TOLL PAYMENT SYSTEM

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PROJEK SARJANA MUDA II

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Date   : _____

Dedicated to **my parents, Nordin bin Che Lat** *and* **Harani binti Ahmad, my siblings, and all my beloved persons.**

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ABSTRACT

Malaysian Expressway network can be considered as the best expressway network in Southeast Asia. As we all know, there are millions of drivers passing through toll booths almost every day. The conventional or the common way of collecting the toll from the vehicle owners or the drivers is to stop the car by the toll booth and then pay the amount to the toll collector standing by the side of the toll booth. Then, after a while the gate is opened either mechanically or electronically for the driver to get through the toll station.

Toll Payment System can be described as the future technologies for Electronic Toll Collection System (ETC) instead of Touch n Go and SmartTag in Malaysia. This project attempts to design a system that is similar to the use of Smart Tag and Touch n Go but it give more advantages to the users. It use passive RFID instead of using active RFID as passive RFID can be function without a battery and typically much less expensive. This system will be controlled by using the PIC. Microsoft Visual Basic 2010 Express also is used in this project as the software to view the database of the system.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

PIC   - Programmable Interface Controller

ETC   - Electronic Toll Collection

RFID   - Radio Frequency Identification

MU   - Microcontroller Unit

EPS   - Electronic Payment System

OBU   - On Board Unit

AVI   - Automatic Vehicle Identification

VES   - Violation Enforcement System

GUI   - Graphical User Interface

DTE   - Data Terminal Equipment

DCE   - Data Circuit-terminating Equipment

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

1.1   Project Introduction

In many countries, drivers are charged for using highways with their cars. Up to now, most toll gates are operated manually, slowing down traffic significantly. Increasing traffic density in Malaysia already caused traffic jams in front of the toll gates. To solve these problems, manual toll gates should be replaced by electronic toll gates. Then payment can be carried out while the car is passing the gate without stopping.

Basically, for this project it is compulsory for all the vehicle owners to have a registered RFID Tag attached to their car's windshield. During registration, the owner needs to submit these details in order to create an account for this service and also for the bill payment at the end of the month:

1.1.1   Driver's / Owner's name and address details.
1.1.2   Cell phone number.
1.1.3   Driving license details with proof.

The booth consists of RFID readers which are installed at the starting point (first toll booth) and at the end point (second toll booth) of the expressway. These RFID readers are connected to the Controller Unit via RS232 interface. The microcontroller that is used in this project is PIC. The microcontroller here works as the backbone controlling the data base and signals obtained from the readers.

Whenever a vehicle comes to the start point of the expressway, as it passes the first RFID reader, the reader will pick up the code being transmitted by the RFID tag attached to the car's windshield in the form of electromagnetic waves. These waves are picked up by the reader and then the code is processed and sent to the MU (Microcontroller Unit) via RS232 wired interface. The MU then separates the ID from the code received in the signal from the reader.

On the other hand, when car reaches the second toll, the tag is again read by the reader and MU will compare the ID to indicate that the car is the same which passed the first toll booth.

1.2   Project Objectives

The goal of this Toll Payment System is to fulfill the needs of users especially the regular toll users. Therefore, below is the objective for this Toll Payment System.

1.2.1   To design a convenient and less hassle way using this Toll Payment System that is using RFID as the sensor.

1.3   Problem Statement

Malaysian Expressway nowadays becomes one of the busiest expressways in Asia. The major factors include the increasing number of vehicles along federal routes and the increasing population in major cities and towns of Malaysia. This is the reason why it always jammed and congested when the user want to make payment at toll booth especially during peak time and peak season such as Hari Raya Holiday.

Normally, most of the users using cash payment but the transaction will take longer time. For touch n go, it is more convenient than cash because user no longer need to prepare for small change or wait in queue at the cash lane to complete the transaction. But this method also needs a process to touch the screen and consume time as well, but it takes less time compared to cash payment. Smart Tag can be described as the fastest way to make payment which allow user to pay toll with drive-through convenience but the device for this method is expensive. Both Touch n Go and SmartTag maybe have possibility in security problem. For example, if the card had scratched or lost, maybe the user can not use that application and need to report for the replacement.

