Android Based RFID Implementation of Vehicle Raids Process Using Arduino

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Abstract. Over the years, the world has developing vehicles required for transportation to achieve a goal. Motor vehicles make the efficiency of time and energy because it was created to help human activity. Lack of public awareness in driving is one of the problems in big cities. The number of police officers who conduct the raids is not proportional to the number of motorcyclists. The high number of traffic violations caused problems such as the time length of the administrative process of violations between police and motorists. This application was built to help the police in motor raids by implementing RFID into the system. The application implemented RFID and Arduino for police patrol which has the benefit of digitalization the manual process using Android so it can minimize the human error in the administration of traffic violations especially in Indonesia.

1. Introduction

Over the years, the world has developing vehicles required for transportation to achieve a goal. Motor vehicles make the efficiency of time and energy because it was created to help human activity. Lack of public awareness in driving is one of the problems in big cities. The number of police officers who conduct the raids is not proportional to the number of motorcyclists. The high number of traffic violations caused problems such as the time length of the administrative process of violations between police and motorists.

In general, the violation ticket process is given manually by the police, with the flow as follows: the police stopped to the riders who committed traffic violations, asked them for their driving license and vehicle registration, then the officer will take their license to process the violation ticket. Afterward, the police will decide whether to give the riders a blue ticket or a red one. Blue ticket means the offender admitted his violation while a red one for those who wanted to defend themselves on the court. If the violator received a blue ticket, he could directly pay the fine to the specified bank then go to the police station to show the proof of the fine payment to get their license back. As for the red one, the offender must go to the court on the specified date written on the red ticket. Based on the violation ticket flow, it shows that the process is not efficient since it is conducted manually which takes a lot of time.

This issue can be minimized using Radio Frequency Identification (RFID). RFID is one of the emerging technologies regarding reading information. RFID uses an identification system with radio waves. For that minimum required two pieces of the device that is tag and reader. RFID tags are used to store specific information whereas RFID reader is used to reading the information contained within the RFID tag [1]. By implementing RFID in the process of vehicle raid, there are advantages such as manual
operation can be digitized to reduce human error. Therefore an approach is needed to record vehicle traffic violations effectively and efficiently by implementing RFID.

RFID has been implemented in numerous research. Kaur in 2011 performed research using RFID Technology Principles, Advantages, Limitations & Its Applications to illustrate the system that transmits the identity in the form of unique serial number [2]. Nambiar in 2009 conducted further research on RFID Technology: A Review of its Applications to facilitate automatic identification of items using radio waves [3]. Akintola & Boyinbode in 2011 conducted another study on RFID Technology Application in Libraries to reduce the amount of time required to perform circulation operations [4]. Singh in 2014 conducted a study about The Place of Emerging RFID Technology in National Security and Development to track objects both globally and locally [5]. Kaushal in 2015 proposed to implement RFID Based Security And Access Control System Using Arduino With Gsm Module to obtain a consistent and efficient protocol to identify objects [6].

One of the problems faced by developed cities is the traffic issue. The high number of traffic violations has caused numerous troubles such as the lengthy administrative process of violations between police and motorists. The number of police officers conducting the raids is not proportional to the number of motorists. In general, the process of violations ticketing is still performed manually and takes a long time. Therefore, it is necessary to have a system that can assist police in overcoming traffic violation problems using RFID, Arduino, and Android; which is the research gap of our research presented in this paper.

2. Methodology

Police must log in to the system by typing-in their work ID and password. After logging in, Police choose Bluetooth and scan the RFID using RFID reader then the scan result will be sent to the Smartphone via Bluetooth. The tag results are in the form of data from violators containing their name, registration number, address, brand, type, colour, and vehicle registration. If the data are in accordance with offender documents, it will proceed to the next process. However, if the data do not match, it will return to the previous process. The following process will be the police to choose the violations committed by the offenders; then it will go to the next process of data confirmation. In this page display, name, registration number, brand, type, colour, article subjected are presented, and here the police will put the location where the violations happened using GPS on the Smartphone. The next process is signing process in which the offender will sign the documents for approval. After the signing, the police will keep the offender's data to be stored in the website view. The general architecture of the proposed methodology in this study is shown in Figure 1.

