



RESEARCH ARTICLE

Factors of Effectiveness on Internet of Things Implementation for Online Bus Ticketing System

Zirawani Baharum^{1*}, Mohamad Haziq Faiq Mohamad Baharudin², Dewi Nasien^{3*}, M. Hasmil Adiya⁴, Rahimah Kassim⁵

^{1,5} Technical Foundation, Malaysian Institute of Industrial Technology, Universiti Kuala Lumpur, Persiaran Sinaran Ilmu, Bandar Seri Alam, 81750 Johor Bahru

² Industrial Logistics, Malaysian Institute of Industrial Technology, Universiti Kuala Lumpur, Persiaran Sinaran Ilmu, Bandar Seri Alam, 81750 Johor Bahru

^{3,4} Institut Bisnis dan Teknologi Pelita Indonesia, Pekanbaru, Riau, Indonesia

ARTICLE INFO	ABSTRACT
Received: Jun 28, 2024	<p>The effectiveness of the bus ticketing system is vital for the bus transportation sector to be more competitive. Public transportation must develop in parallel with the development of technology to meet passenger demand. With the issues that are being faced by the passenger, which are traditional ticketing, the difficulty of obtaining real-time information, and data security, the reliability of public transportation can be disputed against. The implementation of the Internet of Things (IoT) in ticketing systems is an important factor in making public transportation more effective. The development of technology such as IoT is one of the main things that should be implemented in the ticketing system in order to make it more effective, which includes secured online booking, accessible websites and mobile applications, and data security. Therefore, this research will focus on getting the scientific evidence and proof needed to determine the factors of effectiveness on internet of things implementation for online bus ticketing system. The paper will be initially give the spark to the future works such as examine the effectiveness of IoT implementation in the online bus ticketing system. Thus, it is beginning by exploring the process and flow of the RedBus ticketing system to gain an understanding of the ticketing system process, which forms the backbone of operations for all bus operators. Next, the researcher used a literature review to identify the factors that might affecting the effectiveness of IoT implementation in ticketing systems. Through the comprehensive literature review the factors in mapping into the conceptual model shown that 3 main factors determined which are secure online booking, smart tracking and accessible website and mobile application. The importance of prioritizing accessibility, usability, and security in IoT implementation also highlighted as well. Hopefully, this investigation be able to help the public transport industry to improve the factors that satisfy passenger demand and satisfaction.</p>
Accepted: Sep 12, 2024	
Keywords	
Bus	
Determination	
Online booking	
Efficiency	
Transportation	
*Corresponding Author:	

1. INTRODUCTION

Public transportation, also known as public transportation, mass transit, and urban transit, refers to various modes of transportation available to the public, such as van pools, buses, trains, ferries, and their variations. It implies that public transportation will be used more on the road. Taking public transportation is the most convenient and cost-effective option. Public transportation is a type of local transportation that allows more people to travel together along established routes. Public transportation vehicles are intended to make everyone's life simpler. The benefits of public transit are obvious, whether they are transporting people for

their daily commute or visitors travelling for enjoyment on their trips. Public transportation is essential in the lives of inhabitants and visitors alike in cities and towns across the world (Industry Insight, 2021; Nicolas, 2021).

Ticketing system is a software application that allows users to submit support requests, called tickets, for customer service and technical support. A ticketing system lets you record requests made by your customers, assigning them to the appropriate customer service team member for resolution. It also allows users to view requests and other information about their interactions with the company. A ticketing system records the interactions on a support or service case by first creating a document, or ticket. The ticket is shared by both the rep and the customer, and it keeps track of their interactions in one place. Both parties can refer to the thread at any time to check previous material on the issue if there is any confusion or if a detail is missed (Aglibar et al., 2022). The ticketing system provides a point of contact for anyone who needs assistance with a problem. The ticketing tool features a request module that acts as a help-line manager, where all requests from users with questions about their individual problem are retrieved and then essential solutions are offered to them by giving them pre-defined solutions. If the administrator has not predefined a solution, the request for that inquiry is forwarded to the technician to handle the issue (Gohil and Kumar, 2019). The integration of cyber physical systems (CPS), the internet of things (IoT), and services into major industrial processes defines Industry 4.0. (Maria et al., 2020; Ud et al., 2018; Yacob et al., 2020; Gil et al., 2016). IR 4.0 is predicted to transform how we communicate, live, and work. It is also predicted to change our current values as well as how we will value them in the future. IR 4.0 is a new phase of the industrial revolution that emphasizes interconnections, automation, machine learning, and real-time data. IR 4.0 which includes industrial IoT and smart manufacturing, combines physical production and operations with smart digital technologies. Even though each business and organization today are different, they all confront the same problem, the need for connectivity and access to real-time data across partners, products, and people (Tay et al., 2018). IoT generally refers to scenarios where network connectivity and computing capability extends to objects, sensors and everyday items not normally considered computers, allowing these devices to generate, exchange and consume data with minimal human intervention. The concept of combining computers, sensors, and networks to monitor and control devices (Gil et al., 2018).

