

# An Intelligent Toll Booth System for Vehicle Smoke Emission Monitoring and Prepaid Toll Transactions

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## Abstract

**Objectives:** Road Transport is the primary source which is contributing to poor air quality. We propose, an Intelligent Toll Booth System to automate toll transactions and monitor the smoke emission from vehicles. **Methods/Statistical Analysis:** The automated toll operations are done based on the prepaid toll transaction card which is a passive RFID tag. The toll road usage is allowed based on the credit limit of the tag. The smoke sensor detects the amount of Carbon dioxide (CO<sub>2</sub>) exhausted from the vehicle. If it is beyond the specified range, a warning message is given to the vehicle possessor and to the respective transport office through GSM. **Results:** Intelligent Toll Booth System is validated to be more powerful, helpful and efficient than normal system for vehicle emission monitoring and prepaid toll transaction. It is apparent that our intelligent system proves to be more time conserving system and reduces the traffic congestion at toll booths, reduced labour and cost. Investigative results reveal that the proposed framework is viable for vehicle emission monitoring and prepaid toll transactions. Also this system agrees portability and needs very slight effort for smoke emission monitoring and toll transactions. **Conclusion/Application:** The proposed Intelligent Toll Booth system provides an efficient toll transaction method and smoke emission monitoring thereby reducing the congestion at toll booths.

**Keywords:** ARM based Toll Booth System, Intelligent Toll Booth System, Prepaid Toll Transaction System, RFID based Toll Booth System, Smoke Emission Monitoring

## 1. Introduction

With the rise of automobiles, it is very important to resolve the air contamination issues resulting from vehicle exhaust gas. Detection and control of these gasses is a main area of work. To defeat the issue of vehicle smoke emission and manual toll transaction we go for intelligent toll booth system for vehicle smoke emission monitoring and prepaid toll transaction. The system automatically identifies a vehicle equipped with a substantial encoded information tag as it travels through a toll path or checkpoint. The prepaid toll transaction system then posts a charge to user's account to avoid manual toll transaction. The vehicle smoke emission monitoring is carried out by checking the measure of carbon dioxide radiated from the vehicle. It is basically in charge of gathering and transmit-

ting emission data of vehicles. For the control perspectives, a better way to provision passing consents among vehicles to minimize the normal crossing point delays and how to evade accidents without traffic lights tangled, which is well documented in<sup>1</sup>. In the case of multi operator traffic management, a reservation-based convergence control framework which vehicles needed to demand and get time openings from the crossing point when they have to pass, which is experimented and explained in<sup>2</sup>. For the networking phases, a few analysts presented remote sensors. Agreeing to<sup>3,4</sup> the sensors were conveyed on the paths going all through the convergence, which were utilized to detect vehicle number, speed and so on, and sent their information to the crossing point control centre by some unique loops inserted in the roads. Research<sup>5</sup> supports a naturally visible model for traffic flow simulation,

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which presented for evaluating the conditions of vehicles, and after that to gauge CO<sub>2</sub> discharges at regular intervals per connection. Then again, the author considered a brief time, which may not be suitable for long time, and some key parameters were not indicated evidently. Research<sup>6</sup> offers an intellectual fuzzy system for traffic management. Research<sup>7</sup> identifies the micro imitation model for the computerized toll booth system utilizing RFID innovation. Research<sup>8</sup> supports the RFID based programmed toll gated system. The microcontroller was programmed using C programming language and Visual Basic was utilized as a part of the serial communication between the PC and the RFID and in addition with the PIC. The database was created using Microsoft Access in light of the fact that it can contain up to 32768 records of items. The RS-232 link is likewise utilized for the linking in the middle of PIC and PC.

The ETC system utilized as a part of Poland is called national programmed toll gathering framework (NATCS). It comprises of national automatic toll accumulation centre, control doors and locally available units. Utilizing GPS innovation, the OBUs figure the toll charges, and afterward transmit the data to the NATCS

PC focus. Research<sup>9</sup> shows the design of online traffic management which presents the traffic density of heavy and light vehicles.

Research<sup>8</sup> provides new approach to scheduling toll booth collector problem. Research<sup>9</sup> supports recognizing the plate quantities of trucks, the framework has control entryways outfitted with advanced short range correspondence (DSRC) identification gear and high determination cams. Because of the specialized determinations, this framework brings about a high cost for drivers. The functionality and adequacy of the proposed framework is given in Section 2, Result & Discussion shown in Section 3. A conclusion is at long last attracted Section 4.