So, in order to stop all these problems and inconvenience, this project is introduced as an automated or a more convenient way of collecting the toll and traffic management. It is called as a Toll Payment System.

1.4   Scope of Work

This project is to design a system that is similar to the use of Smart Tag and Touch n Go but it give more advantages to the users. It use passive RFID instead of using active RFID as passive RFID can be function without a battery and typically much less expensive. This system will be controlled by using the PIC.

1.5   Project Methodology

There are several sequences for this project as illustrates in Figure 1.1. The complete flow of the project is shown from the Project Methodology.

```
                    ┌─────────────┐
                    (   START   )
                    └─────────────┘
                          │
                          ▼
                 ┌──────────────────┐
                 │ Enter the first Toll │
                 │      Booth.       │
                 └──────────────────┘
                          │
                          ▼
                 ╱──────────────────╲
                 │   RFID Reader    │
                 │ detects the RFID │
                 ╲──────────────────╱
                          │
                          ▼
                 ◇──────────────────◇
                 │  Pick up the code │
                 │ being transmitted │───────┐
                 │ by the RFID Tag.  │        │
                 ◇──────────────────◇        │
                          │                   │
                          ▼                   ▼
                 ┌──────────────┐       ╱──────────╲
                 │ Send to PIC. │       │ Alarm ON. │
                 └──────────────┘       ╲──────────╱
                          │                   │
                          ▼                   │
                 ┌──────────────────┐         │
                 │ Enter the second Toll │     │
                 │      Booth.       │         │
                 └──────────────────┘         │
                          │                   │
```
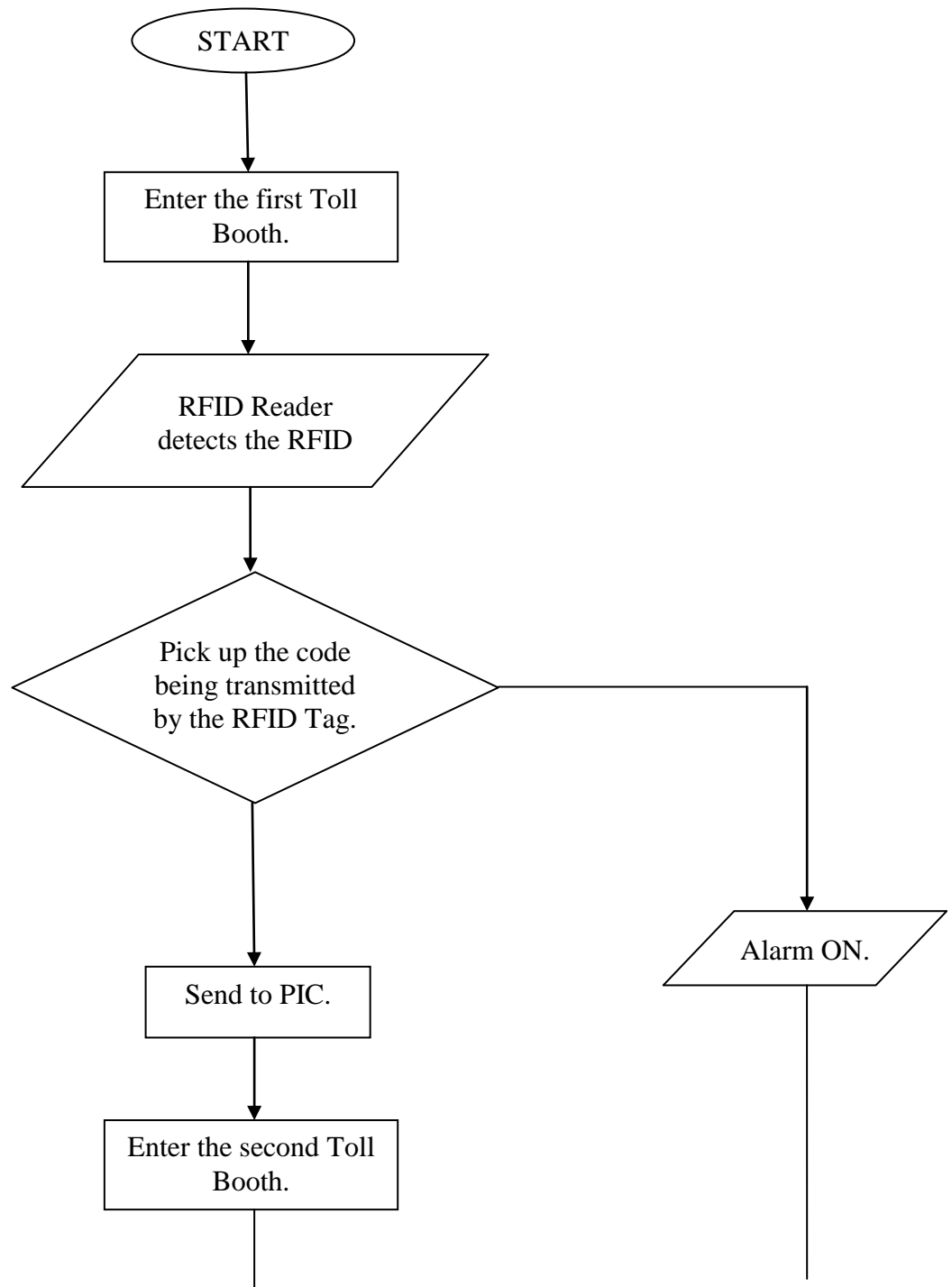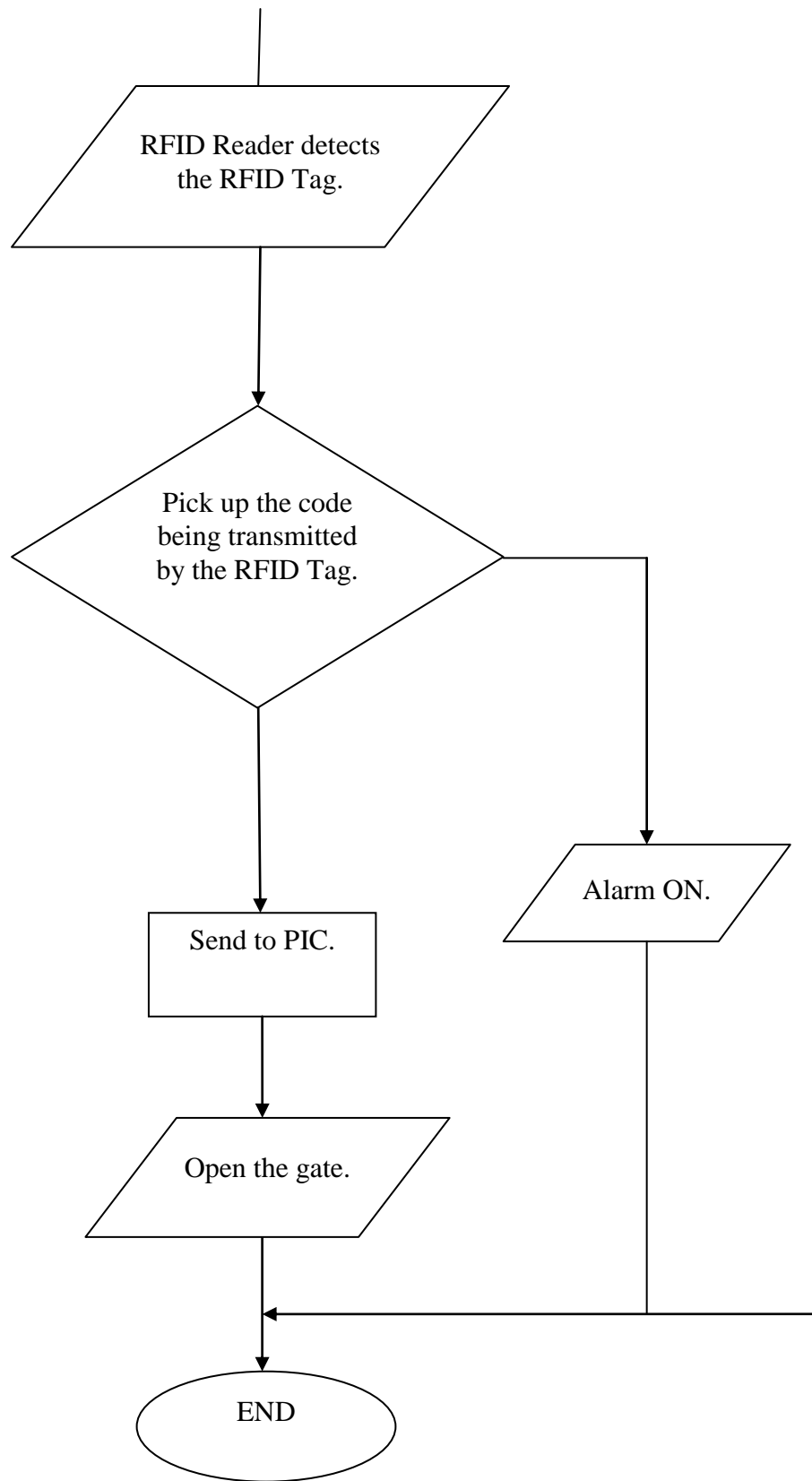
Figure 1.1: Project Methodology.

