

**Automated Toll Collection and Theft Detection  
using RFID and Image Processing  
Capstone Project Proposal**

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## Mentor Consent Form

I hereby agree to be the mentor of the following Capstone Project Team

<b>Project Title:</b> Automated Toll Collection and Theft Detection using RFID and Image Processing		
<b>Roll No</b>	<b>Name</b>	<b>Signatures</b>
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## **Project Overview**

In this era of increased use of vehicles, traffic problems are quite common. Do you ever feel that 10 minutes (or maybe more) could have been reduced from your journey time had there been no congestions at the toll plazas? Due to lack of public awareness, Government efforts and improper implementation of the newly introduced RFID based FASTag system failed to reduce the journey time by any significant amount. This leads to question, what needs to be done for the smooth transit of vehicles through the toll plazas.

This project aims at solving the traffic congestion problem at the toll plazas by some modifications to the present toll infrastructure and toll deduction methods. The vision and future of this project is to reduce the traffic queues to zero at toll plazas by removing all barriers or speed breakers and still ensuring the correct toll deduction even at normal highway speeds. The secondary aim of this project to provide a Theft Detection System that allows the user to report a vehicle as stolen or missing which would lead the vehicle to be under a radar whenever seen at any toll plaza. This would also be triggered whenever the data retrieved from the vehicle ID plate does not match the data retrieved from RFID tag on the car, meaning obvious tampering to either vehicle ID plate or the RFID tag.

The proposed solution is based on a combination of RFID and Image Processing techniques to scan an incoming vehicle through toll with minimal error, without slowing down and automatic toll deduction from the user's payment wallet. This will be achieved by using UHF RFID sensors and HD Slow Motion Cameras that will scan the incoming vehicle, a Central Database that has information of all the vehicles, their owners and their connected prepaid accounts and a Central Server for all the communications and deductions.

## **Need Analysis**

Traffic Problem at Toll plazas is a very common problem commuters have to face every day. Long queues at Toll Booths lead to wastage of already scarce resources like Fuel. Also, these lead to a delay in Emergency Services like Ambulances, Fire Brigades, etc. The fuel burning in the vehicle engines causes air pollution and wastage of fuel and money. These queues, at some toll plazas, are so long that it takes more than 30 minutes just to cross the plaza. This leads to a serious increase in commute timings between two cities. The Government has been introducing many new policies to counter the “Toll Queue Problem”, which includes the modernized FASTag system and the opening of all toll plazas if any vehicle in the queue has to wait for more than 15 minutes. Both of the mentioned policies have failed either due to technical flaws or improper implementation and thus, we are back to square one. FASTag systems also faces the issue of non FASTag enabled vehicles entering the FASTag dedicated lane, defeating the purpose FASTag was introduced for. So, to overcome the above mentioned “Toll Queue Problem”, some new, more advanced and secure method needs to be introduced, which reduces the queues to zero and ensures all toll deductions automatically without any hassle.

### **Assumptions and Constraints**

<b>S. No.</b>	<b>Assumptions</b>
<b>1</b>	As this is an automatic deduction system, it is assumed that the user has a bank account and it is linked with the user profile for seamless toll deductions.
<b>2</b>	The User panel would be provided as a web-based application. So, it is assumed that the user has the basic know how of using the internet and the web-based application
<b>3</b>	Image Processing works on reading the Vehicle Identification Plate. This is an assumption that the vehicle identification plate is easily recognizable and not damaged beyond recognition. If so, the user will be prompted with a notification about the tampering and asked to get the plate repaired.
<b>4</b>	This Toll deduction System is based on the combination of Image Processing and RFID system to ensure accuracy. So, it is assumed that the RFID tags are to be made mandatory by the RTO for all vehicles.
<b>5</b>	The vehicles are assumed to be going at a normal highway speed and not at exceptionally high speed that may lead to dispatch of challan to defaulter for speeding along with toll deduction.

