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Smart Gateless System using RFID Technology in Universiti Malaysia Perlis

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Abstract. This paper describes a smart monitoring gate-less system by using RFID technologies that had been implemented in Universiti Malaysia Perlis. The objective of this system is to ease the security to monitoring the cars-in and cars-out from the main gate manually. The security can check and manage the staff by system management in PC. This smart monitoring gate-less system consists of RFID tag antenna that be attached at sticker's staff, RFID reader and software management application. For the software management application, this project used LabView as a simulation tool for the data acquisition. The data which contains of name, staff number, number plate, car model and color will be stored in cloud-based storage. All the information data can be accessed from any location because the security management can access it through mobile. This project will present how efficient the vehicle control application on campus which enable the security guard to check a car sticker either legal or illegal in a shortest way.

1. Introduction

The rules and regulation have been implemented in every campus to control the traffic movement and parking for students and staff utilizing the parking lots, roads and ways of the campus [1]. Thus, the management needs to hire a number of staffs or security guards to in charge the vehicle control on

campus. However, the security may not complete their work in a short time due to most of the work are performed manually rather than automatically.

To solve this issue, many technologies had been implemented and among of the best technology used is Radio Frequency Identification (RFID)[2]. RFID is used to identify and track the object or individual by an electromagnetic and electrostatic coupling, where these technologies used radio frequency spectrum as their communication medium [3].

The RFID system consist of three main components which are an antenna, a reader and RF tag that programmed with unique information [4]. The tag has a unique ID which is initially stored in the databased before assigning it to the user. The user has to place the tag at a specific distance from the RFID reader. The tag consists of a microchip that helps to store unique sequence number that is useful in identifying objects. The microchip includes micro circuitry and an embedded silicon chip. The tag has a rewritable and permanent memory which can be repeatedly programmed by multiple times.

Nowadays, RFID technologies are widely used in toll gate application [5]–[7]. In Malaysia, MyRFID had been adopted in early 2019 by Touch N Go company where a new electronic toll payment system based on RFID technologies had been implemented [8]. The tag is utilizing with radio frequency chip embedded within the tag an overhead reader in the toll booth. Thus, when a car pass through the toll booth, the overhead reader will scan the tag. This application is same with a barcode or QR code technology [9].

Gate-less vehicle access has been applied over the years to overcome the traffic congestion. It consists of a system that does not require a gate barrier. This is useful as conventional methods of manually opening the gate and checking the person entering the desired location might take too much time and this can create traffic jam. Other advantages include minimizing guard time to manually check person by per-son, faster and efficient service and enable car-in and car-out records.

2. Research Method

This system consists of two main parts which are smart gate-less system and management system. For smart gate-less system, it consists of vehicle classification, identification and violation system. While for management system, it consists of web-based system. The smart gate-less system using RFID technology where the tag will be stored all the necessary information such as vehicle owner, staff number plate number, color and car model.

This system will be operated when there is vehicle approach toward the gate with-in RFID reader coverage. The reader coverage is designed to propagate the waves to specific direction where in coming vehicle located. Thus, to identify the incoming vehicles, the signal will be broadcast from the RFID reader towards the sticker staff with inbuilt tag located on windscreen of the vehicles. Within milliseconds, the in-built tag will response and send the received data to the database. Then, all the in-formation received will be compared with existing information that already stored in database.

3. System Implementation

The proposed system uses RFID-based identification system. It detects upcoming vehicle by identifying radio waves that are backscattered from the vehicle. The system consists of four main components which are:

i. RFID reader: Four readers are used to read the tag information at the same time of vehicle in or out from the main gate.

ii. Staff sticker with inbuilt RFID tag: It represents an id for each staff. Each sticker will have different tag or id number.

iii. Raspberry Pi: inbuilt internet capability to transmit the received data from tag to the cloud and management in real time.

iv. Database: contain all the personal information of the user as well as the data of vehicles in and out from the main campus.

All the components listed above are illustrated in block diagram as in Figure 1 where inbuilt tags are act as input when the cars approach the gate. Reader will extract the data from the incoming car and send it to raspberry pi. Raspberry pi with inbuilt internet capability will transmit the received data from tag to cloud and management in real time.

