Electronic Toll Collection System

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Abstract: The electronic toll collection system (ETC) is a wireless communication system to execute the automatic payments of transportation fee without stopping a toll gate in express ways. In the system, reflected, distracted, shadowed waves by the Canopy, wall, or, booth, and interference waves from neighboring lanes may cause the problems in system operations. To suppress the undesired waves mentioned above, radio absorbers are installed on the whole surfaces of toll gates. But, the function of radio absorbers may be degraded by aging deterioration, and the function of radio absorbers should be maintained for the sustainable usage of the ETC. Then, the system which can evaluate the performance of radio absorbers is needed. In this background, the thesis proposes the radio propagation paths measurement system, which can identify the radio propagation paths in the real time measurement by using the ETC signal. Undesired radio paths enable us to find the radio absorbers degraded. In addition, the thesis also discusses the new scheme to identify the propagation paths.

1.INTRODUCTION

In our daily life we are seeing toll gate. We are going to pay certain amount to the government in form of tax through this toll gate. We can see this toll gates being placed in some national high ways etc., So in order to pay tax we are normally going to pay in form of cash, but instead of that as the technology is growing we can make use of smart card which is nothing but like a memory card in which we are going to store the details of particular person and certain amount. The main objective of this project is to pay the toll gate tax using smart card. Smart card must be recharged with some amount and whenever a person wants to pay the toll gate tax, he needs to insert his smart card and deduct amount using keypad. By using this kind of projects there is no need to carry the amount in form of cash and so we can have security as well. These electronic toll Collection systems are a combination of completely automated toll collection systems (requiring no manual operation of toll barriers or collection of tolls) and semi-automatic lanes. Various traffic and payment data are collected and stored by the system as vehicles pass through. The different technologies involved are logically integrated with each other but remain flexible for upgrades. They also include sophisticated video/image capturing equipment for full-time violation enforcement.

Some of the security components included are:

- Real-time toll plaza surveillance system
- Automatic vehicle identification system (based on in-road sensors)
- License plate recognition
- Zoom capability on captured images
- Laser based Toll Audit Systems

The system effectively correlate captured video images with toll transaction data to provide a state-of-the-art, accurate and cost-effective violation enforcement system. Other benefits of the toll collection system's software include flexible database searches, easy data storage, and configurable archive management.

Fully automatic tolling includes multiple payment options (cash, smart card, debit card). Lanes at the toll plaza can be configured for optimal traffic management, including some which are restricted to pure electronic tolling and others which use manual fare collection.

2. TRENDS

Up to now we are using the contact type smart cards. But during the latest trends contact less smartcards are also introduced it will work on the RF FREQUENCIES with the help of these smartcards there is no need to insert the smartcard in the reader it will read the smartcard from the distance also both the smartcard and the smartcard reader will have Transmitter and the Receiver so therefore it will mutually transfer the information not only that it is very fast compare to the contact type smartcards. A New type of system has been introduced which is "SMARTCARD BASED TOLL GATE AUTOMATED SYSTEM", Smart card must be recharged with some amount and whenever a person wants to pay the toll gate tax, he needs to insert his smart card and deduct amount using keypad. By using this kind of projects there is no need to carry the amount in form of cash and so we can have security as well.

2.1 Overview:

"smartcard based toll-gate automated system" will work on the principle on the contact type communication between the smart card and the reader. Whenever a smart card is inserted in to the smartcard reader the reader will read the data which is present on

the smartcard, and this information is transferred to the microcontroller through the RS232 the microcontroller will checks the balance present on the smartcard and displayed on the LCD. The linear keypad is provided to select according to the type of the vehicle, with the given keys and the amount will deducted from the smartcard and the microcontroller send the signal to the H-bridge now the H-bridge will rotate the motor in anticlockwise after some delay it will rotate in clockwise.
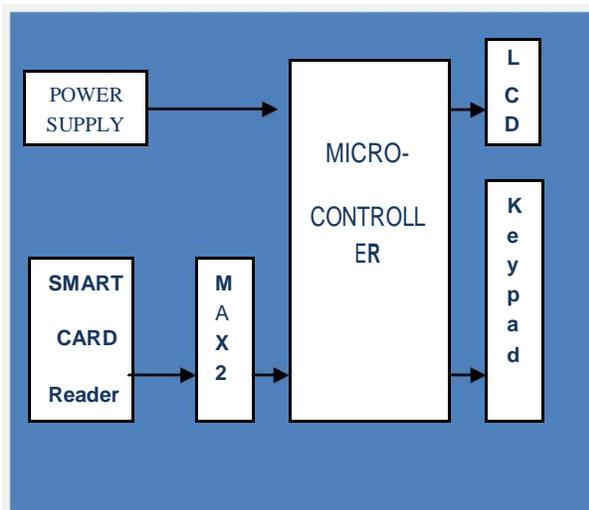
2.2 HARDWARE MODULE:

