Electronic Toll Payment System Using RFID Smart Card

By

Mohd Irfan Bin Badrul Hisham

Dissertation Submitted in Partial Fulfillment of

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(Business Information System)

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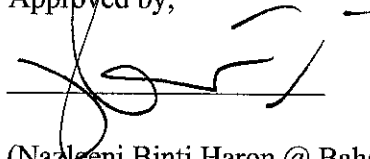
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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the

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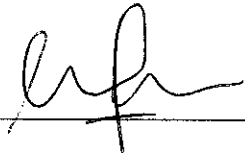Approved by,

(Nazleeni Binti Haron @ Baharon)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

July 2009

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons

MOHD IRFAN BIN BADRUL HISHAM

ACKNOWLEDGEMENT

ABSTRACT

This Degree's Final Year Project presents RFID payment system to be applied to the car toll collection system. The project is entitled "Electronic Toll Payment System Using RFID Smart Card". The objectives are to develop an electronic smart card integrated with RFID technology and prepaid features for toll fare payment purposes. Project's prototype will provide a suitable, fast and up to date technology in collecting toll fare. In actual simulation, it doesn't required interaction between the car owner and the toll but only need the car to pass toll gantry where RFID reader will detect RFID smart card and toll fare payment will be made automatically. Hence, creating an alternative solution for Toll Company which currently using ticketing technology and facing traffic control issues during peak hours. Implementation procedure for this prototype in daily activities, RFID tag serves concurrently as smart card improving current automatic toll payment system, i.e. Touch N' Go. This tag can be programmed to save unique identifier (UID) that determines vehicle information details, retrieved from central database.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Nowadays, technology is an essential factor for our developing country in order to improve efficiency and cross references with time and cost saving. Malaysia has been progressed rapidly in terms of road development transportation. In line with that, toll plaza has been widely built in order to collect fare for the usage of the road infrastructure.

Passing toll has been a daily routine in some area especially to those who live in urban city like Kuala Lumpur. As income per capita for a family has increases, many people in Malaysia are capable to buy two or more vehicles per family. These contribute to traffic issue and accident near toll plaza especially during festive season and peak hours.

Even though, there are innovation in our road for the last 10 years such as the use of Touch 'n Go and Smart Tag but people still prefer to use current ticketing method to avoid expensive smart card reader device and extra fees in smart card reload.

Therefore author has chosen to use Radio Frequency Identification (RFID) as an alternative solution to overcome this issue. The objective is to use RFID smart card (transponder) for toll fare collection. This can be done where each card has a chip inside it which contains different unique identifier (UID) than others. With this chip, it can store information hence capable to be use as payment medium and other further functionality like storing person details. Contactless smart card does not have to interact with smart card reader as it is capable to transmit signal to the reader. In situation where smart card moves at high speed, it can be detectable and transaction can be made. These significant factors made using RFID smart card as

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an alternative that can save time effectively and traffic control efficiency when implemented at toll plaza. Cars do not have to queue and wait since payment can be made fast and easy.

1.2 Project Definition

This project is focusing on Toll Electronic Payment System using RFID smart card. The main challenge for the author is to research and develop toll fare Electronic Payment System (EPS) based on RFID technology. More research focus on contactless smart card as for its feature to perform tasks without any interacts with reader for payment purposes. On this project, EPS made on website platform where it has mechanism to manual reloads, auto reloads, check balance account and also the mechanism to deduct toll fare from user smart card account.

Compare to current toll payment system, RFID technology and this system provides more cheap resources and less hassle. Its only requires the smart card and the reader without third party device like Smart Tag. With auto reload mechanism, user don't have any issue at toll booth example like cannot pass through toll booth when insufficient credit amount or third party device error.

As part of actual implementation, a prototype will be made for mentioned functional and features presentation.

1.3   Problem Statement

1.3.1   Current Payment Method

1.3.1.1 Manual payment

Current ticketing method contributes to heavy traffic jam as vehicles owner need to queue near Toll Plaza especially during peak hours and festive season. This situation happens because vehicles owner want to avoid spending extra money on Smart Tag

1.3.1.2 Touch 'n Go / Smart Tag

- **Add Value/Reload Charge**

  Free reload only available from manual transaction over the counter of Touch 'n Go Hub, Highway Operation Office & "Lorong Tambah Nilai" lanes, major stations of Rapid KL & KTM Komuter. Reload over the ATM and reload agents will incur an additional fee of RM0.50 and RM1.00 at Cash Deposit machine. RM2.00 will be charged for Zingcard autoreload for every RM100. [1]

- **No Usage Discount**

  Concessionary users are charged between 2.0 - 2.5 percent of the profit for using the system. No discount is given but instead card users may have to pay the commission fee. Car park operators usually pass on the Touch 'n Go commission fee onto card users, resulting in users paying 10% more [1].

- **Cheque Refund**

  If the service is terminated, refund for card balance and deposit will only be paid by cheque in one month processing time and will be sent by post by Rangkaian Segar Sdn Bhd [1].

- **Cash Preference**

  Although the system was introduced in the last 10 years, with the support of the Government (particularly by incorporation the system into MyKad), card and concessionary users still prefer to use cash [1].

- **Limited Access Transformation Record**

  However, all E-Statement transaction records within 3 days from the date cannot be viewed through the e-Statement. Fax transactions recorded by phone are however available within 24 hours and mostly depended on data server system [1].

- **Limited CTS Fare Structure**

  Fare structure only applicable for adult. The cards are not available for senior citizen, children, and school uniform & handicapped [1].

  Even though, using Touch 'n Go or Smart Tag can reduce traffic issue but it still require time interval for smart card to touch the toll booth or vehicle need to slow down for toll plaza to detect the smart card for payment purposes.

Photo 1: Smart Tag device

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1.4 Objective

Below are the objectives for this project;

a. To design a prototype for toll fare electronic payment using RFID smart card technology.

b. To develop an Electronic Payment System (EPS) for toll fare system.

1.5 Scope of Study

Below are scopes of study that being divided into several categories, which are;

a. RFID Technology

- RFID Reader / Card Reader

- RFID Tag / Smart Card

- Toll Fare payment

b. Macromedia Dreamweaver, Microsoft FrontPage for smart card website

- Reload smart card prepaid

- Check smart card balance amount

c. Visual Basic .Net – Programming language for Graphical User Interface (GUI) of application system.

d. Microsoft SQL – System store data at this database.

CHAPTER 2

LITERATURE REVIEW

2.1   INTRODUCTION TO RADIO FREQUENCY IDENTIFICATION

Radio frequency identification, or RFID, is a generic term for technologies that use radio waves to automatically identify people or objects. There are several methods of identification, but the most common is to store a serial number that identifies a person or object, and perhaps other information, on a microchip that is attached to an antenna (the chip and the antenna together are called the RFID transponder of the RFID tag). The antenna enables the chip to transmit the identification information to a reader. The reader converts the radio waves reflected back from the RFID tag into digital information that can then be passed on to computers that can make use of it [2].

This literature generally discusses that RFID technology is about interaction between RFID tag and RFID reader. The RFID tag contains unique identification and the reader needs to passes to the unique identification to the database for retrieving information procedure. Other components involves in RFID technology are antenna, transponder, and transceiver.

2.2 INTRODUCTION TO SMART CARD

A Smart Card is a plastic card the size of a credit card with an integrated circuit built into it. This integrated circuit may consist only of EEPROM in the case of a memory card, or it may also contain ROM, RAM and even a CPU.

Most smart cards been designed with the look and feel of a credit or debit card, but can function on at least three levels (credit - debit - personal information). Smart cards include a microchip as the central processing unit, random access memory (RAM) and data storage of around 10MB.

A smart card is a mini-computer without the display screen and keyboard. Smart cards contain a microchip with an integrated circuit capable of processing and storing thousands of bytes of electronic data. Due to the portability and size of smart cards they are seen as the next generation of data exchange [3].

Literature above informs that smart card is made up from plastic card with integrated circuit built attached on it. The integrated circuit built consists of central processing unit (CPU), random access memory (RAM) and data storage. Smart cards can execute three type of function which is credit payment, debit payment and store personal information. As for its small size and mobility, smart card has the potential to be future data exchange medium.

2.3   SMART CARD COMMUNICATE WITH CARD READER

A smart-card chip communicates with a reader by direct physical contact or by a radio frequency (RF) signal, depending on the system design. Three smart-card designs for chip-to-reader communications are:

· Contact cards

· Contactless cards

· Combination cards [4]

A card reader can be used to determine what information is encrypted inside smart-card chip. It interacts with smart card using radio frequency (RF) depend on the smart card's system architecture design. From this literature, the author has been informed that there are three types of smart cards which are contact cards, contactless cards and combination cards.

2.4   CONTACT SMART CARD ARCITECHTURE AND DESIGN

Contact smart cards are the most popular card-connection design, and are used for both card sizes and chip types. Figure 1 depicts the contact-type card.
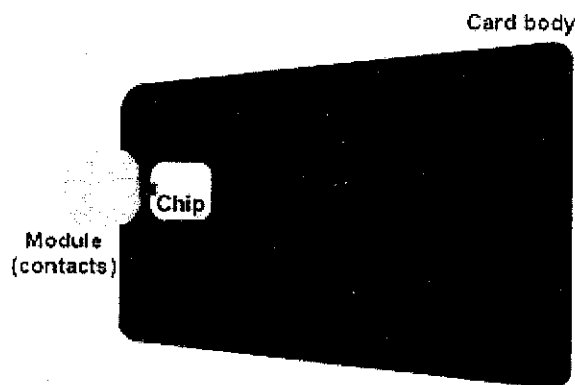
Figure 1: Contact Smart Card

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Contact cards use an eight-pin contact, micromodule to physically connect to the card reader. Five pins are defined as Vcc (+5 VDC), reset, clock, ground, and input/output (I/O). Figure 2 shows an example of a typical contact card module [4].

Typical Module

C1 - Vcc (+5 VDC)   C5 - ground
C2 - reset   C6 - reserved
C3 - clock   C7 - input/output
C4 - reserved   C8 - reserved
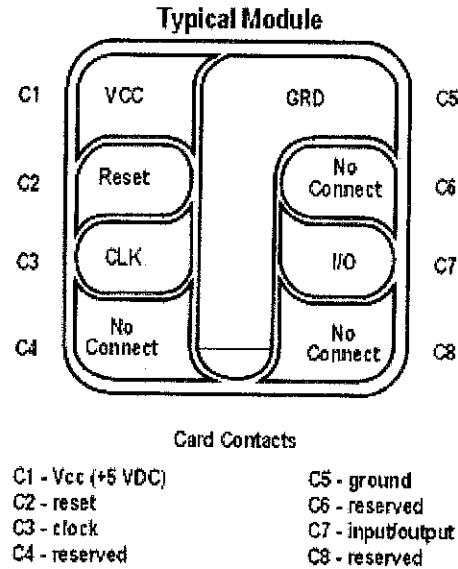
Figure 2: Eight-Pin Micromodule [6]

Based on the literature, contact cards is using eight-point contact which must physically connect to the card reader for retrieving data stored inside the chip. The author has been informed how eight-point microchip being embedded in the smart card and the architecture system of contact smart card.

2.5   INTRODUCTION TO CONTACTLESS SMART CARD

The term Contactless smart card refers to identification cards (for example, some credit cards) that do not need to make contact with the reader to be read, or swiped in a special slot. This capability is implemented using a tiny RFID tag in the card; the intent is to provide the user with greater convenience by speeding checkout or authentication processes [5].

From this literature, author discovered that contactless smart card contain tiny RFID tag. Author can imagine the transaction exchange data happen between transponder (contactless smart card) and transceiver (RFID reader). Although the smart card can only be used for public transportation payment or other electronic purse application, is possible to use this smart card in toll collection context if high frequency chip integrated with the smart card. Toll fare payment can be made without vehicle owner need to stop to pay toll fare at toll booth. Contactless smart card will be read by high frequency RFID reader (transponder) and deduct the toll fare from smart card with condition that the vehicle only need to pass the toll gantry where RFID reader is located.

2.6   CONTACTLESS SMART CARD ARCHITECTURE AND DESIGN

Contactless smart cards as shown in Figure 4 use an antenna with approximately a 10-centimeter (cm) range to communicate with the reader. These credit-card sized memory-chip devices derive their power from an RF field generated by the card reader. The RF field also transfers information to and from the card and card reader. Employee identification badges issued by large companies for building access are typically contactless smart cards [4].
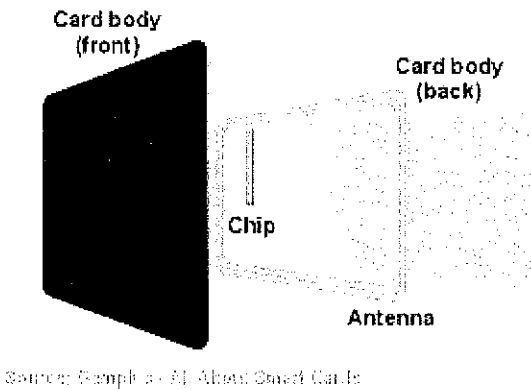
Figure 3: Contactless Smart Card [6]

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From the literature, contactless smart card is consists of plastic card, chip and antenna. The contactsless smart card interacts with card reader trough RFID signal transmits. It can be shown from the Figure 4 where from the chip, it sends signal to antenna and the signal roams to the card reader for exchanging data procedures.

2.7   INTRODUCTION TO COMBINATION SMART CARD

Multipurpose combination smart cards are a hybrid mix of the contact and contactless designs. They include the eight-pin contact for communication with a contact-type reader, and also include an antenna for communication with an RF-type reader [4].

Combination smart card is mixture between contact and contactless smart card. This indicates that combination smart card has both function and design together.

2.8   INTELLIGENT TRANSPORTATION SYSTEM (ITS)

"ITS" stands for "Intelligent Transportation Systems," which are systems that utilize electronics, communications and information processing to improve the efficiency and safety of surface transportation [6].

This literature informs that Intelligent Transportation System is about minimizing cost, times, efficiency traveling and provide new technology solution for transportation sector.

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2.9 ELECTRONIC TOLL COLLECTION (ETC) OVERVIEW

In some urban settings, automated gates are in use in electronic-toll lanes, with 5 mph (8 km/h) legal limits on speed (and 2 to 3 times that as practical limits even with practice and extreme concentration); in other settings, 20 mph (35 km/h) legal limits are not uncommon. However, in other areas such as Dallas, Texas, the Garden State Parkway in New Jersey, and at various locations in Florida, cars can travel through electronic lanes at full speed. Illinois' Open Road Tolling program features 274 contiguous miles of barrier-free roadways, where I-PASS or E-ZPass users continue to travel at highway speeds through toll plazas, while cash payers pull off the main roadway to pay at tollbooths. Currently over 75% of Illinois' 1.4 million daily drivers use an I-PASS [7].

From this literature, this is an example of Smart Tag where vehicle owner needs to slow down for automated gates to detect the Smart Tag for toll payment. By using smart card I-Pass or E-ZPass which use RFID technology can continue to travel at high speed through toll plazas without need to slow down like Smart Tag usage in Malaysia.

