

UTEM VEHICLE STICKER RECOGNITION

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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ABSTRACT

This report is concern about the final year project which is a requirement as to fulfil the Bachelor Degree of Electronic Engineering (Telecommunication Electronics). The project that has been proposed and completed is UTeM Vehicle Sticker Recognition. Nowadays, the safety concern has been arise all around the globe where UTeM had also implement some safety precautions. One of the implementations would be UTeM car sticker where all of the vehicle owner need to register themselves to get a car sticker with written matric no and car plate number. However, the guards have to keep an eye on the moving car which intent to enter to the university area. Moreover, existing car sticker is not user friendly as the car plate number can be wiped off easily. The objective of this project is mainly based on the design of an automated gate system with recognition of QR code and build a usable prototype corresponding with the system proposed. Arduino coding was developed as well. The QR code is created by using encoder which then the database is also updated accordingly. A motion sensor algorithm would help to sense the movement of the cars and then triggering the webcam to capture the windshield image of the car. The image would be processed in order to extract the position of the QR code. After all, the decoded QR code data would be compare with the MySQL database. The Arduino controlled servo motor would give response to the gate where open gate for matched database and QR code data. As conclusion, the prototype of this project has been successfully built. The software is then successfully implemented into the hardware in order to perform the function as required. The burden of the guards are hopefully to be reduced with the implementation of this single system.

ABSTRAK

Projek ini merupakan salah satu keperluan untuk menyempurnakan kursus Kejuruteraan Elektronik Telekomunikasi. Projek yang telah dibentang dan disempurnai adalah mengenali pelekat kenderaan Universiti Teknikal Malaysia Melaka (UTeM). Kebelakangan ini, keselamatan merupakan salah satu isu yang dibangkitkan di persada dunia. UTeM turut melaksanakan langkah-langkah keselamatan dan salah satu merupakan pelekat kenderaan bagi setiap pemilik kenderaan. Pemilik digalakkan untuk mendaftar di Pejabat Keselamatan bagi mendapatkan pelekat kenderaan dengan nombor matrik dan plat kenderaan tulisan tangan. Walau bagaimanapun, pengawal keselamatan perlu memerhatikan kemasukan setiap kenderaan ke dalam kawasan universiti. Selain itu, pelekat yang sedia ada tidak mesra pengguna kerana nombor tulisan tangan boleh digelapkan dengan mudah. Objektif utama bagi projek ini adalah untuk mereka satu sistem yang boleh mengawal pintu secara automatik dengan mengenali pelekat kenderaan iaitu kod QR. Di samping itu, satu prototaip telah dibina serata dengan projek yang telah dibentangkan tersebut. Kod QR dicipta dengan menggunakan system pengekod di samping mengemaskinikan pangkalan data. Penggerak kereta akan dikesan oleh algoritma pengesanan gerakan dan seterusnya mencetuskan kamera untuk menangkap gambar kenderaan tersebut. Gambar tersebut akan diproses dan kedudukan kod QR akan dikenali. Data bagi kod QR akan diekstrak dan dibandingkan dengan pangkalan data. Arduino akan membukakan pintu bagi bandingan yang sepadan. Secara ringkasnya, prototaip telah dibina untuk mengaplikasikan algoritma ini. Melalui sistem ini, diharapkan beban pengawal keselamatan dapat diringankan.

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LIST OF ABBREVIATIONS

1D	- One Dimensional
2D	- Two Dimensional
3D	- Three Dimensional
AIDC	- Automatic Identification and Data Capture
CPU	- Central Processing Unit
DBMS	- Database Management System
DAC	- Digital to Analogue Converter
EEPROM	- Electrical Erasable Programmable Read Only Memory
GPS	- Global Positioning System
IDE	- Integrated Development Environment
Kmph	- kilometers per hour
LED	- Light Emitting Diode
NFC	- Near Field Communication
PIR	- Passive Infra-Red
PDF	- Portable Data Files
QR	- Quick Response
RFID	- Radio Frequency Identification
SSN	- Social Security Number
SRAM	- Static Random Access Memory
IR	- infrared
URL	- Uniform Resource Locator
UPC	- Universal Product Code
USB	- Universal Serial Bus
UTEM	- Universiti Teknikal Malaysia Melaka
WSN	- Wireless Sensor Networks

CHAPTER 1

INTRODUCTION

1 OVERVIEW

Safety, a term to describe the condition of being protected from or unlikely to cause danger, risk or injury according to Oxford Dictionaries. It becomes one of the most concern issue arise all over the world. Everyone speak about this point of discussion as a consequences of significant crime rising rates. The news about crimes, social illness and many more are broadcasting everywhere and every minutes of time, reminding people to alert themselves with the crimes that might happen anytime.

