan meningkatkan keselamatan kerana ia memerlukan kad pelajar dan kata laluan akan digunakan untuk setiap loker oleh pengguna. Selain itu, loker akan menghantar pemberitahuan SMS kepada pengguna jika terdapat seseorang yang cuba untuk memecah masuk ke dalam loker. Dengan bantuan projek ini, produktiviti akan bertambah baik kerana operator tidak diperlukan dan keselamatan akan dipertingkatkan.

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CHAPTER 1

INTRODUCTION

Over many of century, security had always been a major problem for the society. There will always be someone who will try to go against the law and challenge the security that had been invented yet they manage to do so by finding ways to counter the security system. Thus, this is the reason that scientist and engineer had been work together to create an invulnerable security system such as biological security system. However, there is no such thing as invulnerable in this world as there will be someone who find a way to counter all the security system.

Thus this project is to improve the conventional locker, which are key type. This project will enhance the security system by adding image processing as security system by capturing the student or staff card for process purpose. This method will be better than key type locker as the card is a unique identity for every student of UTeM. Everyone will have the same card but with different detail such as name, matrix number and also faculty.

1.1 Problem statement

There are lockers that had been provided by UTeM for the student. However, those lockers do not have high security system where it only required a key to open them. This type of locker is not very secure as it can be easily to de opened and the other might just duplicate the key and open the locker. There is even some place which does not have any locker but just rack for the student to keep their belonging. Thus student will only put books in the locker and carry their laptop or other stuff along with them. The locker is not fully utilizes by the student due to insecure system.

In university, co-curriculum is a compulsory course that must be took by all the student, there is no exceptional. It is good that the student can get involve into sport after whole day of lecture. Even so, there is a problem that will be faced by the student who wanted to go for sport. They will not have a secure place to keep their belonging such as wallet, purse, laptop, mobile phone and so on. This is one of the reason that student prefer joining club rather than sport. The only place that student is able to keep their stuff is the bag but it is not secure at all as it can be easily being open by the other without any effort. A better locker should be provided to the student who wanted to do sport.

For those student who went to library, there are only limited locker which had key lock while the other are open which only allow student to put bag without any expensive stuff in it. It seems like a locker for student but is unable to keep things in it. In this case, student would prefer to carry their belongings with them instead of leaving them in the public locker. Meanwhile, for those locker which had key lock, student must grab their slot on the first week of the semester because each locker will be assigned to the student for a semester. Which means that for those “freshies”, student who just entered the university and does not know this will unable to grab the key locker slot in the library. This is unfair to the student as every student did pay for the utilities fee but unable to use them.

Besides that, people usually will keep their thing in the car because car had alarm and it is hard to break into. Yet, people always forget that car had a fragile part which is the windows. Glasses can be easily to be break into and the glass breaking tools can be

easily to be found in the market. Is it a common item where people use to break the glass during emergency. With the tools, the windows can be break within a few second. This shows that keeping thing in the car is actually not safe at all and will cause damage to the car.

With all those problem, the locker with an image scanning had been introduced in order to solve those problem.

1.2 Objectives

The objectives of this project is:

- i. To design an image enhancing using AForge framework and image analyzing using Optical Character Recognition.
- ii. To fabricate H-bridge and relay board circuit
- iii. To improve current locker security system using software and Arduino.

1.3 Scope

This project is a prototype which using Arduino, webcam, magnetic lock and also a computer. There will be four lockers in this prototype along with LED on each of them as indicator. Those LED will be showing weather it is locked or not. Visual Studio will be the programming platform for the software while the Arduino IDE will be the platform for Arduino coding. The software will be written in C# while Arduino coding will be in C. The communication between Arduino and the computer software will be using serial port. All the data will be stored in computer software database. The webcam will be the medium to capture image and transfer it to computer for analyses purpose. There will be a GSM module for sending SMS for some specific condition. Only Arduino Uno will be receiving power from computer while other items are receiving power from the voltage regulator. Besides that, this project will be tested in UTeM area.

