Research in Management of Technology and Business Vol. 4 No. 2 (2023) 012–022

RMTB

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/rmtb
e-ISSN : 2773-5044

Adoption of RFID Toll Payment among Consumers on Highways in Penang Malaysia

Lim Zhen Liang[1], Alina Shamsuddin[1]*

[1]Department of Management and Technology, Faculty of Technology Management and Business,
Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor, MALAYSIA

*Corresponding Author

DOI: https://doi.org/10.30880/rmtb.2023.04.02.002
Received 30 September 2023; Accepted 01 November 2023; Available online 01 December 2023

Abstract: Malaysia's toll system has been one of the causes of traffic congestion on major highways. One of the reasons for this is that users need to stop or slow down to pay the toll. As technology has advanced over the years, especially radio frequency identification (RFID), we can expect faster response times from the devices. Despite RFID seems to be self-contained to avoid massive congestion, the technology still has problems. One of the barriers, is the reading errors. Moreover, the use of RFID technology by retailers and government agencies raises questions on possible breaches of personal information privacy and potential security threats to personal information. Consumer acceptance of RFID technology is a complex issue, but a major concern for consumers may be the utility of the technology. In this study, the researchers aim is to identify the level of adoption of RFID technology by consumers and the influencing factors of RFID adoption on highways in Penang, Malaysia. Quantitative method was adopted for this study. Statistical Package for Social Sciences (SPSS) was used to analyse data. According to the results of the analysis, perceived usefulness has emerged as the most significant factor, with a mean of 4.106. Furthermore, the level of intention towards RFID use on highways is strong. This study has a significant impact on several parties, including as a reference for government and authorities to better understand RFID users' satisfaction with RFID technology on highways and how the influencing factors of RFID toll payment will affect RFID adoption intentions.

Keywords: Influencing Factors, Technology Adoption, RFID, Technology Acceptance Model (TAM)

1. Introduction

As recently announced, all toll highways on the west coast of Peninsular Malaysia, including the PLUS highway, will be RFID enabled. With RFID designed to reduce congestion and implement Automatic Number Plate Recognition (ANPR) systems, highway users can expect a more seamless

Corresponding author: alina@uthm.edu.my

travel experience (Wong, 2021). The Malaysian government aims to implement Multi-Lane Free Flow (MLFF) by 2026, and the first step towards this goal is to implement RFID. With traditional payment systems such as Touch ‘n Go and SmartTag still in place, Malaysia must take a step-by-step approach before all individual lanes can be completely removed (Wong, 2021). However, the suggested innovation-related markets will create uncertainty. Therefore, Malaysia Competition Commission (MyCC) has agreed to work closely with the government to ensure that these changes are always in the best interests of consumers. While MyCC welcomes the introduction of innovations such as RFID in the charging system, the committee believes that the system needs to be effectively implemented to achieve its objectives. Consequently, complaints about issues related to RFID implementation on PLUS Expressway are increasing (Xian, 2022). Radio frequency identification (RFID) technology is gaining attention from both academics and practitioners. RFID has the potential to be the basic technology for ubiquitous services, where objects and people can be automatically identified through attached RFID tags. The use of RFID technology by retailers and government agencies have raise questions about possible breaches of personal information privacy and potential security threats to personal information (Irawan *et al.*, 2016). From a community and supplier perspective, the automated introduction of RFID and data collection capabilities make many processes more efficient, simplify workflows and reduce production and service costs, thus promoting economic growth and potentially improving and benefiting people's lives (Ahmed *et al.*, 2019). While RFID seems to be self-contained to avoid massive congestion, the technology still has problems, one of the most important being that sometimes there are reading errors so that the boom barrier doesn’t go up, which in turn, even with Touch N ’Go and SmartTag also sometimes improves problem (Fong *et al.*, 2019). The real problem with the current toll system is that users have to slow down the vehicle significantly to scan existing smart cards. Next, traffic jams occur when there are a large number of cars queuing to pay tolls (Fong *et al.*, 2019). Errors sometimes occur when a vehicle is not identified, or the vehicle is incorrectly identified as another vehicle. In this case, road operators will suffer. If the wrong vehicle is detected, disgruntled drivers will be added to the case, making it difficult to cancel the wrong bill and potentially exaggerating negative advertising for toll road services (Wiseman, 2018).