FIG2.2 Block Diagram Of Smartcard Based Toll-Gate Automated System

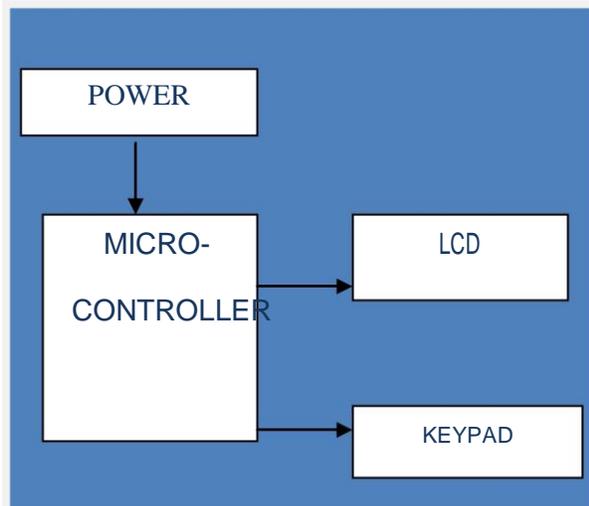*2.3.Controller section:*

Fig 2.3 Controller section block diagram

2.3.1 Power supply:

In this system we are using 5V power supply for microcontroller of Transmitter section as well as receiver section. We use rectifiers for converting the A.C. into D.C and a step down transformer to step down the voltage. The full description of the Power supply section is given in this documentation in the following sections i.e. hardware components.

2.3.2 Microcontroller (8052):

In this project work the micro-controller is playing a major role. Micro-controllers were originally used as components in complicated process-control systems. However, because of their small size and low price, Micro-controllers are now also being used in regulators for individual control loops. In several areas Micro-controllers are now outperforming their analog counterparts and are cheaper as well.

The purpose of this project work is to present control theory that is relevant to the analysis and design of Micro-controller system with an emphasis on basic concept and ideas. It is assumed that a Microcontroller with reasonable software is available for computations and simulations so that many tedious details can be left to the Microcontroller. The control system design is also carried out up to the stage of implementation in the form of controller programs in assembly language OR in C-Language.

2.3.3Keypad Section:

This section consists of a Linear Keypad. This keypad is used to enter the amount to deduct from smart card. The keypad is interfaced to microcontroller which continuously scans the keypad.

2.3.4LCD Display Section:

This section is basically meant to show up the status of the project. This project makes use of Liquid Crystal Display to display / prompt for necessary information.

3. CHARACTERIZATION OF ELECTRONIC TOLL COLLECTION SYSTEMS

DSRC (Dedicated Short range Communication) is typically used as the primary method of charging where a charge is to be applied at one of a discrete number of specific points, such as a toll plaza (an

area where tollbooths are located) or a location on the open highway. The Rationale for Electronic Toll Collection ETC systems take advantage of vehicle-to-roadside communication technologies (traditionally via microwave or infrared communication, more recently via GPS technology) to perform an electronic monetary transaction between a vehicle passing through a toll station and the toll agency. Electronic Toll Road Systems in USA and some European Member States using microwave technology have functioned independently. The telematics systems are implemented in some states, an example being Hitachi System (Japan), as well as Barouh System (Taiwan), which provide the function of electronic road toll for highways and expressways and additionally function of transferring data from digital tachographs.

