Vehicle Tracking and Toll Collection System

Jigar Faria
Electronics,
Atharva College of Engineering
Mumbai, India

Sumit Jha
Electronics,
Atharva College of Engineering
Mumbai, India

Manojkumar Jha
Electronics,
Atharva College of Engineering
Mumbai, India

Ajay Devkatte
Electronics,
Atharva College of Engineering
Mumbai, India

Prof. Samuel Jacob
Electronics,
Atharva College of Engineering
Mumbai, India

***Abstract*—In the modern times, transportation and vehicular movement across the states has increased drastically. With the increase in the number of vehicles, managing the traffic across all the national highways has become a serious issue for the government authorities. In order to counteract the issue prevalent because of the existing manual toll collection system, Electronic Toll Collection system is highly needed. This system not only aids in toll collection but can also be used to track stolen vehicles, weapon identification and overload detection. The RFID tag mounted on the vehicle is read by the RFID reader which is interfaced to a microcontroller. After successful transaction, the user is intimated about the same through a text message which is sent via a GSM modem. Thus this system will eliminate the manual handling of cash, reduce traffic congestion thereby decreasing air pollution and helping the commuters for a pleasurable journey.**

Keywords*—Compendium; Tracking; RFID; heap; ETC

I. INTRODUCTION

Highways play a vital role in the social and economic development of the society. With the development of economy, the growth of highways is becoming faster. The number of vehicles on the roads are also increasing thus leading to congestion at the toll plazas. To overcome the problem of manual toll collection system, an electronic toll collection system has been proposed. It is a technology which ensures smooth flow of traffic in an efficient and faster manner. Electronic toll system includes vehicles equipped with electronic tags, wireless communication, inroad/roadside sensors and a centralized computing system to uniquely identify each vehicle which electronically collects the toll and provides traffic monitoring and data collection. Electronic toll collection system allows more efficient transaction to take place between a vehicle and toll agency. It also has a high degree of transparency.

There are many benefits of using Electronic Toll Collection namely reduction in travel time, reduction in vehicle emissions, increase in lane capacity and convenience to the users. The evolution of communication technology has brought ETC systems from SLFF (Single Lane Free Flow) to MLFF (Multi-Lane Free Flow). Most importantly, the system allows non–stop service to the road users without bothering about toll rates or money change as the same tag is read at all the toll plazas on all the highways across the country coupled with a reduction in the use of paper as well as fuel. This system also provides mechanism for detecting any weapons as well as for sensing any overloaded vehicles. Electronic toll collection utilizes radio frequency identification (RFID) technology. It consists of RFID tag and transceiver.

Tag can be of two types namely active and passive. Each tag has a unique identity number. Active tags have their own internal power supply thus allowing a larger range while passive tags utilize the energy of incoming signal from the reader and thus have a shorter range. Reader consists of an antenna to transmit and receive the signal from each tag. Users can recharge their account at any time. One of the special feature of this system is to detect stolen vehicles by using a database directory which contains the information of stolen vehicles.

II. LITERATURE SURVEY

William Vickrey, who won the Nobel Economics prize in 1959, proposed electronic toll system for Washington Metropolitan Area. Free flow tolling having fixed transponders underlying inside the vehicles and the readers were placed under the highway surfaces in mid of 1970s.

Norway had wide spread implementation of this transponder and reader technology. Norway has electronic fee collection EFC. This kind of toll collection system was first introduced in Bergen in the year 1986. Trondheim had introduced World's first completely unaided full speed electronic toll system, in the year 1991. Single, universal system was implemented firstly by Portugal (1995). The United States was another country implementing ETC system in several states like Garden State Parkway, California, Texas and Pennsylvania, Delaware and Florida where the vehicles can travel at full speed through electronic lanes.

Earlier the toll collection system used Atmega microcontrollers as the heart of the system. The automatic coin machines were then introduced which used to open the gate only when the suitable amount was deposited by the commuter. It was only after 1980's that the RFID technology revolutionized and it was implemented in the toll collection system.

