DEVELOPMENT OF RFID FOR SMART TOLL SYSTEM

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This report is submitted in partial fulfillment of the requirements for the award of Bachelor of Electronic Engineering (Industrial Electronics) with Honours.

Faculty of Electronic and Computer Engineering

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To my beloved family and friends who support me, are most precious to me.

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ABSTRACT

Development of RFID for Smart Toll System can be described as the future technologies of Electronic Toll Collection System (ETC) instead of using a SmartTag or Touch n Go in Malaysia. The ETC system eliminates the need for users vehicle and toll authorities to perform ticket collections manually. The ETC system will ease path for drivers on highways by enabling near non stop toll collection that will reducing the time consuming congestion at toll plazas. The implementation of this project is to give more advantages to the user in cost and conviniences .

The system was controlled by Peripheral Interface Controller (PIC). Moving forward with the objective to reduce congestion at toll booth, reduce environmental issue and increase the road safety. To make toll payments electronically, vehicles will need to be fitted with RFID tags which are mounted on the windshields of vehicles, that will be recognised by the RFID readers installed at toll plazas. Therefore, this toll collection system will be more efficiently by reducing the traffic and human error possibility.

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ABSTRAK

Pembangunan RFID untuk Smart Toll System boleh digambarkan sebagai teknologi pada masa hadapan bagi Electronic Toll Collection (ETC) daripada menggunakan SmartTAG atau Touch n Go di Malaysia. Sistem ETC menghapuskan sistem penggunan ticket tol. Sistem ETC akan memudahkan jalan untuk pemandu di lebuh raya berhampiran dengan membolehkan kutipan tol henti yang akan mengurangkan kesesakan memakan masa yang di plaza tol. Sistem ETC ini memudahkan pemandu kenderaan di lebuh raya membayar tol tanpal henti yang dapat mengurangkan kesesakan di tol plaza. Pelaksanaan projek ini adalah untuk memberi banyak kebaikan kepada pengguna dari segi kos dan keselesaan.

Sistem ini dikawal oleh Peripheral Interface Controller (PIC). berdasarkan objektif untuk mengurangkan kesesakan di plaza tol, mengurangkan isu alam sekitar dan meningkatkan keselamatan jalan raya. Untuk membuat bayaran tol secara elektronik, kenderaan perlu memasang tag RFID yang dilekatkan dicermin hadapan kenderaan, yang akan dikesan oleh RFID reader yang dipasang di tol plaza. Oleh itu, sistem kutipan tol ini akan menjadi lebih cekap dengan mengurangkan lalu lintas dan mengurangkan campurtangan manusia.

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LIST OF ABBREVIATION

ETC	-	Electronic Toll Collection
PIC	-	Programmable Interface Controller
LCD	-	Liquid Crystal Display
GSM	-	Global System for Mobile
PCB	-	Printed circuit board
IC	-	Integrated circuit
SMS	-	Short Message Service
RFID	-	Radio Frequency Identification
LED	-	Light Emitted Diode

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CHAPTER I

INTRODUCTION

This chapter will discuss the idea of the project. The objectives of the project will also discussed and the problem statement will be explained more clearly with the specified scope of project. Lastly, the project methodology will also present at the end of this chapter.

1.1 Project Introduction

In Malaysia toll collection system are manually operated up until now. The increasing of population on this countries caused a traffic jams in front of the toll gates especially in peak hour or any public holidays. The new development of the system should be replaced by electronic toll gates to solve the problems.

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This paper focuses on Electronic Toll Collection (ETC) system using Radio Frequency IDentification (RFID) technology. In this project, all of the vehicle owners are compulsary to have a registered RFID Tag to attached on the windshields of vehicles just like in the existing road tax system. Actually the tag is type of passive RFID tag. The concept is based on existing toll booths in Malaysia. However, in this system human interaction is no longer required. Each time the vehicle passes the toll booth, the tag will be read by RFID reader automatically. This system also provide the manual payment if the tag cannot be read by the reader.

1.2 Project Objective

The main objective of this project is to constribute to the Development of RFID for Toll Road System as well as to study RFID state of the prototype. There are three objective of the project as follows:

i. To design a convenient toll system for vehicle users.
ii. To reduce the traffic congestion at toll plazas
iii. To minimum the intervention of human for manual operations and make life easier fir vehicle users.

