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RFID Security Issue That is Implemented into Malaysia Toll Collection System

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***Abstract* – RFID was invented and use by lots of user and industries. There is a security issue which outsider can get information from the RFID tag and it need to be solved. A survey will be conducted to get an idea on how many users are aware of the security issue of RFID technology. With the help of a new system, the owner can deactivate their RFID tag so it will show non information. Owner of the RFID tag should always check their bank balance and other information that is encoded in their RFID tag to make sure no information is leak to others.**

***Index Terms* - RFID, security, tag, toll**

1 Introduction

Radio Frequency Identification (RFID) was invented in 1945 by Leon Theremin. RFID main function was to read the audio information that was added into the incident radio waves. In 1973, the RFID technology was upgraded to using radio waves instead of using wired connection. The RFID tag is stick to thing that needed to be identified or be track (Ishtiaq et al., 2019).

RFID is widely used in some of the field these days. The RFID has the sensitive information embedded with it (Liang, et al., 2019). Attacker had found their ways on getting the sensitive information from the RFID tag. It is not safe to use RFID technology if the information is expose to other (Xu et al., 2018).

The security issue needs to be solved as there are a lot of industries and users are using the technology.

2 Literature Review

2.1 Research Domain

2.1.1 RFID

The idea of implementing Internet of Things (IOT) concept normally is included with RFID technology. RFID technology is used in some of the fields application such as product tracking, transportation, security and so on (Rathore, Kumar, & García-Díaz, 2020).

RFID is a wireless technology that can unambiguously identify and track information. In a RFID system, there are few requirements are use which is a RFID tag to store the information, a RFID reader to read and get the information from the RFID tag, a backend server to store the information and a place for the RFID reader to operate (Liang, et al., 2019).

In Hong Kong, RFID technology is used in to constantly collect updated information at each point-of-sales (POS), which is useful in visualizing real offer of the advertising patterns. The client will make their choices and save their choices into the RFID database so that the supplier can always get the newest information and send the correct items as soon as possible, this will increase the quality of services and decrease the deliver time for the items. The RFID labels are embedded into the cloths tag in some of their retail shops to get the information of what are the customers interest and what type of cloths they have already (Alia & Haseeb, 2019).

RFID technology is also implemented into Industrial Internet of Things (IIOT) to collect and share information regarding the industrial equipment to improving the efficiency and reliability of industrial production. Industrial equipment such as CCTV, traffic system, router and so on are frequently used every day. Using RFID technology in IIOT ensure that the data can only be accessed and manage by authorized individuals (LIANG, et al., 2021).

There are two types of RFID sensing technology. The first RFID sensing technology is analog RFID sensing. Analog RFID sensing does not need any dedicated sensing electronics to perform analogue processing of physical signals relevant to communication between the reader and the tag. Analog RFID sensing is based on the understanding that the performance of an RFID tag is influenced by the hosting item, and so sensing data may be retrieved simply by assessing the variation of signals backscattered from the tags. (Landaluce, et al., 2020).

The second RFID sensing technology is digital RFID sensing. Digital RFID sensing create an integrated sensor module by combining tags with electrical components. Computational RFID (CRFID) allow embedded computers to run programs using just scavenged Radio Frequency (RF) energy. The key to genuinely pervasive computing applications for the IoT is battery-free, "invisible" sensing and computation. The CRFID tag is used to send data as a communication interface. Passive RFID sensors collect RF energy from RF

radiation to power the circuit, execute the sensing operation, and preserve the data in the RFID chip, which can then be read by RFID readers (Landaluce, et al., 2020).

Based on the study, RFID technology is an advance technology that is included in an IOT concept and it is widely used in lots of fields all around the world. RFID technology provided people and businesses with convenience, effective and efficiency life. Therefore, the study will consider RFID to be used more regularly in more fields. RFID technology can collect and share information faster compared to old ways or old technology such as getting information through messaging and using smart card such as smart tag.

2.1.2 Toll Collection System

Toll collection system (TCS) is a system to collect money from the driver that uses the road to travel to other places. The pricing for the toll is depends on distance travel, vehicle type, trailer types, and vehicle emission class. The purpose of TCS is to finance the road infrastructure construction, operation, and maintenance (Milenkovi, Glavi, & Mladenovi, 2018).