The crimes is recently stretch the devil's claws toward the universities, which define as a high level educational institution in which students study for degrees and academic research is done, according to Oxford Dictionaries. There is also a place only with staffs and students. Type of the crimes that occurred inside the boundaries of the universities and reported including burglary, murder, rape and many more. Hence, there are few safety precautions have been done by the school authorities in order to protect the welfare of the students in the universities.

University Teknikal Malaysia Melaka (UTeM) has implemented the safety precautions as to provide a reliable and secure environment. One of the safety provisions that had been implemented will be the UTEM vehicle sticker. The students and staffs that are wishing to own a vehicle inside the boundary of the university are compulsory to apply the vehicle sticker. The information of the vehicle owner will be recorded from the apply form so that it is easier for the guards to track the owner. After then the sticker needed to be paste on the windshield of the car, where different types and colors of the sticker help the security guards to differentiate identities of the owner. For example, there is a word "Staff" for the staffs and lecturers' vehicle and "Student" for the students' vehicle.

Here come the most stressful part for the UTeM guards when discussing about the implementation of the vehicle sticker system within the university. The safety guards at the entrance point need to pay full attention and concentration towards the vehicle who moving into the university boundaries. The entered vehicle is needed to be checked in order to verify their identities. The burden of the guards uplift where they need to stand continuously and restless in order to perform their duty.

This safety precautions that arise by UTeM authorities did bring advantages. However, this implementation is categorized as not a green technology due to its high man power usage. Besides, the sticker provided is not user friendly. The car plate number and the matric number that has been written in the sticker can be wiped off and changed easily which would then easier for those intruders to burst into the university. Moreover, the sticker need to be change annually which really waste the resources and does not go green.

As an alternative, an automated gate system by recognition of vehicle sticker has been proposed by the student in order to function as a replacement to the existing vehicle sticker implementation. The proposed project is of more green technology as reduced human resources.

1.1 Project Overview

The Automated Gate System by Recognition of Vehicle Sticker implement a new kind of vehicle sticker which is a Quick Response (QR) code sticker in order to replace the existing car sticker. This is because the existing car sticker is not user-friendly where the car plate number can be rubbed out and change easily. This bug gives the intruders more tracks to penetrate into the boundaries of university. Moreover, most of the UTeM guards distributed at the main entrance just to verify the vehicle one by one with the existing car sticker.

The main point for the contemplated idea is to replace the existing vehicle sticker with the QR code sticker. The users can possess their own QR code with registration at security department. The personal details that have been entered will save to the database as well whenever registered process is done. Provided sticker need to stick at the windshield of the car so that the identities of vehicle owner are verified. The vehicle owner is able to move within the range of UTeM.

The automated gate system can be divided into three parts, encapsulated motion detection algorithm, QR code decoder algorithm in conjunction with database and also barrier gate response.

First of all, when the car is moving towards the main entrance, motion detection algorithm would help to detect the position of the car. Video frame of the car will be stored and processed when the car reached certain level, a position where the camera can capture image of windshield clearly. The decoder algorithm mentioned about processing of the captured frame in order to discover the position of the QR code. The next step would be extract information from the sticker follow by comparing information with database.

Third parts of this system refer to barrier gate monitoring by Arduino. The comparison between extracted data and database would produce an output which will then input to the Arduino as to control the gate. For example, a match data in between database and QR code would lead to open gate and vice versa.

This project gives benefits in terms of social, environment and economic. In the perspective of social, a higher technology system would provide reliable security system for the staffs and students. By the implementation of the provided system, human resources at the main entrance gate can be distributed to patrol all over the university.

In terms of environment, this project brings no pollution since a fully coding based algorithm is used for the proposed project. The green technology element describe within this project would be reduce human resources and lower usage of energy.

In addition, the low power consumption of Arduino Uno module which is about 50mA contributes on the view of economic. Furthermore, the algorithm with full coding based also lead to the perspective of saving cost. The low power consumption and no much sensor used would help to save the power, energy and thus create a system with lower cost. Moreover, the main elements for the selection of the components would be cheap and nice to use. For an example, My SQL would be a free source database that allow the user to create specific account and database.