The steps involved in the methodology:-

1. The program starts when the vehicle enters the first Toll Booth of the expressway.
2. When the vehicle enters the first Toll Booth, the RFID Reader will detect the signal that is sent from the RFID Tag which is attached on the vehicle's windshield.
3. Then, the data will be sent to the Microcontroller Unit via RS232 interface.
4. When the vehicle enters the second Toll Booth, the RFID Reader will once again detect the signal from the RFID Tag.
5. After that, the data will be sent to the Microcontroller Unit. At this time, the data received will be compared to the previous one. This is to make sure that both data are from the same vehicle.
6. Finally, after a while, the gate will be opened to let the vehicle pass through it.
7. If there is any vehicle that is accidently enters the Toll Booth for this system (Online Toll Payment System), the alarm will turn ON.

PIC16F877A will be chosen as the Microcontroller. The software that will be used in this project are CCS C Compiler and also Proteus. The C language will be applied in writing the program.

The tests will be made via simulation in the Proteus program. If the desired inputs are not able to produce the correct outputs, the PIC will be reprogrammed and then being tested again.

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 describes about the research and information which is the literature review of the project. Every facts and information, which are found through by any references 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 discuss 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 about 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.

CHAPTER II

LITERATURE REVIEW

2.1   Previous Study and Research

In order to do this Final Year Project, several research and studies have been done. This is to find information about the main point of this project. Most of the information is taken from the referring books, datasheet, and internet.

2.1.1   Touch n Go

The Touch n Go or smart card is used by Malaysian toll expressway and highway operators as the sole electronic payment system (EPS). The credit card sized smartcard made of plastic with Philips' MIFARE microchip technology embedded in it.

The Touch n Go systems are designed to process up to 800 vehicles per hour to ease the queue congestion at toll plazas and if used together with Smart Tag (a non-stop electronic toll collection system), will be able to process up to 1,200 vehicles per hour.

Touch n Go enhances the convenience and efficiency of paying for low-value but high frequency transactions. It is able to reduce the transaction time effectively at the