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Integration of Public Transportation in Smart Transportation System (Smart Transportation System) in Jakarta

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Abstract

Congestion is not a new problem for Jakarta, as the center of government and a metropolitan city in Indonesia. Handling the congestion problem in Jakarta then requires a comprehensive and comprehensive solution. Smart cities and smart transportation systems are thought to be able to do just that. This paper aims to review the existing smart transportation system in Jakarta and attempt to integrate public transportation into this system as an effort to overcome congestion in Jakarta. The review in this paper is carried out qualitatively by reviewing various literatures that have been published previously. The results show that the government has started trying to develop a smart city through the Jakarta Smart City (JSC) so that the development of a smart transportation system as part of a smart city is needed. In this case, this paper has developed a framework for a smart transportation system that integrates the public transportation system into it so that a more integrated smart transportation system is created for Jakarta.

Keywords
smart transportation system; smart city; public transportation; transportation system integration; congestion

I. Introduction

The transportation system available in a city is one of the most important components in city services.Research shows that the quality of transportation services is highly dependent on how well existing transportation resources can be managed and utilized(Zhang J. , 2011). Improved transportation through a smart transportation system will not only have a significant impact on individual lifestyles, but also save time and energy.(Zhang, et al., 2018). In addition, this is also expected to be able to solve the problem that generally attacks the transportation system in big cities, namely congestion.

Congestion has a significant impact on people's lives. This is one of the most difficult problems that people in big cities have to deal with every day. Every day millions of people waste a lot of their time due to being stuck in traffic jams especially in big cities(Khan & Koubaa, 2020). Jakarta is the capital city of the country and is one of the big cities in Indonesia which has the highest level of congestion in the territory of Indonesia. Jakarta has an area of 740.28 square kilometers with a population of around 10.56 million people based on data up to September 2020(Haryanti, 2021). On weekdays, this number will increase due to the arrival of workers from other cities such as Bekasi, Tangerang, Bogor and Depok, which are satellite cities of Jakarta. This growth then results in land use changes that are often inconsistent with urban planning and urban governance as well as a lack of public services for urban infrastructure needs. Along with improving road infrastructure, economic growth, and people's incomes, the number of vehicles also increases(Murad, Abbas, Trisetyarso, Suparti, & Kang, 2018).

This then causes congestion and complexity of the transportation system in Jakarta. On the other hand, the problem of traffic congestion is one of the main sources of pollution and environmental damage in urban areas. It is estimated that pollution from current transportation systems will double by 2025(Woodcock, et al., 2009). Congestion in general then invites the search for a solution to this problem, which is not only used to manage the congestion itself but to reduce traffic congestion efficiently. A smart city can provide a cost-effective and reliable solution to the problem of traffic jams, and thus, is referred to as a Smart Transportation System.(Dimitrakopoulos & Demestichas, 2010). As previously mentioned, the problem of congestion in Jakarta is basically rooted in the transportation system which is considered inadequate. This then prompted the need to develop a transportation system that could solve transportation problems, especially congestion in Jakarta. This paper aims to review the existing smart transportation system in Jakarta and attempt to integrate public transportation into this system.

II. Research Method

2.1 Smart city (smart city)

A smart city can be defined as a technology-intensive and advanced city that connects people, information and city elements using new technologies to create sustainable, greener, competitive and innovative commerce cities, as well as improving people's quality of life.(Bakıcı, Almirall, & Wareham, 2013). The ultimate goal of a smart city is to provide a better use of public resources, by accelerating the quality of services provided to the community, by lowering administrative costs.(Hettikankanama & Vasanthapriyan, 2019). The smart city concept is applied to at least six city domains; namely transportation, economy, government, people, environment, and life(Albino, Berardi, & Dangelico, 2015). In particular, transportation is one of the most difficult domains to deal with, especially in metropolitan areas. This is due to the complexity of transportation problems that involve many aspects within the city itself, including people, environment, technology, and economy.(Benevolo, Dameri, & D'auria, 2016).

