Automated Toll Collection System Using NFC And Theft Vehicle Detection

Sarika Bharambe[1], Priyanka Kumbhar[2], Pragati Patil[3], Kavita Sawant[4]

[1]Bharati Vidyapeeth college of Engineering for Women, Pune-43, India
bharambe69@gmail.com

[2] Bharati Vidyapeeth college of Engineering for Women, Pune-43, India
kumbharpriya1993@gmail.com

[3] Bharati Vidyapeeth college of Engineering for Women, Pune-43, India
patilpragati30@gmail.com

[4] Bharati Vidyapeeth college of Engineering for Women, Pune-43, India
kavitasupugade@gmail.com
Guided by: Prof. Kavita Sawant

Abstract*: This article gives an important guideline for Automated Toll Collection System (ATCS) Using NFC and Theft Vehicle Detection. ATCS emerges as a converging technology where time and efficiency are important in toll collection systems nowadays. In this, NFC tag will be placed by toll authority having unique identification number (UIN) and user details. Active NFC tag will be attached to the RC (Registration Certificate) Book or Smart card . When vehicle passes through the tollbooth system, data on NFC will be read by NFC Reader and also sent to the server for verification. Server will check details and toll amount will be deducted from user's account. Theft Vehicle Detection is done with the help of various algorithms such as OCR and BLOB Detection.*

Keywords: ATCS, NFC tag, UIN, NFC Reader, OCR Algorithm, and Blob Detection.

1. **INTRODUTION**: Automated Toll Collection System (ATCS) is a technology which facilitates the automatic collection of toll payments using NFC technology. The term tolling is used for charging a well-defined special and comparatively costly infrastructure, like a bridge, a tunnel, a mountain pass, a motorway concession or the whole motorway network of a country. This system can be easily goes with existing infrastructure of toll collection system. ATCS technology can check if a Vehicle is registered at toll system, deduction of toll amount from every user's account. The notification about the toll amount deduction will be sent to the customer via SMS.ATCS also presents smart system to track theft vehicles and unregistered vehicles if vehicles no. is uploaded in the centralized server.

2. **PROBLEM DEFINATION**: "An Automated Toll Collection System (ATCS) provides paperless system for toll gate with fully automated toll collection with theft vehicle detection."
   - NFC Technology Applied to Monitor Vehicle in Highway and toll collection. It helps in reducing toll gate traffic and avoids illegal passage and vehicles through toll gate.
   - Also an Electronic Toll Collection system is able to determine if a vehicle is registered in a toll payment program, alerts enforcers of toll payment violations, and debits the participating account.
   - Theft Vehicle Detection is done with the help of various algorithms such as OCR and BLOB Detection.

3. **SCOPE**: An Automated Toll Collection System using NFC and Theft Vehicle Detection is an efficient method in order to control traffic congestion and jams, enhance the payment system without stops and minimizes the pollution and fuel consumption for environmental protection need. ATCS system determines whether the vehicles passing are enrolled in the program, alerts enforcers for those that are not, and debits electronically the account of registered vehicles without their stopping. Also this system is designed for Theft Vehicle Detection which passes through toll gate. When match for stolen vehicle found, notification will get to the police station by message triggering.

4. **RELATED WORK**:
   - In [1]authors Designed a system to give complete solution for traffic and transport related problems such as Toll gate control, traffic signal control, traffic rules violation control, parking management and special zone alert using the latest RFID technology.

   - Active wave Inc [2] has currently deployed a system of active tag vehicle monitoring solution. Active wave vehicle products have a range of 30 meters and operate in the 916 – 927 MHz for the transmit operations and 433 MHz for the receive link. Active wave products are currently equipped with256 Kbits of fixed memory. The tag is powered with a replaceable 3V battery and the total weight is 14 grams.

- Elementary signals are shown with the help of blinking LED sand beeping sounds. Smart key Access Control Systems [3] have a client – server model based system with an SQL server handling multiple vehicle monitoring systems. They have designed a user interface using the Microsoft .NET framework. Smart key also operate in the 900MHz band but have a small range of 30 meters.

