



# **INTELLIGENT HIGHWAY TRAFFIC TOLL TAX SYSTEM AND SURVEILLANCE USING BLUETOOTH AND OPTICAL CHARACTER RECOGNITION**

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## **ABSTRACT**

Paper describes how Bluetooth technology and Machine Learning algorithms can be used for Toll Tax Collection. Bluetooth is a wireless communications technology that is simple and secured. The technology encompasses a low-cost, low-power, global radio system for integration into mobile devices, which can form a quick ad-hoc secure “piconet” and communicate among the connected devices. Also Automatic License plate number recognition is achieved with the help of Optical Character Recognition to ensure the identity of a vehicle for toll collection and stolen vehicle. In the current system (manual) we observed some limitations like mismanagement of time, payment collection and processing, long queues in peak-period and manual operations. These difficulties can be overcome by implementing the system using Bluetooth technology. This will make the system automatic, secure and easier to operate and maintain.

**Index Terms:** Photo OCR, MAC address, ad-hoc.



## 1. INTRODUCTION

Bluetooth is a radio frequency (RF) specification for short-range point to point and point to multipoint voice and data transfer. Bluetooth has enabled to connect to wide range of computing and telecommunications devices without the need for proprietary cables that often fall short in terms of ease of use.

Bluetooth communication involves low-cost transceiver chip in each device. The transceiver transmits and receives in the unlicensed 2.4 GHz spectrum that is available according to Global wireless

## 2. RELATED WORK

### 2.1 ETC (Electronic Toll Collection) Sub-System

This paper is about implementing the Bluetooth and Image processing technology in the application of toll tax system. The Bluetooth chip is included in each vehicle. Each Bluetooth device has a Media Access Control address (MAC address) which is unique identifier assigned to network interfaces for communications on the physical network segment. Bluetooth device identification number ie. MAC

standards. In addition to data, up to three voice channels are available. Each device has a unique 48-bit address which defines its identity Bluetooth technology is Omni-directional and does not require line-of-sight positioning of connected devices.

Automatic License plate recognition is done with OCR which is the mechanical or electronic conversion of scanned or photographed images of typewritten or printed text into machine-encoded/computer-readable text.

address, vehicle license plate number and vehicle types (e.g. car, truck etc.) is stored in the database of toll tax system.

Bluetooth supports both point to point and point to multi point connections. Connection is established when two or more devices come within range of each other. Devices are added or removed from the network dynamically at will and without interruption to the other participants i.e. *ad-hoc networking*. One takes the role of a server while the others act as a client. This grouping shares a single channel known as a *piconet*. In our system, the tollbooth acts



as a server and the vehicles act as the client.

When a vehicle is within the range of the Bluetooth device placed at toll station, an ad-hoc network is established the system extracts the MAC address of mobile vehicle. This MAC address is now searched in the database. In this way system will identify vehicle type, its owner with number plate. According to the vehicle type (car, bus, truck etc.) toll tax amount will be deducted from the prepaid account which is linked. The accounts will be updated with remaining credits.

In our system one small lane will be dedicated for manual cash payment for the user with no Bluetooth devices and one with insufficient balance. If the balance of a vehicle is lesser than the amount required both authority as well as user will be notified and instructions to shift to manual lane will be given to the user for alert.

The image of license number plate of vehicle is captured with the camera located at the toll-booth system which is followed by the Image Processing algorithms for OCR to identify vehicle

and its owner. Another database of stolen vehicle is to be maintained. All the vehicles passing through are searched in a database, if match found, the authority will be notified accordingly.

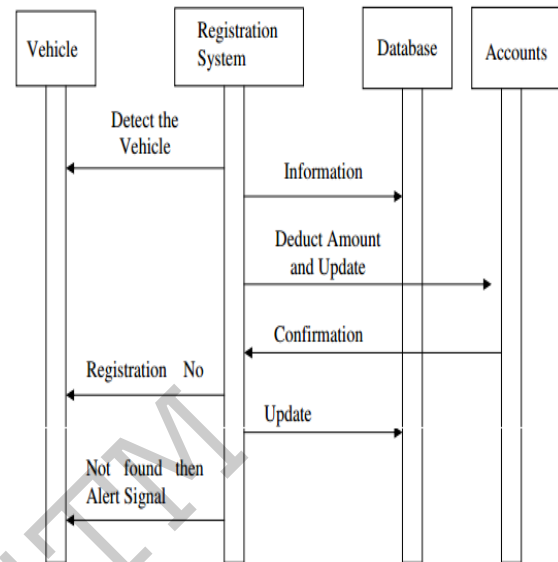


Fig1: Sequence Diagram

## 2.2 Automatic License Plate Recognition

Following primary steps involved in identification of a license plate are:

- **Plate localization** – responsible for finding and isolating the plate on the picture.
- **Plate orientation and sizing** – compensates for the skew of the plate and adjusts the dimensions to the required size.
- **Normalization** – adjusts the brightness and contrast of the image.
- **Character segmentation** – finds the individual characters on the plates.
- **Optical character recognition.**



And the **OCR** works as follows:-

We now describe the architecture used to learn the feature representations and train the classifiers used for our detection and character recognition systems. The basic setup is closely related to a convolutional neural network, but due to its training method can be used to rapidly construct extremely large sets of features with minimal tuning. Our system proceeds in several stages:

1. Apply an unsupervised feature learning algorithm to a set of image patches harvested from the training data to learn a bank of image features.
2. Evaluate the features convolutional over the training images. Reduce the number of features using spatial pooling.
3. Train a linear classifier for either text detection or character recognition.