2.2. Smart transportation system (smart transportation system)

Intelligent transportation systems are technologies that combine wireless technology, and automation to improve driver safety, efficiency and comfort when traveling by vehicle.(Pindarwati & Wijayanto, 2015). This technology will integrate the vehicle, driver system and related transport infrastructure(Gonder, Earleywine, & Sparks, 2012). Intelligent transportation is enabled by a number of technologies such as IoT, GPS, Wireless Technology, and Sensing Technology. Intelligent transportation applications are generally broad and complex in scope because they work with heterogeneous and dynamic devices and data(Pindarwati & Wijayanto, 2015). There are several general functions of intelligent transportation systems including Intelligent Parking Systems, intelligent public transportation systems, traffic management systems, smart taxi applications, smart traffic light systems, disaster prevention systems.(Mahmood, 2018). Smart Transportation is the most important part of Smart City to improve the urban economy. This is because the development of this will save time and money, besides that traffic information can also be easily obtained by road users. Integrated systems have an important role in intelligent transportation to report what is happening on the road. Thus, the mobility of the population will increase because the information they need is available in real time in one application/platform(Sriratnasari, Wang, Kaburuan, & Jayadi, 2019).

III. Research Method

This research basically views the transportation domain as part of a smart city initiative, so the significance of the proposed research direction can be seen by understanding the current state of research in the field of architectural perspectives on smart cities and smart transportation as part of smart city initiatives in the transportation domain. This study will conduct a qualitative review of the transportation system in Jakarta. The review was carried out by conducting a literature study on the development of a smart transportation system in Jakarta. This is done by reviewing various previous studies on smart transportation systems and transportation systems in Jakarta.

IV. Results and Discussion

4.1 Congestion and Jakarta Smart City (JSC) initiatives

Jakarta is known as one of the most densely populated cities in the world. Regional development in Jakarta is quite rapid, especially around the central business district known as the Jakarta Golden Triangle, which includes Jalan Sudirman-Thamrin and the Sudirman main line. Established areas such as Cikini, Menteng, Kuningan, and Kebayoran Baru thrived to become developed residential areas. The development of district areas in Jakarta is often also correlated with the development of transportation infrastructure. For example, the construction of the outer ring toll road around Jakarta and the new highway connecting the suburbs, Bekasi, Bogor and Tangerang. This is also accompanied by the development of settlements and main roads, business areas such as shopping centers, hotels, and office complexes are also growing rapidly(Pindarwati & Wijayanto, 2015). The negative impact of this rapid development is traffic congestion, especially in the Golden Triangle area of Jakarta. These problems lead to other problems, namely air pollution and noise pollution. The construction of several road projects is then expected to address these problems(Cybriwsky & Ford, 2001).

To overcome traffic congestion in Jakarta, several initiatives have been taken; one of them is the Jakarta Smart City (JSC) initiative. JSC started as an integrated public information and reporting platform providing public information about Jakarta, managed by the Jakarta Smart City Technical Implementation Unit, which was established in 2015(Dinita, Maharani Karlina, & Jimmy, 2016). To get information on this smart city, there are at least three applications that function as data sources connected to JSC, namely Qlue, Waze, and @petajkt.(Mukti & Prambudia, 2018). Specifically, in the urban traffic domain, the information collected by the JSC is used to provide real-time traffic information, real-time routes, and real-time situational reports. reports) for urgent urban infrastructure problems such as traffic jams or floods(Dinita, Maharani Karlina, & Jimmy, 2016).

Apart from JSC, Jakarta's urban traffic initiatives have shaped the digital transportation ecosystem. This digital ecosystem in the transportation domain or what is known as the digital transportation ecosystem is shown by the emergence of digital-based transportation service innovations, such as vehicle transportation applications (eg Go-Jek, Go-Mobil, Uber, Grab, etc.), electronic tickets, and payment in public transportation (eg TransJakarta E-Ticket, e-Toll, Rail Card, Go-Pay, e-money, etc.)(Mukti & Prambudia, 2018).