The peak of traffic flow has become a "bottleneck" of highway toll stations. The frequency of starting and braking of vehicles also causes energy waste and environmental pollution, and at the same time accelerates the wear and tear of vehicle components, bringing potential traffic problems (Feng *et al.*, 2010). A large number of metropolitan centers were affected by population growth, which eventually led to increased car use, which led to delays in major traffic lines during rush hour on major roads (Zhengang *et al.*, 2014). Built -in tunnels, bridges and tower storage facilities lead to burdensome travel, time and fuel consumption as well as increased air emissions. Not only dissatisfied with the fees charged for equipment, but also with excessive delays in equipment (Singhal, 2021).

With the development of RFID technology, the use of RFID technology by retailers and government agencies raises questions about possible breaches of personal information privacy and potential security threats to personal information (Hossain *et al.*, 2008). Consumer acceptance of RFID technology is a complex issue, but a major concern for consumers may be the utility of the technology (Hossain *et al.*, 2008). Over the past half century, various theories have been developed to explain the use of consumer technologies such as RFID (Eckfeldt, 2016). Thus, consumers ’intention to use RFID technology influences their acceptance of the technology. Thus, consumer intention to use RFID technology and consumer acceptance of RFID technology are synonymous (Eckfeldt, 2016).

The omnipresence, invisibility, pervasiveness and invasiveness of RFID has also occurred concerns of a new society, particularly in terms of consumer trust and acceptance, invasion of privacy, reduced human control, and the spectre of technology mingling with humans (Musa *et al.*, 2020). Surveys show that consumer familiarity and awareness of RFID is low, and consumers are concerned that the data collected by RFID may be misused by third parties. The level of trust and attention of users also seems to vary by application. For example, the use of RFID in retail has proven to be more problematic than

the use of RFID in highway toll payments. Regarding RFID in public transportation, a review of various RFID cases found that system complexity, privacy, reception, technical interference and feature creep are major challenges (Ardis Storm-Mathisen, 2014). In conclusion, the issues of implementing RFID are consumer trust and acceptance, privacy, security and social influence. Hence, the research will explore the factors that influence the adoption of RFID in highway and the level of adoption of RFID in highway.

2. Literature Review

Almost all major highway in Malaysia, either open toll or closed toll, includes a toll system, and if you must pass through it, you must pay a fixed amount with a smart card, known as a Touch n Go or SmartTag solution that is speedier. Prior to the establishment of the Electronic Toll Collecting (ETC) system, toll collection was done manually or in cash (Fong *et al.*, 2019). Even with the launch of Touch n Go, customers will still be required to stop their vehicles in order to complete the necessary transactions. Initially, just 4-5 automobiles were allowed while waiting to pass through the gates, but once that number was exceeded, it quickly became a nightmare traffic congestion. SmartTag then appears. SmartTag is also another electronic toll collecting device that allows consumers to complete necessary transactions (Jamal *et al.*, 2019).

This opens the door to a new sort of toll system in which users just slow down rather than entirely halt while going through toll booths. Malaysia is taking a positive step toward a better future by implementing a cashless system at toll plazas (Bakar, 2019). Touch n Go then released their new mobile payment system. While all of this is a significant advancement, we still want a better charging method, which is where RFID comes in (Jamal, 2019).

According to the Touch n Go (2022) website, the relevance of RFID adoption is no longer worrying about changing batteries or closing toll windows with Touch 'n Go RFID. Furthermore, Touch n Go e-Wallet allows consumers to top up their accounts online at any time and from any location. Customers may also obtain the SmartTag experience at a tenth of the cost, with a simpler installation and registration process. According to the discussions, the relevance of RFID is both faster and more efficient. It cuts down on the amount of time consumers spend waiting for a high number of automobiles. Control over contactless payment devices is also advantageous to consumers. The technology is never taken away from the user. It also minimises the possibility of criminal fraud. RFID payment systems have been updated to improve security. In addition, the lines are shorter. Quick and simple payment alternatives can help to shorten check-out lines. Finally, RFID is a more convenient solution because top-ups may be completed on smart phones using credit or debit cards or internet banking (Anthony, 2019).