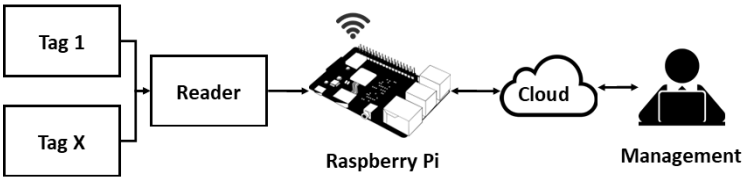


Figure 1. System block diagram

3.1. Smart Gate-Less System

The information on the coming vehicle with the car plate number will be store in the cloud-based storage and accessed from any location. Figure 2 shows the diagram of the proposed system. It is also possible to extend the system further by including a camera to verify license plates for registered vehicles, or record license plates of unregistered vehicles.

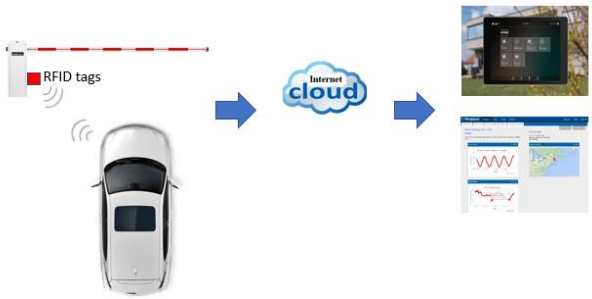


Figure 2. Diagram of purposed system

In proposed system, initially each user must register their car with university security management. Each user needs to provide their details of name, staff number, colour and model of vehicle and vehicle's number plate for registration. After completing the registration process, the user will be provided a car sticker with inbuilt RFID tag as in Figure 3. The car sticker needs to be placed on the windscreen and the position of the sticker is being decide by security management for ease detection.

When the registered user entering the main campus, the reader will fetch the data from the tag built in car sticker and the data will be stored in the database for monitoring and this action is also applied when the registered user go out from the main gate. While, for unregistered user, if the unregistered vehicle entering or out from the main campus, the alarm will be triggered to alert the security for next action. This flow is explained in flow chart in Figure 4. A wireless camera also will be applied in this project. The purpose of using wireless camera is to verify the license plates for registered vehicle or record license plates of unregistered vehicles.

Figure 3. Example of staff sticker with inbuilt RFID tag antenna

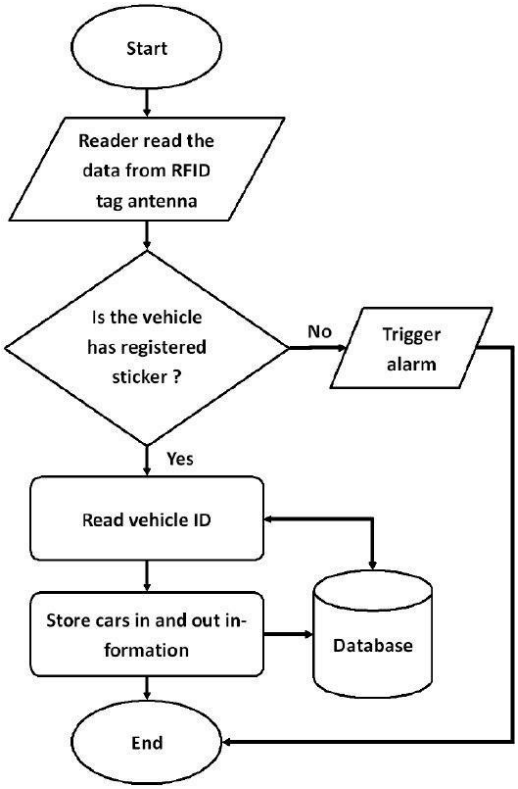


Figure 4. Flow chart of the proposed system

3.2. Management System

For management system, all the information of cars in or out from the campus is recorded in this system. New user also can be added in this system. To start this system, the administrator needs to login using his or her username and password for authentication. For security purpose, when administrator had entered their username and password, the system will check and compare the information received with database. The administrator could access the system if the information entered is matched and she or he has a full authority to see the recorded cars in or out and register the new user. This flow is explained in Figure 5.