An article has collected data about the number of vehicles enter the Sungai Ramal toll plaza on 25th July 2016 and found out that there are 4533 numbers of vehicle enter the Sungai Ramal toll plaza at morning peak hour which is 7 to 8 am. 62% to 69% of the vehicle are paying the toll by using Touch-N-Go cards payment system. There is a total of 7 lanes for Touch-N-Go cards payment system , 3 lanes for Electronic Toll Collection (ETC) systems and 2 lanes for heavy vehicles. Traffic is building up in front of toll booth because of the stop time at the toll booth and driver need to reduce speed at TNG and ETC lanes to pay the toll (Emad, Ismail, Borhan, & Ishak, 2018).

In Greece, due to legal framework difficulties of enforcement and toll collectability, the deployment of a Free Flow Electronic Toll Collection (ETC) System was not viable. Olympia Odos is merging existing conventional toll plazas with ETC structure into some of the lanes in the toll booth. This system was first implemented into the Greece toll booth in the world. This new ETC system is implemented into the tool booth and it does not affect any existing toll booth that is still running cash-based collection for paying toll (Papandreou, 2020).

Some places are using Vehicle number plate detection and recognition (VNPR) in their automation toll system. The VNPR system is strong and efficiency because it has a large amount of data. IT uses a traditional way to identify the number plate of the vehicle which is using contrast enhancement (Chavan & Varma, 2020).

Based on the study, toll collection system is a crucial system in every country to maintain the quality of the road. Some countries have started to use advance technology in their toll collection system to improve the process of collecting toll fees. The study considering using more ETC in Toll collection system. Malaysia toll collection system should learn from other country so that the traffic jam issue can be solve during the peak hour.

2.1.3 RFID in Toll Collection System

RFID is installed into the toll collection system to fix a major problem which is large waiting queues. RFID allows the driver to pay the toll just by slowing down the speed of the vehicle instead of totally stopping the vehicle (Kannan, Goyal, Goel, & Anitha, 2022).

The number of vehicles is increasing. The process for each vehicle to pay the toll may takes few minutes due to manual operations. Implementing RFID will make the process of paying toll faster compared to traditional toll system and reduce the amount of manual work. To use RFID in toll collection system, the driver needs to stick a RFID tag in front of their vehicle so that the RFID reader in the toll booth can read it (Khan, Garg, Tiwari, & Upadhyay, 2018).

Bangladesh has also used RFID in their toll collection system to solve their traffic problem as their economic and development are growing bigger and bigger. Using RFID technology can also reduce human error and manual labor (Ahmed, et al., 2019).

In Ghana, a country in West Africa, they install a 125 KHz RFID reader to constantly scanning the RFID tags that was detached on the driver's vehicles. When the RFID reader read the RFID tag that is detached on the driver's vehicles, the system will get the information of the driver's vehicle information and deduce the fund (Kommey & Acquaye, 2020).

Malaysia has implemented the RFID technology in toll collection system in year 2017. On 2022 March 1, the Dewan Rakyat said that the number of civilians using RFID tags has increased by 18% since 2017 (Bernama, 2022). The RFID tag is stick on a vehicle so that the owner of the vehicle and does not need to open the window and pay cash or scan a smart card to pay the toll (Divvala et al.,2020). Plus Malaysia Bhd (PLUS) is integrating at least one RFID lane per toll plaza of all its highway in the early year of 2022 (TARIQ, 2021).

Based on the study, RFID technology has successful in reducing the traffic jam issue in some country. RFID process the toll fund faster compared to manually calculate the fund and there will be not any human error. The study considers having more drivers install RFID tag into their vehicle to speed

up the process of paying at the toll booth. Having more lanes that is installed with RFID reader to read the RFID tag that is detached on the vehicle encourage more drivers use RFID lanes instead of using the traditional toll system.

2.2 Similar Systems

2.2.1 Similar system 1 - Visa Explore

Visa explore is a mobile application that manage the Visa card by using application program interface (API) (Visa, 2022a).

In this Visa explore application, user can activate and deactivate their Visa card by turning on or off for their Visa card (Visa, 2022b).