However, RFID is no exception. There are always obstacles to adopting new technology. RFID comes in a variety of forms, including passive high frequency and ultra-high frequency, active systems, real- time location systems, and others, each with a significantly different level of acceptance. However, in general, this is why people neglect RFID adoption. RFID is not a plug-and-play technology. Because tags do not emit signals, passive UHF system deployment might be difficult. To read a tag, enough power must be transferred from the reader antenna to the tag antenna. A variety of variables can affect a system's dependability, including environmental constraints that prohibit tags from being read. Reading mistakes do occur on occasion, causing traffic congestion (Mark Roberti, 2022).

2.1 Technology Adoption

According to Christianlly Cena (2016), technology is the application of scientific knowledge for an application or practical purpose whether in industry or in our daily life. Then, basically every time we use the scientific knowledge for a specific purpose, we are using technology. Technology is usually engaged a specific device, but the device can be very simple or complicated. It can be anything from discovery wheels to computers or MP3 players. The successful integration of new technology into a

business is referred to as technology adoption. Adoption entails more than simply utilising technology. Businesses that use new technology can fully utilise the technology and reap the benefits of the new system (Nathan Altadonna, 2022).

Since the technology's introduction in the 1970s, the globe has been incorporating Radio Frequency Identification (RFID) into everyday use (Rida *et al.*, 2010). Radio Frequency Identification (RFID) is the wireless or contactless transfer of digital IDs and other data through electromagnetic waves between RFID tags and readers. Through the use of a unique digital ID, businesses, organisations, and consumers may easily identify, authenticate, monitor, detect, and interact with physical items. RFID, unlike other automated identification technologies such as optical QR codes, can scan tags from a few centimetres to more than 20 metres away, depending on the kind of RFID device. It is now a commonplace feature of auto keys, employment IDs, medical histories/bills, highway toll tags, and security access cards (Dennison, 2022).

2.2 Technology Acceptance Model (TAM)

TAM's main objective was to shed light on the processes underlying technology acceptance in order to predict behaviour and provide a theoretical explanation for successful technology implementation. TAM's practical main objective was to inform practitioners about measures they could take prior to system implementation. Several steps were taken to achieve the theory's objectives (Davis, 1989; Davis, 1993). Davis started work on the technology acceptance model by trying to frame the processes that mediate the relationship between IS characteristics (external factors) and actual system use. The model was based on the Theory of Reasoned Action, a psychological point of view on human behaviour that was lacking in the IS research at the time (Davis, 1989; Davis, 1993).

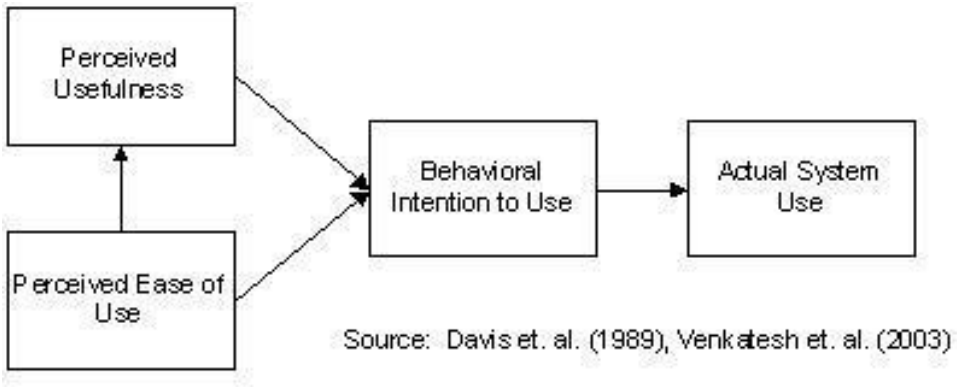

Figure 1: Technology acceptance model

In the previous study, there are many researches applied technology acceptance model (TAM) in their studies. For example, Trust (2018), applied the Technology Acceptance model (TAM) in order to understand the most influential factor in adoption of technology is affecting consumer trust since it involves in IoT transactions.