In recent years, the application of IoT in the transportation sector has accelerated. IoT market for transportation is anticipated to reach \$328 billion in value by 2023. IoT devices are used in the transportation industry for a variety of purposes, including ticketing, security, surveillance, and telematics systems, to provide effective and secure transit in urban areas (Hamilton, 2020). Internet of things offers various potential in the transportation and logistics sectors. These opportunities involve numerous applications or demands of a transportation system (Nallapaneni et al., 2017). Public transportation has increasingly benefited from the advent of new technology in recent decades. Passengers' interactions with transportation services improved when tickets and payment systems transitioned from paper to electronic, and on-line planning and real-time information systems were accessible. Transport operators began to perceive interoperability across rivals as an additional benefit as information transmission became more efficient (Melis et al., 2016).

Malaysia is now preparing to fully embrace the benefits of the pandemic's rapid transition to digitalization, with statistics showing that 80% of Malaysians are now active internet users, and 94% of those in metropolitan areas prefer digital transactions over traditional cash and cheque. This advancement creates new chances for Malaysian industry, particularly the transportation sector, to supply digital innovation and change in response to consumer needs. Considering this development, RedBus, the world's largest bus e-ticketing platform, is presently working with the Ministry of Transport to enhance the way Malaysians travel by embracing the global shift toward more efficient and sustainable transport options (Malaysiakini (2022). Prakash Sangam, Chief Executive Officer of RedBus also said that to jointly embrace innovative ideas for a sustainable future of this business, our discussion with the nation's decision-makers was intended to lay out the vision for intercity bus transportation in Malaysia. Since the epidemic, there has been a definite trend toward consumers preferring to buy goods and services online. Focusing on the current inclination toward digital commerce, which is beneficial for the bus transportation industry (Malaysiakini, 2022).

2. LITERATURE REVIEW

There are many problems that are being faced by passengers with the current ticketing system. Public transport especially buses are getting crowded day by day due to heavy demand of transport facility

(Nedeltcheva, 2018). Streamlined ticketing procedures are necessary for effective transit. People do not like standing in long, congested ticket lines, and touchless ticketing is essential for a public that is virus aware. Transit operators must implement touch less, totally digital payment systems more quickly. Online bus booking systems provide customers with convenience and comfort, as well as peace of mind. There will be no last-minute scramble to find a bus ticket of all seats being booked. Aside from offering booking services to passenger, the system should also include elements that make the online booking system appealing and user-friendly (Nicolas, 2021). Here are issue and challenges in ticketing system.

2.1 Traditional Method of Booking

The type of system being used at the counter is an internal system which is manually used in selling the bus tickets. Problems facing the company with the current system is customers must go to the counter to buy bus ticket or ask for bus schedule. Customers will also have to queue up for a long time to secure a bus especially in peak season like public holiday (Tidke et al., 2018; Nikhil,2020). According to News Straits Times, Larkin Central terminal is crowded with people wanting to return to their hometowns. Hundreds of people were spotted standing at the ticket booth to acquire tickets to their hometowns, while others were seen queuing at the departure hall to join the buses.

2.2 Difficulty to Obtain Real Time Information

Seeing as customers take their smartphone everywhere, public transportation companies could improve the customer experience by allowing the customers to use their smartphone as a tool. Everyone with a mobile data plan and a smartphone should access crucial information on bus timetable or bus location (Azhar, 2020). The difficulty to obtain real-time information regarding the location of the vehicle or the anticipated time of arrival at a specific stop is possibly one of the main complaints raised by passengers about public transportation. Smart tracking has become the need of many businesses to manage their transportation services effectively (Roh and Kim, 2022).