Electronic Toll Collection
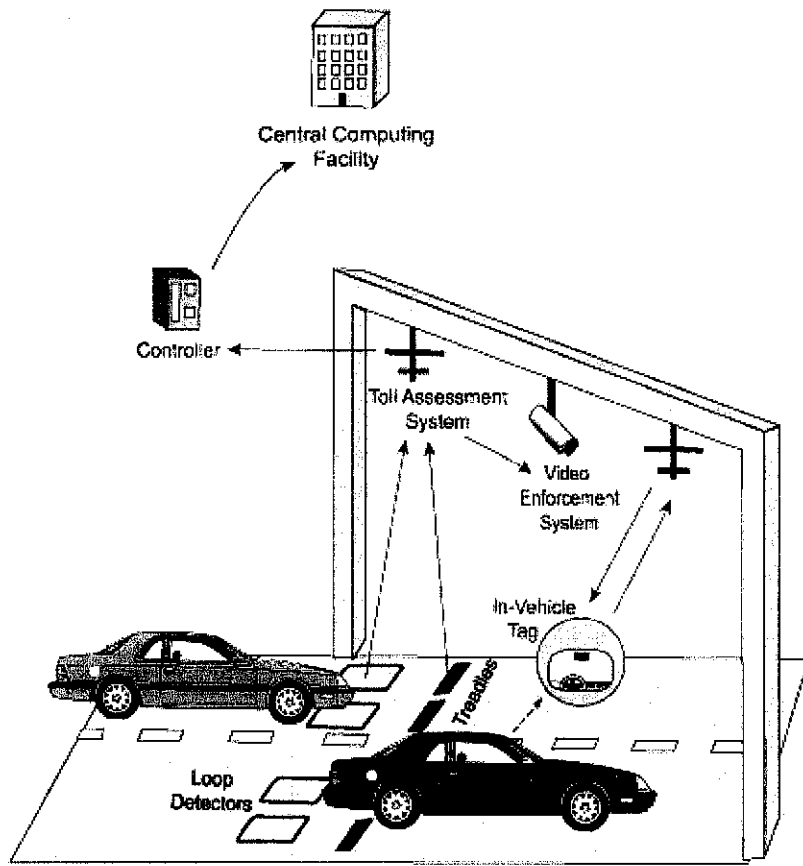
Figure 4: Electronic Toll Collection system flow

2.10 ELECTRONIC ROAD PRICING (ERP)

The Electronic Road Pricing (ERP) (Malay: Sistem Kadar Jalan Elektronik) scheme is an electronic toll collection scheme adopted in Singapore to manage traffic by road pricing, and as a usage-based taxation mechanism to complement the purchase-based Certificate of Entitlement system. The ERP was implemented by the Land Transport Authority in September 1998 too replace the Singapore Area Licensing Scheme after successfully stress-testing the system with speeding Lamborghinis, Porsches and Ferraris. Singapore was the first city in the world to implement an electronic road toll collection system for purposes of congestion pricing [8].

This literature shows in Singapore that RFID technology can be used to manage trafficking issue by usage-based road pricing depend on peak hours and easy toll payment. Vehicle owner also can drive full speed without slowing for toll fare payment.

The new ez-link card, available for sale now in Singapore, can be used for train and bus fares, electronic road pricing fees and even at 7-Eleven convenience stores and McDonald's restaurants. The stored value of the new card has also been increased to a maximum of about U.S. $350 up from U.S. $65 for the existing card.

From January, all passengers will be able to exchange their old ez-link cards for the new ones, for free. Currently, there are more than 10 million ez-link cards in circulation. However, as one analyst pointed out, more merchants are needed for these types of smart cards to be successful [9].

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Ez-link is a smart card that being use to pay public transportation fare and Electronic Road Pricing (ERP) toll fees. This smart card can be easily found at kiosk or convenience shop. It helps consumers to use this smart card for electronic payment system as it portable and easy to be use.

There are lots of demand for this smart card as in Singapore only, it has more than 10 million ez-link card being used. It shows that consumer in support of technology that helps their daily life.

2.11 IMPLEMENTATION OF RFID SMART CARD

Michael Madden, VP of e-business development for Mastercard International, said that using a contactless smart card could reduce the average transaction by 15 seconds. And since customers don't have to figure out how to swipe a card through a reader, the shopping experience is more satisfying. That kind of speed and convenience often leads to an increase in purchases, according to the Alliance. For example, ExxonMobil, has more than six million customers who use its Speedpass contactless payment option. After introducing the RFID device, the company found that customers who used Speedpass spent about 15 percent more, which resulted in a 4 percent increase in total gasoline sales [10].

From this article, RFID contactless smart card called Speedpass can be used for fuel payment. Customer doesn't need to swipe the card through a reader and able to shop more conveniently. This can be applied in this project where toll payment with RFID contactless smart card.

The Utah Transport Authority, following a successful pilot, is paving the way for contactless credit cards to be used as a fare payment medium. Boston-based MetraTech Corp., a billing and settlement provider and automated fare collection company the ERG Group, will be developing and implementing the new fare collection system which will include other types of smart cards as well [11].

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Based on the literature above, contactless smart card can be used as fare payment medium. This smart card has been linked with participating banks for their credit cards features. Customer can pay their fare using latest technology without any hassle to swipe the credit card.

Pakistan now joins the list of growing countries where RFID (Radio Frequency Identification) based electronic toll collection is in use. For now it has been introduced on Peshawar - Islamabad M1 and Islamabad - Lahore M2 Motorways. This technology allows the vehicles to pass through toll booths without stopping and toll amount is automatically deducted from the money account on record. Here is how the system works. An RFID tag (transponder) is now available free-of-cost to motorists using Lahore, Islamabad and Peshawar toll plazas. This tag is attached to a car's wind shield [12].

This article shows that RFID technology can be implementing in electronic payment system. It saves user's time and avoids traffic jam at toll plaza. User's does not need to stop or slow down the vehicle speed for RFID reader to detect the tag. It also can deduct toll fare from RFID tag that link with prepaid account which user already top up before.

CHAPTER 3

METHODOLOGY

3.1   SYSTEM METHODOLOGY

System methodology that will be used in this project is Rapid Application Design (RAD) methodology. This methodology provides a means to develop system faster, while reducing cost and increasing quality. Iterative development cycles in this methodology are document requirements, design, develop and test cycles.

The reason why author choose this method is to develop rapid development and can achieve high quality results than traditional development result. It also enables product to develop faster and saving valuable resources. After have been review with user, the system will apply Joint Application Development (JAD). This is where hardware and software join together to see whether there are compatible or not. Many testing will be conducted during this last phase to enhance the system to meet the objectives of this project.

Traditional Development

| Planning | ► | Analysis | ► | Design | ► | Build | ► | Test | ► | Deploy |

► Compress ◄

RAD

Document Requirements ► Design

JAD   Iterative Development   Develop

User Review ◄ Test
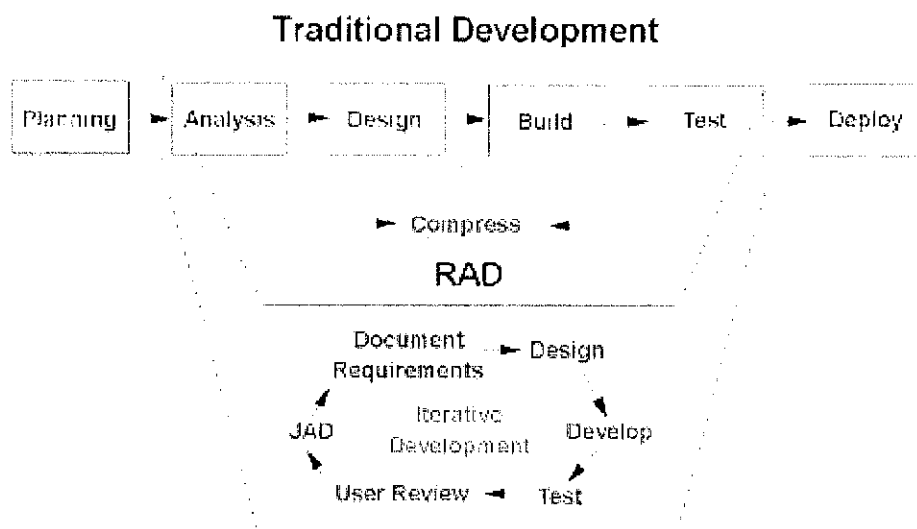
Figure 5: Traditional development and Rapid Application Design methodology

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3.1.1 Planning

During this phase, author has identified the issue faced and set objectives of the project to overcome this issue. Sufficient information has been gathered into supporting this project to be successful and achieve the objectives. Appropriate hardware component, programming language, database server need to be decided by author.

Programming language used is Visual Basic .Net (VB .NET) and Microsoft SQL as the database for this project's prototyping product. As for hardware to use, author need to analyze which the best component that meet the requirement for this project.

3.1.2 Analysis

For this phase, detail research need to be conducted as to find the most suitable hardware component and compatible with the system planned. Information collected by the author has been used to develop and built the prototype with required functionality for this project. Research on journal, article and project related website on the Internet has been performing during this stage.

3.1.3 Design

On this phase, the system is drafted according to information gathering during analysis phase. System interface and algorithm has been identified during this phase in order to perform functionality of prototype system from:

User's side	Web Admin
Check balance account.	Deduct toll fare from smart card
Manual Reload RFID smart card.	account.

For auto reload mechanism, each time the card balance falls below RM50, it will trigger the auto-reload mechanism to reload RM100 into the card. In this project, if owner's bank balance is below RM50, summon statement will be issued to the vehicle owner after it pass the toll plaza for toll payment.

This is to ensure that every auto reload cardholder will not be interrupted at lanes should their previous debit transactions face difficulties or being rejected. This will allow sometimes for the user to regularize his/her account and still be able to use his/her card.

3.1.4 Testing

During this phase, RFID device kit is being tested for its functionality. Tests on users and other necessary testing implanted to meet prototype objectives.
Interaction between device and prototype system is the most important for the system to perform accordingly.

3.1.5 Implementation

Result and output of previous phase need to be gathered in this last phase. This is where actual development of the system is started. System implemention is running side by side with testing phase for enhance quality and reduce errors. When testing result meet with satisfaction, the system is then being used by targeted users (drivers). Further feedback from targeted user used as additional information for system improvising.

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No.	Detail/ Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Selection of Project Topic	■													
	- Propose Topic														
	- Confirmation of Topic Selection														
2	Preliminary Research Work		■	■											
	- Data collection and literature review														
	- Identifying software and tools required			●											
3	Submission of Preliminary Report														
4	Project Work			■	■	■	■	■	■	■					
	- Data adding and report correcting										●				
5	Submission of Progress Report														
	-Literature Review														
6	Project work continue											■			
	- Modelling and correcting data														
7	Interim Report Final Draft Submission												●		
8	Oral Presentation													●	
9	Submission of Interim Report														●

●   Milestone

■   Process   20

3.2.2 FINAL YEAR PROJECT II

No.	Task Details	Duration
1	**Project Design (During Semester Break)**	**7 weeks**
	Research Work	2 weeks
	Project Work (Design GUI System)	3 weeks
	Device Configuration	2 weeks
2	**Project Implementation**	**15 weeks**
	Project Work (Prototyping)	2 weeks
	Progress Report I Submission	1 week
	Project Work Continue (Prototyping and GUI System)	3 weeks
	Progress Report II Submission	1 week
	Seminar II	1 week
	Project Work Continue (Prototyping and GUI System)	3 weeks
	Poster Exhibition and Pre-Edx	1 week
	Dissertation Submission (Soft Bound)	1 week
	Oral Presentation	1 week
	Project Dissertation Submission (Hard Bound)	1 week

CHAPTER 4

RESULT AND DISCUSSION

4.1   ANALYSIS RESULT

4.1.1   Touch 'n Go / SmartTAG Disadvantage

Based on resources materials, SmartTAG technology is using infrared light communications [14]. Infrared signal cover less distance than RFID signal. Below are the requirement steps for Infrared SmartTAG to execute its tasks:

1.   **Require to place SmartTAG infrared panel at wind shield**

- The SmartTAG operates based on line-of-sight, just like television remote control. User requires ensuring that SmartTAG infrared panel (black panel) is pointing upwards, facing the toll gantry in order for the reader to detect Touch 'n Go card. User cannot wave or hold the SmartTAG with hand because movement may also interfere the data transmission. In addition, user's finger may also block the infrared panel. The best way is to place the SmartTAG on the given bracket, properly installed at the lower centre of car's windscreen. As SmartTAG device is expensive and located near to driver's windscreen, thief may smash the car's windscreen in order to obtain the device. With RFID smart card, in any direction as long as it facing the reader, it can be detectable [15].

2. SmartTAG battery

- Weak battery can interfere infrared transmission. SmartTAG battery level is indicated on the LCD screen every time a user presses the balance checker button. Battery lifespan varies according to usage frequency. User should change the battery when the sign on the LCD screen indicates "LO" or when there is a continuous "beep" sound at the toll lane [15].

  As active RFID smart card does require battery power similar to SmartTAG but RFID signal can transmit more distance than infrared signal.

3. Slow down vehicle speed at SmartTAG lane

- User has to reduce vehicle speed to below 40km/h as user enter the SmartTAG detection zone (20 metres from the toll gantry). For vehicles with tinted windscreen, the recommended speed is 20km/h. Active RFID smart card can transmit data eventhough vehicle run at high speed [15].

Table 1: Comparisons among heterogeneous positioning technologies [16]

Technology / Items	GPS	GSM	WLAN	Bluetooth	Infrared	RFID
Range	Wide area	Wide area	Micro area	Micro area	Pico area	Pico area
Accuracy	No signal	Low	Low	Low	High	High
Signal Error Rate	No signal	Low	Mid	Low	Lowest	Lowest
Power Consumption	Low	Low	High	High	Low	Low
Hardware Cost	High	High	High	High	Low	Low
Implementation Complexity	High	High	High	High	Low	Low

4.1.2   Contactless Smart Card

Based on analysis, author decided to use Contactless RFID smart card for its function and features. Contactless smart card attribute like detection signal between smart card and reader within wider distance, external energy and strong signal meet the hardware requirement for prototype of this project.

Smart Card has two types:

- Contact
    - Functioning when near to smart card reader where energy transfer from reader to the card
    - Close distance between reader and smart card
    - Do not have batteries

- Contacless
    - Communicate with card reader through RFID technology
    - Wide distance between reader and smart card depend on Radio Frequency (RF) signal.
    - Do not have batteries but built-in inductor capture some radio frequency then built-in rectifier rectifies it to be use as energy for the card electronics.

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RFID Tag has two types:

- Passive
  - Depend on RFID reader to transfer the energy to the tag
  - Require strong signal from RFID reader.

- Active
  - Uses batteries within the tag to continuously power the tag and its Radio Frequency communication circuit.
  - Require only low-level signal.

Table 2: Comparison between other wireless technologies [17]

Features	RFID	Wi-Fi	Bluetooth
Communication Technologies	Wireless Personal Area Network (WPAN)	Wireless Personal Area Network (WPAN)	Wireless Personal Area Network (WPAN)
Range	~1 - 5 m	~32m(indoors) – 92m(outdoors)	~100 m
Throughout	Small fixed sized	< 54 Mbps	< 3 Mbps
Battery	Up to infinite	High	Moderate
Application	Identification, Inventory	Cable replacement	Cable replacement

4.1.3   Introduction of hardware device.

The DLP-RFID1 is a low-cost, USB-powered module for reading and writing ISO 15693, ISO 18000-3, and Tag-it™ passive RFID transponder tags. It has the ability to both read and write up to 256 bytes of data in addition to reading the unique identifier (UID).

All of the DLP-RFID1's electronics and antenna reside inside the unit and all operational power is taken from PC via the USB interface. The range of the internal antenna is from 2-4 inches depending upon the size of the transponder tag.

The DLP-RFID1 is available with a pack of 10 RFID transponder tags with the following features:

- UID - permanent serial number
- Easy peel-and-stick application
- Also available as an OEM module (DLP-RFID1-OG)
- Support Windows/Windows CE/Linux/Mac Operating System
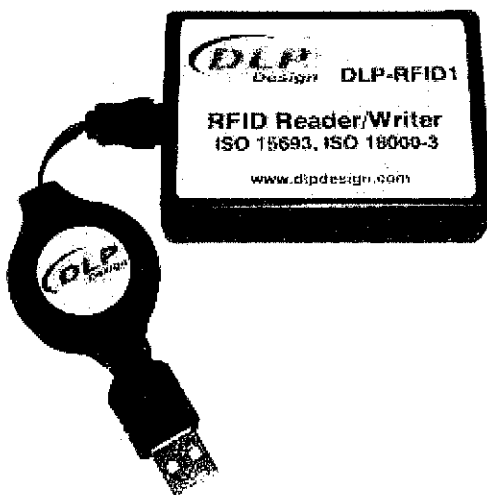
Photo 2: High Frequency RFID Reader and RFID Smart Card [18].