2.3 Influencing Factors of RFID Adoption

a) Perceived usefulness

TAM model includes perceived usefulness (PU), This is the concept that using specific technology would boost an individual's productivity. When a system enhances work efficiency, users' perceptions of the system improve. This assumption heightens the drive to improve system availability (Ahmed *et al.*, 2020). According to the innovation diffusion theory (IDT), people will only adopt innovations if they give a distinct advantage over existing alternatives (Rogers, 1995). This viewpoint is expressed in TAM through the perceived usefulness concept. Perceived usefulness is comparable to the unified theory of technology adoption and utilisation and the relative benefit of IDT (Venkatesh *et al.*, 2003, 2012). It refers to consumer’s perceptions of better performance as a result of using the technology. Adoption of

technology can contribute to speedier highway procedures, less congestion, and efficient service quality experienced by users (Wang *et al.*, 2013). As a result, RFID technologies are likely to have a high perceived usefulness. Existing research indicates that the ease of use of technology boosts consumer satisfaction and influences consumer intentions. RFID technologies are expected to be more widely used if they can make customers' lives easier. According to the TAM, perceived usefulness is a critical factor of behavioural intention to adopt RFID technology (Davis, 1989; Hart and Porter, 2004; Lee *et al.*, 2012; Lu and Su, 2009; Song *et al.*, 2008).

b) Perceived ease of use

Despite the perceived ease of use (PEOU) refers to the ease of using technology. Individuals see PEOU as an element of feasibility to use the system. And both form the influence of individual perception and form the antecedent attitude, which is called the influence of evaluation. Both constructs construct positive or negative attitudes toward the intention to accept technology (Ahmed, 2020). Both of these dimensions are nurtured by an individual's exposure to external factors related to information system norms and the environment. The TAM model states that the use of information systems is controlled by behavioural intentions that interact with personal attitudes and the use of technology. However, despite their attitude towards the system, the public expressed a desire to accept the information system after knowing its usefulness (Ahmed, 2020). The perceived ease of use is related to the effort expectation of the unified theory of technology acceptance and usage and the complexities of IDT (Venkatesh *et al.*, 2003). It is associated with the perceived exertion of effort by users when adopting technology. RFID technology adoption requires consumers to believe that RFID is simple to use. According to past research, perceived ease of use is a strong determinant of behavioral intentions to use the RFID technology (Davis, 1989; Davis *et al.*, 1989; Lee *et al.*, 2012).

c) Perceived privacy

Privacy definitions vary depending on context and surroundings. Privacy is defined broadly as the right to be left alone (Jones *et al.*, 2004). However, according to Privacy International (2003), there are four sorts of privacy: information privacy, body privacy, communication privacy, and territory privacy. The most essential to RFID technology acceptability is information privacy (Jayanti *et al.*, 1998). Individuals' right to regulate the acquisition and use of their personal information, even after they have given it to others, is characterized as information privacy. In the context of RFID technology, perceived privacy is defined as the extent to which a consumer has the right to regulate the gathering and use of his or her personal information using RFID technology. RFID-based application systems provide a variety of concerns to personal data privacy. Organizational acquisition of personal information heightens customers' worries about personal privacy since the information gathered may be made available to third parties (Earp *et al.*, 2005). In other words, the perceived privacy of RFID technology is determined by how people value personal privacy.

d) Perceived security

Security is described as a "circumstance, condition, or event with the potential to inflict economic hardship to data or network resources in the form of data loss, disclosure, alteration, denial of service, and/or fraud, waste, and abuse" (Kalakota, 1998). According to this concept, security risks can occur through network and data transaction assaults, as well as illegal access (Belanger, 2002). RFID tags provide possible security risks since a third party can obtain or steal personal information either intentionally or unconsciously (Smith, 2005). The adoption of RFID-based applications is complicated by security concerns. However, according to Smith (2005), RFID-based application solutions should increase customer loyalty and satisfaction. The increased consumer satisfaction derived through RFID-based technology enhances the chance of future use. As a result, assessing the benefits of RFID technology from the consumer's perspective is critical to increasing consumer acceptability. Consumers tolerate security risks if they feel the advantages exceed the hazards. In effect, customers evaluate the benefits and risks before agreeing to adopt a system (Eckfeldt, 2005). This leads to the hypothesis that customer acceptability of RFID technology is determined by how consumers value security.