This project had a limitation that it depending on the card that provided by UTeM for student. The card image must be clear and without faded word on the card. The faded word will affect the result on the Optical Character Recognition (OCR). Even the dirt on it will make the result wrongly. This project will also require high pixel camera as it will capture the image clearer and less noise. This will greatly effect on the result of OCR.

CHAPTER 2

LITERATURE REVIEW

2.1 Background

2.1.1 Optical Character Recognition (OCR)

Optical Character Recognitions (OCR) is a method to convert text image into digital text. The text image can be any text such as handwriting, printed text, any font, any character and any language. The character need to be scan or capture into computer and undergoes OCR process to recognize the word. This method had been widely used to retrieve data from image. For example, getting data from bank statement, invoice, passport, identity card and even books. All this data can be retrieve within a few second which is obviously way faster than a human typing speed no matter a line of word or a page of word. However, the speed of recognition is depending on the length of character but it is still faster than human typing speed.

OCR is divided into two type which is real-time process which also known as online while the other type is the offline process. Online process will recognize the word in real time where it is usually using an optical pen for writing the character. The system will analyses the word by depending on the motion of pen such as lifting the pen, direction

and also the other factor. Meanwhile, the offline recognition is analyzing the character on a sheet. The capture or scan image will be send to computer for process purpose. The accuracy will be depending on the architectures and recognition method. In this project, the offline OCR will be used as it will get data from user student or staff card which is not handwriting from the user.

2.1.2 Tesseract

Tesseract is an open source OCR engine that develop by Google. Tesseract do support a lot of language which include C, C++, C# and also other language. It can be use in Linux, Windows and even Mac OS. There is also someone who test this OCR engine on Android and it turn out to perform well and smooth. The developer had train this engine to recognize up to 39 languages which is free to use for everyone. If the user wants to use this recognition system to recognize specific character, they can train the system to do so.

It can easily recognize character without any setting but the accuracy of the character will be depending on the image quality and also the region of recognition. A good quality photo will greatly affect the result of the OCR by Tesseract meanwhile, if the photo had bad quality, it will cause the result to be inaccurate. The region of recognition must also be correctly defining as that will be portion for the OCR to do process and analysis. Thus the main factor to be consider in the Tesseract OCR is the quality of photo and the size of character.

2.1.3 AForge framework

AForge framework is an image processing library and also video processing library. It is an open sources library which are made for programmer and developer. This library is only available for C# programming. This library can be easily downloaded from the internet with no license issue. Besides that, there are a lot of support from the internet for this library as it is widely used by the programmer. This library also had been

developing with machine learning library where programmer can train specific object to allow computer to recognize. Lastly, AForge framework is user friendly where it can easily be used by new user who does not have knowledge on image processing because it is easy to use.

EmguCV, which is a competitor for AForge framework in image processing. It performs better than AForge framework in term of processing times. It took less time to complete a processing. AForge framework took approximate 30 milliseconds to perform gray scaling while EmguCV will only took 11 milliseconds. However, in this project differences in millisecond will not give much effect on the output because human will not notice the difference in milliseconds. Thus, AForge Framework has been choosing as a library for image processing in this project.

2.2 Literature review

2.2.1 Finger print locker

Biometric locker is using thumb print as a locker instead of traditional padlocks. It is greatly improve the security system where everyone had their own unique thumbprint and no one can copy them. The system required thumbprint enrollment for register purpose before using the locker. Only correct finger print able to open the specific locker and there is a GSM module where use to send SMS passcode to the user if unrecognized finger print was detected[1]. Biometric is a good system where user does not need to carry any key, RFID or remember a specific password. It is stable, reliable, high accuracy of detection and it is small enough to be apply at small device such as computer[2] . In the other hand, there are also some disadvantage which is this system required high quality image of finger pattern. There is a dirt, cuts, tear and wear on the finger will cause incorrect result or unrecognized[3]. Besides that, designer need to fully understand the specification and combination of algorithms to design a high accuracy system[4].