4.1.4 Device demonstration

For this project, author is using Visual Basic .Net to design system interface. Prototype can be linked to RFID Software Development Kit (SDK) because it has its own library. Figure 6 shows demo program that being used by DLP-RFID1 to identify the unique identifier that indicate the presence of RFID tag (4 tags).

Figure 6: Demo program shows UID for each tag identify by reader.

4.2   DESIGN RESULT

4.2.1   System Flow

Flowchart Diagram for RFID Solution

```
                                    ●
                                    │
              ┌─────────────────────────────────────────┐
              │  Information Gathering of RFID           │
              │  Technology                              │
              └─────────────────────────────────────────┘
                                    │
              ┌─────────────────────────────────────────┐
              │ Research about parties involved regarding│
              │ problem and solution                     │
              └─────────────────────────────────────────┘
                                    │
              ┌─────────────────────────────────────────┐
              │ Equipments (RFID tag and reader) setup   │
              │ and Devices troubleshooting              │
              └─────────────────────────────────────────┘
                                    │
                              ◇ Check        ┌─────┐   ┌──────────────────────────────┐
                              Equipment ─────│ No  │───│ Check with RFID distributor  │
                                             └─────┘   │ for suitable equipment.      │
                                    │                  └──────────────────────────────┘
                               ┌─────┐
                               │ Yes │
                               └─────┘
              ┌─────────────────────────────────────────┐
              │ Develop GUI using Visual Basic .NET      │
              └─────────────────────────────────────────┘
                                    │
              ┌─────────────────────────────────────────┐
              │ Setup Database (MS SQL) and connect to   │
              │ GUI via Visual Basic .NET                │
              └─────────────────────────────────────────┘
                                    │
                              ◇ Satisfied?  ┌─────┐
                                        ────│ No  │
                                            └─────┘
                                    │
                               ┌─────┐
                               │ Yes │
                               └─────┘
              ┌─────────────────────────────────────────┐
              │ Develop Prototype                        │
              └─────────────────────────────────────────┘
                                    │
              ┌─────────────────────────────────────────┐
              │ System Testing                           │
              └─────────────────────────────────────────┘
                                    │
                              ◇ Testing     ┌─────┐
                              Successful? ───│ No  │
                                            └─────┘
                                    │
                               ┌─────┐
                               │ Yes │
                               └─────┘
              ┌─────────────────────────────────────────┐
              │ Final Presentation                       │
              └─────────────────────────────────────────┘
                                    │
                                    ○
```
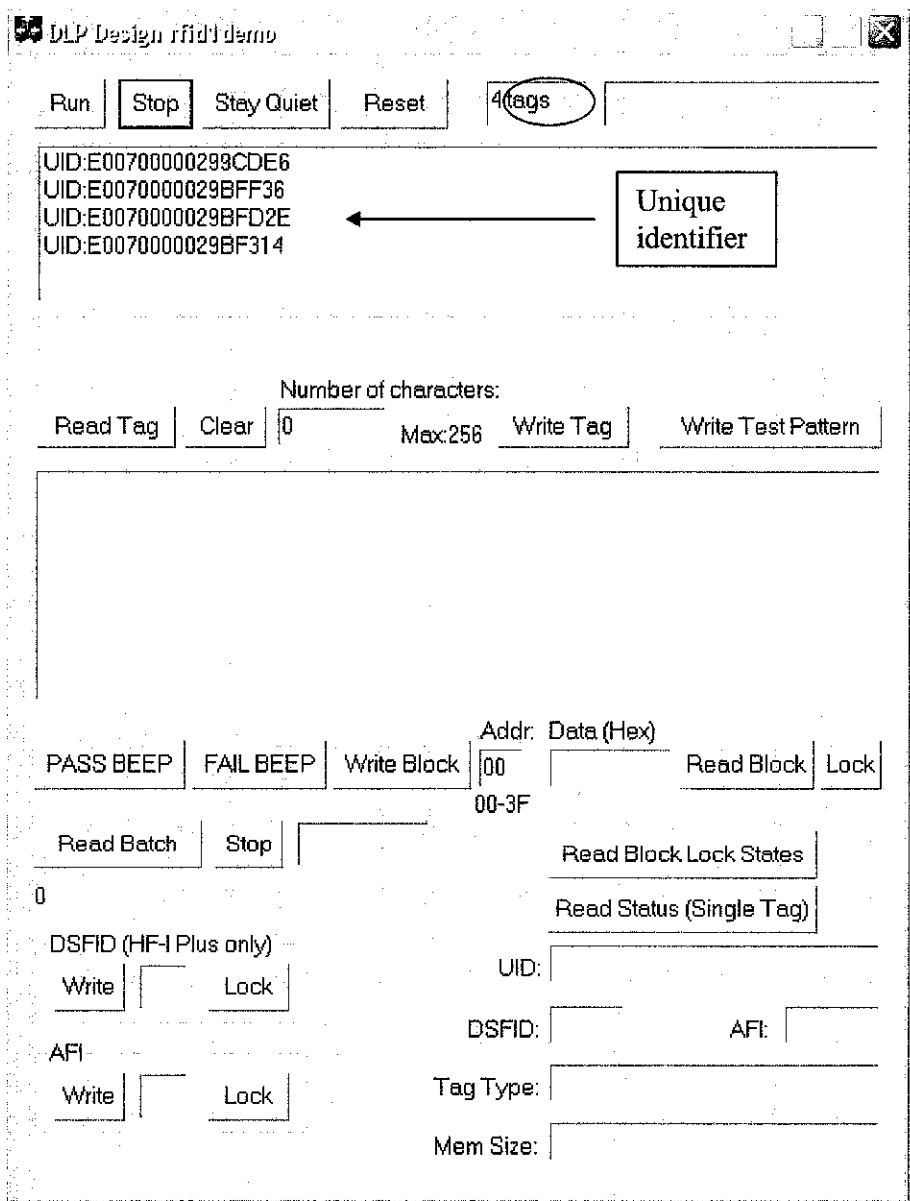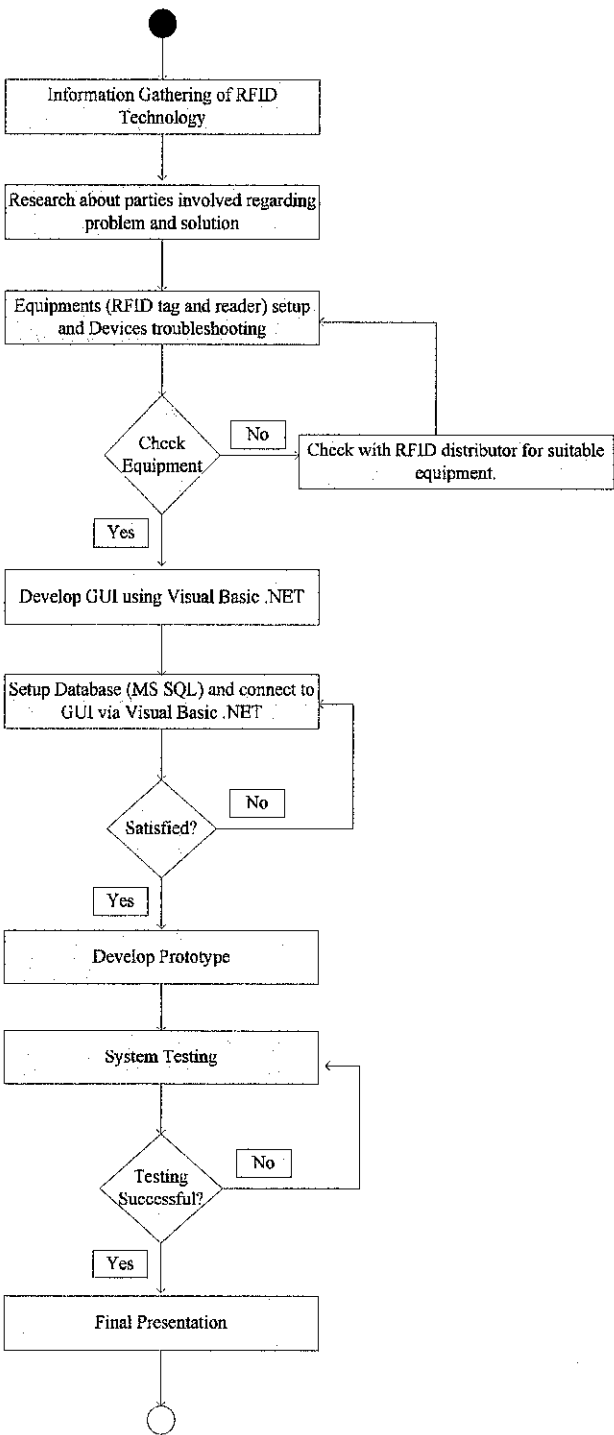
28

Regarding the system flow chart, the author requires to gather sufficient information about RFID technology. Then proceed with research about component and parties involve with problem and solution. In order to find the correct device, proper troubleshooting that meet project's objectives need to be done. After that, develop the system using proposed tools which are Visual Basic .NET and Microsoft SQL. When the system has finished develop, the author require to perform testing on the system to ensure ease of usability and ease of efficiency of the system
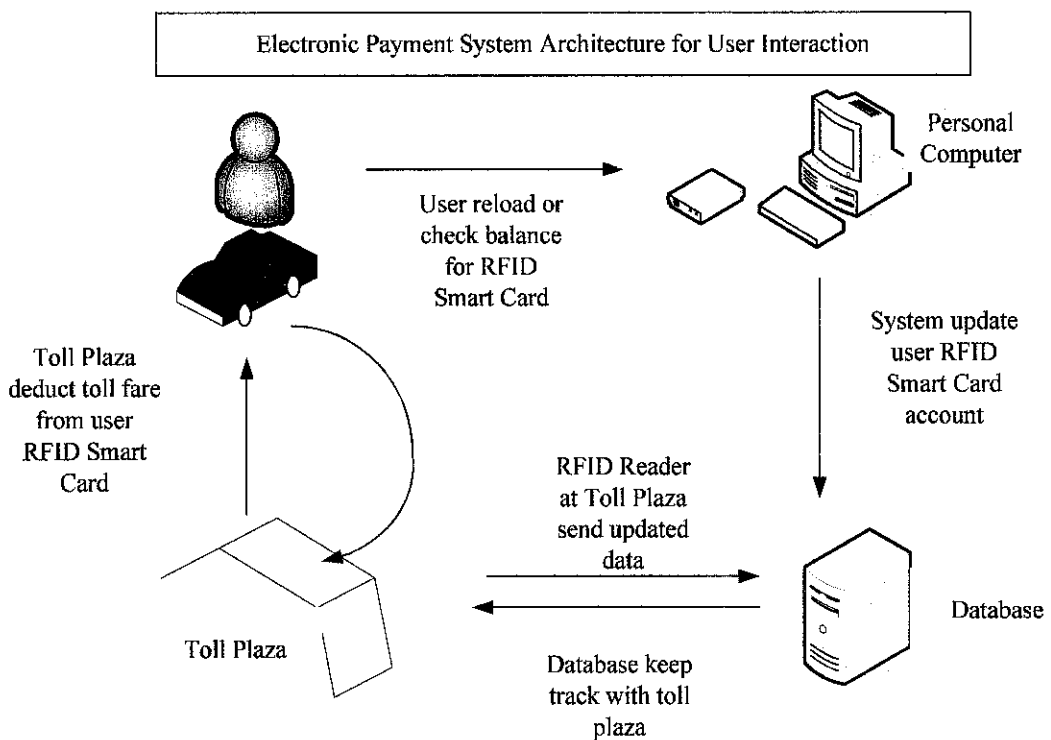

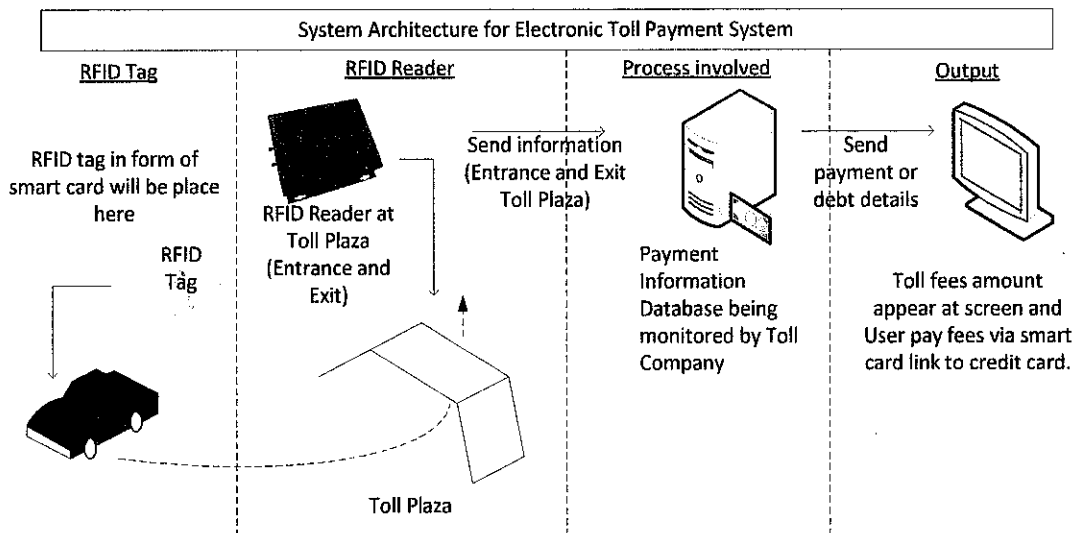*Figure 7: Electronic Payment System Architecture from User side*

System Architecture for Electronic Toll Payment System			
RFID Tag	RFID Reader	Process involved	Output
RFID tag in form of smart card will be place here	RFID Reader at Toll Plaza (Entrance and Exit)	Send information (Entrance and Exit Toll Plaza)	Send payment or debt details
RFID Tag		Payment Information Database being monitored by Toll Company	Toll fees amount appear at screen and User pay fees via smart card link to credit card.
	Toll Plaza		

Figure 8: RFID Architecture for Tracking and Payment System

After user has reloaded his smart card or check balance account using personal computer, the user can start his journey driving trough the highway. When arriving at toll plaza, RFID reader detects user's smart card and automatically deducts toll fare accumulated from smart card account. Hence, server updated data receive from RFID reader. In actual simulation, user does not have to slow down as RFID reader capable to detect RFID smart card although the card moves at high speed.