e) Social influence

When measuring the acceptability of technical advancements, the decision maker's social environment should not be ignored. The social environment is crucial in the decision-making process (Hsu and Lu, 2004). This is especially true for RFID technology in its early stages of development or adoption. Most users in this area lack trustworthy information on use specifics. As a result, the importance of social network opinions for individual product evaluation grows. In line with Venkatesh *et al.* (2012), we include the component of social influence in our study model, which is defined as a user's view of whether other influential individuals believe they should engage in the behaviour. Social impact is comparable to the subjective standard in the theory of reasoned action (Venkatesh *et al.*, 2003). Users' intentions to embrace technology may be influenced by friends, family, and even media which including televisions. Many people have used smart phones because the media portrays it as a trend. Davis *et al.* (1989), for example, underlined the relevance of social impact in RFID acceptance and usage behavior. According to Chong *et al.* (2012), social influence has a major impact on customer intentions to use RFID technology.

f) Intention to adopt

Behavioral intention is the user's subjective probability of influencing behavior. The purpose of the behavioral intention consumption variable is to predict the actual purchase and consumption behavior of the consumer. The core aspects of consumer intention are consumer interest, intent to use products and services immediately, and information to learn more about products and services (Gunawan et al, 2017). There are several influencing factors that influence the level of technology adoption, not least social influence. Social influence plays an important role in the process of adopting RFID technology or the initial stages of diffusion. According to Trust (2018), perceived usefulness and perceived ease of use factors may influence behavioral intention of technology adoption. According to Hossain *et al.* (2014), perceived privacy and perceived security are the factors influencing the behavioral intention of technology adoption.

3. Methodology

This study used quantitative methods to collect the data needed for the analysis. Descriptive research was used to study the level of adoption of RFID and the influencing factors of RFID adoption on highways toll payment. Five influencing factors of RFID adoption have been identified which include perceived usefulness, perceived ease of use, perceived privacy, perceived security and social influence. This study conducted an online questionnaire as a method to test the hypotheses presented. The online questionnaire tool consists of questions from previous research that have proven their effectiveness and reliability. The population of this study is approximately 678,000 people in Penang. The sample size is estimated to be around 384 people.

3.1 Data Collection

The questionnaire had three parts. The first part was the demographic questions which was the background of the respondents. The second part was to describe the influencing factors of RFID adoption. TAM model categorized the factors into five factors which include perceived usefulness, perceived ease of use, perceived privacy, perceived security, and social influence. The third part was the behavioral intention of technology adoption. The scale used was Likert's scale 5 point, which was composed of strongly disagree, disagree, neutral, agree, and strongly agree.

3.2 Data Analysis

The results of the questionnaire were analyzed using IBM SPSS 26 Statistics software was used to evaluate the collected data of mean, standard deviation, frequency and percentage statistics were used in this study.

4. Results and Discussion

The data on respondents' background, mean score, and standard deviation were used to conduct the analysis. The research findings provide justification and support for the conclusion reached in this study. The Statistical Package for Social Sciences (SPSS) software was used to analyze the data collected from the distributed questionnaire.

4.1 Survey Response Rate

Based on Table 1, a total of 384 survey questionnaires has been distributed. However, the total number of returns were only 230, which make the return rate 59.90%.

Table 1: Survey return rate

Sample size	Questionnaire Distributed	Returned Questionnaire	Percentage
384	384	230	59.90%

4.2 Reliability Analysis

A pilot study was carried out to ensure that the questionnaire items were valid and reliable. The results of the pilot study's reliability test are shown in Table 2. The respondents were from the Penang population.