Thus, this project would help to develop a more dependable security system in order to protect the students and staffs from any invaders. Besides, the load on the shoulder of the guards is hopefully to be lighten through this system as they are not need to stand all the while despite changes of weather.

1.2 Problem Statement

Of late the press has been highlighting the social ills plaguing the youths in our country. The devils' claw has been stretch towards the boundaries of the university. For example, there are missing in laptop, motorcycle, or even car, murder cases, rape, burglary and many more. Hence, it is crucial to take action immediately in order to control the rising crime rate.

The point that should be emphasized here would be the free entrance of public into the universities. However, UTeM did concern about it with the practice of vehicle sticker to limit the entrance of strangers. The UTeM guards are in charge to verify the status of the vehicle owner at the main entrance gate of the university. However, there are some shortages for this solution. Most of the human resources, in this case the guards are allocated at the main entrance. There are others more important duty which required operations from human.

On top of that, the guards who take charge of the entrance gate did experience a tremendous load and stress. This duty required a long standing for every incoming vehicle as to perform the job.

Besides, the existing vehicle sticker are not user-friendly. This is because the car plate number and the matric card number can be easily rubbed away and changed accordingly by using the marker pen. Most of the users faced the same problem where the car plate number and matric number on the sticker will disappear as time goes by. Hence, the sticker did not help to perform the function as needed. Furthermore, there might be some missed checking of the car during peak hour of the day due to the car volume. For example, the car flow during 8 o'clock in the morning and 2 o'clock in the afternoon can be considered as many.

1.3 Objectives

There are three main objectives for the proposed project which include:

- To design an automatic gate system with recognition of QR code by using Microsoft Visual Studio
- To develop Arduino coding in controlling the automatic gate
- To build a prototype for the proposed project

1.4 Scope of Project

The main scope of this project can be divided into two parts, which included hardware and software respectively. Hardware included would be Arduino, servo motor and LED whereby the software included would be Microsoft Visual Studio and also MySQL database.

For the software part, Microsoft Visual Studio is the tool that has been used in order to create and perform the algorithm. The coding that has been used throughout the project will be C# code. This is used to create a consistency for the project. Since the proposed project is fully coding based algorithm, hence the whole project rely on Microsoft Visual Studio as the main software.

The algorithm that has been written and produced by Microsoft Visual Studio would be the user interface for registration purpose, QR Code Encoder for creating QR code, motion detection algorithm to detect the position of the vehicle and snap the video frame, decoder algorithm for extract data from the QR code and also control interface for the security guards.

For QR Code encoder system, Microsoft Visual Studio functioned as linking with database. Along with the user interface, personal details that have been entered will be save into database while the QR code created will be made as vehicle sticker to be paste on windscreen of the vehicle. The data input to the database can be withdraw for comparison purpose.

MySQL database is a free and open source database that is useful in storing a very large amount of the data. Various data types for example URL, numbers,

characters, variable and many more can be input into the database for storing purpose. Primary key is needed as a representation for each of the data input, as to make sure there is no repetitive registration.

Motion detection algorithm is important within this project. As an alternative for Passive Infra-Red (PIR) sensor, motion detection would give higher accuracy in detection. This is due to the very high sensitivity of the PIR sensor as mentioned in datasheet. Any tiny movement for example strong wind and sunshine would definitely affect the output of PIR sensor. Besides, motion detection algorithm would also help to cut cost of the whole project since there are no sensor used.

QR decoder algorithm helps to decode the QR code to find out whether the vehicle is allowed to enter UTeM or not. When the vehicle reached certain level, various function will be added to the specific video frame. For example, the image is rotate, change to grayscale and then black and white in order to search the position of the sticker within the vehicle. Once the position is defined, decoder will start function and make sure it matches with database.

For hardware part, Arduino Uno would be serves as a center that is used to control all the hardware for example Light Emitting Diode (LED) and servo motor. The reason behind this would be Arduino can serial communicate with laptop via Universal Serial Bus (USB). Any output from laptop would serial communicate with Arduino so as to perform each of the respective function.

Servo Motor (MG-90S) role as barrier gate for the prototype in this project. This is due to the ability of the servo motor to rotate clockwise and anticlockwise in 90 degrees as required. Arduino sends signal to give command whether to open or close the barrier gate. LED function as give notifications to the guards whenever there are any special cases happened.

However, there are some limitations for the automated gate system algorithm in terms of weather, camera and experimental prototype. The limitation of this system would be further discussed in Chapter 4 as part of the result and discussion.

