A Device for Integrated Traffic Violation Apprehension and Payment System Using NFC Technology

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Abstract—This research project presents the solution on how to eliminate the long process of issuing traffic violations to the caught drivers; the repossessors and confiscation of Driver’s License will be done virtually. The present project includes a device that used by the traffic enforcers to issue traffic violations to drivers that provides a real time notification, payment and traffic violation record system and method for vehicle traffic violations, a system that facilitate the registration of accounts and monitoring of all the transactions made, a Smart Driver’s License Card, an NFC Reader responsible for the reading the information inside the Driver’s License Card, Android Application for the drivers for easy monitoring of his/her own account and a Website to increase the way of how may the driver monitor his/her account. The database of each application is centralized through the Cloud Server to integrate the Windows Application in the offices, the device used by the enforcers, the Website and the Android Application for the drivers. Thus, the present project will be able to help the drivers to know and track their accumulated traffic violation, to be guided and educated at the same time to have the sense of initiative to correct his/her traffic behavior in the future, so as to form a favorable traffic atmosphere and to finally achieve the effects of effective traffic management and apprehension on traffic violation endeavors.

Keywords—NFC, Android Application, Windows Application, Cloud Server.

1 Introduction

In the Philippines today, one of the problem is the alarming heavy traffic because of the massive number of vehicles roving around the city every day plus the undisciplined drivers who will do everything just to reach their destination in the fastest way even if they will cause a roadblock. For information sited in Rappler.com, traffic in the capital and its surroundings is already costing the country about P3 billion ($64 million) a day, or about 0.8% of gross domestic product, according to government figures. And it is steadily worsening as an emerging middle class fuel an auto boom – car sales rose 23% last year with nearly 300,000 new vehicles hitting the roads. Compounding the problem, decades of infrastructure neglect has left Manila with a just a few major roads across the city and their gridlock "peak hours" often last for 3 to 4 hours. [1]

Contributing to the problem, most public utility vehicles were not observing the proper loading and unloading areas, insensitively fetching passengers in the middle of the road, making them one of the top causes of heavy traffic. And since most of these drivers were not educated about traffic rules and regulations, our traffic enforcers caught them; this hinders the movement of traffic because of the long process of confiscating their license, very time consuming. To support the aforementioned statement, in 2011, according to latest statistics from the National Statistical Coordination Board, there was an average of 211 vehicular accidents per day in Metro Manila. In 2012, Transportation and Communications Assistant Secretary Dante Lantin said 79% of road crashes were caused by driver error. This has undoubtedly contributed to the proliferation of untrained and uneducated drivers on Metro Manila’s streets, commented by Rappler in line with road accidents. [2]

2 Background of the study

According to the Metropolitan Manila Development Authority or MMDA, there are 28,000 traffic violations committed in the NCR every day. If a driver is caught violating a traffic rule, the officer who witnessed the committed violation should do an apprehension. [3]

As for the current process of redeeming license, the concerned person has to go to the office where the officer advises him. First, he should go to a certain window where the ticket is presented, the clerk checks the system if the license is already available, if not, the driver is advised to return on the designated date. When the license is ready for redemption, the driver is directed to another area to trade the violation ticket for a stub with a number on it indicating the place with the people also waiting to redeem their confiscated license. He waits for his number to be called and once it’s called, he proceeds to the cashier to pay the fine, and then he gets his license back. [4]

“Spending almost three hours at LTO isn’t as bad as I anticipated it to be. Though it could’ve been faster, still, I am thankful that the system didn’t go wonky on me or that I wasn’t caught in between being offline and running out of card or printer ink” Jackie Go said in her blog. [5] Additionally, according to UrgeI Sarmiento, he spent ~Php1.2k and almost a day (from 8:30AM to 3:30PM) to
retrieve his license. However, the whole process should just take less than half a day (half-day max) to complete if the driver take note of the seminar schedules in advance and plan his time of arrival ahead. [6]

To solve the current problem facing by our beloved drivers as well as the Land Transportation Office, the present researchers propose a device for Traffic Violation Apprehension and Payment System.

3 Objectives

The general objective of this study is to develop a device used for Traffic Violation Apprehension and Payment System to make the payment process less hassle for drivers.

