

# **Software Requirements Specification**

## **CS684 Project**

### **Electronic Toll Tax Collection System**

**Group No. 14**

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# 1 Introduction

## 1.1 Scope

We will make prototype of an Electronic Toll Tax Collection (ETC) system using FIREBIRD V robots. ETC system will detect vehicles passing through toll plaza and automatically deduct the toll tax from the vehicle owner's prepaid cash card and same will be intimated to owner through SMS on registered mobile number. ETC System will take photograph of number plate if vehicle violates the norms. System will have IR sensors to detect vehicle's presence and speed. Character recognition algorithm will be used to read license plate of the vehicle.

## 1.2 Definitions, Acronyms and Abbreviations

1. **ETC System:** Electronic Toll Tax Collection system
2. **OCR:** Optical Character Recognition
3. **Firebird V:** Fifth generation Robot developed at ERTS Lab IIT Bombay
4. **ZigBee:** 802.15.4 communication Protocol
5. **IR Sensors:** Infrared Sensors

## 1.3 References

1. The Making of Singapore's Electronic Road Pricing System by A P G Menonand, Dr Chin Kian Keong Land Transport Authority Singapore Proceeding of the International Conference on Transaction Into The Next Millenium Singapore, 9-11 Sept 1998, Centre for Transaction Studies , Nanyang Technological University.
2. Firebird V Hardware manual
3. Firebird V Software manual
4. MATLAB Help
5. ZigBee:  
[www.zigbee.org](http://www.zigbee.org)

## **2 Overall Description**

### **Product Perspective:**

Electronic Toll Collection system is the effective solution to avoid traffic jams and to maintain the transparency in transactions at toll plazas across India.

### **Product Functions:**

In vehicle unit which has communication capabilities will be present on each vehicle. Toll plazas will communicate to vehicles automatically which enable them to charge the vehicles as per their type.

### **User Characteristics:**

User needs to install in vehicle unit in his/her vehicle.

### **Constraints:**

1. It may be practically difficult to install In vehicle units in all vehicles across country in stipulated amount of time.

### **Assumptions and Dependencies:**

1. For this prototype, we have taken into account only GSM mobile users.
2. A specific license plate format is assumed.
3. Accuracy of image processing algorithm depends on light conditions

### **Requirements Subsets:**

1. USB Camera
2. GSM Modules
3. Two FireBird-V Robots

## 3 Details

### 3.1 Functionality

Each vehicle will have one In vehicle unit which is ZigBee enabled transceiver module, which will communicate to ETC system deployed at toll plaza. In our prototype FireBird-V robot will be used as a vehicle and another FireBird-V robot will be deployed as a Toll Plaza.

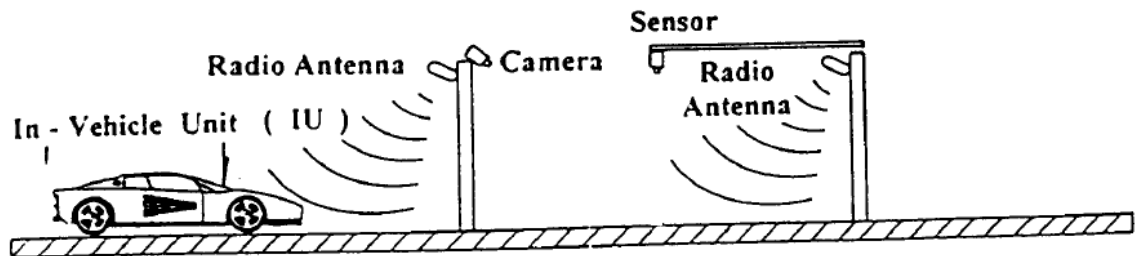
IR sensor will detect the presence of the vehicle. Using pair of IR transceiver modules speed of the vehicle is calculated and if measured speed is greater than required, then automatically speed of the vehicle will be reduced to the optimum value.

Vehicle will violate the norms if it does not have In vehicle unit or if there is no sufficient balance in the cash card. Such vehicles will be photographed using camera which is installed at toll plaza to make law enforcement. Optical Character Recognition algorithm will be used to detect the vehicle number.

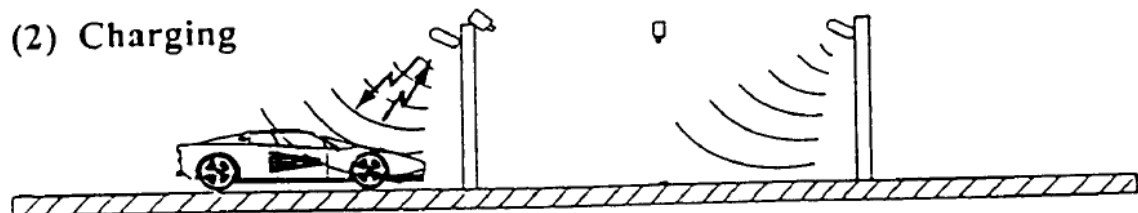
Details of vehicle (nature of vehicle –light, medium, heavy, Type of vehicle) and details of owner (name, address, bank account information etc ) can be found from the database available. Database information will be used to decide amount of toll tax as it varies from vehicle to vehicle. Database will be created on PC.