In terms of weather, QR code sticker maybe blurred when raining cats and dogs. Some cars wiper are not able to wipe off the rain drops cleanly and thus affect the

output for the decoder algorithm. Nevertheless, there is research proposed that the QR code can restore data for most of the partially dirty image. This means that the partially blurred image may be able to recover.

The camera used is also one of the important elements in the whole project. This is because the image captured is related to the functioning of the proposed algorithm. Furthermore, the capture distance of a camera is based on the specifications of the camera where higher resolution cameras can capture images more clearly for a same distance object. The position of the camera is also related to the specifications of the camera. A wide angle camera is preferred as wider images can be captured while the position of the camera is reachable.

A high resolution image is required in order to clearly find out the position of the QR code and thus trigger the decoding algorithm. Therefore, a high pixel camera is required. However, the camera with high pixels is expensive while the budget provided is limited, hence a higher pixel camera that is within the budget is chosen.

Since the project is only an experimental prototype, hence not a real UTEM database will be applied. Hence, the speed of extracting data from the database is just an approximation instead of real analysis. Further research and development is needed in order to practice the system in the university. Further details will be discussed.

1.5 Project Methodology

First of all, the data collection about the method to be used and the algorithm to be implemented is done by collecting the journal about this project or any system that are related to this field of implementations. However, since the proposed project with QR code as a car sticker is considered as a new idea, there are not many published journals with the similar algorithm that can be used as a reference. Hence, the data and information were collected from the related works of this project.

The first level of the proposed project would be the implementation of the QR code encoder. The QR encoder system was written in C# language by using Microsoft Visual Studio. Users are required to enter their personal information in order to acquire their unique QR code. The information that is required to enter will be name, matric number, vehicle number, phone number and faculty. However, only name, matric and

vehicle number will be used to create a unique QR code provided the primary key is matric number.

Furthermore, the data that have been entered by user in the encoder system would be linked to the MySQL database. All the saved data in MySQL would easier the job of the security guards whenever confirmation of identity for vehicle owner is required. The primary key for the database is set to be matric number because it is unique.

Vehicle owner is required to paste their QR code sticker on the windshield of the car. A motion detection algorithm is done as well with C# language by using Microsoft Visual Studio so that the motion of the car can be detected. When the car is moving, the motion detection algorithm will detect the position of the car. The camera will snap the picture with windshield of the car whenever the car reached certain position.

Next, the QR code decoder algorithm also being created. The frame that has been snap by the camera will be processed to find the position of the QR code. Once the data is extracted, a comparison in between the extracted data and MySQL database will be done in Microsoft Visual Studio. An output will be generated and serial communicate with Arduino.

Lastly, the Arduino will control servo motor which will act as barrier gate to be installed at the gate of the main entrance point. The output from data comparison would become the input where match extracted data and MySQL will lead to open gate and vice versa.

1.6 Report Outline

This report mentioned about an automated gate system by recognition of vehicle sticker in UTeM. QR code is used as vehicle sticker instead of traditional vehicle sticker as provided. The aim of this project is to decrease the stress of the guards whereby the entrance of the vehicle will be automatically controlled by the sticker recognition algorithm. The main advantage of this algorithm is that the guards do not need to check the moving car one by one under the hot sun in order to verify their identity. This system implement a low cost device and instrument, included only an Arduino board and servo motor that serve as the barrier gate. Besides, the proposed project is considered as green technology, define as development of system or

technology used to conserve the resources for Mother Nature, and reverse the effects of human activities on the environment [1]. For example, there is low power consumption for this particular, reduction of man power usage and also cheaper automated gate system.

The remainder of the report is organized as follow:

Chapter 2 provides a review of the methodologies employed in this project. Detail findings and way to implement about QR code, MySQL database, Arduino, QR decoder and motion detection algorithm would be included within this chapter. In addition, a short comparison in between different types of database is provided. For each methodologies, an elaboration on methods used is presented.

Chapter 3 reports some important findings of the literature review before, where the procedure and methods used are discussed. Besides, the specific algorithm that are implemented in the proposed project are also presented in this chapter.

Chapter 4 discusses in details the outcome of the automated gate system with the recognition of the QR code. A simple analysis of the outcome is also presented within this chapter.

Chapter 5 summarizes the contributions of all studies to the project and provides concluding remarks. In addition, there are some recommendations and future works from the current project would be discussed.