## 2. Intelligent Toll Booth System

The entire system is composed into two sub-systems: Vehicle smoke emission monitoring and prepaid toll transaction. In the conventional situation, vehicle smoke emission information is accumulated in examination system through CO<sub>2</sub> sensor deployed in toll booth and sent to the control system and notice system. Considering the local emission standard, warning message is given auto-

### Toll Booth Module

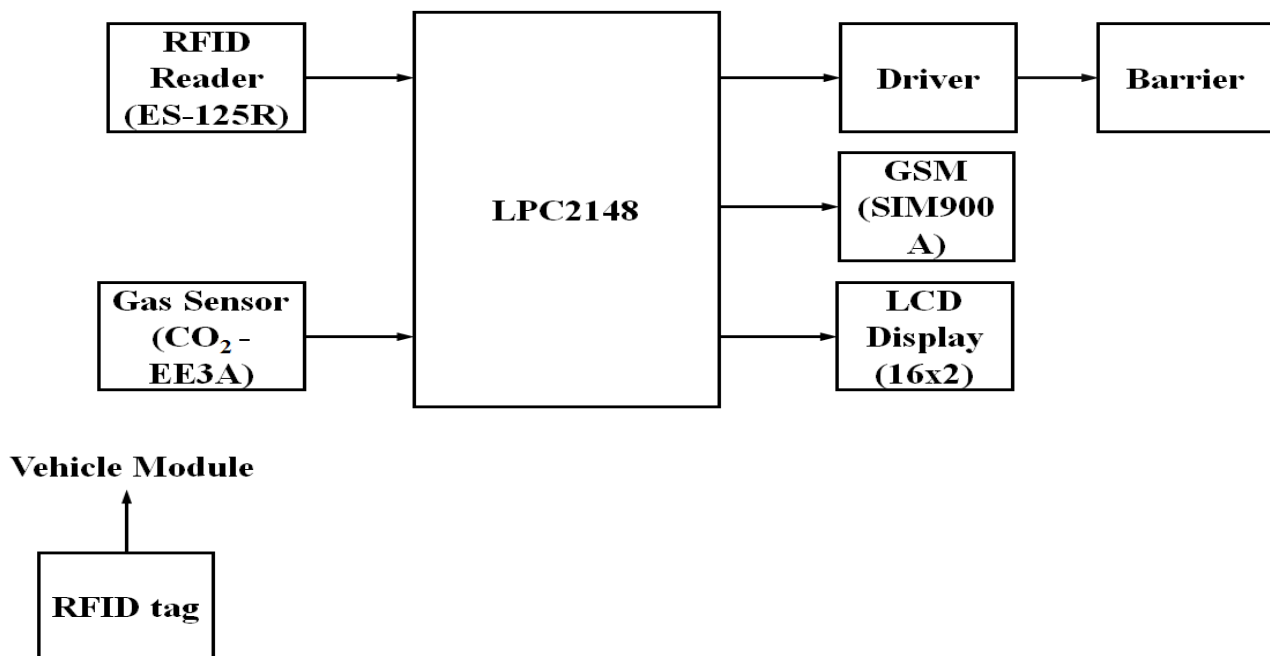


Figure 1. Intelligent Toll Booth System.

matically to the vehicle owner for initial three times, if the discharge from the vehicle is more. In the event that the repair has not been carried out in the wake of offering warning to the owner, a SMS is sent to the RTO office and further moves are made. RFID technology is installed in toll booth. RFID tag is basically responsible for information gathering while information reader can be acknowledged by means of RFID reader. The proposed prepaid toll booth system will apply RFID technology. The vehicles are given a passive tag and each time the vehicle passes the toll booth, the tag is read and information will be transmitted to the system. At the path point, the system records vehicle information with the preferred technique while at the receiving end, the system deducts the payment from the tag. If the balance is not sufficient, the barrier is not lifted and a prompting message is displayed to the vehicle possessor. Intelligent Toll Booth System is made out of CO<sub>2</sub> emission monitoring module and prepaid toll transaction module. The block diagram of Intelligent Toll Booth System is depicted in Figure 1.