1.3 Problem Statement

Nowadays Plus Expressway become one of the busiest places in Malaysia. The increasing number of population is the major factor of increasing number of vehicles in Malaysia. This is the reason why it always jammed at toll booth especially at peak hour start from 7.00 to 9.00am and 4.00pm to 8pm and public holiday such as School Holiday and celebration day likes Hari Raya Holiday. Figure 1.1 shows the cutting paper about traffic jamming at toll PLUS.

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PLUS keluar jadual waktu perjalanan cuti Hari Raya Aidiladha

Elak kesesakan lalu lintas

Oleh KASTHURI JEEVENDRAN
pengarang@utusan.com.my

KUALA LUMPUR 23 Okt. - Plus Malaysia Berhad (PLUS) mengeluarkan jadual waktu perjalanan (TTA) bagi Lebuh Raya Utara-Selatan sempena cuti Hari Raya Aidiladha dari Khamis ini hingga 28 Oktober.

Ketua Komunikasi Korporat PLUS, Mohd. Nizam Ismail berkata, TTA yang dikeluarkan pada musim perayaan lalu berjaya membantu orang ramai bergerak lebih selesa di lebuh raya dengan merancang perjalanan selain mengelakkan kesesakan lalu lintas.

Talian bebas tol PLUSline 1800-88-0000 atau layari laman Twitter PLUSTrafik

"PLUS menasihatkan pengguna jalan raya yang pulang bercuti dan kembali ke Lembah Klang supaya terus memberi kerjasama dengan mematuhi jadual perjalanan yang dikeluarkan ini," katanya dalam kenyataan akhbar di sini hari ini.

Bagi Khamis dan Jumaat ini, waktu perjalanan yang dicadangkan ialah dari Lembah Klang ke Kedah, Perlis dan Pulau Pinang melalui Juru serta perjalanan ke Johor melalui Skudai, Senai Utara, Ayer Hitam, Yong Peng dan Tangkak.

Menurutnya, perjalanan dari Lembah Klang ke Kuala Kangsar, Changkat Jering dan Taiping serta Melaka melalui Ayer Keroh antara 12 tengah hari dan 3 petang manakala perjalanan ke Ipoh, Simpang Pulai dan Gopeng serta Tampin dan Alor Gajah melalui Simpang Ampat bermula antara 3 petang dan 6 petang.

"Orang ramai boleh mula memasuki lebuh raya ke Tapah, Bidor, Sungkai, Slim River, Tanjung Malim, Senawang, Port Dickson dan Seremban selepas 6 petang," katanya.

Kenderaan dengan nombor plat ganjil bagi semua laluan perjalanan melalui Tambak Johor dan Linkedua serta Jambatan Pulau Pinang pula dinasihatkan memasuki lebuh raya setiap jam ganjil seperti 9 pagi, 1 petang dan 7 malam manakala kenderaan plat genap dinasihatkan memulakan perjalanan pada setiap jam genap.

Sementara itu, bagi 27 dan 28 Oktober, perjalanan dari Lebuh Raya Utara-Selatan ke Lembah Klang dicadangkan bermula sebelum 9 pagi dan selepas 10 malam manakala perjalanan yang tidak melalui kawasan Lembah Klang pula adalah antara 12 tengah hari atau selepas 6 petang.

"Semua perjalanan dari utara dan selatan melalui Tambak Johor dan Linkedua serta Jambatan Pulau Pinang bagi kenderaan dengan nombor plat ganjil dinasihatkan pada setiap jam ganjil manakala kenderaan dengan nombor plat genap pula bermula pada setiap jam genap," jelasnya.

Untuk mendapatkan maklumat trafik terkini, pengguna dinasihatkan menghubungi talian bebas tol PLUSline 1800-88-0000 atau melayari laman Twitter PLUSTrafik.

Figure 1.1 : The Cutting Paper about Traffic Jamming at Toll PLUS

The manual payment or cash payment in the toll booth is inefficient because of the human handling can easily cause the traffic jamming. Other than that, the human handling could lead to cheating and human errors in the toll booth.

Today the payment in toll booth can be in cash or prepaid likes Touch n Go, where it more convenient because user no longer need to prepare for small change and wait in queues lane for the transaction. Eventhrough most of the user have their own Touch n Go card to do the transaction, it still jammed because of the user must stop at the toll booth to do the transaction.

Smart Tag work in combination with Touch n Go make the payment more easy and faster which allow user to drive through more convenience without stop at the toll booth. But, the user only can used this sytem if their have a smarttag device.