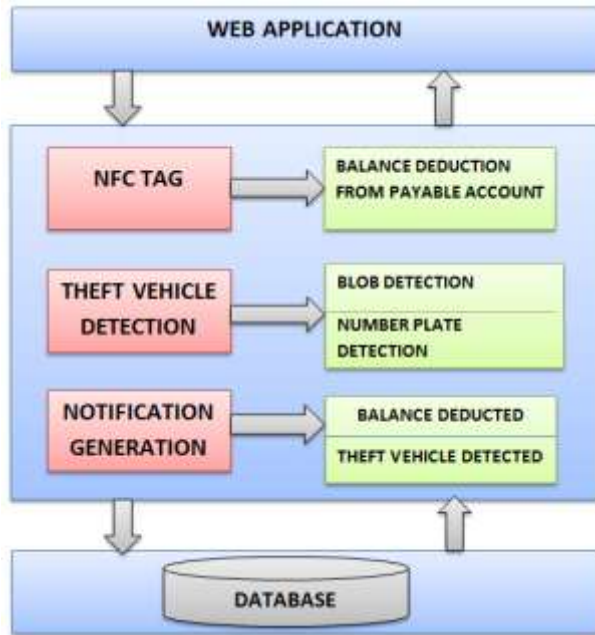## 5. SYSTEM IMPLEMENTATION:

5.1 System Architecture:

Figure 1: System Architecture

5.1.1 Web Application (GUI Design)
5.1.2 This comes under presentation layer of architecture**.**

a)   GUI (Graphical User Interface)

A GUI is type of interface that allows users to interact with electronic devices through graphical icons and visual indicators such as secondary notations, as opposed to text based interfaces, type command over labels or text navigation. The actions in GUI are usually performed through direct manipulation of graphical elements. It is designed for the requirements of a vertical market as application specific graphical user interfaces. It uses a combination of technologies and devices to provide a platform that the user can interact with, for the task of gathering and producing information.

In proposed system the GUI will show the interfacing hardware device status, vehicle information, and card residual amount etc.The working rules and laws of interfacing hardware device is described as: The highway network is divided into a number of independent sections by their arrival, leaving it and optional

interchange.User login, add/modify vehicle types, user registration, complaint registration part is done in web based i.e. html part.

5.1.2. User (with NFC Tag)

NFC tag will be on vehicle's RC book or Smart card. And it is linked with account which actually used for toll transaction. Near field communication (NFC) technology lets smart phones and other enabled devices communicate with other devices containing a NFC tag. Like Bluetooth and Wi-Fi, its a wireless radio communications standard Near Field Communication, or more commonly known as NFC, is a subset of RFID that limits the range of communication to within 10 centimeters or 4 inches. NFC is a branch of High-Frequency (HF) RFID, and both operate at the 13.56 MHz frequency. NFC is designed to be a secure form of data exchange, and an NFC device is capable of being both an NFC reader and an NFC tag. This unique feature allows NFC devices to communicate peer-to-peer.

Figure 2: NFC Tag and Reader

5.1.3. Theft Vehicle Detection:
It can be done in two steps

a)   Detect the vehicle

Camera will capture image of each vehicle which passes through the toll booth for detecting theft vehicle. In this process vehicle is detected by using Blob Detection algorithm.

(1) BLOB Detection algorithm:

BLOB Analysis Algorithm is the algorithm which is used to count the number of vehicles in our system.
It works in five steps:
- **Background Subtraction** - It collects the color co-occurrences in the image and applies quantization. Accuracy is increased in presence of moving background objects. The important property is to adapt the background model to the changing condition in the scene.

- **Blob Detection** - The background subtraction model supplies the pixels detected as foreground. Pixels are

grouped in current frame together. Algorithm groups individual pixels into disconnected classes

- **Blob Analysis** - In Blob analysis the model receives the candidate blob with their position as input and provides the new blob in current video frame. This module identifies which candidate blob in current frame belong to same vehicle.

- **Blob Tracking -** Blob tracking is a method by which computer can identify and trace the movements of objects within images. A blob is a group of pixels the computer identifies as an object. This tracking method allows the computer to find the blob's positions in successive frames.

b) Match vehicle number plate

After getting vehicle from blob detection , system will match number plate with theft vehicle complaint database using OCR Algorithm.

(2) OCR (Optical Character Recognition):

OCR is the mechanical or electronic conversion of scanned images of typewritten or printed text into machine-encoded/Computer readable text. The main purpose of OCR system based on a grid infrastructure is to perform the document image analysis, document processing of electronic document formats converted from paper formats more effectively and efficiently. This improves the accuracy of recognizing the characters during the document processing compared to various existing available character recognition methods.

5.1.4. Database:

This is the centralized database which consist of all the vehicle related information. And also it consists of the theft vehicle complaint record which is used for theft vehicle detection.