4.2. Smart Transportation System in Jakarta

The government through the Ministry of Transportation is basically trying to build a smart transportation ecosystem that can be implemented in Jakarta. The intelligent transportation system is carried out by integrating several systems, namely Advanced Traffic Signal Control Systems (ATSCS), which is a system that controls traffic density signals in real time; Electronic Toll Collecting System (ETCS), namely the implementation of toll payments using a special On Board Unit (OBU); Bus Rapid Transit (BRT); Bus Information Management System (BIMS), which provides bus arrival information in real time via internet and smartphone applications; Automatic Fare Collection (AFC) and Smartcard are public transport payment concepts using smart cards; Integrated Traffic Management Center (ITMC) which provides traffic information in real time with the control center at the Jabodetabek Transportation Management Agency (BPTJ); and Moovit and Trafi, which are integrated public transportation information applications in Greater Jakarta. On the other hand, Jakarta also has various modes of public transportation, namely the commuter line (KRL), Integrated Busway Boarder Transportation (APTB), TransJakarta (Bus Rapid Transit), Mass Rapid Transit (MRT), Online Transportation, Taxis, and Light Rapid Transit (LRT)(Sriratnasari, Wang, Kaburuan, & Jayadi, 2019).

These various intelligent transportation systems then need to be integrated with the existing public transportation system in Jakarta so that congestion reduction can be carried out. Moreover, smart traffic signs and smart roads are also needed to support the establishment of a smart transportation system. This is considered to be able to help make decisions based on data that emerges from cameras, RFID, sensors, and devices related to traffic control. Previously, data was collected from the starting point, destination point, and existing traffic so that it could then be assembled in a computation to send decisions(Azgomi & Jamshidi, 2018).

Transjakarta is one of the public transportation that has implemented IoT. Transjakarta has an OBU (On Board Unit) in the bus that will send information such as position, bus identity, speed, and direction. Connected to the Jakarta Smart City portal to provide information for residents who use Transjakarta for transportation. Furthermore, Transjakarta is collaborating with Trafi, a public transportation application that provides travelers with a travel experience using public transportation. The information provided is real-time, so users can easily control their schedule. Transfers from TransJakarta can be maximized if connected to other public transportation such as MRT Jakarta, Taxi, Online Transportation, LRT, and Commuter Line(Sriratnasari, Wang, Kaburuan, & Jayadi, 2019). This then leads to the integration of one public transportation with other public transportation which then provides a solution for the community in traveling to all corners of Jakarta.

Apart from advances in vehicle technology, transportation infrastructure as a whole is advancing due to the inclusion of smart technology, thus enabling the system to detect, accumulate and exchange data, thereby providing real-time traffic estimates and assisting traffic flow, and security. According to Aamir, Masroor, Ali, and Ting(2019), an intelligent transportation system can be developed based on the division into several different administrative zones. This system manages city traffic by coordinating with the involved autonomous sub-systems, which are further linked to a centralized traffic data management system, acting as an information and data collection junction, and then relaying information to residents and suggesting solutions for traffic congestion that occurs. at specific sites and guides to alternative routes. Based on the intelligent transportation system framework developed by Aamir, Masroor, Ali, and Ting(2019)then

it can be integrated public transportation in Jakarta with Jakarta's smart transportation system. Figure 1 shows the framework of Jakarta's integrated smart transportation system. This system is said to be integrated because it has integrated a smart transportation system with the public transportation system available in Jakarta.