Other than that, users have to spend the high cost to owning this method for this system. The device can operate with the battery. A low battery also will cause the failure of transaction. In order to solve these problem, the new development of RFID for smart toll road will be introduced to make sure the user can have a convenient way at toll expressway.

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1.4 Scope Of Work

The development of this project is to upgrade the system toll in Malaysia. It will used the passive RFID tag instead using the active RFID tag. Where the passive RFID tag can be operate without a battery. The RFID reader can only detect the distance less than 120 mm read range. The other important components in this project is stepper motor. The driver UCN5804 is used as a driver to control the movement of stepper motor. The system will be viewed at the computer data base and it was controlled by the PIC16F877A microcontroller.

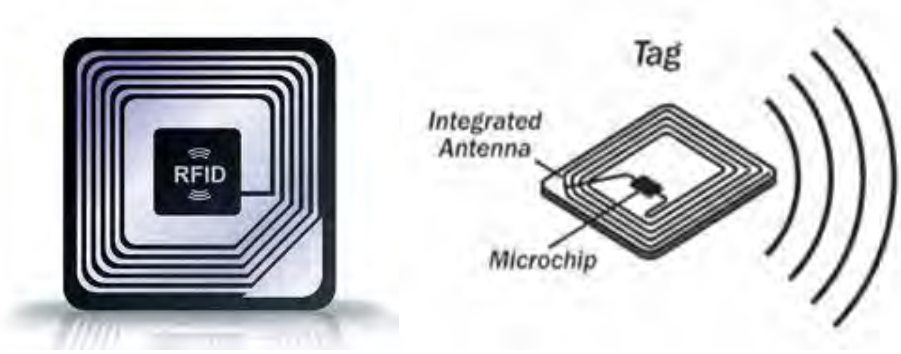

Figure 1.2 : The RFID tags

1.5 Project Methodology

The complete flow of the project is shown in figure 1.3 overall process of the project toll system. This process will start when the vehicle enter to the toll booth. The RFID reader will pick up the code that being transmitted by the RFID tag and sent to the Microcontroller Unit (PIC). Then the PIC will sent the data to the motor driver to opened the gate in 90 degree. After the vehicle passing the gate, the gate will closed to the normal position. The manual transaction was builded in this project to standby if the RFID reader failed to detect the RFID tags. The manual button will controlled the gate at the booth.

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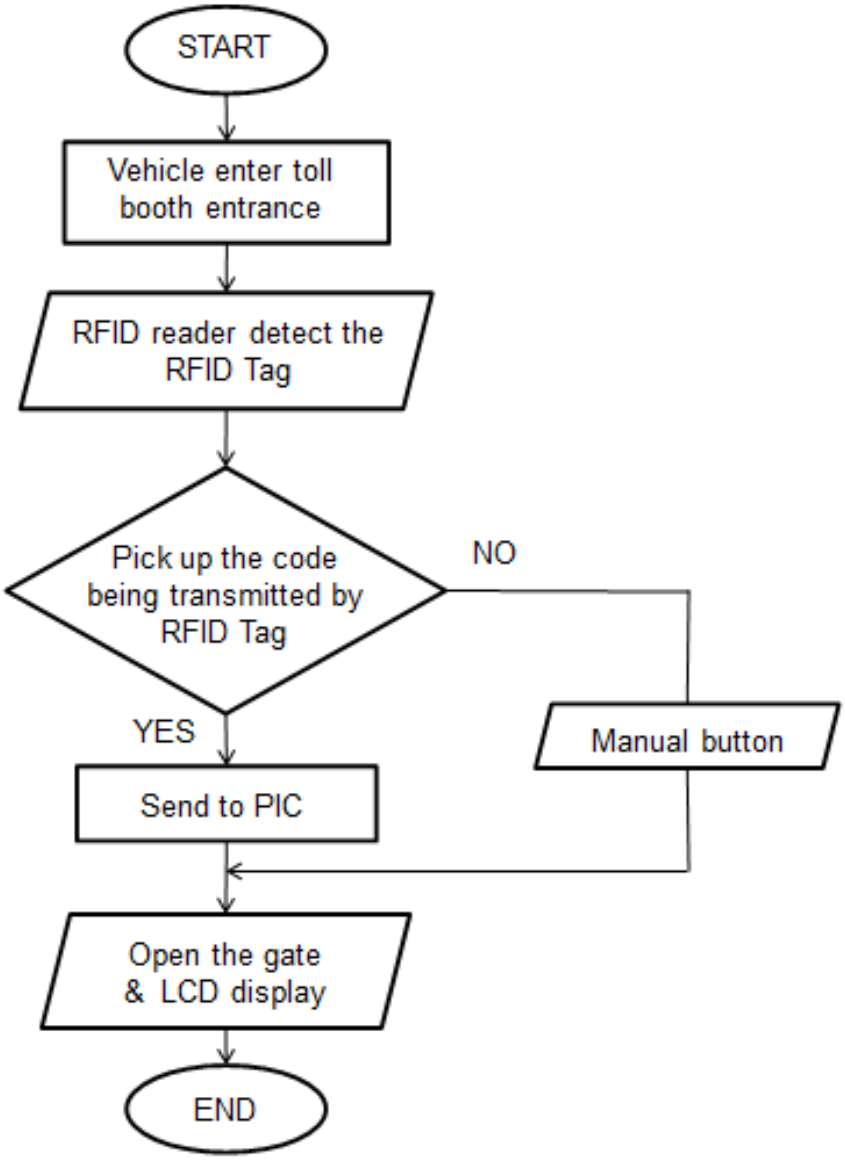

