Delivering Artificial Intelligence for Electronic Traffic Law Enforcement in Yogyakarta Region: Current Effort and Future Challenges

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Abstract. Nowadays, the presence of Artificial Intelligence (AI) in the government sector has been rapidly experiencing a significant increase in its uses. Therefore, AI technology can attract the attention of several scholars to find out more deeply about the variety of its capacities. In Indonesia, the government uses AI as an instrument in formulating regulation, and focusing on managing complex data as well as its implication for accelerating activity and work. More importantly, it is very useful for decision making. In this context, as one of the adoptions of AI in the government, one of the highlights is Electronic Traffic Law Enforcement (e-TLE). E-TLE intends to handle cases of traffic violations in the Yogyakarta region (“DIY”). The high number of accidents and traffic violations in the DIY jurisdiction are a significant issue that is especially important to discuss when the presence of AI is necessary to manage them. Therefore, this paper aims to examine artificial intelligence in ‘Electronic Traffic Law Enforcement’ that overviews current efforts and future challenges of its implementation. This paper used qualitative research with explorative-oriented; it attempts to explore the meaning of information from sources that are then interpreted to obtain more in-depth insights that are easier to understand. Finally, this paper highlights the current situation and future challenges in providing public convenience in traffic. The police officer can promote the e-TLE system periodically to reduce the number of accidents and traffic violations in the DIY region.

1. Introduction
Over the past decade, artificial intelligence (AI) has become a concept and part of public disclosure [1]. Therefore, the advance of AI is found in various sectors such as; medical and health services [2], education and learning services [3], manufacturing and industrial services [4], legal aid and decision making services [5], and also government and administration service [6].

In particular, through this article, to reflect on the insight of the advancement of artificial intelligence in the public sector, lately the government is seen to have intensified use of technology with the aid of AI in every public service matter. Wherein, the government has tried to design, develop, and use AI systems to obtain accurate data and information [7]. One of the cases of the use of artificial intelligence system in the public sector is the technology to manage traffic violations. As the important point to note, the problem of traffic violations is a high-risk problem, so the government
must regulate it [8]. In which, several past studies provides views on various forms of traffic violations, especially in the Special Region of Yogyakarta province [9].

**Figure 1.1.** Accident Data and Traffic Violations - DIY Region

By looking at the number (figure 1.1), it shows the high number of accidents and traffic violations in the DIY jurisdiction. Based on traffic violations data in the DIY region, the level of traffic violations continues to increase every year, in 2016 as total as 80,922 people; in 2017 as many as 154,472 people; and in 2018 there was a surge in violations number at 404,250,000 people. Nevertheless, then it fluctuated with a downward trend compared to the previous year. However, it cannot deny that the preliminary data of 2019 will continue to increase along with the traffic density in the province of DIY. Besides, the number of traffic accidents in DIY in the 2016-2019 period displayed high increase from year to year, peaking in 2019 with a total of 5,381 people. Therefore there were fatalities, minor injuries and severe injuries. In addition, DIY government implements smart camera for traffic management, i.e. Electronic Traffic Law Enforcement. The type of this technology is a smart traffic control system with aid of artificial intelligence technology.

More importantly, this innovation was given birth due to the increased number of vehicles, traffic jams, violations of traffic regulation, and also traffic accidents. Furthermore, the government must have practical technology that is able to manage transportation traffic and increase safety in driving, thereby creating the need for an efficient traffic management system. In addition, the presence of e-TLE is seen as capable of turning cities into smart cities because its application is supported by technology. Therefore, we consider that there is a need for a closer review of the implementation of this traffic control system. Therefore, the formulation of our research is to examine DIY government's efforts in implementing e-TLE and its future challenges.