Existing system: Two types of toll collection systems are in existence. In one system all the vehicles have to stop at the toll plaza along the highway to pay the toll. One person collects the money and issues a receipt, after which the gate is opened either mechanically or electronically for the vehicle to get through the toll plaza. Another is smart card system in which driver displays a smart card after which the money will be deducted from the account without the need for manual cash handling.

Drawback of existing system: The above system for collecting toll tax is time consuming; there is a long queue of vehicles at toll plaza thereby creating the probability of traffic jam around toll junction.

III. PROPOSED STRUCTURE

The system is simple in construction, provides automatic toll collection and vehicle theft detection. Before crossing any toll plaza, a vehicle has to pass two major blocks. In the first block the vehicle will be screened for any type of arms and ammunition so that any type of uneven activity can be determined beforehand. This will ensure a reliable security mechanism that will be helpful in preventing any anti-social activities. The second block which will be implemented in this system will be helpful in detecting any overloaded vehicles thereby reducing the possibility of any accidents due to overloading. RFID tag is mounted on each vehicle with unique ID. This ID contains all the information about the vehicle and the owner. When vehicle reaches the toll plaza, tag will start emitting the radio wave signals. RFID reader receives the signal from tag, decodes that signal and sends it to the ARM microcontroller. The controller will display the vehicle number and amount on LCD. ARM is interfaced with computer host to collect the vehicle and its owner information through serial port for future use.

When accessed from the database, it shows all the vehicle details on a computer screen such as ID, vehicle number, date, time and if this information matches with that of the directory of stolen vehicles then it will give the indication of the same and required action will be taken by the concerned authorities. ARM microcontroller will check for balance in the account and if there is sufficient balance, the predetermined amount will be deducted and user will be notified through a SMS which is sent through a GSM modem. If there is insufficient balance in the user's account, the user is notified to recharge his account through any of the outlets where the RFID cards are issued.

IV. BLOCK DIAGRAM

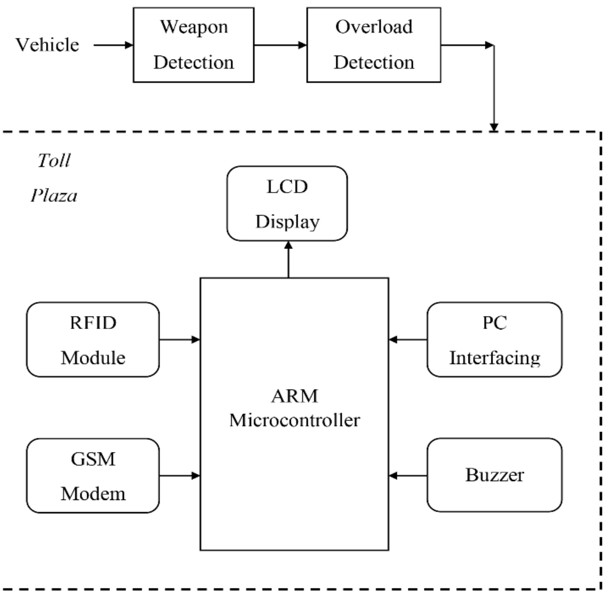

Fig. 1. Block Diagram

V. DYNAMICS

The block diagram of Electronic toll collection (ETC) using RFID technology is as shown in Fig No. 1. The Proposed System provides automatic toll collection and vehicle theft detection along with special features of detecting weapons and sensing overloading of vehicles. One of the ways of detecting weapons is through the use of X-rays. In order to detect weapons which are hidden in vehicles, X-rays of different energies can be used. Overloading of vehicles can be detected through the use of different weight sensors. A RFID module consists of two parts-RFID Tag and RFID Reader. A RFID tag is mounted on each vehicle with unique ID. This ID is not visible to humans; it contains all the information about the vehicle and the owner. When vehicle reaches the toll plaza, tag will emit radio wave signal. RFID reader receives the signal from tag, decodes that signal and sends it to the ARM microcontroller. The microcontroller will display the vehicle number and a particular toll amount on LCD.