4.2.2 System Flow

Payment Database

After receiving UID info from toll booth, this system will automatically calculate toll fees and deduce from user account via RFID Smart Card

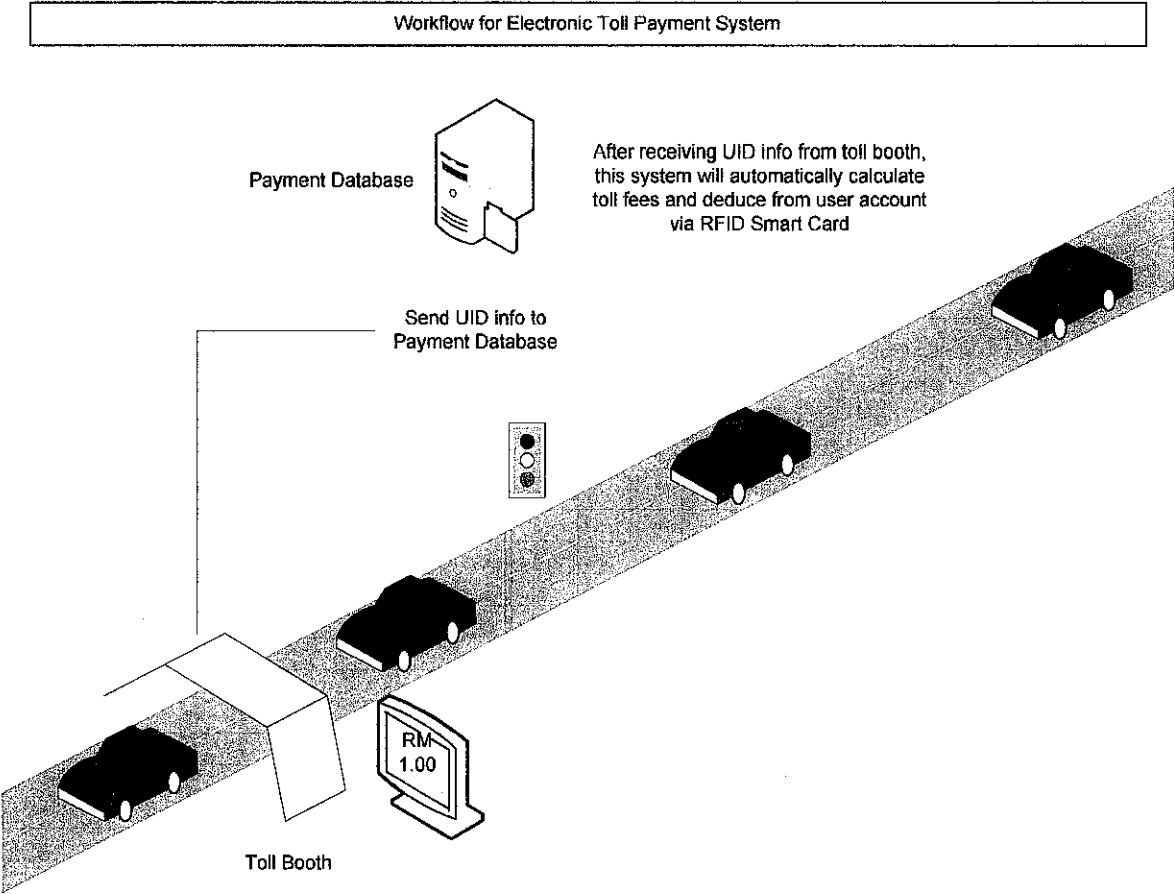Send UID info to Payment Database

RM 1.00

Toll Booth

Figure 9: System Workflow for Electronic Payment System

When the vehicles pass the toll plaza, RFID reader detects the smart card and sends UID to the Payment Database to retrieve user's account balance. Then prototype system deduct toll fares based user's account balance retrieved from database. After that, update user's account balance at the database.

4.2.3 Electronic Payment System

From user's perspective when using the client website, prototype system has two (2) functions which are:

- Manual reload smart card prepaid via Internet.
- Balance smart card enquiry.

As for system administrator's perspective from server site, prototype system has four (4) functions where it can:

- Register smart card with user details
- Add auto-deduct and auto- reload features on selected smart card
- Deduct toll fare from selected smart card
- View monthly statistics archive
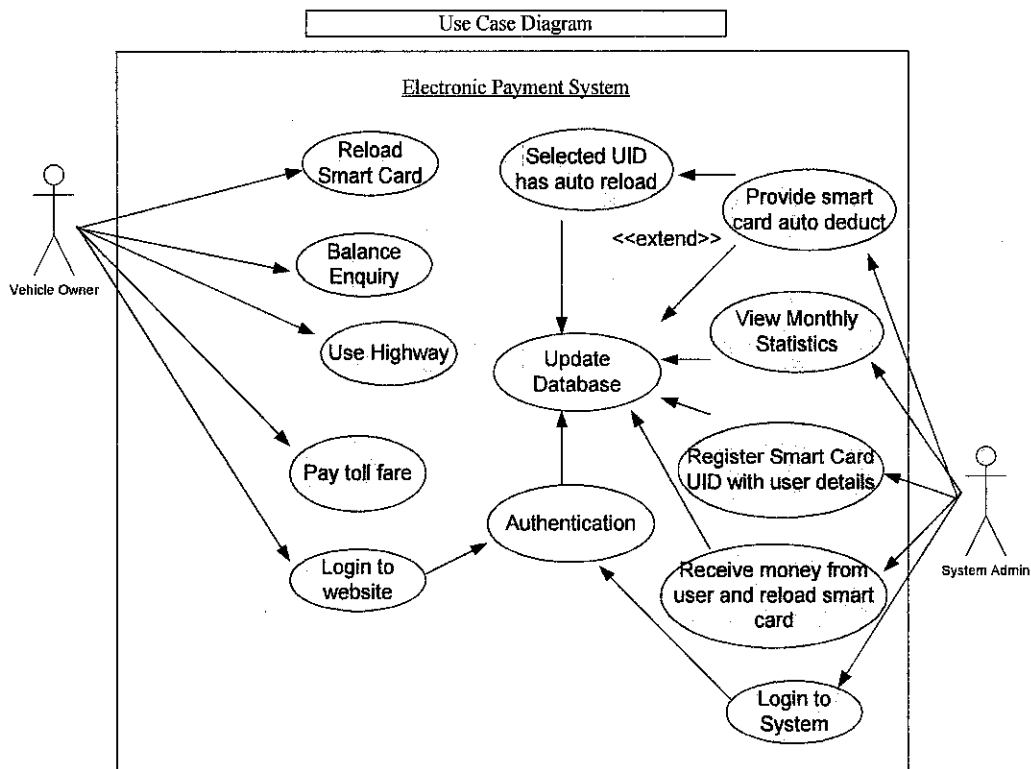
Figure 10: Use Case Diagram for Electronic Toll Payment System

4.2.4   Flowchart Electronic Payment System (EPS)

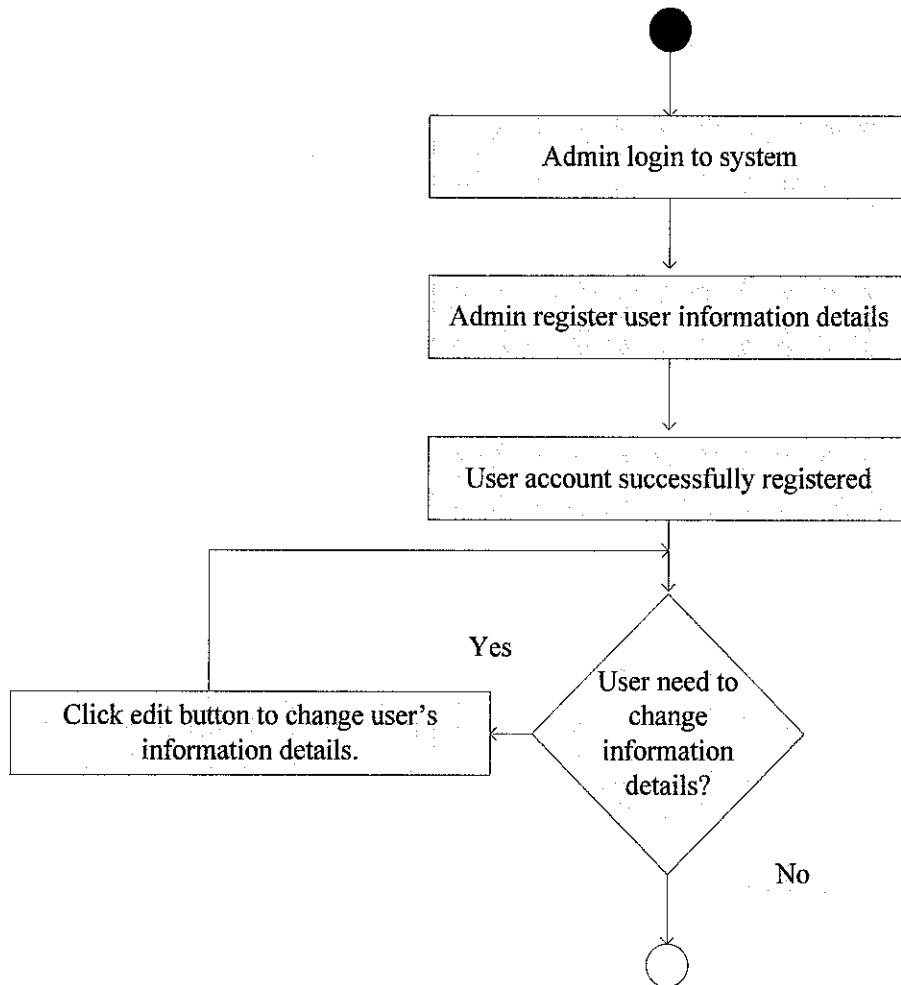<u>**Flowchart Diagram for EPS User Registration**</u>

Figure 11: Flowchart Diagram for Electronic Toll Payment System User Registration

Admin has the authority to register new user's account and edit existing user's account. RM 10 will be added into the new registered smart card. If users want to change information details, they can request it to be change at admin.
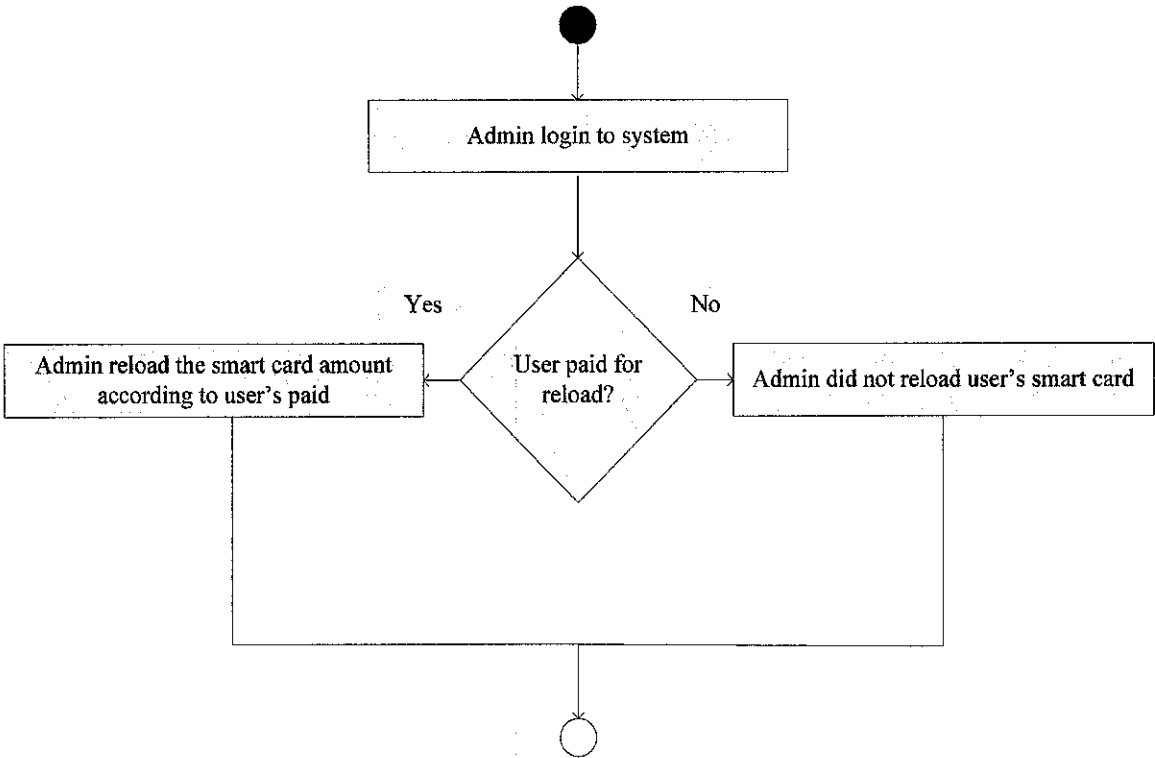
33

Flowchart Diagram for EPS Manual Reload

Figure 12: Flowchart Diagram for Electronic Toll Payment System Manual Reload

This mechanism requires interaction between user and admin. If user want to manual reload the smart card, they need to pay the admin certain amount that will be reloaded into their smart card. After payment has been made, admin reload the smart card amount according to the amount that user paid.
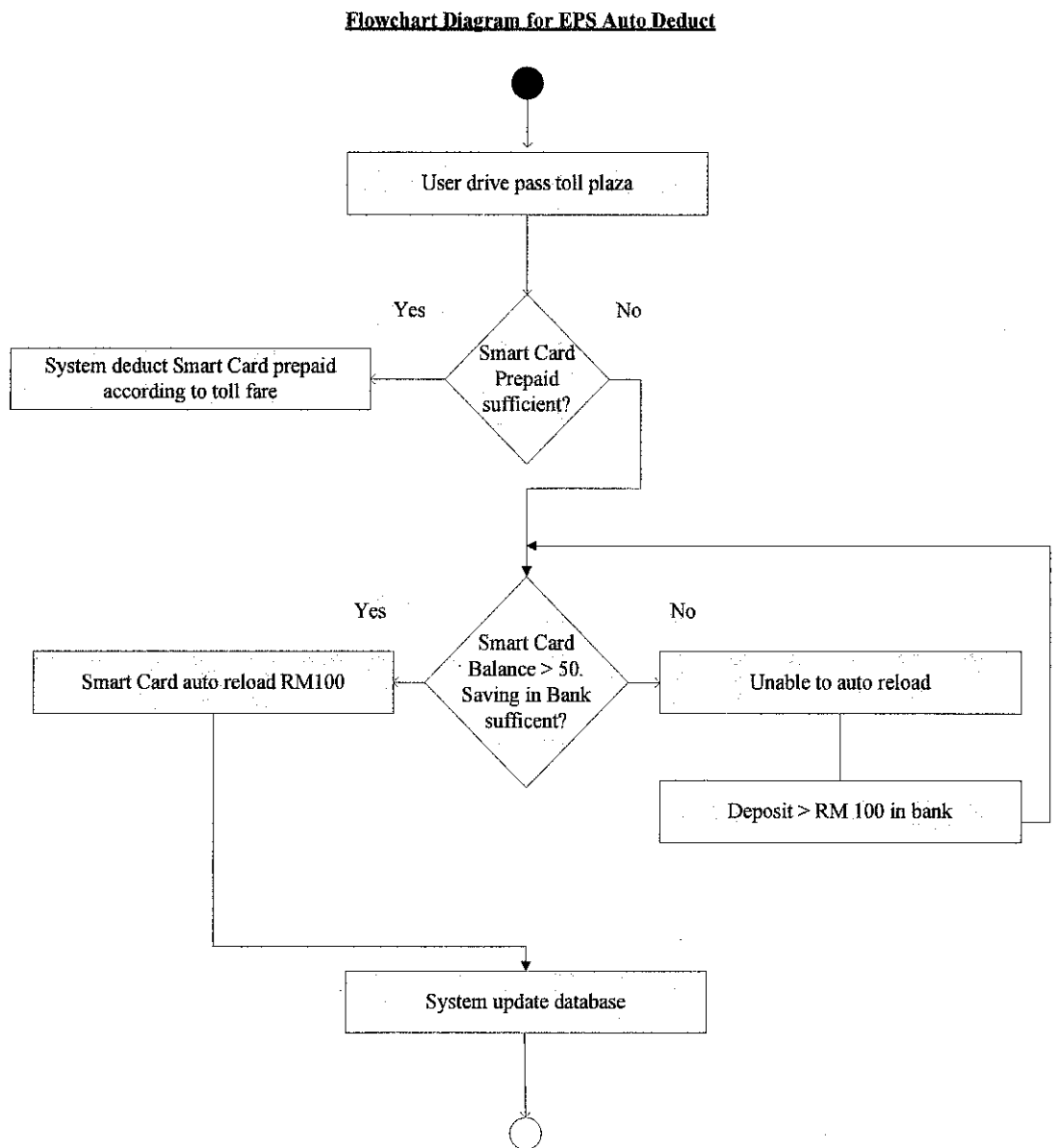
34

Figure 13: Flowchart Diagram for Electronic Toll Payment System Auto Deduct

Next mechanisms is auto deduct where it can be start and stop session according to admin conveniences. During start session, this mechanism will auto detect presence of the smart cards. When that happens, the system will retrieve UID details and payment process and database update will be executed. In actual simulation, if smart card balance is below RM 50 ringgit,

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the system will charge RM100 from user's bank account and reload into smart card to make user's journey more easy and hassle-free.