2. **Methods**

In particular, this article uses a qualitative method with explorative-oriented technique. A qualitative method is a research method that collects data on a natural setting with the intention of understanding and interpreting the phenomena as an attempt to gain enlightenment in certain situations that will be interpreted scientifically [29]. Furthermore, qualitative research intends to seek contextual understanding of phenomena experienced by subjects/objects, where researcher can interpret the meaning of context in providing views and experiences [30]. Then, this qualitative method uses an explorative orientation; the explorative-oriented aims to broaden awareness/ seek new ideas about such phenomena and explain how social phenomena arise to articulate research problems more comprehensively [31]. Therefore, qualitative explorative-oriented research attempts to explore the meaning of information from sources that are then interpreted in descriptive narratives based on the researcher's perspective. Thus, for data collection, the first stage was to collect the documents from government official website to design and analyze what the data share on it. Secondly was to manage
and interpret the data to understand further what data meaning is. The third stage was to discuss and analyze the data. The last but not least was the conclusion of this paper.

3. Basic Theory

3.1 Using Artificial Intelligence in Public Sector: A Current Trend

In current era, the presence of artificial intelligence as a technological system is widely applied in several sectors, including the government sector [10]. The existence of AI is considered capable of reducing various problem related to human resources with the help of technology [11]. Therefore, it has a good effect on resolving cases more quickly and easily [12]. In addition, the presence of AI system enhances data visualization and produces information from the complex and challenging verification results [6]. AI’s great opportunity in the public sector provides convenience in service management. Enabling artificial intelligence as data collection technology with large volume is considered to be a source of data to support decision making [12]. Therefore, the presence of AI technology is able to ease the burden of human tasks in providing government services accurately and it is able to provide an assessment for future policy option [13].

3.2 Managing Traffic Violation and Accident for Transportation

AI technology provides a big opportunity and also a big risk at the same time [17]. It because that is considered an emerging technological field and forms a significant future that is developing at an accelerated rate [18]. The use of AI in reviewing traffic violations is an example. The AI innovation in traffic control systems is able to provide convenience for employees [19]. Therefore, AI in the traffic sector is important to govern the city [8]. In general, traffic problems consist of traffic jams [20], traffic violations [21], and traffic accidents [22]. However, the adoption of smart camera technology influences law enforcement and control efforts to minimize violations [23]. Therefore, the relationship between police officers and cameras certainly provides a strategic advantage in generating an inherent sensation in its use, even though it has risks [24]. Adopting camera technology as a data source has fundamental implications for measuring scores from the results of monitoring the spread of cases. In addition, there are social consequences of oversight of the law [25]. Especially, there are several reasons, first, giving a deterrent effect to the drivers, because traffic violations become easily reviewed. Second, the mobility of a well-organized camera effect contributes significantly to the effectiveness of law enforcement [26]. Furthermore, traffic control system is also considered capable of minimizing the occurrence of data corruption in the field, because they are not easy to modify [27]. Thus, AI technology has a diverse framework of challenges in managing its work [27].

4. Finding and Discussion

The use of artificial intelligence (AI) technology by the Traffic Law Enforcement Agencies is currently in the period of exploration and implementation, especially in the Yogyakarta special region province. Therefore, this article aims to examine briefly about the law enforcement efforts as well as the challenges faced from the use of e-TLE tools as part of traffic law enforcement in the Yogyakarta region.

4.1 Using an Electronic Traffic Law Enforcement: A Smart Policing Initiative

Regarding the digital camera system, i.e. Electronic Traffic Law Enforcement or e-TLE, it is a technological system that can deal with traffic violations by providing law enforcement that is fast, reliable, safe, and open. Its system aims to improve safety, regulate roads, improve traffic control, and reduce the death rate of accident victims. Furthermore, the e-TLE functions as traffic inspection system for automated law enforcement. In sum, e-TLE can be understood as a camera technology system that has the capacity to record every passing vehicle; in other words, innovation in digitizing a traffic system. The goals of the implementation of e-TLE are to manage, monitor and control various acts of traffic violations. In Yogyakarta region, e-TLE had been adopted to manage violation with
electronic capacity, such as violations of signs, violations of road markings, and also violations of the use of helmets. This smart camera can also detect vehicle numbers.