Table 2: Reliability test for pilot study

Dimensions	Cronbach's Alpha	N-item in scale	N-respondents
PU	0.928	5	30
PEOU	0.962	5	30
PP	0.921	5	30
PS	0.934	5	30
SI	0.911	5	30
BI	0.979	6	30

The Cronbach’s alpha for perceived usefulness (PU) is 0.928. While for perceived ease of use (PEOU), the Cronbach’s alpha is 0.962. The Cronbach’s alpha for perceived privacy (PP) is 0.921. In addition, the Cronbach's alpha for perceived security (PS) is 0.934. Cronbach's alpha for social influence (SI) is 0.911. the Lastly the value of Cronbach’s alpha for behavioral intention (BI) to adopt RFID is 0.979. The result shows that the reliability level of Cronbach’s alpha of the questionnaire is very good since the value of each construct is greater than 0.9. All value was exceeded 0.9 which was above 0.8, hence all factors were accepted.

4.3 Normality Analysis

A normality test has been implemented to test the data's normality. The Kolmogorov-Smirnov (K-S) and Shapiro-Wilk (S-W) tests were used to determine normality by comparing data to a normal distribution with the same mean and standard deviation. A normal distribution is a symmetric bell-shaped curve defined by mean (average) and variance (variability). The data for this study was non-

normal because the p value was less than 0.05. The actual study was carried out after the pilot study revealed that the questionnaires were valid and reliable. The results of the reliability test for the actual study are shown in Table 3.

Table 3: Reliability test for actual study

Dimensions	Cronbach's Alpha	N-item in scale
PU	0.827	5
PEOU	0.876	5
PP	0.910	5
PS	0.923	5
SI	0.865	5
BI	0.934	6

4.4 Correlation Analysis

Consequently, Spearman's rho correlation was used. Spearman's rho correlation coefficients range from -1 to +1 (Duncan *et al.*, 2014). The greater the value of the coefficient, the stronger the relationship between the independent and dependent variables (Duncan *et al.*, 2014). Table 4 shows that that there was a strong significant relationship between the influencing factors and RFID intention of adoption on highways in Penang. Overall hypothesis for each factor which are perceived usefulness, perceived ease of use, perceived privacy, perceived and social influence has been accepted. All factors have correlation with the intention towards adoption of RFID technology on highways. The correlation coefficient value (r) is between 0.562 to 0.610, which show they have relationship between the independent variables and dependent variable in this study.

Table 4: Relationship between the independent variables and dependent variable

Variables			Coefficient value (r)	Interpretation
Spearman's rho	Perceived Usefulness *(PU)*	Correlation Coefficient	0.604**	Strong
		Sig. (2-tailed)	0.000	
	Perceived Ease of Use *(PEOU)*	Correlation Coefficient	0.610**	Strong
		Sig. (2-tailed)	0.000	
	Perceived Privacy *(PP)*	Correlation Coefficient	0.562**	Moderate
		Sig. (2-tailed)	0.000	
	Perceived Security *(PS)*	Correlation Coefficient	0.601**	Strong
		Sig. (2-tailed)	0.000	
	Social Influence *(SI)*	Correlation Coefficient	0.607**	Strong
		Sig. (2-tailed)	0.000	

**. Correlation is significant at the 0.01 level (2-tailed).

5. Conclusion

As a conclusion, all of the influencing factors towards behavioral intention of technology adoption are at a high level. Furthermore, the level of intention toward RFID use on highways is strong. Furthermore, according to this study, there is a significant relationship between the influencing factors and RFID intention of adoption on highways. According to the findings, perceived usefulness and perceived ease of use have the most positive relationship with intention of RFID adoption. As a result, all three objectives have been completed. Hence as a result, this study can help the education sector comprehend the respondents' perspectives of influence factors on the intention of RFID adoption on highways.

On the other hand, the recommendations are essential in order to enhance the research in the future that can assist the researcher conduct the research better than previous researchers. Recommendations are also important since they help to ensure that future researchers are more structured and understandable. Based on all above literature review and research findings, the following recommendations are provided to enhance the research and research issue.