2.2.2 Face recognition

Face recognition system is a part from biometric security. The system will register an individual facial feature using photo. During recognition, a real-time identification camera will capture the real time image. This system is ease to use and low cost but there are too many factor will affect the result such as quality of photo, facial expression, light condition, angles of face and other method[3]. It is also very difficult to implement because now a day the plastic surgery is very common. There is statistic that show the face expression and angle will affect the outcome and recognition[5].

2.2.3 Eye recognition

Eye recognition are divide into 2 part which is retina and iris. Iris is the center of our eye and it cannot be genetically changed while the retina is the layer which made of a complicated network of neural cells at the back of the eye. Studies show that both of them will remind the same from the first year of the life and will not genetically change[3].

Iris recognition had very high accuracy compare to other type of biometric recognition system but it is not easy to use[6]. However, the system had a lot of disadvantage where it will be inaccurate if the user wearing glasses and eye lenses. Besides that, it is also very costly to implement[3].

Retina recognition also had very high accuracy because they are both in our eye where it will not have dirt or injury. This system will be affected by high blood pressure because the blood pressure will affect the retina blood vessels. Furthermore, it will cause a kind of user discomfort due to hard effort by the contributor while capturing their retina vessels[3].

2.2.4 Radio Frequency Identification(RFID)

RFID is widely being use as they able to be scan from a distance or near. Besides that, it supports larger set of unique ID compare to bar codes. RFID is also always accurate as the data are set in the card and will not affected by the environment, temperature and others. Anyhow, RFID will have collision, standardization problem, and also the frequency problem[7]. If there are two card is scan at the same times, it will cause the system unable to identify which data belongs to which RFID. This is one of the data collision example which is not efficient as the RFID card need to be scan one by one.

2.2.5 Optical character recognition(OCR)

Optical character recognition had become a very common technology in this era. It is a process where it scans the text image and converts them to an editable text form in an electronic device[8]. However, there are few process need to be done before it can recognize the character such as pre-processing, segmentation, feature, extraction, classification and recognition[9] . Besides that, there are another method which are pre-processing, segmentation, representation, training and recognition and post processing[10].

OCR are divided into two categories which is handwritten document or the printed document. Handwritten document only had accuracy up to 90%[11]. This is due to handwriting had variation in shape, scale, style and orientation.

2.2.6 Foreground and background

This is two important things that need to be done accurately in the OCR as it will directly affect the result and output of OCR. The background will not be taken as data and it will be removed while the foreground is the data that the OCR will capture. If this process is not done well, the data might be accidentally being assigned as background and

the data will not be taken. There is a method to calculate the value for background and foreground which is using Niblack's approach[12]. The background will be calculated depending on the neighbor pixel value. This method is better than getting background by getting the value from the whole image because each section will have different threshold value.

After determine the background and foreground, the text data will be in black while the background will be purely white. This will make the image had less noise compare to original image[13].

2.2.7 Noise

Noise is the unwanted signal that located in the data. It will affect the accuracy of OCR as it will be assume as data if it is not be well handled. Usually noise will contaminate the image sensor. Noise are cause by imperfect instrument, problem of the image process, and also the interfering of natural phenomena. Even the dust particle that land on the camera or scanner will also causes noise in the image. There is a lot type of noises which include Gaussian noise, Poisson noise, speckle noise and also other type of noise[14]. Each type of noise had the specific algorithm to remove the noise. However, noise type need to be manually identify by the programmer by studying and analyses the image.

2.2.8 De-noising

The process of removing the noise from an image are known as de-noising. This is an important process which will greatly improve the output of the OCR because all the distractive item had been removed and all the detail will be remain. All the de-noising methods are using mathematic calculation and mathematics algorithm. However, correct method need to be used for specific noise because each algorithm is design for specific condition. There are few type of de-noising method which are averaging filter, Order