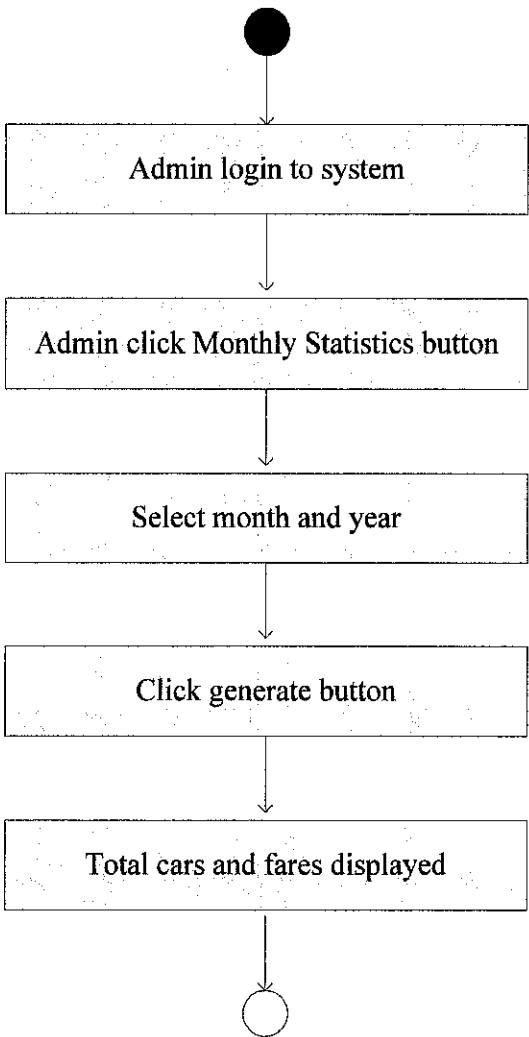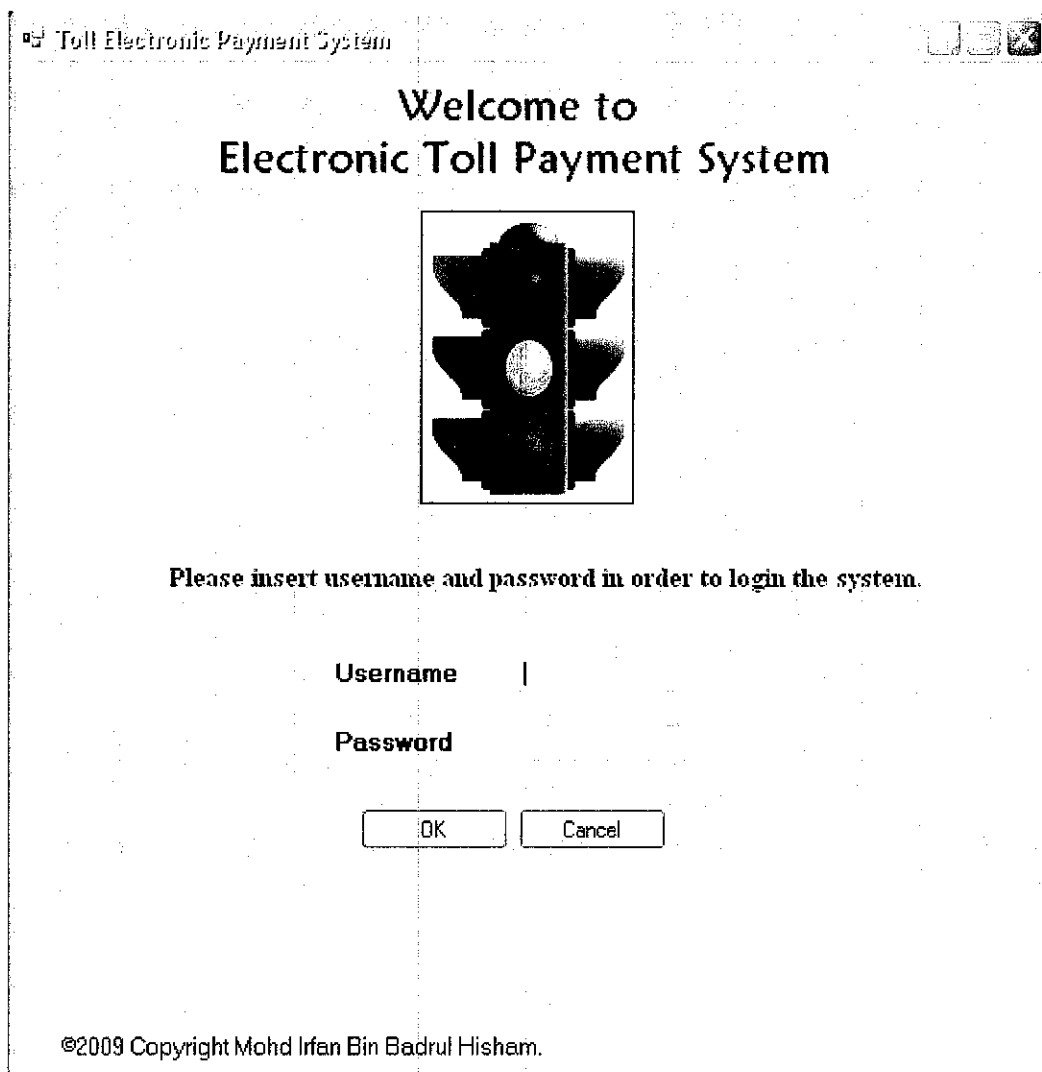**Flowchart Diagram for EPS Monthly Statistics**

Figure 14: Flowchart Diagram for Electronic Toll Payment System Monthly Statistics

With this mechanism, admin can retrieve total cars and fares for particular month and year. After select this mechanism, admin require to select month and year then click generate button. Total cars and fares will be displayed at given boxes.

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4.2.5   System Graphical User Interface

Author successfully managed to develop the prototype using Visual Basic .Net. Pictures below show how the prototype looks like and together with the function of the system.
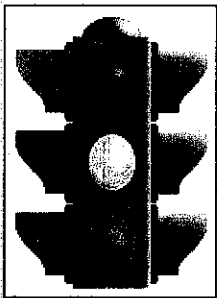
4.2.5.1 Login Page

Figure 15: Login Page

Figure 15 shows login page interface for this system. Only authorized personnel that have access to the application can login to the system. Both username and password have to be matched and correct.

If a person wants to login but the username and password does not correct, the system cannot be use by the unauthorized person.

4.2.5.2 Main Menu
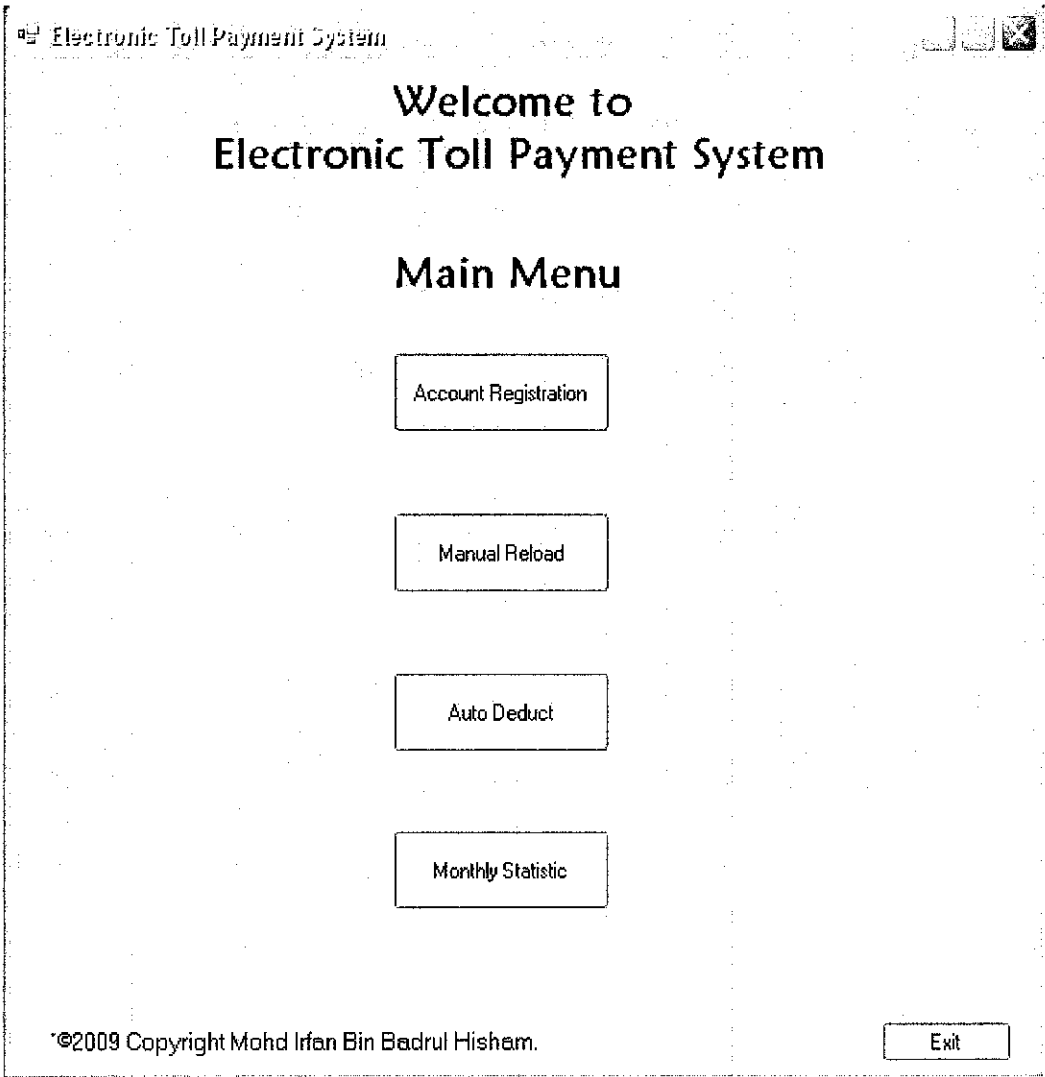
Figure 16: Main Menu Selection

After the login page, the system proceeds to menu application selection. In this page as shown in Figure 16, user will be served with three (4) type of application. Account Registration function is to register new user account or edit existing user information details. Manual Reload function is for reloading RFID smart card in exchange with money.

Current balance of the smart card will be added up with the amount of money given by the user. Auto Deduct function is for subtracting toll fare from the user that passes by the toll booth. Toll fare charges will reduce the current balance amount of the RFID smart card. Last function is Monthly Statistics which in this application, Administrator will be able to view each and every month statistics of total fare charges and total cars that passed by in order to analyze the pattern of toll's users and further market research.

4.2.5.3 Account Registration

Figure 17: Account Registration Page

When first time user want to use this smart card, they require providing
information details like name, IC. No. , Address and Bank Account. This will
be stored at specific UID for identifying and payment purposes. After fill in
the entire textbox required, Administrator click button Register to submit that
registration form and then user can already use the smart card while edit
button is update user information details. This button will redirect
Administrator to new window for updating existed user account details.

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Update Toll User Details

RFID Tag UID

Number of Tags Found   0

Information Details

Unique ID: Text1   [Read Tag]

Name: Text2   [Edit]

IC No: Text3   [Edit]

Address: Text4   [Edit]

Bank Account No: Integer1   [Edit]

[Find]   [Back]

©2009 Copyright Mohd Irfan Bin Badrul Hisham.   [Main Menu]   [Exit]

Figure 18: Update User Details Page

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4.2.5.4 Manual Reload

Figure 19: Manual Reload Page

When user choose this application, main menu redirect user to this manual reload page. In this page, smart card unique ID will appear if the smart card near to RFID reader. Number of smart card found can be shown on box given. Next, user click read tag button to read unique ID of selected smart card on the selection box.

Then, click the find button to find information store on selected smart card based on its unique ID. Reload button is to top up current balance with reload amount that being given by the customer. New balance will show at box given after payment has been made. Clear button is to clear information on previous payment transaction for next new transaction. Main menu button is to redirect user back to the application selection menu while Exit button is to terminate this program.

4.2.5.5 Auto Deduct

Figure 20: Auto Deduct Page

This application's function is to detect car passed that using smart card automatically in order to deduct toll fares charges from user's smart card. New balance generate after current balance deduct fare from its credit. If current balance of the smart card is below 50, user bank account automatically will add up 100 into its credit ready for toll fares charges deduction.

4.2.5.6 Monthly Statistics

Figure 21: Monthly Statistics Page

In this function, authorize user capable in viewing archive from each and every month on certain year. With information gathered using this function, further research and implementation can be done for better business decision in the future.

4.2.6 Project Database

4.2.6.1 Class Diagram
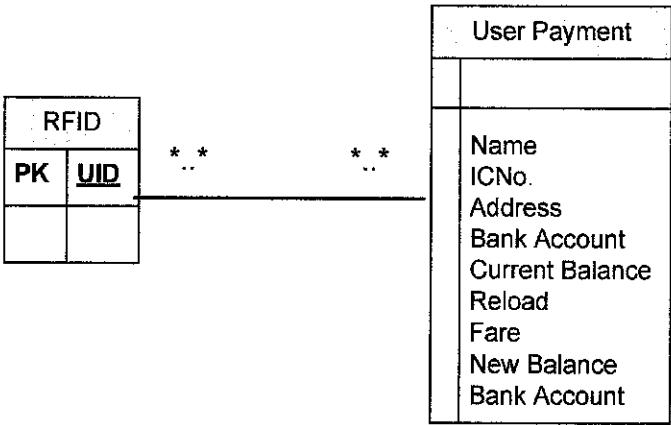
Figure 22: Class Diagram for User Payment
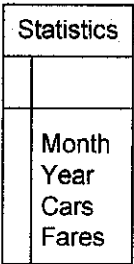
Figure 23: Class Diagram for Statistics

Figure 22 and Figure 23 shows class diagram for User Payment Database and Statistics which indicates only two (2) database being use in this system and UID as its primary key. As this program is to provide solution for payment system, each data input needed to update the database for synchronization purposes between each application.

Relationship for this database is many-to-many relationship as many vehicles that have a specific UID each are using the same toll both which charges the same toll fare. Many UID also can store different amount of current balance, reload amount and new balance and many bank account numbers.

As for statistics, previous month and year cumulative transaction will keep in this database. This is for monitoring cars and amount of fares to suit with future business plan.

4.2.6.2 Data Flow Diagram
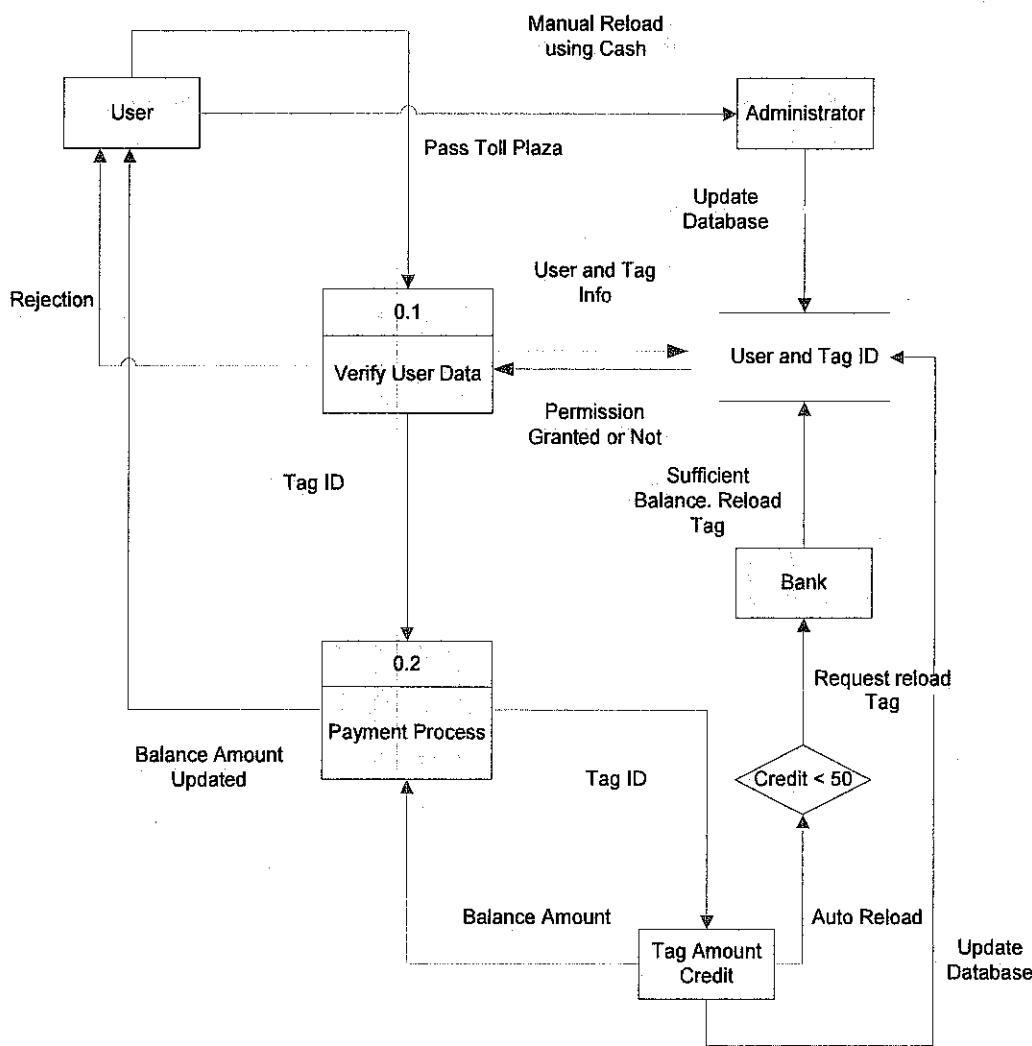
Figure 24: Data Flow Diagram for Electronic Toll Payment System

Figure 23 designate the Data Flow Diagram of this system that uses Payment Database. This diagram shows the flow of the system and relationship between application and users. UID or Tag ID as primary key is the most important role in making this flow works as specific UID store and use the specific information for update the Payment Database purposes.

