

ETHIOPIAN Toll GATE Automation System Using RFID & NFC TECHNOLOGY.

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Abstract: This article gives an important guideline for the electronic Ethiopian toll gate collection using RFID & android application is a technology that will allow user to make the payment of highway tolls automatically. This terminology will in turn save the time as well as the money by decreasing the waiting time as well as the queues of vehicles at the tollbooth. The RFID tag will be deployed by the toll authority by embedding unique identification number (UIN) and customer's details into the tag. The deployed active RFID tag will be attached to the windshield of the vehicle. Whenever the vehicle passes through the tollbooth, tag data will be read by RFID reader & same will be sent to the server for verification. Server will check tag details & depending upon the type of the vehicle, the toll amount will be deducted from the user's account. The notification about the toll amount deduction will be sent to the customer via SMS and email as well. The developed android application will be used to recharge the customer's account. NFC is then used to allow the toll tag to communicate with the smartphone, allowing payment to be taken from the user's prepaid account and for invoicing by email. Users can also see a record of tolls paid with the app.

Key terms: EETG(Electronic Ethiopian Toll Gate), NFC(Near Field Communication), RFID(Radio frequency Identifier).

1. INTRODUCTION

The modernization of transport has become one of the essential signs for the urban modernization level, the increase in the number of cars leads to serious problems concerning transport system. [1] Electronic Toll Collection facilities offer travelers the ability to pay toll electronically, most commonly via Radio Frequency Identification (RFID) transponders placed within the vehicle. Many toll authorities have searched for ways to improve the toll collection process. Over the last decade, a significant improvement in this process was implemented and dubbed Electronic Toll Collection (ETC). Considering the current scenario, the numbers of vehicles passing through a specific tollbooth are substantially high. Hence there is a need for the alternate solution for the high- way toll collection method which should be more opportune, cost effective and more efficient to the traditional toll collection method. The considered system will provide the better solutions to the toll collection and will deal with the problems coming due to the traditional toll collection system.

For this firstly the introduction to RFID was done. RFID is abbreviation of Radio Frequency Identifier which plays vital role in electronic toll collection. RFID is also used for tracing of the vehicles. The drawback of RFID is that it doesn't work properly in the cloudy and unconditional climate. So, to overcome from this drawback identified NFC i.e. Near Field Communication. NFC's full-form itself tells that it is a communication protocol that works within 9cm area (near field) for data transfer.

In this Paper we developed Client server protocol. At client side, the client communicates with server through a NFC Android mobile Application which is able to store the information of user and its unique individual NFC ID generated and given by server. For this the user should contain the NFC enabled mobile and registration should be done online.

II. LITERATURE SURVEY:

The Addis Ababa-Adama expressway in Ethiopia will be first expressway in Ethiopia and East Africa when complete and also the first toll road in the nation. It will connect the capital city Addis Ababa to Adama in Nazareth.

Construction started in April 2010 and is scheduled to be complete in April 2014. The project is estimated to cost US\$612 million and when complete the expressway will be able to accommodate 15,000 vehicles per day. The project is financed through a US\$350 million loan from Export-Import (Exim) Bank, with the remaining US\$262 million coming from the Ethiopian Government.

Constructed by Chinese Communications Construction Company (CCCC) on behalf of the Ethiopian Roads Authority (ERA), the new road uses advanced technologies such as a traffic management centre and intelligent transportation systems (ITS) for effective operation, together with overpasses, underpasses and interchanges. ITS technologies include traffic cameras and variable message signs (VMS) for effective traffic management and incident management.

Tolling is expected to be implemented on the Addis Ababa-Adama expressway, a first for Ethiopia. Toll gates will be installed at Addis Ababa and Adama, as well as at the six other interchanges. The toll road will reduce the travel time to around 40 minutes from the average two hours between Addis Ababa and Adama.

2.1. The ETG system used in different countries:

The ETC system currently in use in India [4][5] do not provide an external module that acknowledges the toll transaction to the vehicle owner. The system simply scans the vehicle tag and proceeds provided the vehicle is not under any sort of defaulter category.

The ETG system used in Canada is known as the Canada 407[4][5] Express toll route (ETR). It is one of the most sophisticated toll roads in the world. In Canada, the ETG system has deployed close barrier at each end of the stretch

In Japan, NFC tags are built into card popularly named as Felica card which are used to uniquely identify people. In [3] paper the authors tried to make an Attendance management system based on NFC identity cards which when swiped on corresponding smart phone or tab (having Android app) will add attendance into the attendance record present onto the cloud system. Further these attendance records can be viewed and analysed by authorities anytime and anywhere.

III. Problem of EETG system:

- So, according to serve of Ethiopian Government carried out in Sept.2015,.They have proposed to get the annual toll collection of 78 million Birr income during the first six months of the current fiscal year. But in the present situation only According to the Tewodros Asrat, Finance Team Coordinator at Ethiopian Toll Roads Enterprise, currently, the expressway in average serves 14,000 vehicles per day and generates 450,000 Birr income in the mean time due to some human errors. So, we have to control this leakage.
- Now the present system we have with us on the high ways takes 1 minute to complete the toll collection process for one vehicle. With this automatic process, it will take just 40 to 42 sec. to complete the whole process.
- As there is reduction in time for completion of the process so indirectly there will be no traffic as such & as there is no traffic so no fuel wastage takes place & the purpose of designing the highways is achieved i.e. reduction in journey time & also the money loss will be reduced.

IV. SYSTEM ARCHITECTURE AND WORKING



Figure1. Electronic Toll Collection System

This system is used to get and collaborate end user allowing them edit their information in the application and provide more automated details about toll amount and toll location. It also provides many facilities such as editing personal and vehicle details, top up the account that is being registered with the Ethiopian TollGate Collection Company etc.