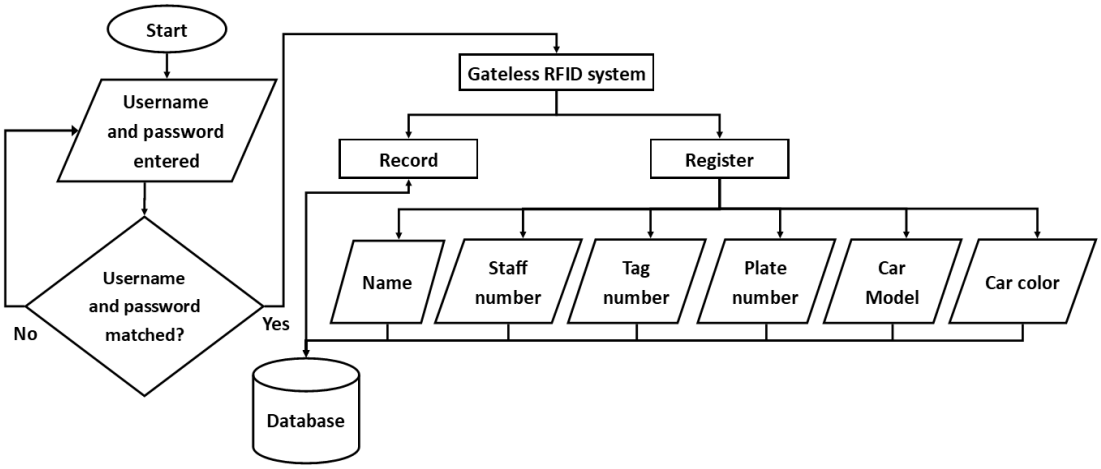


Figure 5. Flowchart for management system

3.3. Software Tools

In this project, LabVIEW (Figure 6) is used as the software tools for data acquisition to fetch the data from multiple reader and send to the web-based system. LabVIEW is known as a programming language. LabVIEW is an acronym for "Laboratory Virtual Instrumentation Engineering Workspace". This software tool is preferable because of its ease programming by using a data flow model instead of sequential lines of text code.

Figure 6. LabVIEW software tool

The management system was developed using Lab View as stand-alone application (compiled as .exe) and being installed in PC as shown in Figure 7. Four RFID readers were connected using RS485 cable (blue line) and communicate serially to the management system as shown in dotted box. This management system will acquire the data and processed it. The process was performed and managed in web-based platform (PHP and HTML). The data was stored into the server virtually (cloud).

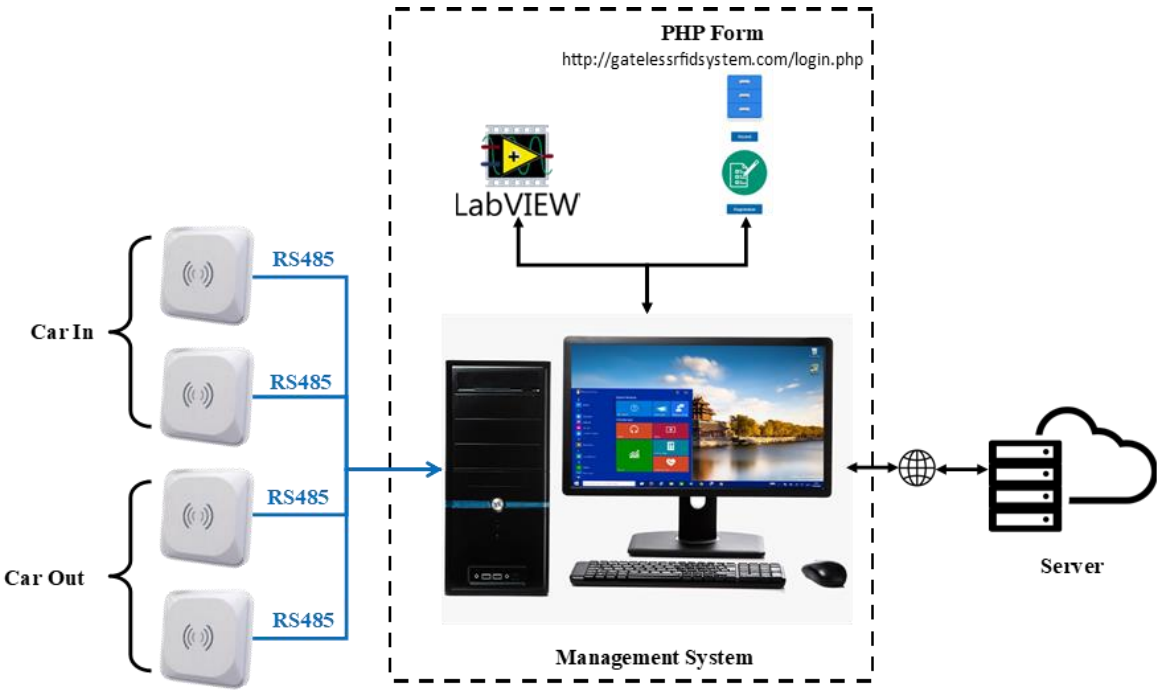


Figure 7. Full block diagram management system illustration

4. Implementation and Results

In this project, once the car enters to the campus, the registered number of the vehicle will be scanned using RFID reader and the data recorded from the RFID will automatically sent to the system management in security PC. By using LabView as data acquisition and process core system, the data of the car entering will be collect-ed by the security for automatic monitoring. Figure 8 shows an illustration for this project. The read range estimated for reader to detect the RFID tag from the car is

160cm. While height of the reader antenna that be mounted is 160cm from ground. Four RFID readers had been mounted in both access gate which is at in and out gate as illustrated in Figure 9.