First, it is recommended that respondents not simply focus on the Penang people. It has the potential to expand in any developing region. Furthermore, the questionnaire questions that are distributed to respondents should be basic and easy for them to answer. This makes it easier for responders to complete the questionnaire depending on their comprehension. For future research, the researchers can use other methodologies, such as qualitative methods, to examine the adoption of IoT on highway toll payment systems with technological outcomes such as IoT adoption and IoT satisfaction.

Besides that, data collection should be started earlier in order to increase the amount of time for data collection, as well as increases the number of respondents that could be taken part in the survey. Apart from that, future research might find other relevant factors to verify the findings of the current study. In the future, researcher can use more effective methods through online surveys or questionnaires.

Acknowledgement

The author would also like to thank the Technology Management Focus Group and Faculty of Technology Management and Business, Universiti Tun Hussein Onn Malaysia for its support.

References

Abdulkader, O., Bamhdi, A. M., Thayananthan, V., Jambi, K., & Alrasheedi, M. (2018, February). A Novel and Secure Smart Parking Management System (SPMS) based on integration of WSN, RFID, and IoT. In 2018 15th Learning and Technology Conference (L&T) (pp. 102-106). IEEE

Ahmed, W., Hizam, S. M., Sentosa, I., Akter, H., Yafi, E., & Ali, J. (2020). Predicting IoT service adoption towards smart mobility in Malaysia: SEM-neural hybrid pilot study. arXiv preprint arXiv:2002.00152.

Aktar, L. (2016). Research in Social Science: Interdisciplinary Perspectives (pp.17) Edition: 1st Chapter: Research Design. Retrieved from

https://www.researchgate.net/publication/308915548_Research_Design

Anthony, L. (2019). All about RFID technology in Malaysia, and the potential value it offers to connected motorists. Retrieved from https://paultan.org/2019/04/30/all-about-rfid- technology-in-Malaysia-and-the-potential-value-it-offers-to-connected-motorists

Ardis Storm-Mathisen (2014). RFID in toll/ticketing - a user-centric approach. Vol. 16 No. 6, 2014, pp. 60-73. DOI: 10.1108/info-07-2014-0029

Avery Dennison (2021). RFID technology basics. Retrieved from https://rfid.averydennison.com/en/home/explore-rfid/rfid-technology-basics.html

Blythe, Philip. (2019). RFID for road tolling, road-use pricing and vehicle access control. 8/1 - 816. 10.1049/ic:19990681.

Charness, N., Boot, W. R. (2016). Handbook of the Psychology of Aging (Eighth Edition). Retrieved from https://www.sciencedirect.com/science/article/pii/B97801 24114692000200

Davis, F. D. A. (1986). A technology acceptance model for empirically testing new end user information systems: theory and results. Ph. D. Dissertation, MIT Sloan School of Management, Cambridge, MA ,1.

Eckfeldt, B. (2015). What does RFID do for the consumer. Communications of the ACM, 48(9), 77-79.

Feng, Z., Zhu, Y., Xue, P., & Li, M. (2010, July). Design and realization of expressway vehicle path recognition and ETC system based on RFID. 3rd International Conference on Computer Science and Information Technology (Vol. 7, pp. 86-90).

Fong, S. L., Bakar, A. A. A. bin A., Ahmed, F. Y. H., & Jamal, A. (2019). Smart Transportation System Using RFID. Proceedings of the 2019 8th International Conference on Software and Computer Applications - ICSCA '19. doi:10.1145/3316615.3316719

Formplus Blog (2022). What is Primary Data? Examples & Collection Methods. Retrieved from https://www.formpl.us/blog/primary-data

Gao, L., & Bai, X. (2014). A unified perspective on the factors influencing consumer acceptance of internet of things technology. Asia Pacific Journal of Marketing and Logistics.

Gunawan, F., & Aprianingsih, A. (2017). Assesing customer acceptance toward intention to use e-toll card using technology acceptance model (TAM). Journal of Business and Management, 6(2), 311-320.