2.3 Data Security

There are security threats lying around every corner in this digital age, as most firms use some form of system that processes business-related data. Every organization requires cyber security and attack security. Cyber-crime and malware are continual risks to anyone with an internet connection, and data breaches are both time-consuming and costly. The intercity bus sector is no different because ticket reservation systems are the backbone of every bus operator, their security is critical and cannot be disregarded. If something goes wrong, it might be terrible for any company (Turnit, 2019; Brian, 2022). The Internet will eventually be connected to every item we use daily. All physical items, also referred to as IoT devices, will be controlled centrally or remotely using mobile phones (Leloglu, 2017). It is predicted that there will be 50 billion Internet-connected devices, up from the current 25 billion. Due to the prevalence of such a large network, there are additional security threats that might allow hackers to acquire even more personal data from consumers or businesses connected to such an IoT system.

IoT has the potential to disrupt the transportation industry by fundamentally transforming how transportation systems gather data and information by bringing together the major technical and business trends of mobility, automation, and data analytics. IoT refers to the networking of physical items using embedded sensors, actuators, and other devices that can gather and transmit data on network activities in real time. The data collected by these sensors can subsequently be evaluated by transportation authorities (Alcatel-Lucent, 2022).

There are many problems that are being faced by passengers with the current ticketing system. Public transport especially buses are getting crowded day by day due to heavy demand of transport facility (Nedeltcheva, 2018). The public transport has growth rapidly in our country and the number of passengers that using services at public terminal also increasing. All passenger or customer that using public transportation services wants, need, and demand a high and better services. The advancement of information technology in IoT development has a significant impact on many aspects of human activity. This technology will further improve the passenger's experience on public transportation. The existence of IoT takes the public transportation sector to the next level and beyond what passenger can benefit from it (Azhar, 2020). From the issues and challenges in bus ticketing system, the traditional ticketing, difficulty to obtain real time information and safety data of the passenger is become as main factors for this research. They will give big impact to public transportation and thorough the system. Therefore, it is important to determine the effectiveness of IoT

implementation on ticketing system in order to show the relation between the factors and the system as well. The case study for the data collection is taken at one of famous company for online ticketing system.

3 CASE STUDY OF ONLINE TICKETING SYSTEM

RedBus is the biggest online bus ticket marketplace in the world, linking numerous locations around the world with a single click. (Shastri, 2021), inspired from the difficulties occurred to Phanindra Sharma when finding the bus. Since its founding in 2006, RedBus has sold more than 75 million tickets. RedBus is a subsidiary of the ibibo Group and is supported by Naspers which a South African multinational company. By uniting more than 2,000 bus companies that operate along more than 100,000 routes around the world, RedBus transformed the online bus ticket booking sector. RedBus is currently possibly the world's largest community of bus travellers with its mobile app having had over 7.5 million downloads. RedBus makes it more convenient and comfortable for its customers by providing multiple travel Bookings offers such as thousands of routes across multiple travel options, efficient customer service, low fare of tickets, pilgrimage tours, discounts, deals and festival offers, mobile ticketing apps and bus hiring. Nowadays, there are a few websites about online services or online ticketing system can be found powered by RedBus. Below are the few examples from website or e-ticketing system that allow to book and reserve the ticket online, which are:

3.1 Mara Liner Website Ticketing System

Mara Liner is a well-established transportation company that operate ticketing system through its website. The Mara Liner website ticketing system provides a convenient and user-friendly platform for customer to book and manage their bus tickets online. In conclusion, Mara Liner website ticketing system stands as a reliable and efficient platform for passenger to book bus tickets conveniently.

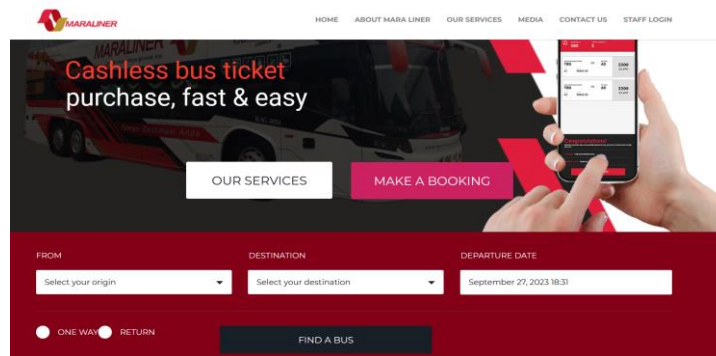


Figure 1. Mara Liner Website Ticketing System

3.2 Plus Liner Website Ticketing System

Plus Liner is a well-established transportation company that operate ticketing system through its website. The Plus Liner website ticketing system provides a convenient and user-friendly platform for customer to book and manage their bus tickets online.