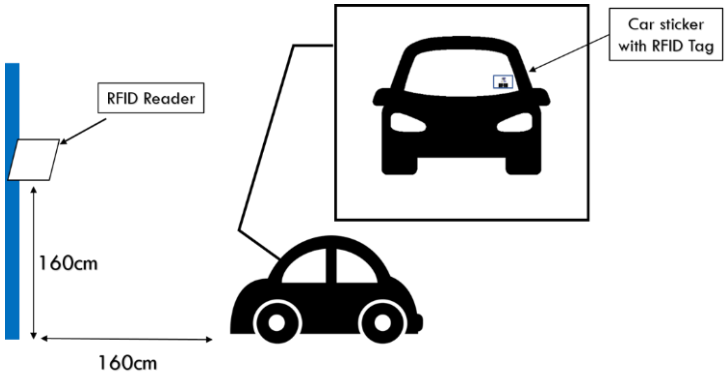


Figure 8. Illustration of project implementation

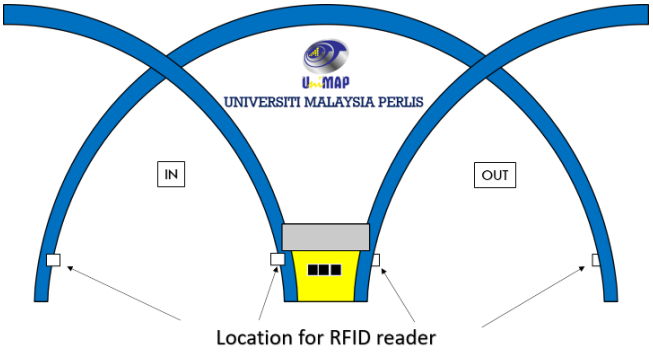


Figure 9. Illustration location for RFID reader at the main gate

The collection data from car in or out from the main campus will be shown in the web base interface where the Home Page is shown as in Figure 10. There are two buttons at the Home Page which is record button and registration button. The recorded data received from the RFID reader will be shown in record page as in Figure 11. While for the registration button, the management can register new staff car by entering name of the staff, staff number, tag number, plate number, car model and car color for proceeding the registration as shown in Figure 12. User management also can view this web base interface via their phone as shown in Figure 13.