- To develop a handheld device that facilitates the issuance of traffic violation and payment system.
- To develop a mobile application for drivers that provides traffic violation and load balance monitoring.
- To generate location for the monitoring of the device and where certain driver get violation.
- To use NFC Cards to be driver’s license, that can be manipulated via NFC Reader/Writer.
- To develop a method of encryption to level up the security of the NFC Cards.
- To generate electronic receipt through text message.
- To develop a record management system that will facilitate registration, monitoring and report generation of drivers.
- To design a centralized database to integrate registration management system, android application, and the handheld device with Raspbian application.

4 Methodology

In order for the project to prosper, every aspect of the study was thoroughly analyzed to fully understand its function to the project, from the development of an Application that is NFC-Enabled and its functionalities to the implementation of cloud computing as the central database of the whole project. Furthermore, the project used an Object-Oriented kind of methodology to balance the focus between process and data by incorporating both into one model. It will be focused first in defining the major elements of the system and look the processes data that were gathered. The gathering and reviewing of related studies of the project will help the researcher to prevent any anomalies before they could arise. Moreover, apart from planning: analysis, design and implementation were simultaneously done in order for the researchers to balance the time needed in building the project. During the analysis, all the components were gathered and studied carefully in order to prevent any possible errors. Once done, the project moved to the design and implementation phase.

Figure 1 shows the block diagram of the whole system, this illustrates the connection of all the modules of the project; including the device for issuance and paying for traffic violation, mobile application, windows application, module for loading driver’s license and a cloud database server.

All the modules of the project are centralized to one Cloud Server; this is the central storage for all the information needed in issuance of traffic violation as well as the records of drivers; the records of drivers is handled by the Windows Application of the Administrator or the Personnel in-charge. On the other hand, the handheld device to be used by the traffic enforcers is responsible for issuance of traffic violation and can also receive payments for traffic fines with the used of NFC Technology integrated to the device and on the driver’s license. Moreover, this handheld device can also view the status of the a driver’s account to monitor if he/she still has a pending fine that has not been paid yet; an invalid or confiscated license.
Figure 2 shows the out view of the traffic violation apprehension system. If a driver commits a traffic violation, a traffic enforcer will apprehend the driver and will be fined based on the violation. The traffic will then ask for the driver’s smart license to scan it for the personal information of the driver and balance using the NFC card reader connected in the handheld device. The device will retrieve the driver’s personal information from the cloud server then sends it back to be viewed. The GPS finds the specific location where the violation is committed. The officer will then proceed to search the specific violation committed from the embedded database that includes its equivalent fine. A confirmation notice will appear to verify if the selected the selected violation is correct. After confirming, a receipt in the form of text message that shows the details related from the violation will be sent to driver’s mobile number. The violation will now be saved in the cloud server to update the recorded violations together with the time, date, and location of the area. Also, the remaining balance after the transaction is made will be saved in the cloud server so the drivers can monitor their own account using the Android Application connected to the cloud database server. A notification in a form of text message will be sent to the mobile number of the driver that states the details of the transaction. The administrator or the traffic control center will handle situations like an update of driver’s information or renewal of license so it can be saved in the cloud server. But the only the mobile phone and email address can be updated using the android application the rest is solely handled by the administrator.

4.1 Loading Module

Figure 3 shows the loading module of the project. This module is responsible for loading driver’s account; the driver needs to input his/her license number, his/her name and the amount he/she wishes to load up to his/her account as you can see in the number 1 of Figure 4. This module covers the thermal printer for printing receipt and a barcode reader. Its like the other ordinary KIOSKS present in most convenient stores; e.g. 7-Eleven.
Figure 4 shows Windows Application for Loading the driver’s account. This figure illustrates the step by step procedure that the driver will encounter when reloading his/her account. The output of this application is a thermal receipt in which the driver will give it to the cashier for barcode reading as you can see on Figure 3 and to finally reload his/her account. Further, in the loading module, the driver has an option to check his/her balance or purchase a load as you can see in Figure 5.

Figure 5 shows Windows Application for Loading the driver’s account. This figure illustrates the step by step procedure that the driver will encounter when reloading his/her account. The output of this application is a thermal receipt in which the driver will give it to the cashier for barcode reading as you can see on Figure 3 and to finally reload his/her account. Further, in the loading module, the driver has an option to check his/her balance or purchase a load as you can see in Figure 5.