Figure 1.3 : The Flow Chart For Toll System

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1.6 Project Outline

This thesis comprises of five chapters. The first chapter briefly discusses the overview about the project such as Project Introduction, Project Objectives, Problem Statement, Scope of Work and Project Methodology.

Chapter II describe about the research and information which is the literature review of the project. Every facts and information, which are found through by any references that has been selected. This literature review covers the whole things about the toll payment. Further research that is related to the toll payment such as Smart Tag and also Touch n Go has been done through this literature review.

Chapter III will discusses about the methodology that have been used in this project. Methodology is one of the most important things in planning of a project. The project must be understood first and then followed by further research about the previous projects that are related to this project.

Chapter IV describes the result and discussion. In this chapter, the results of the project, all the problems encountered and discussion on the works will be presented. The results that presented here involving the hardware and software part.

Finally, Chapter V covers the conclusion and recommendation of the project. The conclusion describes about the task that have been completed for the entire two semesters. On the other hand, the recommendation part is added in order to give an opinion and also for further improvement on future works.

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CHAPTER II

LITERATURE REVIEW

This chapter reviews on the related systems so that the idea to design the project can be obtained. All the related components such as the microcontroller, RFID reader, RFID tags and Stepper motor are also discussed in this chapter.

2.1 Previous Study And Research

The use of Radio Frequency IDentification (RFID) technologies is growing. Many different RFID applications are implemented in various sectors and used for very different purposes such as public transport for many years in Malaysia. In order to find information and idea, a several research and studies have been used in this project.

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2.2 Touch N Go

Touch 'n Go card is an electronic purse that can be used at all highways in Malaysia, major public transports in Klang Valley, selected parking sites, retail and food outlets and theme park.

Figure 2.1 : Touch n Go Card

Touch 'n Go uses contactless smartcard technology. The card looks similar to a credit card as in figure 2.1. The sized smartcard made of plastic with Philips MIFARE Microchip Technology embedded in it [1].

The card was designed to process up to 800 vehicles per hour to ease the queue congestion at toll plazas [1]. Touch 'n Go enhances the speed of paying for low value but high frequency transactions. Apart from the speed, it is also very convenient because user no longer need to prepare for small change or wait in queue at the cash lane to complete the transaction.

2.2.1 Advantages and Disadvantages of Touch n Go

In this system, Touch n Go give a benefit to the user. It give more convenience during the transaction at the toll booth Table 2.1 shows the advantages and disadvantages of using Touch n Go.

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Table 2.1 : Advantages and Disadvantages of Touch n Go

Advantages	Disadvantages
▪ Contactless smartcard technology ▪ The user no longer need to prepare for a small change or wait in queue at the cash lane to complete the trnsaction. ▪ Process up to 800 vehicles per hour	▪ The user needs to stop at the toll booth to make a transaction. ▪ The reader only can detect less than 2cm from the tag.

2.3 SmartTag

SmartTAG is the Malay acronym for "Sistem Membayar Automatic Rangkaian Tol," or literally means Automatic Payment System For Toll Network [1]. In figure 2.2 shows a SmartTag and Touch n Go Card, it is a vehicle on-board unit that works in combination with the Touch ‚n Go card to allow user to pay toll with drive-through convenience.

Figure 2.2 : SmartTag and Touch n Go Card

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