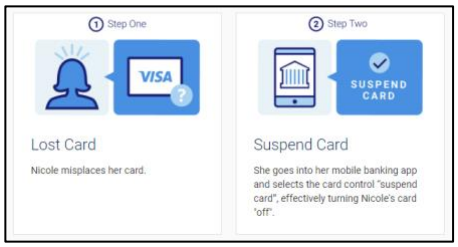

Figure 1: example 1 (Visa, 2022b)

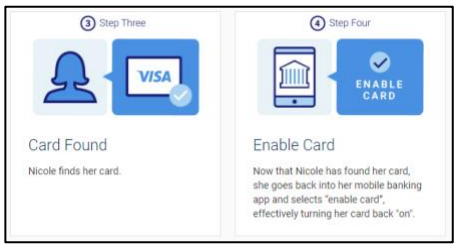

Figure 2: example 2 (Visa, 2022b)

For example, Nicole cannot find her card so she immediately suspends the card so the person who took her card cannot use it. She immediately enables the card when she found her card (Visa, 2022b).

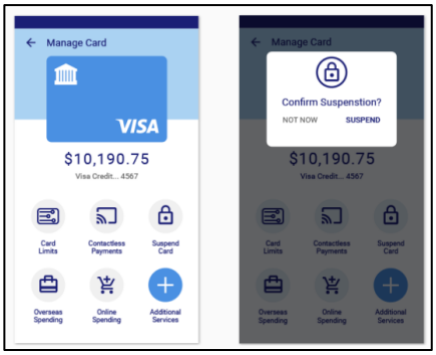

Figure 3: Visa Explore (Visa, 2022b)

Figure 3 shows the interface of the application where user can suspend their Visa card.

2.2.2 Similar system 2 - Touch ‘n Go eWallet

Touch 'n Go eWallet is an application that function as an electronic wallet (e-wallet) that store the money as electronic money (e-money) (TNG, 2022a).

User can add their Touch ‘n Go card or MyKad card to the Touch 'n Go eWallet to use the eWallet money while paying the toll (TNG, 2022b).

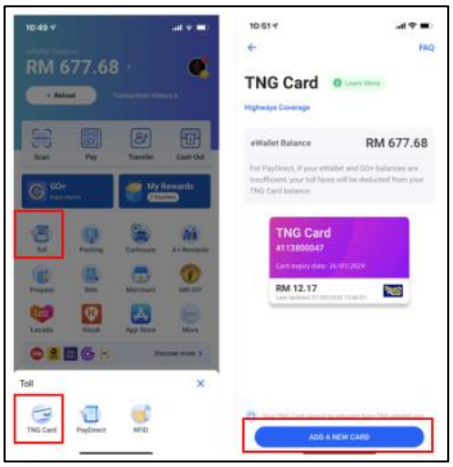

Figure 4: add card step 1, 2 (TNG, 2022c)

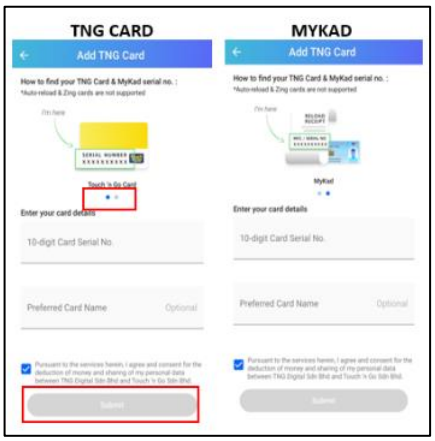

Figure 5: add card step 3, 4 (TNG, 2022c)

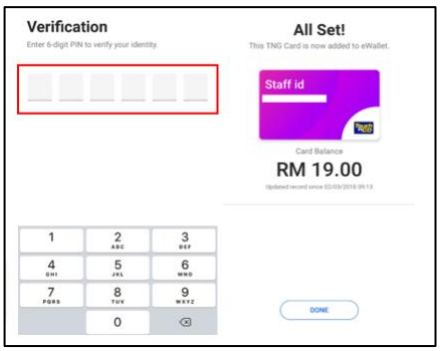

Figure 6: add card step 5, 6 (TNG, 2022c)

Figure 4, Figure 5 and Figure 6 shows the steps of adding Touch ‘n Go card or MyKad card into Touch 'n Go eWallet (TNG, 2022c).