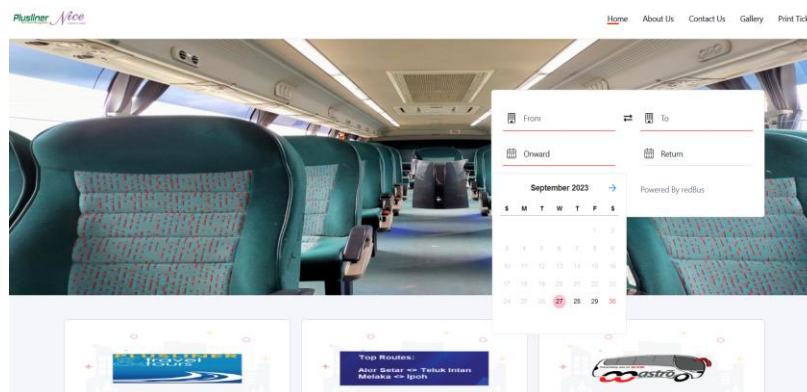


Figure 2. Plus Liner Website Ticketing System

3.2 Transnasional Website Ticketing System

The Transnasional Website ticketing system is an innovative and convenient platform that allows customers to book their tickets online. Developed by Transnasional, a leading transportation company, the website ticketing system offers a seamless and user-friendly experience for passenger looking to plan their bus travel arrangements.

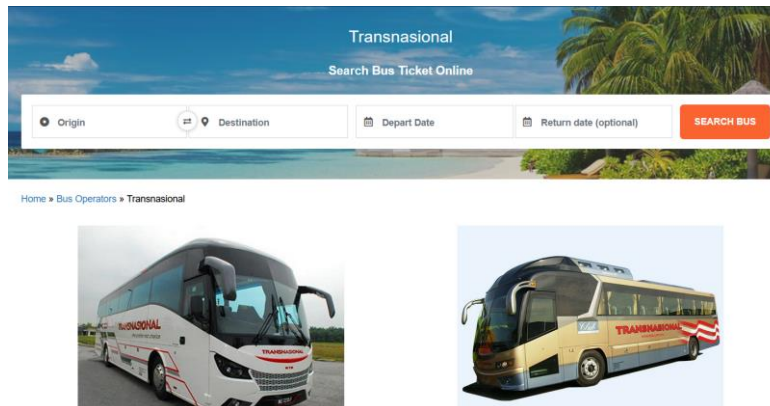


Figure 3. Transnasional Website Ticketing System

4 FACTORS OF IOT IMPLEMENTATION IN BUS TICKETING BOOKING SYSTEM

A bus reservation system is a mobile or web software solution that provides customers with a customized, easy-to-use user experience for online ticket booking and paying. It keeps personal data records, scheduled routes, frequent journeys, drop places, and other information for clients. Since ticket reservation systems serve as the foundation for any bus operator, their security is crucial and cannot be compromised. It's essential for any organization to secured online ticket booking system (Daniil, 2022). The system will allow passengers to book tickets for different routes & destinations. The system also enables the passenger to check the availability of buses they decide on and book the seats of their choice. Therefore, to simplify their life, people are using online ticketing. It's clear that bus ticketing system make it easy for passengers of public transport services in a variety of things. In addition, passengers can make ticket reservations anytime and anywhere without having to come directly to the ticket kiosk or counter to buy ticket.