We will be using GSM technology to send a SMS as an acknowledgment to payment made. Acknowledgment will contain mode of payment, amount of toll tax and remaining balance in cash card.

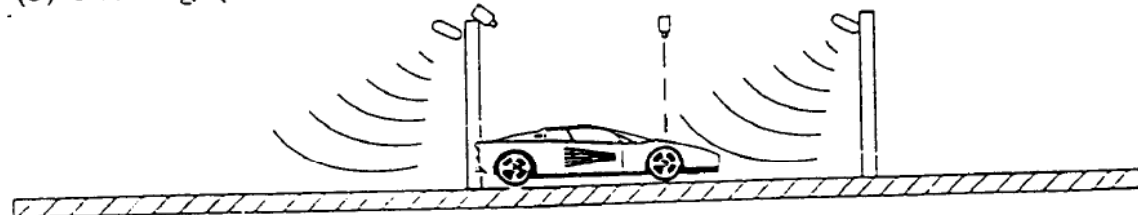
## (1) Approach Of Vehicle



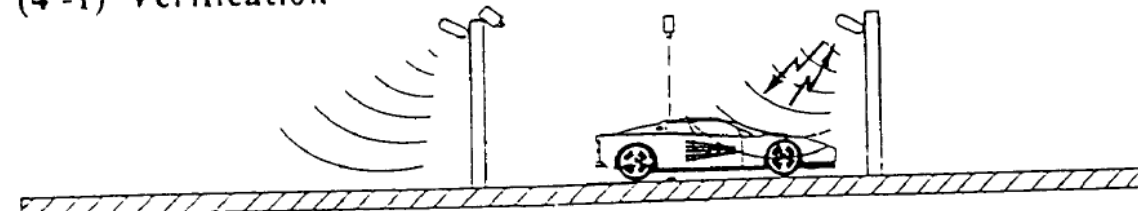
## (2) Charging



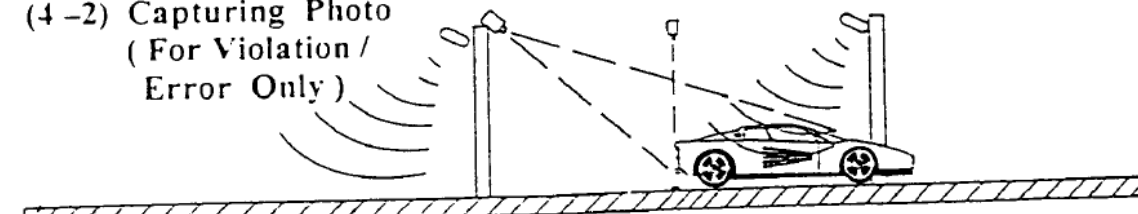
## (3) Debiting (IU - CashCard)