2.1. Scanning Process

The police stopped motorists then requested to hand him their documents in the form of vehicle registration and driver's license. After the police checked the vehicle registration, the officer scanned the existing tag under the seat of the motorcycle then re-checked vehicle registration with data from the tag. If the data match, police will proceed the data to data violations input system. If the scanned data are correlated with the vehicle registration, then the police will re-scan it to ensure the data authenticity.

2.2. Violation Input Process

The police will input data violations committed by the motorists in accordance with traffic laws. The system also provides the information on sanctions and penalties imposed on the offenders. After all the details were inputted, the police will conform to the violator whether the data have matched with the violations or not. If there is any mistake made by the police, then the police need to revise the data in accordance with the case, and if all is good, then the offender will sign the document as proof to confirm that the offender broke the traffic law. All the data will be saved in the database to be used for follow-up.

2.3. Global Positioning System (GPS)
GPS is a satellite-based navigation system that interconnects in its orbit and transmits its signal to the earth and is captured by a receiving device [7].

Figure 1. General Architecture.

2.4. Radio Frequency Identification (RFID)
Radio Frequency Identification (RFID) is an automatic identification system with a data transfer process whose tools containing the data, and the reader have no contact, making it more flexible [7].

1. RFID Reader
RFID reader is used to transmitting and receiving signals from tags. RFID reader can be in the form of a dumb reader that can read tags roughly (RAW) and has no computational capabilities, or it could be an intelligent reader that can compute so that it can process the filtering of the signals sent from the tag.

2. RFID Tag
RFID tag consists of a microchip and an antenna. The microchip can be as small as a sand grain, about 0.4 mm in size. The chip stores a unique serial number or other information. Transponder requires energy from RFID reader for the tag to transmit identification data to the reader [7].

2.5. Arduino
Arduino is an open-source platform for physical computing. Arduino is not only a development tool, but it is also a combination of hardware, programming languages and Integrated Development Environment (IDE) [8].

2.6. Bluetooth
Bluetooth is a short-range radio communications system to replace cables as the connector of all the portable devices and electronic devices. The advantages of Bluetooth include robustness (good resistance, such as against interference), and simple, low power and low-cost device.
2.7. Android
Android is an operating system designed as an open-source platform for Linux-based mobile devices that includes operating systems, middleware, and applications. Android provides an open platform for developers to create their apps.

2.8. Arduino and RFID Reader Connection
The connection between Arduino and RFID tags to operate the work of RFID Reader to read data from RFID Tags. The connection can be seen in Figure 2.

![Arduino and RFID Reader Connection](image1)

| Arduino RFID Reader | 10 | SDA  |
|---------------------|----|------|
|                     | 13 | SCK  |
|                     | 11 | MOSI |
|                     | 12 | MISO |
|                     | GND| GND  |
|                     | 9  | 9    |
|                     | 3.3V | 3.3V |

2.9. Arduino and RFID Bluetooth Connection
Arduino and Bluetooth connections aim to transmit data read by RFID reader into the Smartphone. The connection can be seen in Figure 3.

![Arduino and Bluetooth Connection](image2)

2.10. Device Design
The design of Arduino, RFID reader, and Bluetooth is a design created to scan the tags to be sent to the Smartphone via battery. The design can be seen in Figure 4.
2.11. Types of Traffic Violations in Indonesia
In legislation, the regulation of the sanctions or penalties serves a crucial part since in the criminal law stated all the acts that are not allowed, prohibited, and must be followed with a threat or sanction of a certain penalty for those who violate the provisions. The criminal sanctions imposed on the perpetrators of traffic violations are regulated in several Articles, namely:

- Article 281 "Violation in this Article is that the conduct of two or more motorized riders who do not have a Driver's License or often referred to as DL as referred to in Article 77 paragraph (1) shall be subjected to a maximum imprisonment of 4 (four) months or a maximum fine of Rp.1,000,000 (one million rupiahs)."

- Article 288 paragraph (1) contains criminal provisions on motorists who are not equipped with motor vehicle registration as referred to in Article 106 paragraph (5) A can be punished by a maximum imprisonment of 2 (two) months or a fine with the maximum amount of Rp.500,000 (five hundred thousand rupiahs). In paragraph (2) of this Article contains criminal provisions for drivers who cannot show a valid driver's license as referred to in Article 106 paragraph (5) B may be punished with a maximum imprisonment of 1 (one) month and/or a fine at most Rp.250,000 (two hundred and fifty thousand rupiah) [9].