4.3   TESTING RESULT 1: USER ACCEPTENCE TEST

Below is the questionnaire that use system acceptance test model and pass to ten (10) people who going to test this system. They require choosing between agree, neutral and disagree.

A.   I often become confused when I use the electronic toll payment system.

a. Agree = 2   b. Neutral = 1   c. Disagree = 7

B.   Interacting with the electronic toll payment system is often frustrating.

a. Agree = 1   b. Neutral = 4   c. Disagree = 5

C.   I need to consult the user manual often when using electronic toll payment system.

a. Agree = 0   b. Neutral = 1   c. Disagree = 9

D.   Interacting with the electronic toll payment system requires a lot of my mental effort.

a. Agree = 1   b. Neutral = 1   c. Disagree = 8

E.   I find it easy to get the electronic toll payment system to do what I want it to do.

a. Agree = 10   b. Neutral = 0   c. Disagree = 0

F. The electronic toll payment system often behaves in unexpected ways.

a. Agree = 0   b. Neutral = 0   c. Disagree = 10

G. I find it cumbersome to use the electronic toll payment system.

a. Agree = 1   b. Neutral = 0   c. Disagree = 9

H. My interaction with the electronic toll payment system is easy for me
to understand.

a. Agree = 9   b. Neutral = 1   c. Disagree = 0

I. It is easy for me to remember how to perform tasks using the
electronic toll payment system.

a. Agree = 10   b. Neutral = 0   c. Disagree = 0

J. Overall, I find the electronic toll payment system easy to use.

a. Agree = 8   b. Neutral = 2   c. Disagree = 0
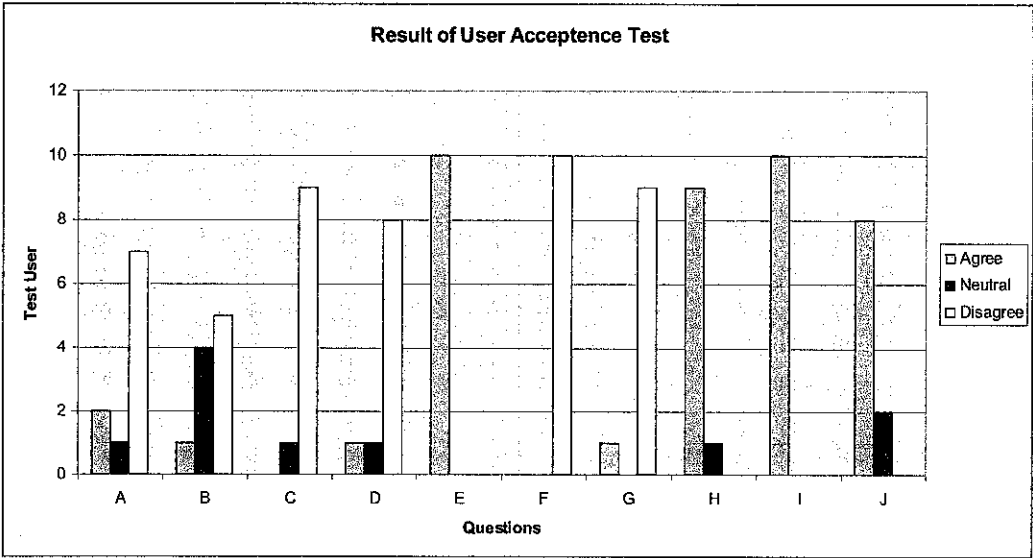
Figure 25: Result of User Acceptance Test

Most questions that answered by test people indicate this system meet the objectives that it should be. Seven (7) people disagree that they confused when using this system while nine (9) people disagree to always need to consult manual user in order to use this system. This shows that Electronic Toll Payment System is easy to execute task given. The system also does not behave beyond its capability as it been agreed by ten (10) test users.

4.4   TESTING RESULT 2: FUNCTIONALITY TEST

No	Function	Action Perform	Expected Test Result	Actual Test Result	Pass / Fail
1	Login Function	Insert correct username and password in provided text space.	Successfully login and user redirect to selection menu page	Successfully login and user redirect to selection menu page	Pass
		Insert incorrect username and password in provided text space	System notify invalid user	User still redirect to the selection menu page	Fail
2	Select application	Click on button in order to select application to use	User redirect to the application that user choose	User successfully redirect to the chosen application	Pass
3	Account Registration	Capture UID from Electronic Toll Payment System	UID captured and shown in provided box	UID successfully being captured and shown the provided box	Pass
		Reset captured UID	UID captured has been cleared	Successfully clear UID from provided box	Pass
		Read the captured UID	Captured UID shown at Unique ID box	Successfully shown UID at Unique ID box	Pass

		Insert user information. Register filled information.	Application prompt box message "Thank you for using our smart card system!"	Successfully receive prompt message	Pass
		Insert new user information but using existing UID in the database	Error message prompt	Error message prompt	Pass
		Find user information based on UID.	Application prompt box message "User Account Found" and all information displayed	Successfully display all information at given text box and received the prompt message	Pass
		Edit user information by editing one detail at the same time.	Application prompt box message "Records Affected = 1"	Successfully received the prompt message	Pass
4	Manual Reload	Auto capture UID when smart card near reader and reset captured UID when smart card far from reader	UID captured and shown in provided box. UID captured has been cleared	Successfully UID captured and shown the provided box. Successfully clear UID from provided box	Pass
		Read captured UID	Captured UID shown at	Successfully shown UID at	Pass

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				Unique ID box	Unique ID box	
		Find valid Bank Account No. and Current Balance	Bank Account No. and Current Balance shown at given box	Successfully Bank Account No. and Current Balance shown at the box	Pass
		Add and reload payment amount at Reload box	New Balance will be shown at given box and prompt box message "Thank you for reloading your smart card prepaid with our system. Have a save journey!"	Successfully shown new smart card balance and prompt the message box	Pass
5	Auto Deduct	Auto capture UID when smart card near reader after start this application	UID captured and shown in provided box.	Successfully UID captured and shown the provided box.	Pass
		Auto reset captured UID when smart card far from reader after start this application	UID captured has been cleared	Successfully clear UID from provided box	Pass
		Auto read UID smart card after start this application	Captured UID shown at Unique ID box	Successfully shown UID at Unique ID box	Pass

		Auto deduct UID balance when smart card near reader and when balance below RM 50, system will charge RM 100 from Bank Account to auto reload smart card after start this application	New balance shown at given box	Successfully shown new balance at given box	Pass
6	Monthly Statistics	Select specific Month and Year in order to know total cars pass by and toll fares collected.	Generate total cars passed by and toll fares collected at given box	Successfully show total cars passed by and toll fares collected at given box	Pass

Table 3: Functionality Test Table

From the above test, only one (1) function fail to operate which is login using invalid username and password. The system should verify the input data first before proceed. When the invalid detail has been submitted, user will be asked to enter the correct details. For now, this system will accept any input to login and just proceed to the selection menu page. Conclusion, this system is functioning and passed the functionality testing.

4.5 TESTING RESULT 3: ACCURACY TEST

No	Function	Action Perform	Expected Test Result	Actual Test Result	Pass / Fail
1	Read Distance	Read when the tag touch the reader	Reader capture UID from Electronic Toll Payment System	Successfully capture UID from Electronic Toll Payment System	Pass
		Read from 1 cm distance	Reader capture UID from Electronic Toll Payment System	Successfully capture UID from Electronic Toll Payment System	Pass
		Read from 2 cm distance	Reader capture UID from Electronic Toll Payment System	Successfully capture UID from Electronic Toll Payment System	Pass
		Read from 3 cm distance	Reader capture UID from Electronic Toll Payment System	Successfully capture UID from Electronic Toll Payment System	Pass
		Read from 4 cm distance	Reader capture UID from Electronic Toll Payment System	Successfully capture UID from Electronic Toll Payment System	Pass

		Read from 5 cm distance	Reader capture UID from Electronic Toll Payment System	Successfully capture UID from Electronic Toll Payment System	Pass
		Read from 6 cm distance	Reader capture UID from Electronic Toll Payment System	Unable to capture UID from Electronic Toll Payment System	Fail
2	Read tag simultaneously	Read 1 tag simultaneously	Reader can capture 1 tags simultaneously	Reader capture tags simultaneously	Pass
		Read 2 tags simultaneously	Reader can capture 2 tags simultaneously	Reader capture tags simultaneously	Pass
		Read 3 tags simultaneously	Reader can capture 3 tags simultaneously	Reader capture tags simultaneously	Pass
		Read 4 tags simultaneously	Reader can capture 4 tags simultaneously	Reader capture tags simultaneously	Pass
		Read 5 tags simultaneously	Reader can capture 5 tags simultaneously	Reader capture tags simultaneously	Pass

		Read 6 tags simultaneously	Reader can capture 6 tags simultaneously	Reader unable capture tags simultaneously	Fail
3	Read time	Time to read tag after click capture button	Reader read the tag below than a second	Successfully read the tag below than a second	Pass

Table 4: Accuracy Test Table

The author discover that RFID reader capable to capture UID for below than a second and can only capture the UID with the maximum distance of 5 cm and for the read test, the reader can read the UID maximum 5 tags simultaneously. From the RFID device description, the reader should be able to capture the UID up to 10 cm and read up to 15 tags simultaneously. The value in this test is not reaching the theoretical value because of other factors such as hardware limitation which is the reader is too small to read more than 5 tag simultaneously. For this project, the author is using the High Frequency RFID Device but in the actual simulation, this system will use Microwave Frequency RFID Technology which can read more than 50 meters distance, read more than 200 vehicles at the same time.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1   CONCLUSION

By making this project, it is a starting point for others to give ideas in enhancing transportation system in Malaysia. Electronic Payment System via RFID smart card help drivers saves cost and time in paying toll fare. It also makes authorities easier to control traffic and execute law action on reckless driver by detecting their information details using the smart card. People also do not have to worry about the amount on the smart card as it has been linked with user's bank account. This system will charge the user bank account for auto reload mechanism so the user doesn't have any trouble when using the highway.

This system can solves issue in the existing toll payment system. With this transportation technology, toll company can minimize issues near toll plaza and maximizing profit where vehicle drivers that want fast and easy toll payment transaction will buy contactless smart card. It happens in advanced countries where transportation technology is rapidly advanced that traffic control solution and highway information is at the people's hand for their convenience.

5.2   FUTURE RECOMMENDATION

Future ideas for recommendation can be add at the RFID systems, so it can be more useful to users and working efficiently.

b.   Vehicle Entry Permit

Smart Card can be used as identification card for house security. Security system able to analyze the smart card to prove a person is living in the house area or not.

c.   Parking Payment System

Shopping complex able implement the system in deduct parking fees from driver's smart card. This system will capture the time in and out vehicle and being charges by hours.

d.   Electronic Road Tax

RFID smart card also can be use as Electronic Road Tax. In order to replace current road tax sticker which can be forged easily, sticker stains at windshield and eventually faded. These advance road taxes can safe driver and vehicle information digitally. It can be to trace by authorities for checking trafficker offences details and cannot be forged easily.
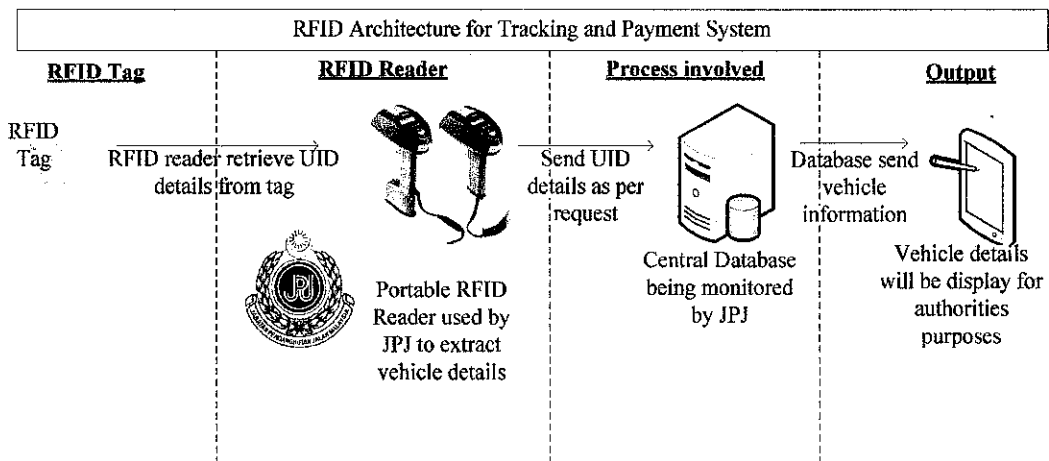
Figure 18: Future recommendation for Electronic Road Tax

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APPENDICES

APPENDIX I – System Interface and Coding

a. Login Page

Welcome to
Electronic Toll Payment System

Please insert username and password in order to login the system.