4.2 Administrator Module

Figure 7 shows the Windows Application, checking of load balance. In order for the driver to check his/her balance, he/she needs to tap his card, for reading of that specific license, to the NFC reader for displaying of his/her account on the screen.

Figure 7 shows the Login Form of the Administrator Module.

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Module. The admin needs first to login for security purposes. This module is exclusive only for the personnel in-charge in manipulation of driver’s accounts.

Figure 8 shows the Menu of the Administrator Module after login. Further, the admin can add new driver, renew driver’s license and preview previous drivers. The admin can add new driver by inserting new driver’s details as you can see on Figure 9 and writing a unique ID by tapping the new driver’s license in the NFC Writer as you can see in Figure 10. In the preview previous drivers, the admin can easily view all the registered drivers as a list, and can search for one driver by inputting the license number of the driver the admin wishes to view.

4.3 Driver’s Module: Android Application

Figure 11 shows the login form of the Android Application for Drivers. This android application was created for the drivers to check and monitor their own account; to know and track their accumulated traffic violation, to be guided and educated at the same time to have the sense of initiative to correct his/her traffic behavior in the future as you can see on Figure 12.
Further, as you can see on Figure 13, every violation of the driver has dropdown to view the detailed information of each accumulated violation.

Figure 13 shows the detailed information of an accumulated violation; the driver can see his violation, where the enforcer caught him, the date, the amount of that violation, if it’s unpaid or paid as well as their balance.

Moreover, this android application will also retrieve the driver’s information, he/she can update his/her email address and contact number as you can see below in Figure 14.

4.4 Handheld Device Prototype

Figure 15 shows the actual prototype of the handheld device. The casing used is acrylic glass covered with carbon fiber; carbon fibers are commonly used in cars for aesthetics; so this carbon fiber design device is very road-friendly device; it remains its neat design condition even on the dusty roads. Moreover, this handheld device facilitates all the transactions between enforcer and the caught driver. Further, the driver’s license is an NFC card, in which by placing the card on top portion the device, the device can retrieve all that specific driver’s information.

Figure 15. Actual prototype of handheld device for traffic enforcers: Front View.

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Figure 15. Actual prototype of handheld device for traffic enforcers: Front View.
5 Summary of findings
This study summarizes the following findings:

- The acceptance test for the following worked as expected:
  - Issuance of traffic violation using the handheld device.
  - Payment for traffic fines using NFC Technology.
  - Reloading the driver’s license using the NFC Reader/Writer.
  - Mobile Application and Webpage for the monitoring of driver’s account.
  - Windows Application for the administrator was able to register new driver and monitor all the driver’s accounts.

- The database of each of the modules are centralized through the cloud server any changes made in one module will be visible to all and updated real-time.

6 Conclusions
This study concludes the following:

- It is clear that using this device for traffic violation apprehension and payment system using NFC Technology able to handle the traffic violation issuance and the payment made by the caught driver without the need of going to the LTO Office; this promotes improvement in the process of paying for traffic fines and confiscation of driver’s license; it is confiscated virtually. That is, certain driver will no longer required going to the nearest Office dedicated for paying traffic fines, just to pay for his violation; he will just present his driver’s license with sufficient balance and the officer will tap it to the handheld device to retrieve driver’s account.

- It is well defined that virtual confiscation of licenses promotes convenience for drivers who failed to abide by the traffic regulations imposed by the Land Transportation Office. Further, this clearly eliminates any kinds of corruption during confiscation, which ensures the offenders to have their rights properly assessed by any traffic enforcer through cashless transaction.

- In terms of the notification system, this project will help the drivers to know and track their accumulated traffic violation through the use of the mobile application and or by logging in to the Webpage, to be guided and educated at the same time to have the sense of initiative to correct his/her traffic behavior in the future, so as to form a favorable traffic atmosphere and to finally achieve the effects of effective traffic management and apprehension on traffic violation endeavors.

7 Recommendations
This study recommends the following:

- To lessen further the size and weight of the handheld device.
- To used a more advanced technology for faster processing of the virtual apprehension and payment system.

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9 References