## **Standards**

- Web 2.0
- ISO 20954 – Image Stabilization standard for camera.
- ISO 20490 – Auto-focus standard for camera.
- ISO 19093 – Low-light performance.
- IEEE 802.11 – Wireless Connection.
- ISO and EPCglobal standards for RFID.

## **Objectives**

- Detection of front and rear Vehicle Identification plates using Optical Character Recognition.
- RFID sensors to transmit information from the vehicle which is received by the receiver at the plaza.
- Using the information received from the above sources to connect to the Central server to initialize toll deduction.
- Using Secure Payment Gateways for transactions.
- Development of a User Application Panel which provides the user about the information of his recent transactions.
- Issuing of automatically generated challans to defaulters.



## Methodology

- Image recognition to identify vehicle Identification plates.



Fig 1.1 Extraction of Vehicle Identification Number from plates.

- Radio Frequency Identification System to hold information of vehicle used as a cross reference to the above method.

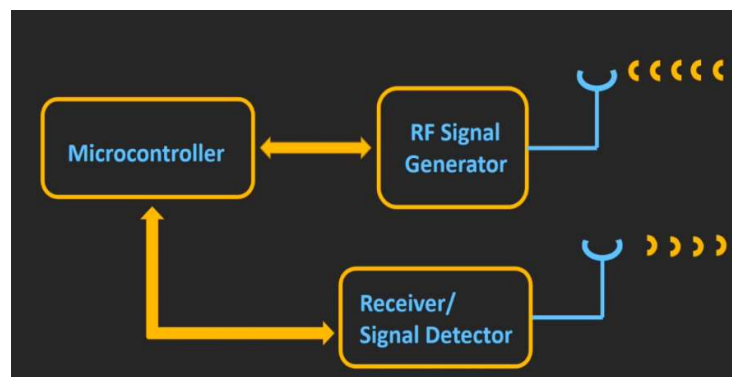


Fig 1.2 RFID Architecture

- Using secure payment gateways to do all the toll deductions automatically.

## Work Plan

Legend



S. No.	Activity	Month	July				August				September				October				November				December			
		Week No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
1	Identification, formulation and planning of project	Plan																								
		Actual																								
2	Testing of RFID modules on Demo cars	Plan																								
		Actual																								
3	Hardware Implementation of RFID Scanner and Cameras	Plan																								
		Actual																								
4	Testing different Image Processing Algorithms for	Plan																								
		Actual																								
5	Combining the results of RFID and Image Processing	Plan																								
		Actual																								
6	Hardware and Software Interfacing, Development of	Plan																								
		Actual																								
7	Optimisation and Modifications to get best	Plan																								
		Actual																								
8	Results Evaluation	Plan																								
		Actual																								
9	Final Report	Plan																								
		Actual																								

Fig 1.3 Work breakdown structure using Gantt Chart

## **Project Outcomes & Individual Roles**

- Faster transit on Toll Roads.
- Cashless Toll Deductions.
- Effective Theft and Tampering Detection.
- Time and Fuel Savings.
- Similar Technologies can be implemented for automated parking systems.

### **Individual Roles**

- Image Recognition - Shervil Gupta and Shivam Mittal.
- RFID - Sehajbir Singh and Shivam Bhushan.
- Web Application - Shervil Gupta and Sehajbir Singh.
- Hardware and Software Interfacing - Shivam Bhushan and Shivam Mittal.
- Documentation - Sehajbir Singh and Shivam Mittal.

## **Course Subjects**

- Image Processing (UCS615) – Using Image Processing to extract the features from an image, i.e. the vehicle identification number from the plates.
- Embedded Systems (UCS614) – Using the RFID sensors along with a Raspberry Pi 3B module.
- Database Management Systems (UCS310) – Managing the Central Database containing the information of all the vehicles and vehicle owners.

## **References**

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- [5] Muhammad Tahir Qadri ; Muhammad Asif (2009) - IEEE - Automatic Number Plate Recognition System for Vehicle Identification Using Optical Character Recognition.