Username

Password

OK   Cancel

©2009 Copyright Mohd Irfan Bin Badrul Hisham.
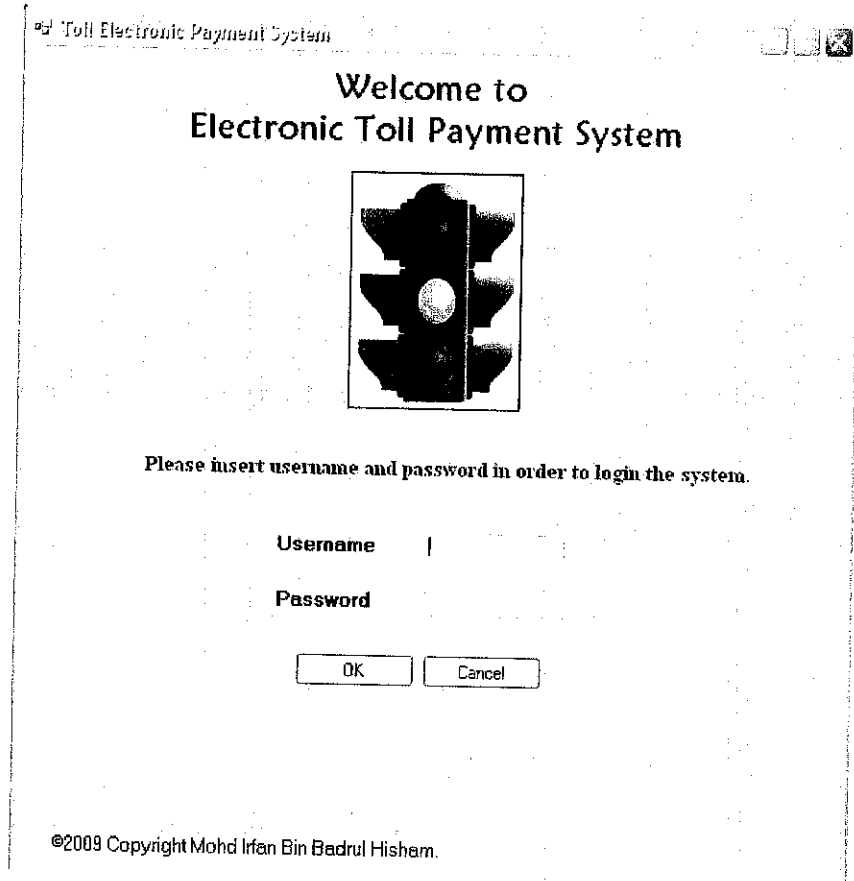
```
Public Class Login

    Private Sub OK_Button_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles OK_Button.Click
        MainMenu.Show()
        Me.Hide()
    End Sub

    Private Sub Cancel_Button_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles Cancel_Button.Click
        MessageBox.Show("Thank you for using our smart card
system!")
        End
    End Sub

        End Class
```

b. Main Menu Selection Page
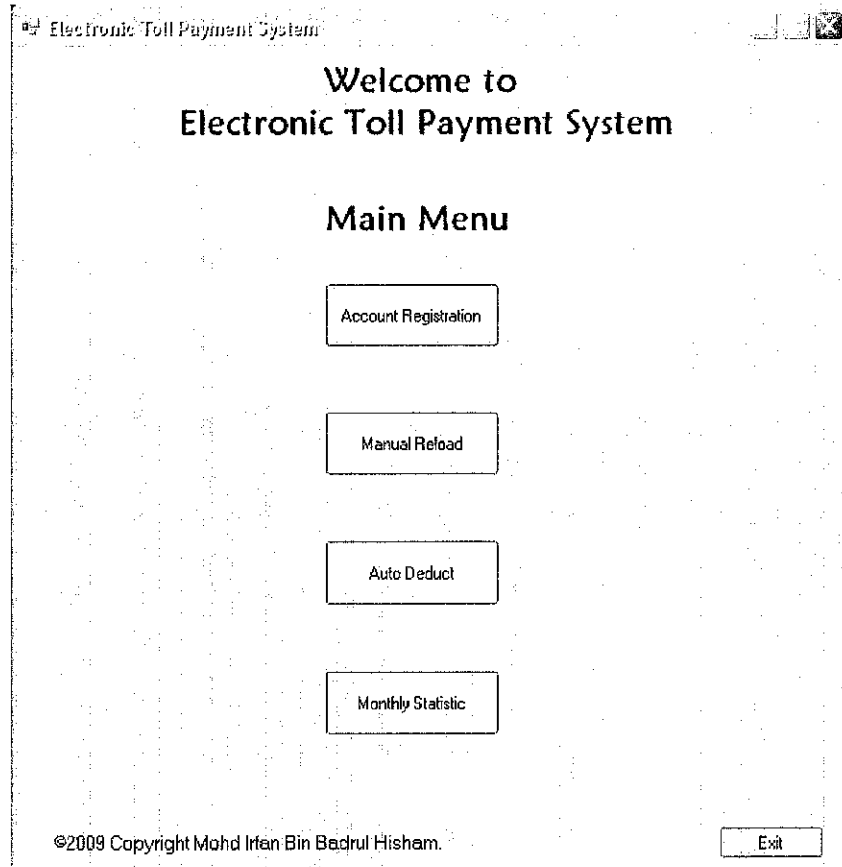

```
Public Class MainMenu

    Private Sub Manual_Reload_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles Manual_Reload.Click
        ManualReload.Show()
        Me.Hide()
    End Sub

    Private Sub Auto_Deduct_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles Auto_Deduct.Click
        AutoDeduct.Show()
        Me.Hide()
    End Sub

    Private Sub Monthly_Statistic_Click(ByVal sender As
System.Object, ByVal e As System.EventArgs) Handles
Monthly_Statistic.Click
        MonthlyStatistic.Show()
        Me.Hide()
    End Sub
```

```
    Private Sub Account_Registration_Click(ByVal sender As
System.Object, ByVal e As System.EventArgs) Handles
Account_Registration.Click
        AccountRegistration.Show()
        Me.Hide()
    End Sub

    Private Sub Cancel_Click(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles Cancel.Click
        MessageBox.Show("Thank you for using our smart card
system!")
        End
    End Sub
        End Class
```

c. Account Registration Page

User Toll Account Registration

RFID Tag UID

Number of Tags Found   0

Information Details

Unique ID:	Text1	Read Tag
Name:	Text2	
IC No:	Text3	
Address:	Text4	
Bank Account No:	Integer1	

Find   Register   Edit   Clear

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Main Menu   Exit

```
Imports System.Data.SqlClient
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' 8171
' Final Year Project Part II
' Electronic Toll Payment System Using RFID Smart Card
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Friend Class AccountRegistration
    Inherits System.Windows.Forms.Form

    'Definitions (members of class DLPTest)
    Dim DLPObject As DLPMULTITAGLib.DLPRWTags          ' Demonstrates
Early-Binding.  Use "... As Object" for Late-Binding
    Dim RetCode As Short
    Dim stSelTag As String
    Dim dataSet As New DataSet
    Dim myConnection As SqlConnection
    Dim myCommand As SqlCommand
    Dim dr As SqlDataReader



    ' When the form loads, create the object and open the port
```

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```
    Private Sub DLPTest_Load(ByVal eventSender As System.Object,
ByVal eventArgs As System.EventArgs) Handles MyBase.Load

        'Create the object
        DLPObject = CreateObject("DLPMultiTag.DLPRWTags")

        'Open the port
        'UPGRADE_WARNING: Couldn't resolve default property of
object DLPObject.OpenPort. Click for more: 'ms-
help://MS.VSCC.v80/dv_commoner/local/redirect.htm?keyword="6A50421D-
15FE-4896-8A1B-2EC21E9037B2"'
        DLPObject.OpenPort(1, 1, 1)

    End Sub


    ' Exit
    Private Sub Cancel_Click(ByVal eventSender As System.Object,
ByVal eventArgs As System.EventArgs) Handles Cancel.Click
        ' Close the Port before closing App
        DLPObject.ClosePort()
        MessageBox.Show("Thank you for using our smart card
system!")
        End
    End Sub


    ' Read Status
    Private Sub ReadStatus_Click(ByVal eventSender As System.Object,
ByVal eventArgs As System.EventArgs) Handles ReadStatus.Click

        ' Defines our parameters to pass to the DLL.  Note stSelTag
is called by value, the others
        ' are called by reference.  By using late-binding, VB knows
this implicitly.
        Dim iDSFID As Integer
        Dim iAFI As Integer
        Dim stCardType As String
        Dim iMemSize As Integer

        stCardType = ""                    ' Prevents a warning by VB.
Should be ok without...

        If (stSelTag <> Nothing) Then

            ' Call across COM passing and get the data from the DLL
            DLPObject.ReadStatus(stSelTag, iDSFID, iAFI, stCardType,
iMemSize)

            ' Display the string in the box
            UID.Text = stSelTag

        Else
            MsgBox("Please Select a tag after clicking Inventory")
        End If

    End Sub

    ' Get a list of all Tags on the reader
```

```vb
    Private Sub Inventory_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles Inventory.Click
        Dim varTags As Object

        'empty snifflist
        'SniffList.

        ' Call the DLL and get the tags
        varTags = DLPObject.ReadAllTags()

        If (varTags.ToString = Nothing) Then

            ' Let the user know
            NumTags.Text = "0"

        Else

            ' Tell the listbox about the data source
            SniffList.DataSource = varTags

            Dim iCount As Integer
            iCount = SniffList.Items.Count
            NumTags.Text = CStr(iCount)

        End If

    End Sub

    ' Reset the reader
    Private Sub Reset_Click(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles Reset.Click

        ' Call the DLL and reset the reader
        DLPObject.ResetReader()

        ' Clear the listbox's data source
        SniffList.DataSource = Nothing

    End Sub

    ' Get the currently selected Tag from the inventory list
    Private Sub OnSniffListValChange(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles SniffList.SelectedValueChanged

        ' Set the class variable to the selected text
        stSelTag = SniffList.Text

    End Sub
```

```
'Insert information details into database
    Private Sub Register_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles Register.Click

        myConnection = New System.Data.SqlClient.SqlConnection("Data
Source=.\SQLEXPRESS;AttachDbFilename=C:\Toll.mdf;Integrated
Security=True;Connect Timeout=30;User Instance=True")
        myConnection.Open()
        myCommand = New System.Data.SqlClient.SqlCommand("Insert
into Reload (tagid, name, icno, address, bank, newbalance) values('"
& Trim(UID.Text) & "','" & Trim(TextBox1.Text) & "','" &
Trim(TextBox2.Text) & "','" & Trim(RichTextBox1.Text) & "','" &
Trim(BankAcc.Text) & "','" & Trim(10) & "')", myConnection)
        MessageBox.Show("Thank you for using our smart card
system!")
        myCommand.ExecuteNonQuery()
        myConnection.Close()

    End Sub


    Private Sub Find_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles Find.Click
        myConnection = New System.Data.SqlClient.SqlConnection("Data
Source=.\SQLEXPRESS;AttachDbFilename=C:\Toll.mdf;Integrated
Security=True;Connect Timeout=30;User Instance=True")
        myConnection.Open()
        myCommand = New System.Data.SqlClient.SqlCommand("Select *
from Reload where tagid='" & UID.Text & "'", myConnection)
        'executing the command and assigning it to connection
        dr = myCommand.ExecuteReader()

        While dr.Read()
            MessageBox.Show("User Account Found")
            TextBox1.Text = Trim(dr(1).ToString())
            TextBox2.Text = Trim(dr(2).ToString())
            RichTextBox1.Text = Trim(dr(3).ToString())
            BankAcc.Text = Trim(dr(4).ToString())
        End While
        dr.Close()
        myConnection.Close()
    End Sub

    Private Sub Clear_Click(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles Clear.Click
        UID.Text = ("Text1")
        TextBox1.Text = ("Text2")
        TextBox2.Text = ("Text3")
        RichTextBox1.Text = ("Text4")
        BankAcc.Text = ("Integer1")
    End Sub

    Private Sub Timer1_Tick(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles Timer1.Tick
        Call Inventory_Click(sender, e)
    End Sub
```

```
    Private Sub Main_Menu_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles Main_Menu.Click
        MainMenu.Show()
        Me.Hide()
    End Sub

    Private Sub Edit_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles Edit.Click
        AccountRegistrationEdit.Show()
        Me.Hide()
    End Sub
          End Class
```



```
Imports System.Data.SqlClient
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' 8171
' Final Year Project Part II
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```

```vbnet
Friend Class AccountRegistrationEdit
    Inherits System.Windows.Forms.Form

    'Definitions (members of class DLPTest)
    Dim DLPObject As DLPMULTITAGLib.DLPRWTags         ' Demonstrates
Early-Binding.  Use "... As Object" for Late-Binding
    Dim RetCode As Short
    Dim stSelTag As String
    Dim dataSet As New DataSet
    Dim myConnection As SqlConnection
    Dim myCommand As SqlCommand
    Dim dr As SqlDataReader
    Dim ra As Integer


    ' When the form loads, create the object and open the port
    Private Sub DLPTest_Load(ByVal eventSender As System.Object,
ByVal eventArgs As System.EventArgs) Handles MyBase.Load

        'Create the object
        DLPObject = CreateObject("DLPMultiTag.DLPRWTags")

        'Open the port
        'UPGRADE_WARNING: Couldn't resolve default property of
object DLPObject.OpenPort. Click for more: 'ms-
help://MS.VSCC.v80/dv_commoner/local/redirect.htm?keyword="6A50421D-
15FE-4896-8A1B-2EC21E9037B2"'
        DLPObject.OpenPort(1, 1, 1)

    End Sub

    ' Exit
    Private Sub Cancel_Click(ByVal eventSender As System.Object,
ByVal eventArgs As System.EventArgs) Handles Cancel.Click
        ' Close the Port before closing App
        DLPObject.ClosePort()
        MessageBox.Show("Thank you for using our smart card
system!")
        End
    End Sub
```

```vb
' Read Status
    Private Sub ReadStatus_Click(ByVal eventSender As System.Object,
ByVal eventArgs As System.EventArgs) Handles ReadStatus.Click

        ' Defines our parameters to pass to the DLL.  Note stSelTag
is called by value, the others
        ' are called by reference.  By using late-binding, VB knows
this implicitly.
        Dim stCardType As String

        stCardType = ""                    ' Prevents a warning by VB.
Should be ok without...

        If (stSelTag <> Nothing) Then

            ' Display the string in the box
            UID.Text = stSelTag

        End If

    End Sub


' Get a list of all Tags on the reader
    Private Sub Inventory_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles Inventory.Click

        Dim varTags As Object

        'empty snifflist
        'SniffList.

        ' Call the DLL and get the tags
        varTags = DLPObject.ReadAllTags()

        If (varTags.ToString = Nothing) Then

            ' Let the user know
            NumTags.Text = "0"

        Else

            ' Tell the listbox about the data source
            SniffList.DataSource = varTags

            Dim iCount As Integer
            iCount = SniffList.Items.Count
            NumTags.Text = CStr(iCount)


        End If

    End Sub
```

```vbnet
    ' Get the currently selected Tag from the inventory list
    Private Sub OnSniffListValChange(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles SniffList.SelectedValueChanged

        ' Set the class variable to the selected text
        stSelTag = SniffList.Text
    End Sub

    Private Sub Find_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles Find.Click
        myConnection = New System.Data.SqlClient.SqlConnection("Data
Source=.\SQLEXPRESS;AttachDbFilename=C:\Toll.mdf;Integrated
Security=True;Connect Timeout=30;User Instance=True")
        myConnection.Open()
        myCommand = New System.Data.SqlClient.SqlCommand("Select *
from Reload where tagid='" & UID.Text & "'", myConnection)
        'executing the command and assigning it to connection
        dr = myCommand.ExecuteReader()

        While dr.Read()
            MessageBox.Show("User Account Found")
            TextBox1.Text = Trim(dr(1).ToString())
            TextBox2.Text = Trim(dr(2).ToString())
            RichTextBox1.Text = Trim(dr(3).ToString())
            BankAcc.Text = Trim(dr(4).ToString())
        End While
        dr.Close()
        myConnection.Close()
    End Sub

    Private Sub Edit_Name_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles Edit_Name.Click
        myConnection = New System.Data.SqlClient.SqlConnection("Data
Source=.\SQLEXPRESS;AttachDbFilename=C:\Toll.mdf;Integrated
Security=True;Connect Timeout=30;User Instance=True")
        myConnection.Open()
        myCommand = New SqlCommand("Update Reload set name='" &
Trim(TextBox1.Text) & "' where tagid='" & Trim(UID.Text) & "'",
myConnection)
        ra = myCommand.ExecuteNonQuery()
        MessageBox.Show("Records Affected = " & ra)
        myConnection.Close()
    End Sub

    Private Sub Edit_ICNo_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles Edit_ICNo.Click
        myConnection = New System.Data.SqlClient.SqlConnection("Data
Source=.\SQLEXPRESS;AttachDbFilename=C:\Toll.mdf;Integrated
Security=True;Connect Timeout=30;User Instance=True")
        myConnection.Open()
        myCommand = New SqlCommand("Update Reload set icno='" &
Trim(TextBox2.Text) & "' where tagid='" & Trim(UID.Text) & "'",
myConnection)
        ra = myCommand.ExecuteNonQuery()
        MessageBox.Show("Records Affected = " & ra)
        myConnection.Close()
    End Sub
```

```
    Private Sub Edit_Address_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles Edit_Address.Click
        myConnection = New System.Data.SqlClient.SqlConnection("Data
Source=.\SQLEXPRESS;AttachDbFilename=C:\Toll.mdf;Integrated
Security=True;Connect Timeout=30;User Instance=True")
        myConnection.Open()
        myCommand = New SqlCommand("Update Reload set address='" &
Trim(RichTextBox1.Text) & "' where tagid='" & Trim(UID.Text) & "'",
myConnection)
        ra = myCommand.ExecuteNonQuery()
        MessageBox.Show("Records Affected = " & ra)
        myConnection.Close()
    End Sub

    Private Sub Edit_BankAcc_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles Edit_BankAcc.Click
        myConnection = New System.Data.SqlClient.SqlConnection("Data
Source=.\SQLEXPRESS;AttachDbFilename=C:\Toll.mdf;Integrated
Security=True;Connect Timeout=30;User Instance=True")
        myConnection.Open()
        myCommand = New SqlCommand("Update Reload set bank='" &
Trim(BankAcc.Text) & "' where tagid='" & Trim(UID.Text) & "'",
myConnection)
        ra = myCommand.ExecuteNonQuery()
        MessageBox.Show("Records Affected = " & ra)
        myConnection.Close()
    End Sub

    Private Sub Timer1_Tick(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles Timer1.Tick
        Call Inventory_Click(sender, e)
    End Sub

    Private Sub Main_Menu_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles Main_Menu.Click
        MainMenu.Show()
        Me.Hide()
    End Sub
    Private Sub Back_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles Back.Click
        AccountRegistration.Show()
        Me.Hide()
    End Sub
            End Class
```