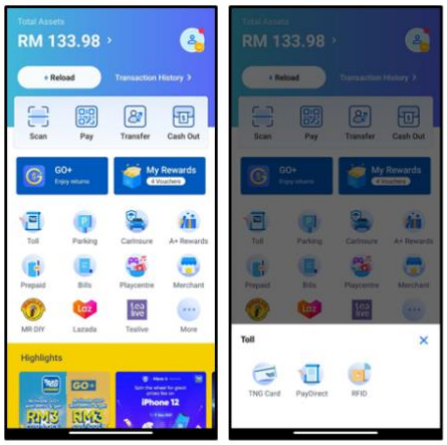

Figure 7: remove card step 1, 2 (TNG, 2022d)

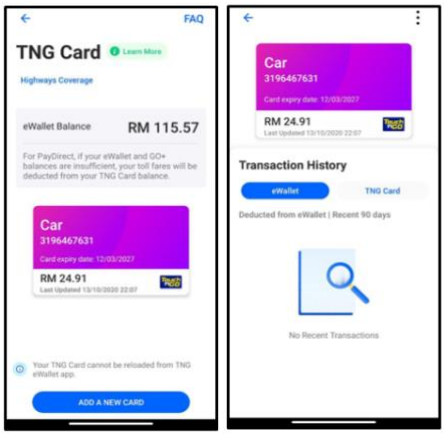

Figure 8: remove card step 3, 4 (TNG, 2022d)

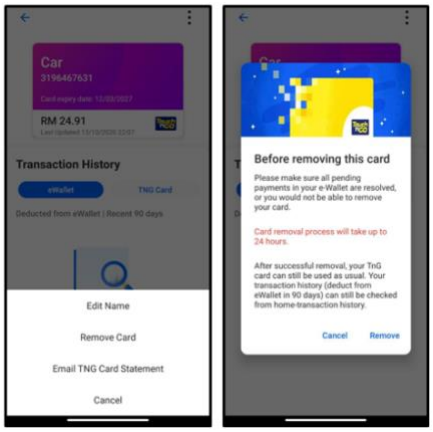

Figure 9: remove card step 5, 6 (TNG, 2022d)

Figure 7, Figure 8 and Figure 9Figure 4, shows the steps of removing Touch ‘n Go card or MyKad card from the Touch 'n Go eWallet (TNG, 2022d).

Removing the card from Touch 'n Go eWallet does not deactivate the card but just remove it so the card cannot use the money in the Touch 'n Go eWallet, but the money in the Touch 'n Go card still can be used.

2.2.3 Comparison Table

Feature	Visa Explore	Touch ‘n Go eWallet	Proposed System
Activate function	Yes	No, only add to the app	Yes
Deactivate Function	Yes	No, only remove from the app	Yes
Regional Available	North America, Asia-Pacific, Europe, CEMEA, LAC (Visa, Regional Availability, 2022c)	Malaysia	Malaysia

3 Problem Statement

Radio Frequency Identification (RFID) has provided people with convenience, effective and efficiency life but the technology security is also exposed to others (Xu, Ding, Li, Zhu, & Wang, 2018). The government has also said that they are targeting to achieve 60 % of the civilian use RFID to pay toll by the end of 2022 (Lim, 2021). However, there are some vulnerabilities related to RFID are exposed to the others (Tu, Zhou, & Piramuthu, 2020). There are some of the security problems for RFID such as eavesdropping, man-in-the-middle attack, falsifying and so on (Zhou, Zeng, Yang, & Li, 2021). The attacker can get the debit or credit card information from the RFID by using some technology to scan the RFID tag (Xu et al., 2018). The attacker can also clone and track the RFID tag and relaying attack. The attacker can start doing spoofing attack if they successful clone the RFID tag. The attacker can track the vehicle that has the RFID tag attach to it. The attacker can link the RFID tag to an authorized reader even if they are far away from the RFID tag (Wu, 2021). RFID technology make people life easier but at the same time the privacy is also exposed to the others.

4 Research Aims & Objectives

4.1 Aims

This research aim is to propose an effective solution to enhance the RFID technology security issues.

4.2 Objectives

- The identify the tools that the attacker use attack the RFID technology.
- To create a software or application that prevents the attacker to read the RFID.
- To disable the RFID to share information when the owner disables the RFID tag.

5 Research Significance

The finding of this research will help RFID users to protect their personal information that is encoded into the RFID tag. This research addresses the danger of exposing sensitive information to the other or attackers. The users can use the application to disable the RFID tag when it is not in used. By doing so, this research shows the significance on stopping attackers decode the information of the owner from the RFID tag with the application. And thus, an application that can enclose the information that is encoded in the RFID tag might be invented in the future.

6 Methodology

6.1 Sampling method

The sampling used in this research is stratified sampling. The reason behind using stratified sampling method is because the sampling will be from a lot of respondents from all around Malaysia.