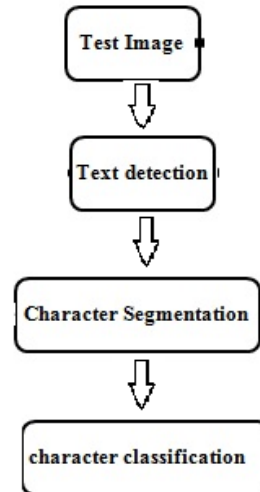


Fig 2 : Photo OCR pipeline

### Principle Algorithm

- When Bluetooth device attached in vehicle comes in the range of Bluetooth device fitted at tollbooth station, Its MAC address is obtained and identity of vehicle is confirmed from database.
- Information about vehicle like owner, type of vehicle, number plate number, contact number and available balance in that particular account.
- Based on that type of vehicle money from that account will be deducted.
- If balance in account is less than amount to be paid then vehicle will be instructed to pay manually in other lane.



- If money in account is more than amount to be paid, then no problem, account balance will be updated according to type of vehicle.
- Same time photo will be taken of number plate of vehicle and run through OCR program.
- Obtained number will be compared with number saved in database.
- If number matches then no problem.
- If it mismatches then Vehicle will be stopped and it will be informed to traffic police.
- If that number is not found in database then vehicle will have to pay manually in other lane.

### 3. ADVANTAGES OF ETC SYSTEM

In the existing toll tax system, we have observed the some limitations. The very first is the mismanagement of time. In this system when one vehicle reaches at the station, the employees there first take the payment for the toll tax from the owner and then the operator at the computer feeds the amount, vehicle number and other information etc. in the computer and then gets the printed slip from the computer and gives it to the owner. During this period, there may be a long queue for the payment of toll tax. Due to this problem, the traffic system may be disturbed

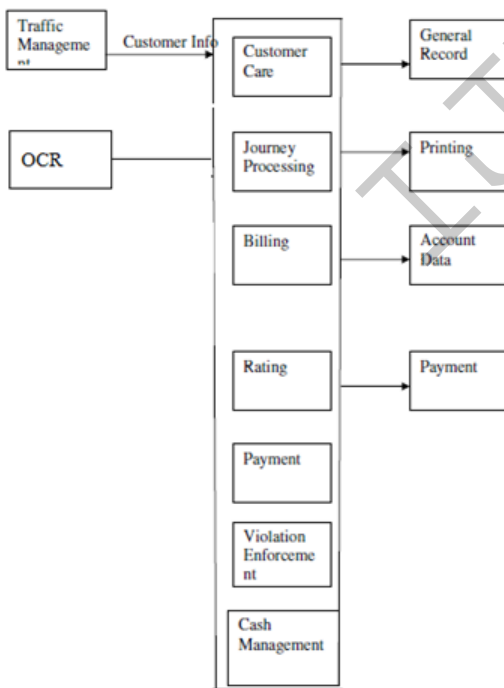


Fig 3 : Operational Model of the Toll Tax System

The next problem which I have observed is that there may be the case when one vehicle may pass through the station without giving the toll tax due to the negligence of the employees or may be due to more manual load.

The last problem which may be considered is that the payment in cash which is collected, the proper attention is given to deposit the amount to the government and risk of cash at the toll tax stations and security forces are there



for this purpose. All these limitations are overcome by our system.

#### 4. RESULTS AND TABLES



```

C:\Users\DELL\documents\visual studio 2010\p...
OpenCV Automatic Number Plate Recognition
working with file: MH36N1113
Num plates detected: 1
=====
License plate number: MH36N1113
=====
    
```

```

C:\Windows\system32\cmd.exe
496287383046
Vehicle number is:MH042356
Type of vehicle is: truck
Credit:100
It is truck      Rs.50 deducted
  new credit:50
-----
27384513135945
Vehicle number is:MH36N1113
Type of vehicle is: car
Credit:75
It is car       Rs.40 deducted
  new credit:35
    
```

Type	Vehicle Plate No	Initial Balance	Transaction amount	Balance after deductions (TOLL Paid)
Truck	MH042356	100	50	50
Car	MH36N113	75	40	35

#### 5. CONCLUSION

In our thesis, we have presented the implementation of Bluetooth technology in the application of toll tax system. Bluetooth toll collection stations allow the traffic to flow continuously and vehicle having avoided stopping and starting again. This in combination with reduced fuel consumption has positive

effect on environment i.e. pollution created will be minimum. Implementing the Bluetooth technology is also not so much costly as its price is only \$5. Man power and cash risks are also reduced to minimum. Furthermore, only a minimum of traffic disruption is caused during installation. The system also increases safety, as bottlenecks and long queues are avoided. Society and business



community also gain from the system as it results in faster transportation. The system is cost-effective, time saving and easy to install which benefits the operator as well as user.

## 6. FUTURE SCOPE

The objective of the Bluetooth standard is to enable seamless communications of data and voice, over short-range wireless links between both mobile and stationary devices. Indeed, the focus of Bluetooth wireless technology on low-cost, high levels of integration and ease of configuration has the potential to change current mobile computing and network connectivity paradigms. We can say with confidence that the work of toll tax be an easy one when Bluetooth technology will be fixed for this purpose. This work can be further implemented in the field of Road Tax Office for the collection for road taxes, which are applicable on motor vehicles and may be for the collection of insurance fee of the motor vehicles.

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