4.1. Methodology of the system:

The simplest method used by NFC is just the tapping of Mobile at the toll's NFC device which helps in automatic transaction from user's bank account and also helps in the smoothening of the process at the Toll Collection area.

In this Toll Automation System we are using languages such as JavaScript, JSP, AJAX and software such as NetBeans 8.0.2 (IDE).

At the client side for making Mobile App we are using Android Studio Powered by IntelliJ Platform with software as Android SDK for Android device monitors.

On touch is been done by the user with user's NFC device at the toll area, user's NFC id is been accepted by the toll device and forwarded to the server side. Server stores the data in the database and also the transaction process is been done and the details is been transferred back to the toll device. Finally NFC connection is terminated when user receives transaction acknowledgment.

4.2. System Architecture:

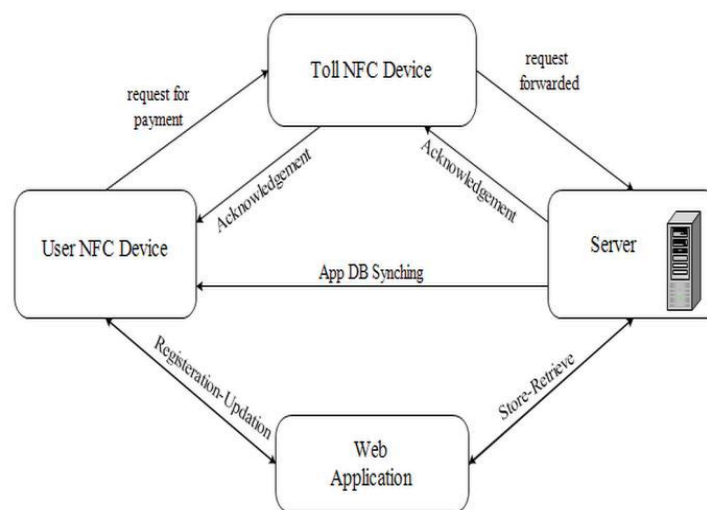


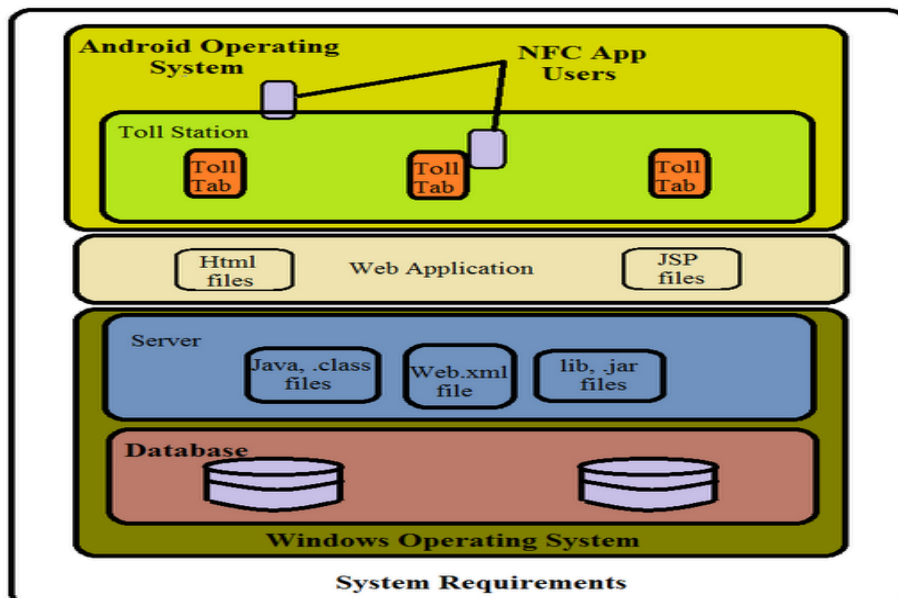
Fig 2: System Architecture diagram

The block diagram mainly consists of four components those are user NFC device, Toll NFC device, Server and presented web Application. The web application is hosted for purpose so that initially user can register his details and make android app available in his device may be tab or smart-phone which supports NFC communication protocols.

During the registration process, client/user will be provided with the NFC-Id that will be unique as per user's filled details. The whole required details will be saved into user's respective account database (Server). The web Application can be serviced from PC Desktop, tab, smart-phones. The Server then validates and process the request further while making usage of information stored in database.

Toll NFC device is a bridge that fills up the communication gap between user's NFC device and the server. The toll NFC device accepts the request from user which is invoked on tap/contact of these two devices. The request is then dispatched from toll device for server for requested payment processing. All the transaction history is maintained in user's account. The Server returns an acknowledgement which is the response of the processing. The acknowledgement is saved and send to both toll and user device

4.3. System Requirements:



Due to this architecture design there will be an idea about the software contents used in this system. The first block represents Android OS which contains NFC App users and toll station. The second block is of web application which contains all web containers for user interfacing like html, jsp files. The last block represents Windows OS used which contains server and database. Server has java, .class, web.xml, lib, .jar files which is logical and back end tier of client server model and web app

V. ADVANTAGES of EETG

- i. Car documents can be checked in once.
- ii. Standardizations and transparency at Toll fair collection and its utilization.
- iii. Security is enhanced as both the centralized server and toll device know who is crossing the toll.
- iv. Need for manual toll based system is completely reduced.

VI. CONCLUSION:

In this paper, from the above research and techniques used we conclude that the system provides a paperless passage for toll gate with fully automated toll collection. Hence the considered system provides an intelligent solution to the traditional & toll collection method. Thus the system achieves performance factor as better user convenience from payment without stops, less traffic congestion, better audit control and transparency at toll transaction.

The only disadvantage is internet connection is necessary.

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