City buses and intercity buses utilize the bus ticketing systems that offer an electronic document without physical paper on mobile devices since they are the most practical. By simplifying the lives of your customers, you may become their preferred bus company. Bus ticketing management lowers the cost of processing tickets, reducing usage of paper, and gives customers and travel planners more freedom to adjust their travel plans. It is a strategy for promoting companies in the bus transportation sector that use online tools to run their bus ticketing operations. Bus Ticketing System helps the process of booking journeys easier and minimizes conflicts in time. Since checking information online is now a very common issue for everyone, utilizing it can save the passenger a lot of time. It not only makes the ticket purchasing procedure simpler, but it also has the potential to minimize the crowds that can be created throughout the ticket buying and selling process (Solution 1, 2022)

IoT security is the technology segment concerned with the protection of linked devices and networks on the internet of things. IoT entails connecting a network of interconnected computing devices, mechanical and digital machinery, items, or people to the internet. Each "thing" is given a unique identifier and the capacity to send data autonomously over a network. Allowing devices to connect to the internet exposes them to a variety of major risks if not adequately protected. Without strong security, any connected IoT device is subject to breach, compromise, and control by a cyber-terrorist, allowing them to eventually infiltrate, steal user data, and bring down networks. The main goal of IoT security is to protect users' privacy and confidentiality, to secure the security of IoT infrastructures, data, and devices, and to assure the availability of IoT ecosystem services (Mohamad, 2019). A framework for automating as more physical things is expected to link to the Internet, the IoT is expected to contain millions or billions of devices that will communicate with one another as well as with humans. The IoT faces multiple dangers and attacks due to its complexity and varied structure,

which will significantly impact its regular functionality. Thus, ensuring the security of IoT devices is a complex but critical task (Ge et al., 2017).

In general, cloud computing is internet-based computing in which shared resources, software, and information are made available to computers and other devices on demand. Cloud computing is used to handle big data infrastructure requirements. A system for data received from highly distributed, real, and virtual devices that may be handled, analyses, and controlled automatically by distributed cloud-based services is described (Nedeltcheva, 2018). The internet of things generates vast amounts of data from devices, applications, and users, which must be efficiently managed. IoT cloud provides capabilities for real-time data collection, processing, management, and storage. These data may be easily accessed remotely by industries and services, allowing them to make vital decisions as needed. IoT cloud is essentially a complex high-performance network of servers built to perform high-volume data processing of billions of devices, traffic control, and accurate analytic. The cloud system combines billions of devices, sensors, gateways, protocols, data storage, and predictive analytic. When data is needed to be extracted for analysis reasons in a company, IoT is the source for that data. The data than can be analyse and extract the relevant data to create the required information (Rajiv, 2022).

User interface (UI) is engagement and communication between humans and computers in a device. This can include desktop visuals, keyboards, mouse, and display screens. Additionally, it refers to how a user interacts with a website or application. Many organizations now give UI a higher emphasis to improve the user's entire experience because of the rising reliance of many businesses on web applications and mobile applications (Churchville, 2021). Other than that, user interface is the point at which human users interact with a computer, website, or application. The goal of effective user interface is to make the user's experience easy and intuitive, requiring minimum effort on the user's part to receive the maximum desired outcome. The most crucial aspects of an application are the user interface and the user experience. It is because the user interface and user experience are the link between the user and the system, which is a component of a system that functions as an intermediate between users and systems, allowing users to engage with the system efficiently. The application's user interface and user experience will assist users in understanding what must be done to fix a problem. A good user interface and user experience will assist users in getting the information they require (Pratama and Cahyadi, 2020).

Many industries will alter because of IoT, including web design and development. The Internet of Things is a technology that connects the digital world by altering human-machine interface interactions. IoT has now entered the sphere of web development, making users more engaging with websites. The IoT edge in web development will transform the front-end interface and user interactions, among other things. This front-end interface will be used by all users to communicate with cameras, sensors, and other Internet-connected devices. Many IoT devices can currently display website information and outcomes.

RedBus use best-in-class security methods to keep payments safe. Any personal information from the passenger is encrypted and sent using transport layer security (TLS). TLS is well-established coding system that allows passengers browser to automatically encrypt, or scramble, data before sending it. The website has strict security measures in place to prevent the theft, misuse, and alteration of information under our control (RedBus, 2021). There are several factors determined in this paper which are secure online booking, smart tracking and accessible website and mobile application as shown in Figure 4. While, Table 1 shows the summaries on previous research according to the factors of effectiveness on IoT implementation on bus ticketing.