Artificial intelligence is a processing system by a sophisticated machine that analyzes language and images with algorithmic patterns, so it can solve problems easily and quickly. Therefore, with the ability to capture images of traffic violations, it gives glory and highlights to the e-TLE system. In this context, the existence of e-TLE that adopts AI systems becomes a complementary spotlight between the work system and humans. With the e-TLE assistance instrument, traffic law enforcement can be overcome without any indication of fraud; therefore, the application of e-TLE is a form of traffic discipline for the community and also changes the behavior of police officers who commit acts of corruption with illegal fees. This can also become an essential element in decision making.

Yogyakarta region is the highlight in this paper, as a reference (see figure 1.1). Several locations in the Yogyakarta region often experience traffic congestion. It is in line with the increasing number of vehicles that exist in the DIY region, thus raising the risk of traffic violations. E-TLE in several crossing points in the DIY region acts as the manifestation of the government’s responsibility in regulating its territory.

The working mechanism of e-TLE as an electronic ticket-based instrument (e-tilang) captures vehicle speed at each intersection that has an e-TLE system integrated on the ATCS (Area Traffic Control System) camera, which will detect several violations. This recording data is used by the police to see the number of plates of drivers who commit traffic violations. With the ability of the zoom system on e-TLE, it can clarify the rider motor plate. Through the control room (MTRC), the Transportation Office can control the conditions of traffic density, traffic crime, accidents, and traffic violations. Then e-TLE will record and photograph the identity of the relevant vehicle which is then confirmed by the MTRC office and verified by the officer for the violations committed. Afterwards, the police will provide a notice sent to the offender's home via the post office. For those who receive a letter of a violation, the notification must be confirmed within 15 days, if it exceeds the specified limit, the validity of the vehicle administration will be blocked and cannot pay taxes. It will be unblocked if the violator completes the violation obligations; after that, they can pay the vehicle tax again. Payment through a Bank (Virtual Account) with a unique code becomes an essential point in e-tilang system; in other words, it no longer uses paper ticket.

4.2 Legal Basis of Electronic Traffic Law Enforcement

Basically, e-TLE has a legal regulation i.e. Law number. 22/2009 concerning “Road Traffic and Transportation”, and also Government Regulation no. 80/2012 about “Enforcement of Traffic and Road Transportation Violations”. In article 272 paragraph 1 of Law no. 22 of 2009 states “to support violation enforcement activities in the field of traffic and road transportation, electronic equipment can be used”. In another paragraph 2 in the same article, states that “the results of the use of electronic equipment can be used as evidence in court”. Therefore, the electronic equipment in question is an event control device for storing information.

Therefore, it is similar to the implementation of e-TLE, which can become a part of electronic equipment that serves to record vehicles that violate traffic law. This system is also related to legal basis in article 23 of Government Regulation no 80/2012. Therefore, this rule is based on finding in the process of inspecting motor vehicles on the road directly, report and/or records of electronic equipment. Moreover, looking at the rule, it appears that the ticket given was not electronic, but the evidence of the ticket was in the form of an electronic record. The e-TLE system exists to be a great innovation in the police, where it provides services that are effective and efficient than conventional tilang/fine. This highlight provides an overview of the implementation of e-TLE, this system has a clear legal basis contained in the law. In short, for further implementation, how to do it in the field; could be another further highlight.