System require database for storing the information of user details, vehicle details, date and time. It will contain following tables :

- User
- Vehicle type
- Toll Plaza
- Fee list
- Transaction
- Stolen Vehicle
- Detected Vehicles

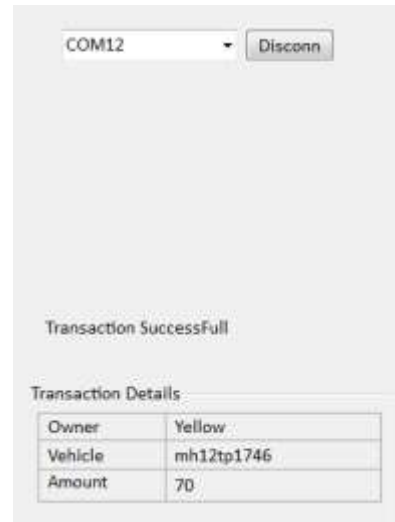### 6. EXPERIMENTAL RESULTS OF THE SYSTEM:

6.1. Transaction at Toll Plaza

Figure 3: Transaction Window

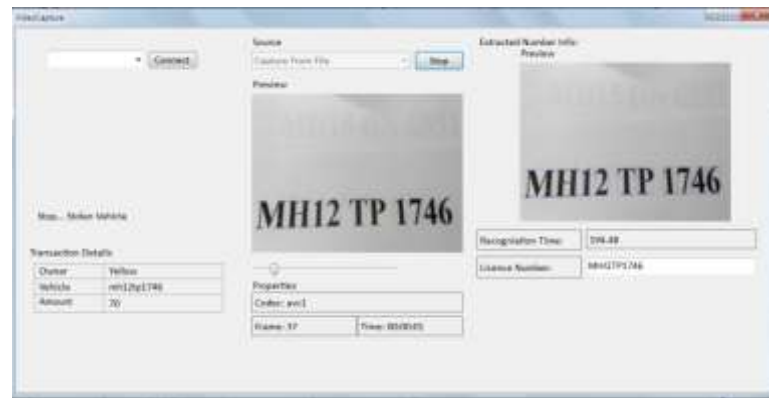### 6.2. Theft Vehicle Detection:

Figure 4: Stolen Vehicle Detection Window

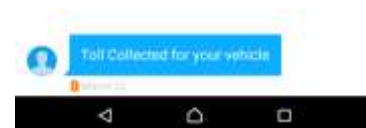### 6.3. Notification generation after transaction:

Figure 5: Message notified on Phone

7. ADVANTAGES:

- Increases user convenience from payment without stops.
- Less traffic congestion.
- Less operating cost.
- Better audit control.
- Transparency of toll transactions.
- Reduces revenue leakages.
- No need to wait in the queue.
- No need to carry cash.
- No need to stop the car.
- Car documents can be checked in once.
- Blocked car can be track and catch.
- Government can block any car all over India by a centralized server.
- Owner can get the instance SMS regarding his/her prepaid account.
- Number Plate Recognition using OCR.
- Need for manual toll based system is completely reduced.

8. 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.

9. REFERENCES:

[1]Guo-Huang Hsu, Liang-Rui Lin, Rong-Hong Jan, and Chien Chen ," Design of ETC Violation Enforcement System for Non-payment Vehicle Searching", ICACT Transactions on Advanced Communications Technology (TACT) Vol. 2, Issue 1, March 2013

[2] Wern-Yarng Shieh, Chen-Chien (James) Hsu, Shen-Lung Tun,,Po-Wen Lu, Ti-Ho Wang, and Shyang-Lih Chang," Design of Infrared Electronic- Toll-Collection Systems With Extended Communication Areas and Performance of Data Transmission", IEEE Transactions On Intelligent Transportation Systems, Vol. 12, No. 1, March 2011

[3] Z. Feng, Y. Zhu, P. Xue and M. Li, "Design and realization of expressway vehicle path recognition and ETC system based on RFID," 3rd IEEE International Conference on Computer Science and Information Technology (ICCSIT),vol. 7, pp.S6- 90, 2010.

[4] Saijie Lu, Tiejun He, Zhaohui Gao," Design of Electronic Toll Collection System based on Global Positioning System Technique", 2009 ISECS International Colloquium on Computing, Communication, Control, and Management 978-1- 4244-4246-1/09/$25.00 ©2009 IEEE CCCM.

AUTHOR PROFILE:

Prof. Kavita Sawant
Faculty member at Bharati Vidyapeeth College of Engineering for Women, PUNE-43

Sarika Bharambe
Pursuing B.E in field of Computer Engineering from Bharati Vidyapeeth College of Engineering for Women, PUNE-43

Priyanka Kumbhar
Pursuing B.E in field of Computer Engineering from Bharati Vidyapeeth College of Engineering for Women, PUNE-43

Pragati Patil
Pursuing B.E in field of Computer Engineering from Bharati Vidyapeeth College of Engineering for Women, PUNE-43