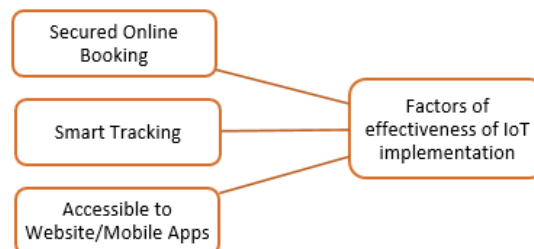


Figure 4. Factor of effectiveness of IoT implementation

4.1 Secured Online Booking

Cyber security is very essential for IoT. Internet of Things devices frequently transfer highly sensitive data over the Internet and this data is frequently unencrypted. TLS is a wonderful solution for encryption, authentication, and data integrity, but it is also the procedure that makes it secure. Using TLS in a ticketing system can help to protect sensitive information, such as personal identification, payment details and travel itinerary, from being intercepted or tampered with during transit. Additionally, by using a certificate from a trusted certificate authority, the ticketing system can also ensure that the user is communicating with the correct server and not an imposter (Henke, 2022).

4.2 Smart Tracking

Bus transport service is on the edge of digital revolution. To reduce human intervention, waiting time, and energy consumption, a cloud-based bus tracking system based on IoT is proposed. To provide better and more effective bus service, the actual location and arrival time of the bus can be tracked dynamically by using a mobile application which real-time tracking of any individual public bus using a global positioning system (GPS). This functionality allows the vehicle's current position and movement to be tracked and communicated to the passenger (Akter, 2019). Considering the existing system at 2016 the navigation routes were developed; passengers can examine all the route information and navigation of buses using a mobile app. The internet of things is essential for updating the data that has been acquired from the system to the main station. Passenger can access the required information from the station efficient system of monitoring the overall urban bus network and can provide a comfortable platform for urban bus passengers. Location of the current bus can be watched from the website (Shanmugapriyaa et al., 2020).

4.3 Accessible Website and Mobile Application

The emergence of mobile ticketing has led to a rapid expansion and evolution of ticket sales channels. Currently, customers can buy tickets through conventional ticket booths or automated kiosks at the station, book individual tickets online or via automated voice input devices, or purchase stored value e-tickets (Chen, 2022). Mobile application usage on smartphones and tablet computers is becoming more widespread among businesses and service providers. It has been demonstrated to be efficient and effective in capturing consumers' attention, introducing new technologies, and designing processes such as ticketing systems for transportation sector (Adducul, 2020). The main goal of this web-application is to make ticket booking easier by eliminating the stressful process of standing in lengthy lines and booking tickets for short distance travel in trains and buses. Users can purchase the ticket online 24 hours a day, 365 days a year, which eliminates the problem of a missing or stolen bus ticket in the real world (Yashaswini, 2022).

Table 1: Factors of effectiveness of IoT implementation from previous research

Title	Author	Factors of Effectiveness of IoT Implementation on Online Bus Ticketing		
		Secured Online Booking	Smart Tracking	Accessible to Website/Mobile Apps
Best bus booking platform in the World- redbus.com	(RedBus, 2021).	✓		
A cloud-based bus tracking system based on internet-of-things technology	(Akter, 2019).		✓	

Exploring the factors of using mobile ticketing applications: Perspectives from innovation resistance theory	(Chen, 2022).	✓		✓
What is transport Layer Security (TLS)?	(Henke, 2022).			✓
Mobile bus ticketing system: Development and adoption	(Adducul, 2020).			✓
Implementation of Smart Bus Tracking System Using Wi-Fi	(Bhavani and Kiran, 2017).			✓
Implementation of cloud computing technology for Ticket Booking	(Yashaswini, 2022).		✓	
Implementation of cloud computing technology for Ticket Booking	(Shanmugapriyaa et al., 2020)		✓	

5 CONCLUSION

Ticketing system is very essential for bus transportation sector to improve and easier the process of ticketing for passengers. Internet of things provides a lot of benefits for businesses particularly in public transportation. Top management needs to be more aware of and concerned about the factors that need to implement on bus ticketing. As cities become more congested and the demand of public transportation is increase, IoT technology has a bright future as it embraces new technologies and contributes to a greatly enhanced consumer experience. This project used the appropriate resources to identify and determine the factors of IoT implementation on ticketing system and found several factors form the previous research. The literature review study on effectiveness of IoT implementation on ticketing system is explained there are 3 main factors, which are secure online booking, smart tracking and accessible website and mobile application, that contributed from 3 main issues and problems such data security, traditional method of booking and difficulty to obtain real time information. For future research, the effectiveness of IoT implantation will be analyzed in order to determine the online bus ticketing system is practical and necessary to their passengers and people. With technology so integrated on their lives, customer today is expecting more convenience, comfort and public transportation needs to update and meet those needs. With proper system and automated with the IoT insertion, the technology will make the system more valuable by fulfil their customer satisfaction as well.