By using stratified sampling, the population are divided into smaller group called strata. The group or strata are divided based on a specific characteristic, in this case, it is divided based on state (NICKOLAS, 2022).

Stratified sampling ensuring that the sample is reflecting to the diversity of the population. It also allows the researcher to collect the sampling using different collecting data method (Thomas, 2020).

6.2 Identify Target user

The respondents that are collected for the research is people that owns a vehicle and used RFID tag to pay the toll booth in Malaysia. Respondents that use RFID tag on their vehicle experience the RFID tag first handed so they know what is happening and what is the problem with the current RFID tag.

6.3 Data Collection method

The data collection method for this research will be using survey. Survey data collection method is chosen for this survey because the question in a survey is simple and easy to understand by respondents from different ages and social backgrounds. Using survey is also cost a lot cheaper compares to other data collecting method. Survey can collect large amount of data in a short period of time and can be done by respondents from anywhere anytime by sending them the survey through emails or social media. Survey form is easy to create and can be send to respondence as soon as possible.

Before the survey is send to the respondents, a pilot test will be conducted to ensure the quality of the survey. 5 to 10 people will be chosen to conduce the pilot test to make sure that the question is easy to understand, interesting and the option is valid. The person who conducting the pilot test can give suggestions to improve the survey after they are done with the survey.

A conclusion with graphs will be made by the survey after the respondents are done with the survey. The main purpose of the survey is to find out the usability of the RFID technology and does the respondence are aware of the RFID technology security issue.

7 Overview of the Proposed System

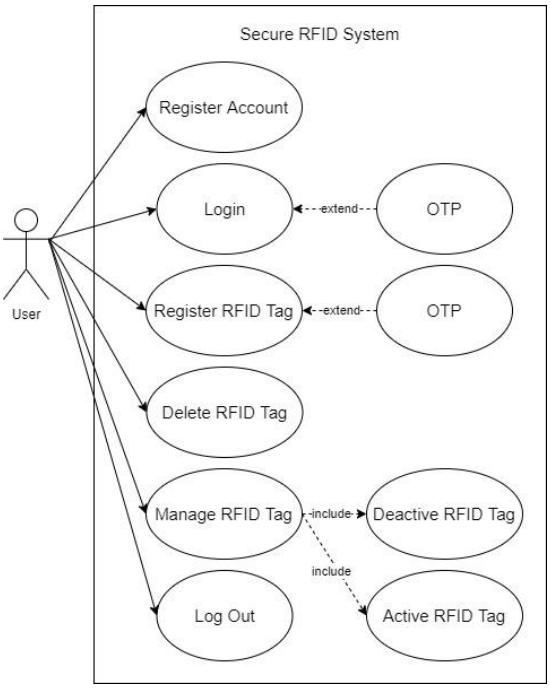

*Figure 10: Secure **RFID** System use case diagram*

Figure 10 shows the use case diagram for a new system which is Secure RFID System. To use the system, the user needs to have an account to login into it. If the user does not have an account to login into the system, the user can register a new account. The user can login into the system by using the registered account.

Every time the user login into the system, the system will send a one-time password (OTP) to the user's phone number and the user are required to key in the OTP to login into the system. If the user key In the wrong account information, the system will show an error message.

After the user login into the system, they can register their RFID tag into the system just like how the user

register their RFID tag into their TNG application. The user needs to register their vehicle then enter the 24-digit RFID tag number or scan the bar code on the TNG RFID Tag packaging to register their RFID tag into the system. After the user try to register their RFID tag into the system, the system will send an OTP to the TNG application that the RFID tag register to and the user need to key in the OTP then only the register for the RFID tag is complete.

The user can register multiple RFID tag into the system using the same method so the user can manage multiple RFID tags. The user can also delete or remove any RFID tag that is register into the system. The user can manage the RFID tag by activating and deactivating the RFID tag. When the RFID tag is deactivated, the RFID tag will not show any information when it is been scan. This will not share any sensitive information that is encoded into the RFID tag. The user can activate the RFID tag when they almost reach a toll booth to pay the toll. The user can also log out of the system whenever they want.

8 Conclusion

In conclusion, this research shows that RFID technology have a serious issue which is the attacker can get sensitive information from the RFID tag with the help of an application. The owner of the RFID tag can use the proposed system to deactivate the RFID tag by clicking the deactivate button to ensure that attacker cannot get any information from the RFID tag.

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