## 2.1 CO<sub>2</sub> Emission Monitoring Module

A CO<sub>2</sub> sensor is deployed in toll booth to measure the engine air extent. The discharged gas is sensed and converted by the analog to digital converter and the amount

of CO<sub>2</sub> is measured by LPC2148 processor. In the event that the presence of CO<sub>2</sub> surpasses the breaking point, then a warning message is sent to the vehicle owner and the vehicle data is updated in the database. On the off chance that the vehicle is warned continuously for more than three times, then the message is sent to the respective transport office for further actions. The GSM module takes care of the message communication between the toll booths, vehicle owner and the transport office. The vehicle proprietorship and contact data are recovered from the RFID tag of the specific vehicle. The RFID label ID is coordinated with the vehicle number for validation reason and the data recovered from the tag are utilized.

## 2.2 Prepaid Toll Transaction Module

The prepaid toll transaction module utilizes RFID innovation which comprises of toll card reader which is a RFID reader conveyed at toll booths while toll card is a passive RFID tag implanted with each vehicle. The toll cards can be recharged with different amounts based on the requirements of passengers for utilizing the toll routes. At whatever point the vehicle crosses the toll, the toll card is read; if the card has sufficient sum, the vehicle is permitted. Generally a message is provoked for recharging the card. The user either can recharge the card or continue

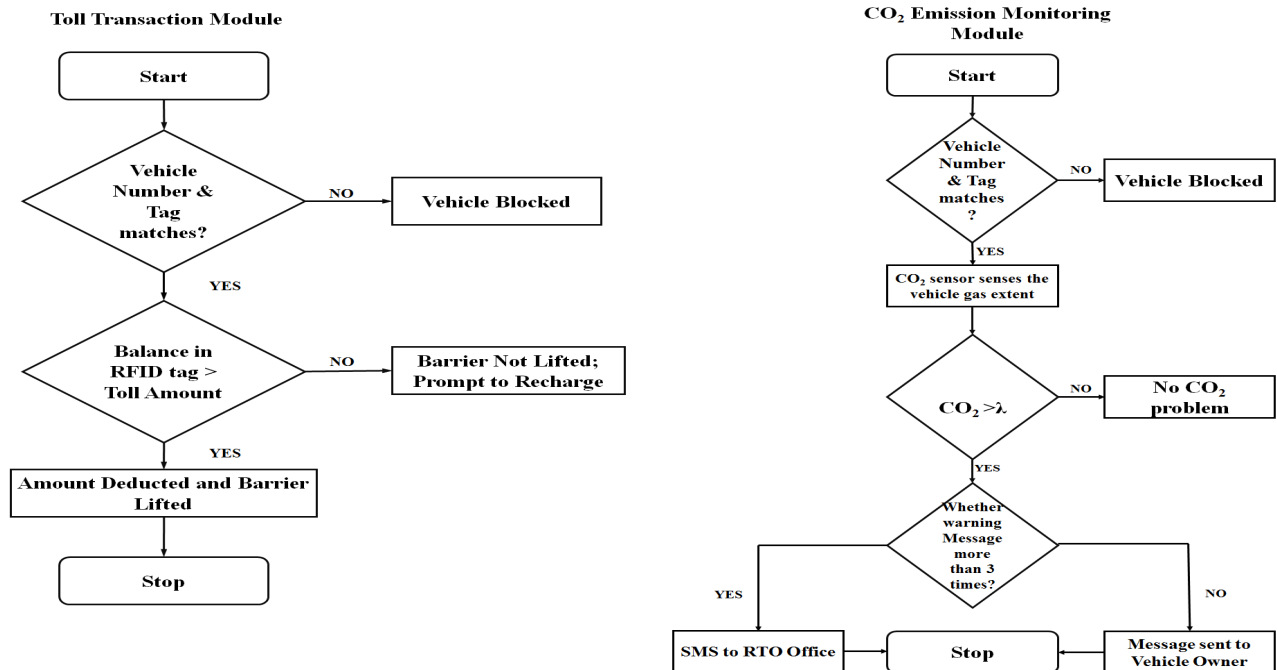


Figure 2. Flowchart of Intelligent Toll Booth System.