ARM microcontroller is interfaced with computer host to collect the vehicle data through serial port for future use. When accessed from database it shows all the vehicle details on the computer screen such as ID, vehicle number, date, time. Microcontroller checks the balance; if sufficient balance is present then the predetermined amount is deducted from the prepaid account and the account is updated. Message will be sent to the vehicle owner by using GSM modem.

Secondly, a postpaid system will also be interfaced along with the module comprising the tag which will allow the drivers/passers to go for e-billing in case the balance in the prepaid module goes without balance; the driver will be alarmed to acknowledge the permission of getting e-billing done.

If the vehicle is stolen the vehicle owner registers a complaint with the local police station whereby only authorized persons are allowed to update the registration ID and RFID tag number on the website. When vehicle passes by the toll plaza the vehicle tag number is compared with the stolen vehicle tag numbers in the database at toll plaza. If it is matched the buzzer will ring and a message will be sent to the registered police station.

VI. METHODOLOGY

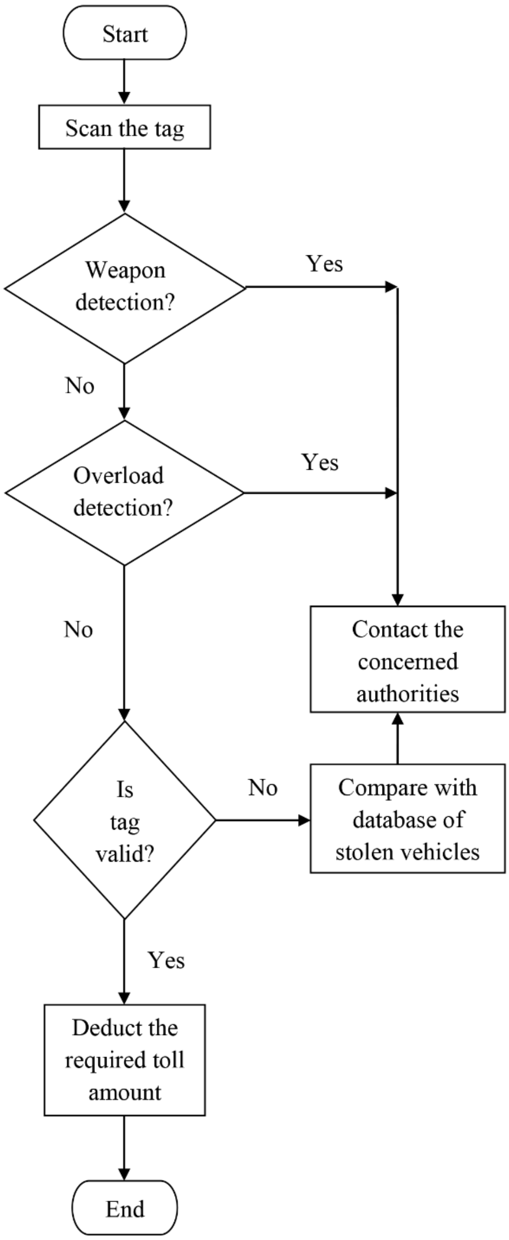

Fig. 2. Flowchart

VII. APPLICATIONS

The proposed system identifies the class of vehicle and collects the toll amount accordingly. It also identifies whether the vehicle is carrying any weapons or not. In order to prevent any accidents due to overloading, this system also detects for any overloaded vehicles. In case of any mishap due to the above reasons, the concerned authorities are informed to take the necessary action.

VIII. CONCLUSION

A number of highways can be connected by providing a single database of a large number of vehicles and providing an efficient way of collecting toll. It reduces the human efforts for collecting toll amount and provides smooth flow of traffic around toll junction thereby helping Government authorities.

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