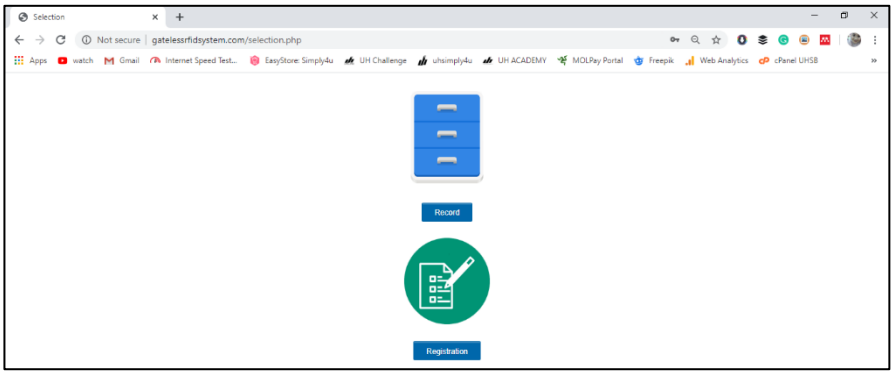


Figure 10. Main page for system management in desktop view

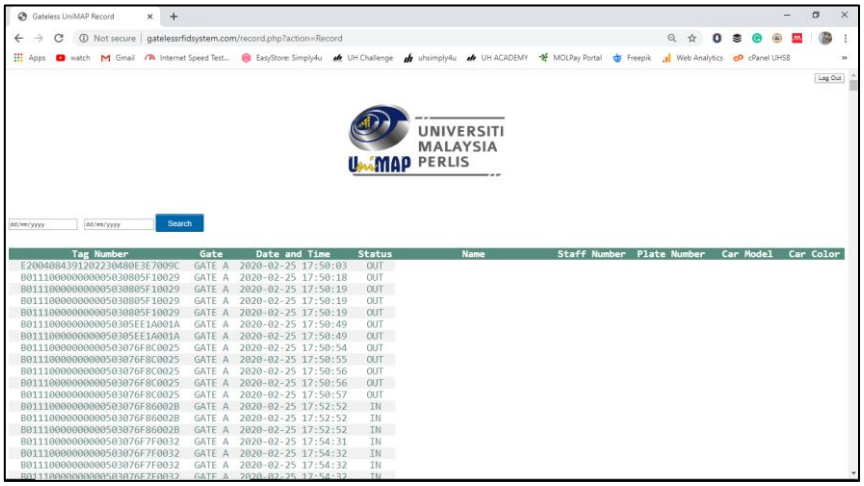


Figure 11. Record page for system management in desktop view

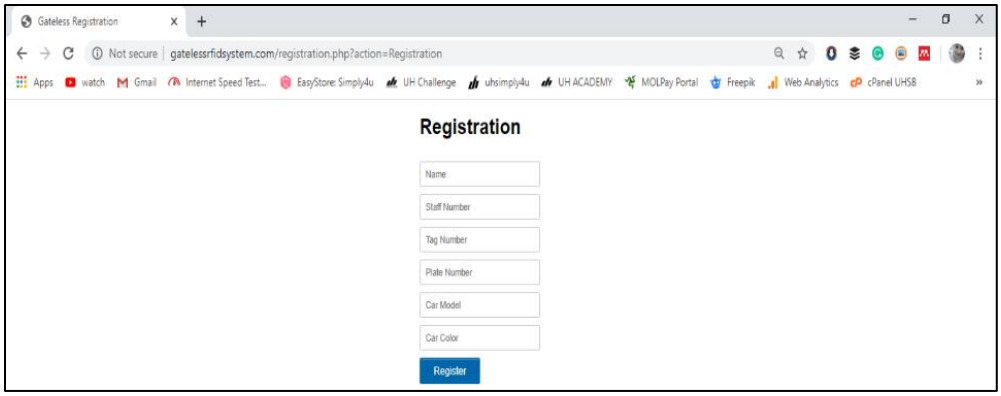
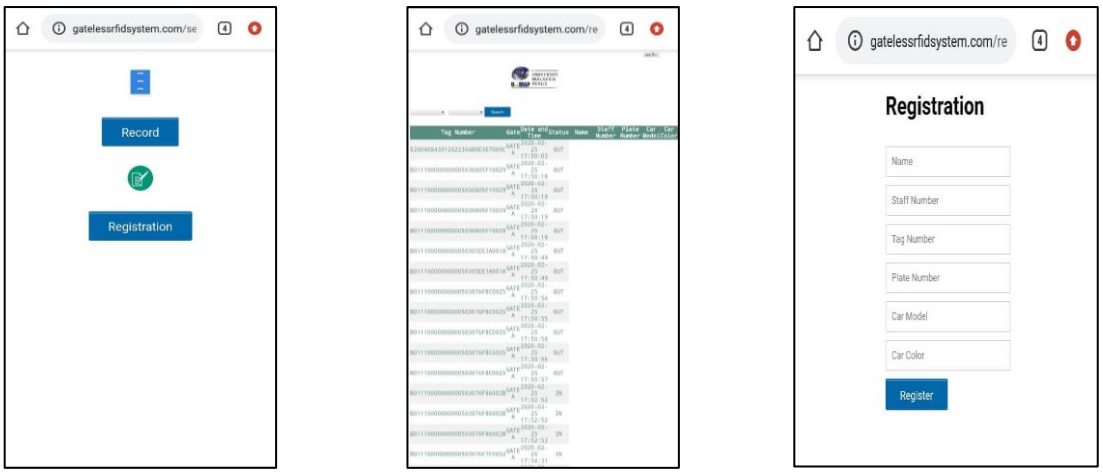


Figure 12. Registration page for system management in desktop view



(a) (b) (c)

Figure 13. (a) Main page for system management in phone view (b) Record page for system management in phone view (c) Registration page for system management in phone view

5. Conclusion

A smart gate-less system has been successfully designed and implemented in front gate at Universiti Malaysia Perlis (UniMAP), Pauh Putra Campus. The proposed work mainly focuses on real-time automated smart vehicle management system that is dedicated to monitor the car in and out from main campus. This proposed system is believed can reduce many problems or workload that had been involve in security or university management. In essence, this system is produced barrier gate free vehicle entrance control at UniMAP main gate in Pauh Putra, RFID detection for staff or university vehicles and database for vehicle entry and exit. This successful implementation will provide UniMAP with visitor friendly environment with minimal invasive security checks and will be test under varies weather.

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