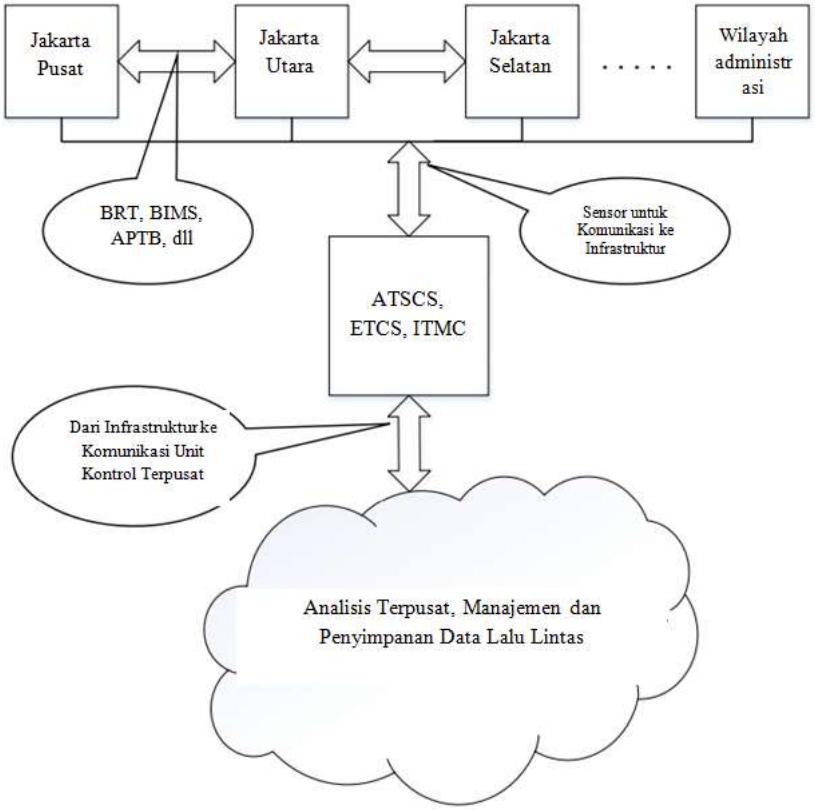

Figure 1. *The framework of Jakarta's integrated smart transportation system (adapted from Aamir, Masroor, Ali, and Ting(2019)*

Jakarta is an area that is divided into 5 administrative areas, namely Central Jakarta, North Jakarta, West Jakarta, South Jakarta and East Jakarta. Each of these autonomous sub-systems is responsible for collecting data from different zones throughout the city. The sub-system will then receive data from the cloud data that is used in certain administrative areas. Whereas subsystem represents WSN, network layer, data layer whereas zone represents real time data monitoring and collection, its storage and processing. These zones can communicate with each other so that they have information on the traffic flow of their neighboring zones. With this, existing systems, such as ATSCS, ETCS, ITMC can be integrated with BRT, KRL, MRT, LRT and online transportation.

V. Conclusion

Traffic density which then causes congestion is a problem that has its own level of complexity so that then requires a comprehensive solution to solve this problem. Conceptually smart city provides a solution to solve the problem of congestion in Jakarta through one part of it, namely the smart transportation system. Smart transportation system provides a unified system that is integrated to be able to provide traffic information on the highway. Furthermore, integrating the system into the available public transportation system in Jakarta will then provide a smart transportation system in a better way. This

paper has proposed an intelligent transportation system framework that integrates public transportation systems into it. This will then further unify the entire transportation system in Jakarta and then provide comprehensive traffic information. Furthermore, with better access to public transportation information for public transportation users, it is hoped that people will be more interested in using public transportation than their private vehicles, which in turn will reduce the number of private vehicles and reduce congestion. This paper still has limitations, mainly because the review was conducted conceptually on the integration of public transportation into a smart transportation system.

References

Aamir, M., Masroor, S., Ali, ZA, & Ting, BT (2019). Sustainable Framework for Smart Transportation System: A Case Study of Karachi. Wireless Personal Communications , doi:10.1007/s11277-019-06259-4 .

Albino, V., Berardi, U., & Dangelico, RM (2015). Smart cities: Definitions, dimensions, performance, and initiatives. Journal of urban technology, 22(1) , 3-21.