d. Manual Reload Page


```
Imports System.Data.SqlClient
' Mohd Irfan Bin Badrul Hisham
' 8171
' Final Year Project Part II
' Electronic Toll Payment System Using RFID Smart Card
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Friend Class ManualReload
    Inherits System.Windows.Forms.Form

    'Definitions (members of class DLPTest)
    Dim DLPObject As DLPMULTITAGLib.DLPRWTags        ' Demonstrates
Early-Binding.  Use "... As Object" for Late-Binding
    Dim RetCode As Short
    Dim stSelTag As String
    Dim dataSet As New DataSet
    Dim myConnection As SqlConnection
    Dim myCommand As SqlCommand
    Dim dr As SqlDataReader
```

```vb
' When the form loads, create the object and open the port
Private Sub DLPTest_Load(ByVal eventSender As System.Object,
ByVal eventArgs As System.EventArgs) Handles MyBase.Load

    'Create the object
    DLPObject = CreateObject("DLPMultiTag.DLPRWTags")

    'Open the port
    'UPGRADE_WARNING: Couldn't resolve default property of
object DLPObject.OpenPort. Click for more: 'ms-
help://MS.VSCC.v80/dv_commoner/local/redirect.htm?keyword="6A50421D-
15FE-4896-8A1B-2EC21E9037B2"'
    DLPObject.OpenPort(1, 1, 1)

End Sub


' Exit
Private Sub Cancel_Click(ByVal eventSender As System.Object,
ByVal eventArgs As System.EventArgs) Handles Cancel.Click
    ' Close the Port before closing App
    DLPObject.ClosePort()
    MessageBox.Show("Thank you for using our smart card
system!")
    End
End Sub


' Read Status
Private Sub ReadStatus_Click(ByVal eventSender As System.Object,
ByVal eventArgs As System.EventArgs) Handles ReadStatus.Click

    ' Defines our parameters to pass to the DLL.  Note stSelTag
is called by value, the others
    ' are called by reference.  By using late-binding, VB knows
this implicitly.
    Dim iDSFID As Integer
    Dim iAFI As Integer
    Dim stCardType As String
    Dim iMemSize As Integer

    stCardType = ""                      ' Prevents a warning by VB.
Should be ok without...

    If (stSelTag <> Nothing) Then

        ' Call across COM passing and get the data from the DLL
        DLPObject.ReadStatus(stSelTag, iDSFID, iAFI, stCardType,
iMemSize)

        ' Display the string in the box
        UID.Text = stSelTag

    Else
        MsgBox("Please Select a tag after clicking Inventory")
    End If

End Sub
```

```vb
    ' Get a list of all Tags on the reader
    Private Sub Inventory_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles Inventory.Click

        Dim varTags As Object

        'empty snifflist
        'SniffList.

        ' Call the DLL and get the tags
        varTags = DLPObject.ReadAllTags()

        If (varTags.ToString = Nothing) Then

            ' Let the user know
            NumTags.Text = "0"

        Else

            ' Tell the listbox about the data source
            SniffList.DataSource = varTags

            Dim iCount As Integer
            iCount = SniffList.Items.Count
            NumTags.Text = CStr(iCount)


        End If

    End Sub

    ' Reset the reader
    Private Sub Reset_Click(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles Reset.Click

        ' Call the DLL and reset the reader
        DLPObject.ResetReader()

        ' Clear the listbox's data source
        SniffList.DataSource = Nothing

    End Sub

    ' Get the currently selected Tag from the inventory list
    Private Sub OnSniffListValChange(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles SniffList.SelectedValueChanged

        ' Set the class variable to the selected text
        stSelTag = SniffList.Text

    End Sub
```

```vb
'Insert reload value into database
    Private Sub Reload_Click(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles Reload.Click
        myConnection = New System.Data.SqlClient.SqlConnection("Data
Source=.\SQLEXPRESS;AttachDbFilename=C:\Toll.mdf;Integrated
Security=True;Connect Timeout=30;User Instance=True")
        myConnection.Open()
        myCommand = New SqlCommand("Update Reload set newbalance='"
& Trim(TextBox3.Text) & "' where tagid='" & Trim(UID.Text) & "'",
myConnection)
        myCommand.ExecuteNonQuery()
        MessageBox.Show("Thank you for reloading your smart card
prepaid with our system. Have a save journey!")
        myConnection.Close()

    End Sub


    'Find the detail from database base on TagID Value
    Private Sub Find_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles Find.Click
        myConnection = New System.Data.SqlClient.SqlConnection("Data
Source=.\SQLEXPRESS;AttachDbFilename=C:\Toll.mdf;Integrated
Security=True;Connect Timeout=30;User Instance=True")
        myConnection.Open()
        myCommand = New System.Data.SqlClient.SqlCommand("Select *
from Reload where tagid='" & UID.Text & "'", myConnection)
        'executing the command and assigning it to connection
        dr = myCommand.ExecuteReader()

        While dr.Read()
            MessageBox.Show("User Account Found")
            BankAcc.Text = Trim(dr(4).ToString())
            TextBox1.Text = Trim(dr(5).ToString())
        End While
        dr.Close()
        myConnection.Close()
    End Sub

    'Show Main Menu
    Private Sub Main_Menu_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles Main_Menu.Click
        MainMenu.Show()
        Me.Hide()
    End Sub

    'Clear text box
    Private Sub Clear_Click(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles Clear.Click
        UID.Text = ("Text1")
        TextBox1.Text = 0
        TextBox2.Text = 0
        TextBox3.Text = 0
        BankAcc.Text = ("Integer1")
    End Sub
```

```
    Private Sub Add_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles Add.Click
        Dim current, reload, newbal As Double
        current = CDbl(TextBox1.Text)
        reload = CDbl(TextBox2.Text)
        newbal = current + reload
        TextBox3.Text = CStr(newbal)
    End Sub
    Private Sub Timer1_Tick(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles Timer1.Tick
        Call Inventory_Click(sender, e)
    End Sub
            End Class
```

e. Auto Deduct Page


```
Imports System.Data.SqlClient
' Mohd Irfan Bin Badrul Hisham
' 8171
' Final Year Project Part II
' Electronic Toll Payment System Using RFID Smart Card
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```

```
Friend Class AutoDeduct
    Inherits System.Windows.Forms.Form

    'Definitions (members of class DLPTest)
    Dim DLPObject As DLPMULTITAGLib.DLPRWTags        ' Demonstrates
Early-Binding.  Use "... As Object" for Late-Binding
    Dim RetCode As Short
    Dim stSelTag As String
    Dim dataSet As New DataSet
    Dim myConnection As SqlConnection
    Dim myCommand As SqlCommand
    Dim dr As SqlDataReader

    ' When the form loads, create the object and open the port
    Private Sub DLPTest_Load(ByVal eventSender As System.Object,
ByVal eventArgs As System.EventArgs) Handles MyBase.Load

        Timer1.Enabled = False
        'Create the object
        DLPObject = CreateObject("DLPMultiTag.DLPRWTags")

        'Open the port
        'UPGRADE_WARNING: Couldn't resolve default property of
object DLPObject.OpenPort. Click for more: 'ms-
help://MS.VSCC.v80/dv_commoner/local/redirect.htm?keyword="6A50421D-
15FE-4896-8A1B-2EC21E9037B2"'
        DLPObject.OpenPort(1, 1, 1)

    End Sub

    ' Exit
    Private Sub Cancel_Click(ByVal eventSender As System.Object,
ByVal eventArgs As System.EventArgs) Handles Cancel.Click
        ' Close the Port before closing App
        DLPObject.ClosePort()
        MessageBox.Show("Thank you for using our smart card
system!")
        End
    End Sub
```

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```
' Read Status
    Private Sub ReadStatus_Click(ByVal eventSender As System.Object,
ByVal eventArgs As System.EventArgs) Handles ReadStatus.Click

        ' Defines our parameters to pass to the DLL.  Note stSelTag
is called by value, the others
        ' are called by reference.  By using late-binding, VB knows
this implicitly.
        Dim iDSFID As Integer
        Dim iAFI As Integer
        Dim stCardType As String
        Dim iMemSize As Integer

        stCardType = ""                     ' Prevents a warning by VB.
Should be ok without...

        If (stSelTag <> Nothing) Then

            ' Call across COM passing and get the data from the DLL
            DLPObject.ReadStatus(stSelTag, iDSFID, iAFI, stCardType,
iMemSize)

            ' Display the string in the box
            UID.Text = stSelTag

        End If

    End Sub

    ' Get a list of all Tags on the reader
    Private Sub Inventory_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles Inventory.Click

        Dim varTags As Object

        'empty snifflist
        'SniffList.

        ' Call the DLL and get the tags
        varTags = DLPObject.ReadAllTags()

        If (varTags.ToString = Nothing) Then

            ' Let the user know
            NumTags.Text = "0"

        Else

            ' Tell the listbox about the data source
            SniffList.DataSource = varTags

            Dim iCount As Integer
            iCount = SniffList.Items.Count
            NumTags.Text = CStr(iCount)

        End If
    End Sub
```

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```vbnet
' Reset the reader
Private Sub Reset_Click(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles Reset.Click

        ' Call the DLL and reset the reader
        DLPObject.ResetReader()

        ' Clear the listbox's data source
        SniffList.DataSource = Nothing

    End Sub

    ' Get the currently selected Tag from the inventory list
    Private Sub OnSniffListValChange(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles SniffList.SelectedValueChanged

        ' Set the class variable to the selected text
        stSelTag = SniffList.Text

    End Sub

    'Insert reload value into database
    Private Sub Reload_Click(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles Reload.Click, Reload.Click
        myConnection = New System.Data.SqlClient.SqlConnection("Data
Source=.\SQLEXPRESS;AttachDbFilename=C:\Toll.mdf;Integrated
Security=True;Connect Timeout=30;User Instance=True")
        myConnection.Open()
        myCommand = New SqlCommand("Update Reload set newbalance='"
& Trim(TextBox3.Text) & "' where tagid='" & Trim(UID.Text) & "'",
myConnection)
        myCommand.ExecuteNonQuery()
        myConnection.Close()

    End Sub

    'Find the detail from database base on TagID Value
    Private Sub Find_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles Find.Click
        myConnection = New System.Data.SqlClient.SqlConnection("Data
Source=.\SQLEXPRESS;AttachDbFilename=C:\Toll.mdf;Integrated
Security=True;Connect Timeout=30;User Instance=True")
        myConnection.Open()
        myCommand = New System.Data.SqlClient.SqlCommand("Select *
from Reload where tagid='" & UID.Text & "'", myConnection)
        'executing the command and assigning it to connection
        dr = myCommand.ExecuteReader()

        While dr.Read()
            BankAcc.Text = Trim(dr(4).ToString())
            TextBox1.Text = Trim(dr(5).ToString())
        End While
        dr.Close()
        myConnection.Close()
    End Sub
```

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```vb
    'Show Main Menu
    Private Sub Main_Menu_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles Main_Menu.Click
        MainMenu.Show()
        Me.Hide()
    End Sub

    Private Sub Deduct_Click(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles Deduct.Click
        Dim current, newbal As Integer
        current = CDbl(TextBox1.Text)

        If current < 50 Then
            newbal = current + 100 - 1
        Else
            newbal = current - 1
        End If
        TextBox3.Text = CStr(newbal)

    End Sub


    Private Sub Timer1_Tick(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles Timer1.Tick
        Call Inventory_Click(sender, e)
        If stSelTag <> Nothing Then
            Call ReadStatus_Click(sender, e)
            Call Find_Click(sender, e)
            Call Deduct_Click(sender, e)
            Call Reload_Click(sender, e)
            stSelTag = Nothing
        End If
    End Sub

    Private Sub StartTimer_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles StartTimer.Click
        Timer1.Enabled = True
    End Sub

    Private Sub StopTimer_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles StopTimer.Click
        Timer1.Enabled = False
    End Sub
            End Class
```

f. Monthly Statistics


```
Imports System.Data
' Mohd Irfan Bin Badrul Hisham
' 8171
' Final Year Project Part II
' Electronic Toll Payment System Using RFID Smart Card
' Copyright (c) 2009

Friend Class MonthlyStatistic

    Inherits System.Windows.Forms.Form

    'Definitions (members of class DLPTest)

    Dim myConnection As System.Data.SqlClient.SqlConnection
    Dim myCommand As SqlClient.SqlCommand
    Dim dr As SqlClient.SqlDataReader
    Dim ra As Integer
```

```vb
    Private Sub Generate_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles Generate.Click

        myConnection = New System.Data.SqlClient.SqlConnection("Data
Source=.\SQLEXPRESS;AttachDbFilename=C:\MonthlyStatistics.mdf;Integr
ated Security=True;Connect Timeout=30;User Instance=True")
        myConnection.Open()
        myCommand = New System.Data.SqlClient.SqlCommand("Select *
from Month where Mnth='" & MonthComboBox.Text & "'", myConnection)
        'executing the command and assigning it to connection
        dr = myCommand.ExecuteReader()

        While dr.Read()
            TextBox1.Text = Trim(dr(1).ToString())
            TextBox2.Text = Trim(dr(2).ToString())
        End While
        dr.Close()
        myConnection.Close()
    End Sub

    Private Sub Main_Menu_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles Main_Menu.Click
        MainMenu.Show()
        Me.Hide()
    End Sub

    Private Sub Clear_Click(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles Clear.Click
        TextBox1.Clear()
        TextBox2.Clear()
    End Sub

    Private Sub Cancel_Click(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles Cancel.Click
        MessageBox.Show("Thank you for using our smart card
system!")
        End
    End Sub
        End Class
```

APPENDIX II – Questionnaire

A.   I often become confused when I use the electronic toll payment system.

   a. Agree   b. Neutral   c. Disagree

B.   Interacting with the electronic toll payment system is often frustrating.

   a. Agree   b. Neutral   c. Disagree

C.   I need to consult the user manual often when using electronic toll payment system.

   a. Agree   b. Neutral   c. Disagree

D.   Interacting with the electronic toll payment system requires a lot of my mental effort.

   a. Agree   b. Neutral   c. Disagree

E.   I find it easy to get the electronic toll payment system to do what I want it to do.

   a. Agree   b. Neutral   c. Disagree

F.   The electronic toll payment system often behaves in unexpected ways.

   a. Agree   b. Neutral   c. Disagree

G.   I find it cumbersome to use the electronic toll payment system.

   a. Agree   b. Neutral   c. Disagree

H.   My interaction with the electronic toll payment system is easy for me to understand.

   a. Agree   b. Neutral   c. Disagree

I. It is easy for me to remember how to perform tasks using the
    electronic toll payment system.
    a. Agree   b. Neutral   c. Disagree

J. Overall, I find the electronic toll payment system easy to use.
    a. Agree   b. Neutral   c. Disagree