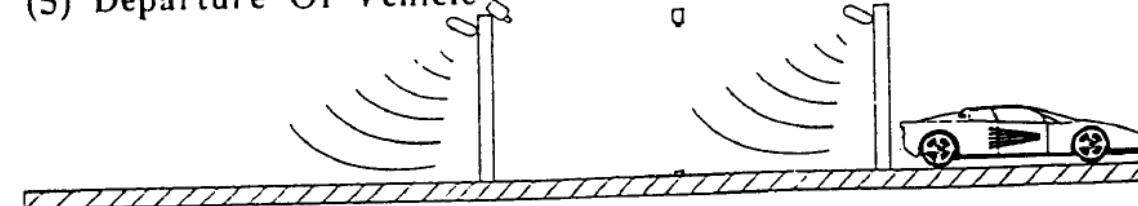
## (4 -1) Verification

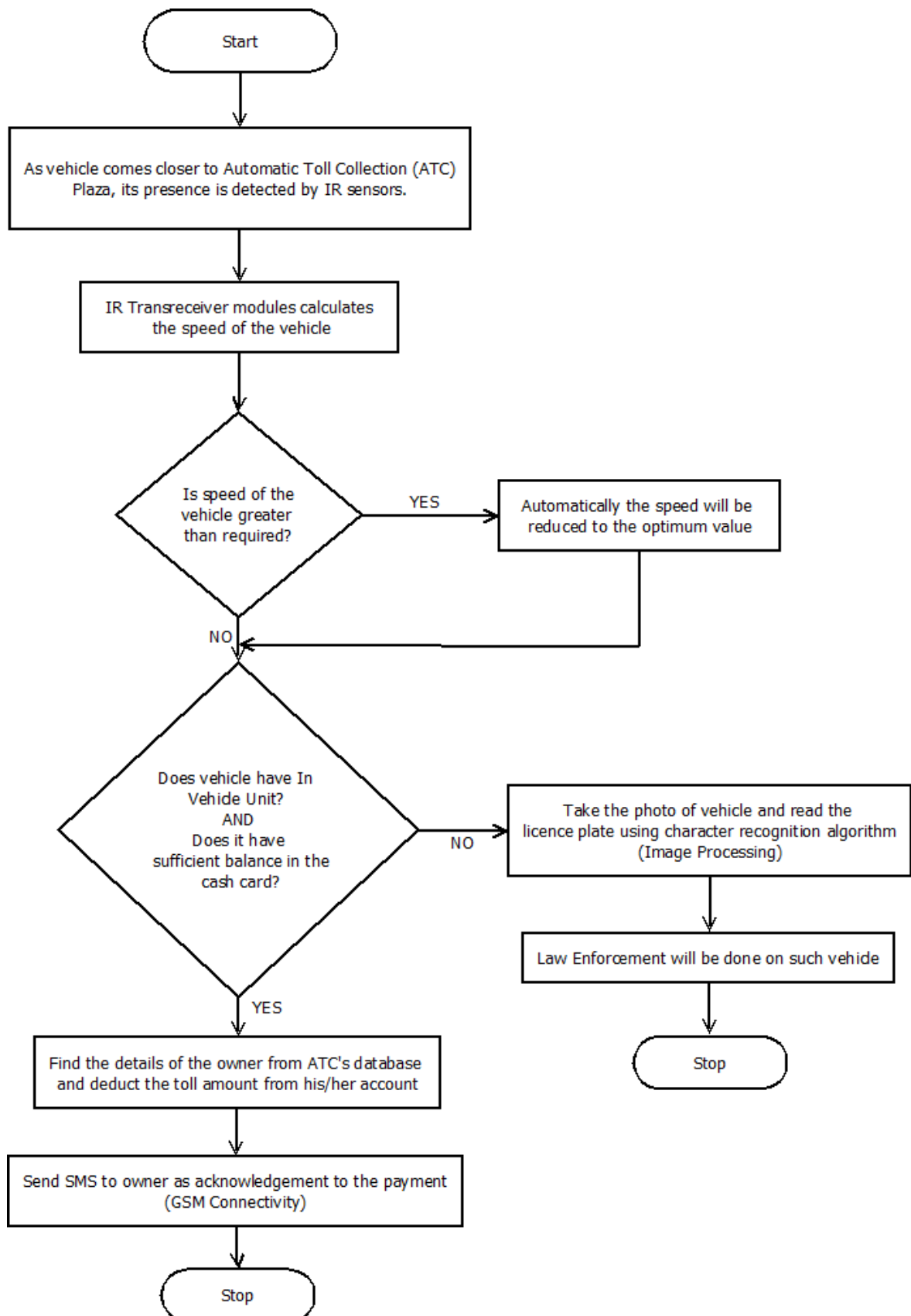


## (4 -2) Capturing Photo ( For Violation / Error Only )



## (5) Departure Of Vehicle





### **3.2 Supportability**

1. Modular approach and reusability will be used to code the application.
2. Each functionality should be well defined and commented.

### **3.3 Design Constraints**

1. In order for system to work efficiently, we have to limit speed of the vehicle.
2. Robot should follow lane discipline. This is required to ensure that vehicle remains in visibility range of camera. (This is achieved by making robot follow white line)
3. Image processing becomes difficult in case of insufficient lights, improper colour co-ordination.
4. Payment acknowledgements will only be sent to GSM mobile users.

### **3.4 Interfaces**

#### **3.4.1 Hardware Interfaces**

1. GSM module interface to control centre (PC).
2. Control centre (PC) is connected to toll plaza (F V) through USART.

#### **3.4.2 Software Interfaces**

1. Database needs to be accessed by control centre to get vehicle owner's details.
2. Image which is captured by USB camera needs to be processed automatically and it is required to store such processed data in database to do law enforcement.

#### **3.4.3 Communications Interfaces**

1. ZigBee communication: It Communicates between F V Toll Plaza and F V Vehicle.
2. USART: It communicates between F V Toll Plaza and Control Centre (PC)
3. GSM communication: It communicates between control centre and vehicle and also between control centre and law enforcement authority personnel.



#### **4. Work Division**

Pushkar Kothavade : Image processing , ZigBee Communication,  
Sensors placement and speed measurement mechanism.

Mugdha Nazare : Image processing, GSM communication, White line follower.

Ashish Paradhi : Image processing, Database management,

#### **5. Testing plan**

Test-1 : Vehicle with proper In vehicle device and having required amount of cash  
in account will be tested.

Test-2 : Vehicle with proper In vehicle device but do not having required amount  
of cash in account will be tested.

Test-3 : Vehicle without In vehicle device will be tested.