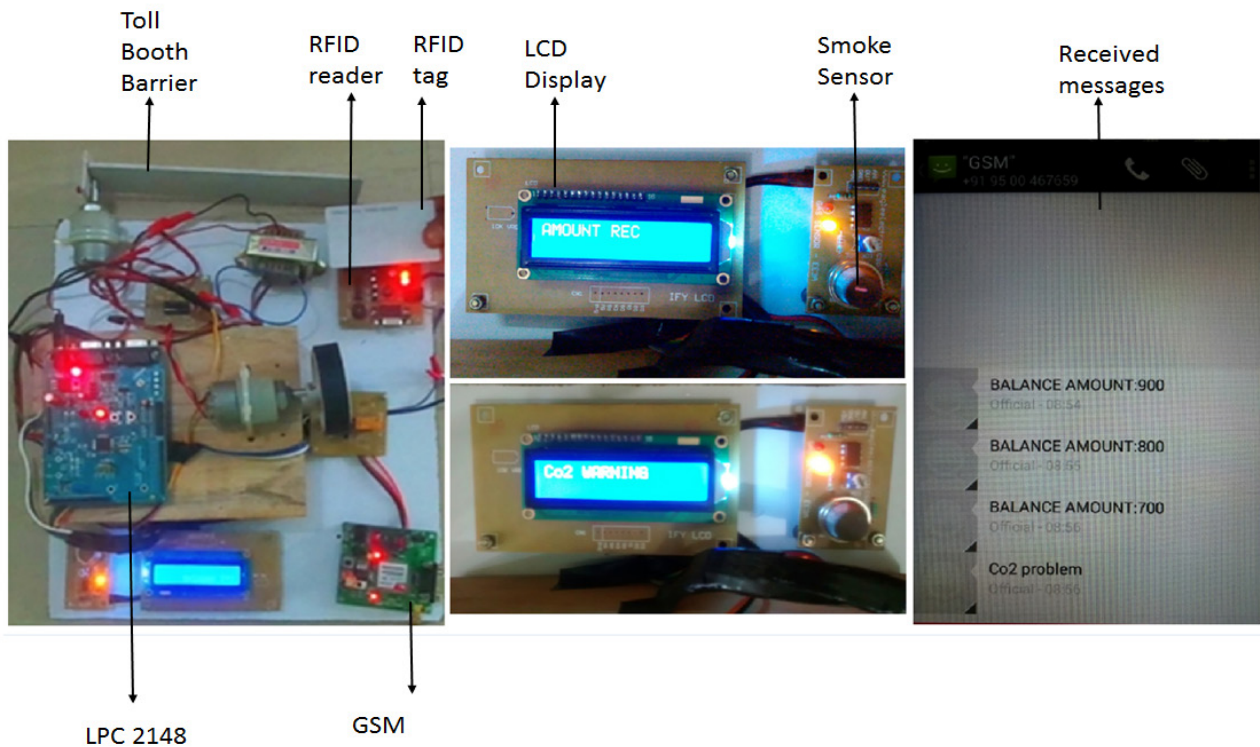


Figure 3. Experimental Set-up.

with manual payments. Figure 2 illustrates the flow of the proposed system.

### 3. Results and Discussion

Examinations are done to confirm the adequacy of Intelligent Toll Booth System. Vehicles outfitted with the planned RFID tag would drive here. In light of the experimental results (Figure 3), Intelligent Toll Booth System is demonstrated to be more powerful, helpful and efficient than customary test program for vehicle emission monitoring and prepaid toll transaction. It is evident that our intelligent system proves to be more time preserving system which can greatly reduce the traffic congestion at toll booths.

### 4. Conclusion

In this paper, we proposed an Intelligent Toll Booth system which monitors vehicle smoke emission and uses prepaid toll transactions which reduced the labour, cost and time. With CO<sub>2</sub> sensor, the vehicle emission marker

is read and investigated. If the measured value exceeds a threshold rate, a warning message is sent to the vehicle owner. The same is informed to the government officials after three successive warnings. Alongside, RFID technology is used for prepaid toll transactions which greatly reduced the waiting time at toll gates. Exploratory results demonstrate that the proposed framework is viable and dependable for vehicle emission monitoring and prepaid toll transactions. This system offers portability and requiring little to no effort for smoke emission monitoring and toll transactions. By utilizing this, movement can be boosted at the toll entryways and the users can pass the toll without stopping for elongated time.

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