4.3 Challenges of Electronic Traffic Law Enforcement (e-TLE) as Intelligent Control
The presence of police officers at a crossroads makes traffic reduces the potential of violation. It also binds motorists’ awareness to follow the rules and prevents violations. However, due to the large number of crossroads and the shortage of police officers assigned in each crossing, this is not possible. Therefore, the e-TLE camera is a part of the solutions offered by the DIY government to observe traffic violators in the Yogyakarta region with the e-TLE system (see figure 1.2). The use of the e-TLE camera system is very practical and fast. With the help of this technology, it provides openness in its implementation process.

| Locations | Type of Technology | Functions |
|-----------|-------------------|-----------|
| 4-way junction in Ketandan - east of ring road | e-Police camera with artificial intelligence | violation of signs, road markings, and running through traffic lights |
| 3-way junction in Maguwoharjo - north ring road | e-Police camera with artificial intelligence | violation of signs, road markings, and running through traffic lights |
| 4-way junction in Ngabean | e-Police camera with artificial intelligence | violation of signs, road markings, and running through traffic lights |
| 4-way junction in Tambak, Wates, Kulon Progo. | check point camera with artificial intelligence | speed limit, safety belt, and use a hand phone (when driving) |

Based on table 1.1, DIY region has only at least four e-TLEs, therefore, for the future, it needs another tools that should be paired with in Yogyakarta region. Because, it is possible that there are still many motorists who violate traffic signs. The addition of the number of e-TLE cameras to be installed at this intersection will definitely maximize the implementation of e-tilang programs, so that the placement of e-TLE must be at a crossroads that are prone to traffic violations. Related to this, further study is needed. This illustrates that the total e-TLE has been installed as a preliminary study to see the extent to which the e-TLE system functions and the community's tendency to comply with traffic rules. It is also related to the governmen's socialization to the public to abide by the rules, and the system of violations will be carried out electronically. When implemented, the Yogyakarta Regional Police will evaluate this system, expecting it to have positive impact on changing the culture of the community in traffic. If this is the case, the Yogyakarta Regional Police will ask for help from the DIY Government to increase the number of smart cameras.

4.4 Challenges of Traffic Accident and Violation: e-TLE Implement

The application of e-tilang is considered as a practical choice that can achieve the target in implementing the traffic ticketing for violators of traffic regulations. This e-tilang system is essentially efficient, because everything will be recorded by a digital system. So, the challenge in the future is how the police can implement e-TLE with the right steps. Thus, the role of government is to protect its people. That is to enforce rules through the government because law enforcement authorities must ensure and protect people from threats. Therefore, the government must introduce the application of e-TLE to the public.

Several factors cause some of the violations and accidents in the Yogyakarta region (see figure 1.1). There are at least four factors that cause violations and traffic accidents, namely - human factors, vehicle factors, road infrastructure factors, and environmental factors. The human factor is due to the driver's indiscretion, for example, using cellphone while driving. Related with it, human factors become the dominant factor in the occurrence of accidents. Therefore, the characteristics of road accidents both in human and developing areas are the impact of the behavior of road users. Besides, vehicle modification factors can also be related to the possibility of a large number of accidents. There are indications that vehicle modification has a risk of traffic accidents. Therefore it is necessary to provide a traffic safety education program for high-risk driver groups. Then, the road infrastructure factor gives a positive value on the number of traffic violations, so the action is needed to overcome inadequate road infrastructure and locations. Moreover, bad weather or wrong views are environmental factors that also cause traffic violations.
After reviewing several past studies regarding traffic violations above. There are many indications of violations and accidents that have occurred. Therefore, the presence of e-TLE is to minimize the incidence of accidents and violations in the Yogyakarta area. Therefore, it requires socialization to increase public understanding of the presence of the e-TLE system. This is emphasized that there are still many people who are not technologically literate. Many of the people do not know about this e-tillang system, thus there is a need for promotion to the community.

5. Conclusion
The e-TLE system serves as an electronic law enforcement system supported by artificial intelligence to monitor violations and traffic control in the Yogyakarta area. Furthermore, law regulation has been provided when e-TLE is implemented, and the DIY government from the Transportation Office with DIY Region Police have also introduced it to the public. The application of e-TLE, in case of violations, has not been fully implemented because it is still in its early stages. However, the spotlight is that the number of cameras installed is still minimal. Additional e-TLE equipment is needed to be installed at several crossroads in the Yogyakarta area, so that the implementation and sanctions against traffic violators can be carried out immediately.

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7. References
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