3. Result and Analysis
Here is the result of readings performed by RFID Reader on RFID Tags and taking the location where the police conducted the raids.

3.1. Experimental Setup
Tools used in this study are Arduino, RFID reader, RFID tag, Bluetooth and Smartphone.

Data used in the research are the data taken from RFID Tag. The factor that affect the research data is RFID reader quality RC-522 that is able to read RFID tags quickly.

In this study, the author used Android Smartphone of Xiaomi Note 3 Pro with CPU specification of Hexa-core Max 1.8Ghz.

- Laptop OS of Window 8.1 64-bit
- Android Studio v.2.2.3
- Android Smartphone v. 5.1.1 (Lollipop)
- XAMPP v.3.2.2
- MySQL v.5.5.27
- Laptop with processor of Intel Core i7-4500U
- Laptop RAM of 4GB
- Laptop HDD of 1TB
- Android Smartphone with processor of Octa-core Max 1.8GHz
- Android Smartphone RAM of 3GB
- Smartphone internal memory of 32GB
• RFID Reader 13,56 Mhz
• RFID Tag 13,56 MHz

3.2. RFID Tag
System testing aims to prove whether the tag data is in accordance with the existing system on a Smartphone. The system testing conducted with RFID tag was put in the back seat then it will be read by RFID reader to obtain the data from the tag. RFID tags are created behind the seat to keep RFID tags secure because the tag is the identity of the motorcycle. The tag can be seen in Figure 5.

![Figure 5. RFID Tag.](image)

3.3. Raid Location and Data Confirmation
This page presents the offender’s data in the form of name, registration number, brand, type, color, the violation committed. It also shows the name of the officer in charge, the purpose of the police name is still the same as the previous page. Then the police will take the location of the refinery for the offender. After the location inputted, will appear the details of the location such as the name of the street, district, city, province and zip code. This location is valid since it is taken based on GPS from Smartphone that utilized by the police. If the data is correct, it will go to the next process. This data confirmation view is the final process for the data of violators who have committed the violation. Data confirmation can be seen in Figure 6.

3.4. Test of TAP RFID and Data Delivery

| No. | Test                                      | 50 Data | 100 Data | 150 Data | 200 Data |
|-----|-------------------------------------------|---------|----------|----------|----------|
| 1.  | Tap through RFID succeed                  | 50      | 100      | 150      | 200      |
| 2.  | Send data from app to server succeed      | 50      | 100      | 150      | 200      |
| 3.  | Received by server                         | 49      | 99       | 148      | 198      |

Based on the table of the conducted tests, All the tests are successful except for the server part. The data failed to enter the server may cause by the unstable network during the sending-to-server process.
3.5. Raid Location Test Based on Latitude and Longitude

Table 2. Location Test Sample.

| No. | Location                                                                 | Data (Latitude, Longitude) | Result |
|-----|--------------------------------------------------------------------------|----------------------------|--------|
| 1.  | Jl. Kapten Muslim No.54 A, Sei Sikambing C. II, Medan Helvetia, Kota Medan, Sumatera Utara 20123, Indonesia | 3.5942776, 98.64456232     | Matched |
| 2.  | Jl. La Piazza, Helvetia, Medan Helvetia, Kota Medan, Sumatera Utara 20123, Indonesia | 3.6043622, 98.63391051     | Matched |
| 3.  | Jl. Abdullah Lubis No.2, Darat, Medan Baru, Kota Medan, Sumatera Utara 20152, Indonesia | 3.5767402, 98.66580411     | Matched |

4. Conclusion and Future Research
Based on the result, it can be concluded that the RFID tag as a means of record-keeper and RFID reader as a reader of RFID tags. They created to help the police to transform the manual raid to digital one. This research makes the police time more efficient in conducting raids. The tool utilized in this study should be connected to Arduino, RFID reader, Bluetooth, and Smartphone so that the process will run successfully to get the data to be sent.

For further research, it is recommended to design smaller devices to ease the police conducting the raids. In addition, Immediate action should be implemented to the offenders to avoid future violations.

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