Acknowledgement: This work is supported by the Research and Innovation, Universiti Kuala Lumpur.

REFERENCES AND NOTES

- Adducul, R. B. (2020). Mobile bus ticketing system: Development and adoption. *International Journal of Advanced Trends in Computer Science and Engineering*, 9(1.3), 189–196.
- Aglibar, Kent & Alegre, Garret and del Mundo, Gerald & Duro, Kenny & Rodelas, Nelson. (2022). Ticketing System: A Descriptive Research on the Use of Ticketing System for Project Management and Issue Tracking in IT Companies. *International Journal of Computing Sciences Research*, 7.

- Akter, S. T. Islam, R. F. Olanrewaju and A. A. Binyamin (2019) A Cloud-Based Bus Tracking System Based on Internet-of-Things Technology. 7th International Conference on Mechatronics Engineering (ICOM), Putrajaya, Malaysia, 2019, pp. 1-5.
- Alcatel-Lucent (2022) The Internet of Things in the Enterprise Build a secure foundation to leverage IoT business opportunities. Solution brief IoT in the Enterprise via <https://www.al-enterprise.com/-/media/assets/internet/documents/iot-enterprise-solution-brief-en.pdf>
- Azhar, Aliff (2020). How can the Internet of things (IoT) applicable to public transport? The IOT Magazine. <https://theiotmagazine.com/how-can-the-internet-of-things-iot-applicable-to-public-transport-68d5c52201ad>
- Bhavani, Durga and Ravi Kiran (2017) Implementation of Smart Bus Tracking System Using Wi-Fi. International Journal of Innovative Research in Science, Engineering and Technology, 6. 12940-12946.
- Brian McGlynn (2022) How IoT Improves Public Transport for Passengers: The IoT Offers Many Benefits to Public Transport Passengers. Davra via <https://www.davra.com/how-the-internet-of-things-improves-public-transportation-for-passengers/>
- Chen, C.-C., Chang, C.-H., & Hsiao, K.-L. (2022). Exploring the factors of using mobile ticketing applications: Perspectives from innovation resistance theory. Journal of Retailing and Consumer Services, 67(102974), 102974.
- Christian Henke (2022) What Is Transport Layer Security (TLS)? Emnify via <https://www.emnify.com/iot-glossary/tls>
- Churchville, Fred (2021). user interface (UI). App Architecture, TechTarget via <https://www.techtarget.com/searchapparchitecture/definition/user-interface-UI>
- Daniil Torkut (2023) How to Build an Online Bus Booking System: Key Features and Benefits. Ascendix Tech. via <https://ascendixtech.com/online-bus-ticket-booking-reservation-system-development/>
- Ge, M., Hong, J. B., Guttman, W., & Kim, D. S. (2017). A framework for automating security analysis of the internet of things. Journal of Network and Computer Applications, 83, 12–27.
- Gil, D.; Ferrández, A.; Mora-Mora, H.; Peral J. (2016) Internet of Things: A Review of Surveys Based on Context Aware Intelligent Services. Sensors, 16, 1069.
- Gohil, Florika and Kumar, Mr. (2019). Ticketing System. International Journal of Trend in Scientific Research and Development. Volume-3. 155-156.
- Hamilton J. O. (2020). Industry 4.0 - Current Status and Future Trends. IntechOpen. London, United Kingdom.
- Industry Insight (2021). 8 Benefits of Public Transportation. Remix.com. via <https://www.remix.com/blog/8-benefits-of-public-transportation>
- Leloglu, E. (2017) A Review of Security Concerns in Internet of Things. Journal of Computer and Communications, 5, 121-136.
- Malaysiakini (2022) Ministry of Transport supports blueprint for a resilient transportation sector in Malaysia. Malaysiakini via <https://www.malaysiakini.com/announcement/631570>
- Maria Imdad, Deden Winarsyah Jacob, Hairulnizam Mahdin, Zirawani Baharum, Shazlyn Milleana Shahaudin, Mohd Sanusi Azmi (2020) Internet of Things (IoT); Security Requirements, Attacks and Counter Measures, Indonesian Journal of Electrical Engineering and Comp. Science, 18 (3), 1520-1530.
- Melis, A., Prandini, M., Sartori, L., Callegati, F. (2016). Public Transportation, IoT, Trust and Urban Habits. In: Bagnoli, F., et al. Internet Science. INSCI 2016. Lecture Notes in Computer Science, 9934. Springer, Cham.
- Mohamad Noor, M. B., & Hassan, W. H. (2019). Current research on Internet of Things (IoT) security: A survey. Computer Networks, 148, 283–294.
- Nallapaneni, Manoj Kumar and Dash, Archana, (2017) Internet of Things: An Opportunity for Transportation and Logistics (May 27, 2017). Proceedings of the International Conference on