Hillier, W. (2022). What Is Secondary Data? A Complete Guide. Retrieved from https://careerfoundry.com/en/blog/data-analytics/what-is-secondary-data/

Hongjian, W., & Yuelin, T. (2012, July). RFID technology applied to monitor vehicle in highway. In 2012 Third International Conference on Digital Manufacturing & Automation (pp. 736- 739). IEEE.

Hossain, M. M., & Prybutok, V. R. (2014). Consumer acceptance of RFID technology: An exploratory study. IEEE transactions on engineering management, 55(2), 316-328.

Hossain, M. A., & Quaddus, M. (2014). Mandatory and voluntary adoption of RFID. In Encyclopaedia of business analytics and optimization (pp. 1457-1475). IGI Global.

Hsu, C. L., & Lin, J. C. C. (2018). Exploring factors affecting the adoption of internet of things services. Journal of Computer information systems, 58(1), 49-57.

Hushangabade, M. R., & Dhopte, S. V. (2013). Implementation of rats for the purpose of vehicle tracking & toll tax collection. International Journal Of Computer Science And Applications, 6(2).

Irawan, H., Hendayani, R., & Widyan, D. (2016). Adoption of electronic toll application analysis. International Journal of Economics and Management, 10(1), 211-222.

Kang, J. (2019). Lightweight mutual authentication RFID protocol for secure multi-tag simultaneous authentication in ubiquitous environments. The Journal of Supercomputing, 75(8), 4529-4542.

Kapoor, K., Dwivedi, Y., Piercy, N. C., Lal, B., & Weerakkody, V. (2014). RFID integrated systems in libraries: extending TAM model for empirically examining the use. Journal of Enterprise Information Management.

Kommineni, V. V., Kumar, K. R., & Joseph, W. J. (2017). Integrated highway management system using radio frequency technology based on arm.

Lim, S. H., Kim, S. H., Cho, N. J., & Kim, D. K. (2010). Measuring RFID Adoption Factors with Cognitive Styles: A Preliminary Examination of Consumers' Perceptions. Journal of Information Technology Applications and Management, 17(3), 99-119.

Mark Roberti (2022). What Are the Main Barriers to RFID Adoption? Retrieved from https://www.rfidjournal.com/question/what-are-the-main-barriers-to-rfid-adoption

Mesay, D. (2019). Design and Development of Vehicle Detection and Payment System Using RFID Technology: A case of Addis Abeba to Adama Expressway (Doctoral dissertation, ASTU).

Musa, Munirah & Hashim, Nor & Muhammad, Rahimah. (2020). Integrated Transport System: Challenges and Potential Toward Sustainability in the Malaysian Transport System. IOP Conference Series: Materials Science and Engineering. 884. 012032. 10.1088/1757-899X/884/1/012032.

Popoola, S. I., Popoola, O. A., Oluwaranti, A. I., Atayero, A. A., Badejo, J. A., & Misra, S. (2017, October). A cloud-based intelligent toll collection system for smart cities. International conference on next generation computing technologies (pp. 653-663). Springer, Singapore.

Rida, A., Yang, L., & Tentzeris, M. M. (2016). RFID Enabled Sensor Design and Applications. Boston: Artech House.

Shobana, K., Sait, A. N., & Haq, A. N. (2016). RFID based vehicle toll collection system for toll roads. International Journal of Enterprise Network Management, 4(1), 3-15.

Sukwadi, R., Caroline, L. S., & Chen, G. Y. H. (2022). Extended technology acceptance model for Indonesian mobile wallet: Structural equation modeling approach. Engineering and Applied Science Research, 49(2), 146-154.

Singhal, P. (2021). RFID Based Vehicle Toll Collection System for Toll Roads. Turkish Journal of Computer and Mathematics Education (TURCOMAT), 12(2), 2104-2113.

Yair Wiseman (2018). Vehicle Identification by OCR, RFID and Bluetooth for Toll Roads. International Journal of Control and Automation, 11(9), pp.67-76. http//dx.doi.org/10.14257/ijca.2018.11.9.07

Zhengang, R., & Yingbo, G. (2014, July). Design of electronic toll collection system in expressway based on RFID. In 2009 International conference on environmental science and information application technology, 3, pp. 779-782