Azgomi, HF, & Jamshidi, M. (2018). A brief survey on smart community and smart transportation. In 2018 IEEE 30th International Conference on Tools with Artificial Intelligence (ICTAI) (pp. 932-939). IEEE.

Bakıcı, T., Almirall, E., & Wareham, J. (2013). A smart city initiative: the case of Barcelona. Journal of the knowledge economy, 4(2) , 135-148.

Benevolo, C., Dameri, RP, & D'auria, B. (2016). Smart mobility in smart city. In In Empowering organizations (pp. 13-28). Springer, Cham.

Cybriwsky, R., & Ford, LR (2001). City profile: Jakarta. Cities, 18(3) , 199-210.

Dimitrakopoulos, G., & Demesticas, P. (2010). Intelligent transportation systems. IEEE Vehicular Technology Magazine, 5(1) , 77–84.

Dinita, A., Maharani Karlina, C., & Jimmy, T. (2016). From Smart City to Open City: Lessons from Jakarta Smart City. Jakarta: Center for Innovation Policy and Governance.

Gonder, J., Earleywine, M., & Sparks, W. (2012). Analyzing vehicle fuel saving opportunities through intelligent driver feedback. SAE International Journal of Passenger Cars-Electronic and Electrical Systems, 5(2012-01-0494) , 450-461.

Haryanti, R. (2021, Feb 15). Census 2020: Jakarta Population 10.56 Million People, the Most in East Jakarta. Retrieved Apr 20, 2021, from https://megapolitan.kompas.com/read/2021/02/15/13573391/sensus-2020-penresident-jakarta-1056-juta-jiwa-terbanyak-di-jakarta-timur

Hettikankanama, HK, & Vasanthapriyan, S. (2019). Integrating Smart Transportation System for a Proposed Smart City: A Mapping Study. 2019 International Research Conference on Smart Computing and Systems Engineering (SCSE) (pp. 196-203). doi:10.23919/scse.2019.

Khan, Z., & Koubaa, A. (2020). Smartflow: An adaptive congestion avoidance protocol for smart transportation systems. . In 2020 International Wireless Communications and Mobile Computing (IWCMC) (pp. 1535-1540). IEEE.

Mahmood, Z. (2018). Smart cities development and governance framework. Springer International Publishing AG, part of Springer Nature .

Mukti, I., & Prambudia, Y. (2018). Challenges in Governing the Digital Transportation Ecosystem in Jakarta: A Research Direction in Smart City Frameworks. Challenges, 9(1) , 14. doi:10.3390/challe9010014 .

Murad, DF, Abbas, BS, Trisetyarso, A., Suparta, W., & Kang, C.-H. (2018). Development of smart public transportation system in Jakarta city based on integrated IoT platform. 2018 International Conference on Information and Communications Technology, (pp. 872-877).

Pindarwati, A., & Wijayanto, AW (2015). Measuring performance level of smart transportation system in big cities of Indonesia comparative study: Jakarta, Bandung, Medan, Surabaya, and Makassar. 2015 International Conference on Information Technology Systems and Innovation (ICITSI), (pp. 1-6. doi:101.1109/icitsi.2015.7437716).

Sriratnasari, SR, Wang, G., Kaburuan, ER, & Jayadi, R. (2019). Integrated Smart Transportation using IoT at DKI Jakarta. . 2019 International Conference on Information Management and Technology (ICIMTech), (pp. 531-536.doi:101.1109/icimtech.2019.8843747).

Woodcock, J., Edwards, P., Tonne, C., Armstrong, B. G., Ashiru, O., Banister, D., et al. (2009). Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. The Lancet, 374(9705) , 1930–1943.

Zhang, J. (2011). Data-Driven intelligent transportation systems: a survey. IEEE Trans. Intell. Transp. syst. 12(4) , 1624–1639 .

Zhang, Y., Li, L., Li, G., Zhu, P., Li, Q., Zhang, Y., et al. (2018). Smart Transportation Systems for Cities in the Framework of Future Networks. (pp. 70-79). Springer, Cham.