- Inventive Computing and Informatics (ICICI 2017), pp. 194-197, Coimbatore, India, Available at SSRN: <https://ssrn.com/abstract=3213883>
- Nedeltsheva, G. N. (2018) Dependence of Public Transport on Cloud Technologies. *International Scientific Journals of Scientific Technical Union of Mechanical Engineering Industry 4.0* 3(1), 23-26.
- Nicolas Pocard (2021). 4 ways to improve public transport (with input from the public). *Clean Energy Fuel Cell Electric Buses*, Ballard.com. via <https://blog.ballard.com/4-ways-to-improve-public-transport>
- Nikhil Pal (2020) Bus Ticket Management System. *International Journal of Creative Research Thoughts*, 8(7), 657-660.
- Pratama, M. A. T., and Cahyadi, A. T. (2020). Effect of User Interface and User Experience on application sales. *IOP Conference Series. Materials Science and Engineering*, 879(1), 012133.
- Rajiv, R. (2022) What are the major components of internet of things, RF Page via <https://www.rfpage.com/what-are-the-major-components-of-internet-of-things/>
- RedBus (2021) Best bus booking platform in the World. RedBus via <https://www.redbus.com/info/privacypolicy>
- Roh, C.-G.; Kim, J. (2022) What Are More Efficient Transportation Services in a Rural Area? A Case Study in Yangsan City, South Korea. *Int. J. Environ. Res. Public Health*, 19, 11263.
- Shanmugapriyaa R., Sowmya A., Sowmya S., Sriram S. R. (2020). Smart Bus Monitoring and Ticketing System Using IoT. *International Research Journal of Engineering and Technology*, 7(5) 6167-6170.
- Shastri, Aditya (2021) A Case Study on the Impressive Business Model of RedBus. *IIDE* via <https://iide.co/case-studies/business-model-of-redbus/>
- Solution 1 (2022) Bus Ticketing. Solution 1 via <https://solution1.com.tw/solutions/e-commerce/bus-ticketing-system/>
- Tay, Shu, Te Chuan, Lee, Aziati, A. and Ahmad, Ahmad Nur Aizat. (2018). An Overview of Industry 4.0: Definition, Components, and Government Initiatives. *Journal of Advanced Research in Dynamical and Control Systems*. 10. 14.
- Tidke, Dipika, Nair, Vinayak, Pawar, Amit, Pagar, Vishakha and Wani, Nikita. (2018). Online Bus Tracking and Ticketing System. *Journal of Engineering Sciences*. 10.18311/mvpjes/2018/v1i1/18297
- Turnit (2019) Is your bus ticket reservation system secure? Via <https://blog.turnit.com/is-your-bus-ticket-reservation-system-secure>
- Ud Din, Ikram, Guizani, Mohsen, Hassan, Suhaidi, Kim, Byung-Seo, Khan, Khurram, Atiquzzaman, Mohammed and Ahmed, Syed Hassan. (2018). The Internet of Things: A Review of Enabled Technologies and Future Challenges. *IEEE Access*. 1-1.
- Yacob, A. (2020). A Review of Internet of Things (IoT): Implementations and Challenges. *International Journal of Advanced Trends in Computer Science and Engineering*, 9(1.3), 373-376.
- Yashaswini, U. and Patil, P.V. (2022) "Implementation of cloud computing technology for Ticket Booking," *International Journal for Research in Applied Science and Engineering Technology*, 10(4), pp. 2764-2767.