3.CREDIT-BASED PAYMENTS FOR ETC

3.1 *ETC and Credit-Based Payments*

In ETC, users can complete their payment for their use of the road simply by passing the toll gate. Technologies for ETC are regarded to be quite important in terms of e ciency of tra c. Namely, if we can realize the safe communication between toll gates and cars within limited time for communications, tra c on the road can work much more smoothly. Although such systems have already been realized using prepaid-based payments, their functions are not enough. Usually, prepaid cards are emitted not as general-purpose cards but limited to certain systems. It will be hard to convince users of ETC systems if they have to use separate prepaid cards for each tollgate operation. Furthermore without a general-purpose prepaid card system, procedures to join such systems must be specified for each system individually. Then, however, users might be reluctant to join ETC systems. These disadvantages might bring problems in the ETC. However, credit-based payments are available for many purposes. And, since there are already a lot of credit-card holders in the world, they can easily join the system. Hence, if credit-based payment can be realized in ETC, the system will be more e cient. Although credit-based payments have a number of advantages over other payment systems in terms of its simplicity, openness and so on, there seems to be a consensus among both researchers and practitioners regarding the relative ine ciency of the protocol. Namely, since messages in credit-based payments consist of simple contents, they must be sent with high authenticity and confidentiality by using cryptographical techniques.

Conventional credit-based payment systems (e.g. SET , CyberCash) use public-key cryptosystems for this purpose. As well known, public-key cryptosystems require a large amount of computation time. Thus, when a conventional credit-based payment system is applied to ETC straightforwardly, it seems to be di cult to finish the communication between a toll gate and a car while the car passes the gate. Furthermore, toll gates also have to communicate with the credit company during the communications. The total time for communications is estimated to be 100ms. There has already been an attempt to solve this problem by using new cryptographical techniques such as elliptic curve cryptosystems or signcryption]. These technologies make the credit-payment systems much more e cient . Nevertheless, their performance is

considered to be too low to work e ectively in ETC; so still computers with high performance are required even if these technologies are used. In this article, we propose an optimized credit-based payment system for ETC taking these requirements into account.

3.2 *Requirements for ETC*

In order to carry out credit-based payment system for ETC e ciently, some requirements must be fulfilled. These are shown below:

Requirement1. A users' computational power is assumed to be low.

Requirement2. The computational power of the toll gates is also assumed to be low.

Requirement3. Communications should be limited to a number as small as possible.

Requirement4. Messages between users and toll gates must be kept secret and authenticated.

Requirement5. Users' privacy should be protected if possible.

Typically in ETC, the available time for processing a payment is limited to approximately 100ms in total. Extensive computations take a lot of time and therefore attention must be paid to Requirements 1. and 2. This holds in particular for the car, where we can only assume computers with low performance such as IC cards. But also for the toll gates no computers with high computation power are expected because this reduces the costs for the equipment. Requirement 3. Is also a consequence of the strictly limited time for communications. Requirements 4. and 5. are usual requirements in many payment systems. When the system is constructed to be able to detect users' illegal behavior more easily, users' privacy is also revealed more easily. Such tradeo can be regarded as the general problem in all of the electronic payment systems. In our system, of course, we have to consider it carefully. The cryptographical algorithms and protocols at present allow to fulfill these requirements

only with prepaid cards. Elliptic curve cryptosystems are 10 times faster than RSA, but still they are to slow to make contactless payments with credit cards feasible. Therefore here a di erent approach is proposed based on the KPS. This allows to implement credit–based ETC using IC cards

3.3 *Properties of ETC*

ETC possesses some useful properties. Our optimization of credit-based payment for ETC is based on them.

Property 1. Payment procedures are executed when car and toll gate meet.

Property 2. The users' cars can be clearly identified by unique information (e.g. number plates, shapes, colors and so on) .

Property 3. All the users that passed an entrance toll gate also have to pass an exit toll gate

.Properties 1. and 2. indicate that toll gates can obtain the unique information of users that want to use the road operated by the toll gates. Since these users' unique information can be regarded as their identifiers, we can apply an ID-Based key cryptosystem to ETC.

Assuming that users' personality is not detected by using the users' unique information, the users' privacy can be protected. Besides, Property 3. indicates that toll gates have extra time to detect a user's illegal behavior that could not be detected at the entrance toll gate. If the illegal behavior of a user is detected while the user is being on the road, he can be stopped when passing the exit toll gate.

CONCLUSION

It allows an **electronic monetary transaction** to take place between a vehicle and toll agency. This reduces the manual labor and delays that often occur on roads. This system of collecting tolls is eco-friendly and also results in increased toll lane capacity. Moreover, the commuters have to wait less for paying the tolls, which is convenient for them. **Electronic toll collection system** is efficiently used in the traffic surveillance for detection which helps in identifying incidents. India's Metro Road System works on electronic toll collection system. Along with world leader Kapsch TrafficCOM, the government has set up many automatic and semi-automatic toll collection systems. This new system includes various payment options and helps in traffic and parking management.

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