

AUTOMATIC TOLL SYSTEM

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ABSTRACT: This paper focuses on an electronic toll collection (ETC) system using radio frequency identification (RFID) technology. Research on ETC has been around since 1992, during which RFID tags began to be widely used in vehicles to automate toll processes [1]. The proposed RFID system uses tags that are mounted on the windshields of vehicles, through which information embedded on the tags are read by RFID readers, The proposed system eliminates the need for motorists and toll authorities to manually perform ticket payments and toll fee collections, respectively. The transmitter will be charged by the operator of the booth office and the data will be stored. It will be get sensed by the IR. receiver mounted at the toll plaza, the fare will get deducted automatically according to the toll charged and the remaining amount will be displayed. Stepper motor is used to open and close the gate. Data information are also easily exchanged between the motorists and toll authorities, thereby enabling a more efficient toll collection by reducing traffic and eliminating possible human errors. get opened for the legitimate user and for others it will remain close. This system is designed in order to control congestion, convenience and safety of a patron.

I. INTRODUCTION

Electronic toll collection (ETC) is a technology enabling the electronic collection of toll payments. In this system we will identify each vehicle uniquely with a RFID-TAG. We will attach a RFID-TAG as a sticker with every vehicle during the registration process. That RFID-TAG will bear the unique identification number for that particular vehicle. During the registration process the vehicle's owner will be asked to provide the following information registration no, owner's national id, phone number, bank account no and the name of the bank. In each automated toll booth we will have a RFID sensor and a load sensor set up along with the control booth which will house a computer and an operator. Whenever a vehicle will pass through the booth the RFID sensor will read its identification number from the sticker it's carrying. And the load sensor will measure the vehicle's weight and the amount of toll to be paid will be shown in an LCD

display. The toll money will be deduced from the vehicle owner's bank account and he will be notified of the transaction via a SMS. If the owner's bank account is out of money then this payment will be marked as pending and he will be asked to pay it as soon as possible via a SMS. If a pending payment is not cleared within 15 days then that vehicle will be blacklisted. If such a vehicle comes to the booth that doesn't have a RFID-TAG or hasn't been registered yet or the RFID-TAG has been destroyed somehow, then the gate will be automatically closed and the vehicle will be shown the direction to go to the counter following a different lane. In the counter the vehicle can register providing all the information needed and can have its own RFID-TAG attached or it can just pay the cash and pass by.

II. WORKING

Reading Card

We are using a RFID tag as a unique identification module of a vehicle. As RFID works in radio frequency, when a vehicle having TAG comes close to a toll booth the RFID sensor detects it. As soon as it detects the vehicle with a TAG, it sends the detected ID read from the TAG to our server through MAX232 serial communication.

Measuring Weight

After the detection of ID of a vehicle passing through a tollbooth will have to go through a platform where a load sensor has been pre-installed. When a load cell gets a weight, it outputs an mV voltage. This tiny amount of voltage is hard to detect, that's why we amplified this voltage with the help of AD620 IC and sent this amplified voltage to the ADC pin of our first microcontroller. Then weight has been calculated with the ADC in the microcontroller and then the weight and corresponding toll amount is displayed in the LCD display. The calculated weight and

corresponding toll amount is also sent to the server through serial communication.

Gate & Direction

RFID reader outputs a voltage in one of its pins when it detects a TAG. Here the voltage output by the RFID reader is sent to the ADC pin of the 2nd microcontroller. When we get a weight, we keep a pin of our 1st microcontroller high. This is sent to a pin of the 2nd microcontroller as input. When a vehicle with both TAG and weight appears then two pins of the second microcontroller becomes high and green light will be on indicating to the vehicle that you are safe and ready to go through this tollbooth without waiting a single second. The two pins that became high in 2nd microcontroller go to the 3rd microcontroller which controls a dot matrix. This dot matrix shows the direction to the vehicle that which way it should follow. We used another microcontroller that controls a stepper motor that is used to lock and unlocking the gate of the booth. When a registered vehicle comes, gate is opened automatically and locked in the same way to an unregistered vehicle.

When No Card

When a vehicle comes to the tollbooth which has no TAG that means an unregistered one, then one pin of the 2nd microcontroller becomes low which makes the direction shown in the dot matrix to become opposite than before. Stepper motor will close the gate and red light will turn on. So the vehicle has to go through another way where he will have to pay the toll manually to someone assigned for collection. If the vehicle owner wants to register his car with a TAG, he can do so here but it is optional. After paying toll, the vehicle can go. There is another gate which will be opened manually by pressing a switch. Unregistered vehicles will go through this gate.

DATABASE

We have a server where we keep a database of the vehicles. Its frontend is designed with C#.NET and Oracle database runs in the backend. When a vehicle

performs its registration, mobile number and bank account number of the owner is stored in our database. When RFID TAG is detected and corresponding weight is measured then the amount according to the weight of the car is deducted from the car owner bank account. A SMS is sent to the owner's mobile phone about the process.

Sending SMS

In our system we notify the vehicle owners of any transaction made from their vehicle corresponding bank account via SMS. These SMS are sent automatically from the system using a GSM modem. We have used .NET serial communication and universal AT-Commands to send these SMS This system can be hugely used on the bridges and flyovers across the country. It can modify and deploy for car parking garages, shopping malls and residential apartments.

III. CONCLUSION

The implemented ETC based system significantly contribute to improve travel conditions by addressing delay caused by both recurring and nonrecurring congestion. People hate the delay at tollbooths. This system collects toll from the vehicles driving on toll roads without making the vehicle stop at Tollbooths. This has been accomplished by installing a wireless in both vehicles and tollbooths to exchange toll related information using different data transfer techniques like via cable, infrared, Radio frequency, Bluetooth, etc.. These systems include benefits to both toll authorities and facility users, in terms of time and cost saving, improved security, increased capacity and greater convenience. This system provides a broad overview for collecting toll and thus provides advantage to toll operators and motorist. The proposed ETC system discussed in this work applies passive RFID technology. By doing so, increased efficiency will be guaranteed since RFID is known as a highly stable technology. With the elimination of human interaction in the entire toll collection process, we can create a better ETC system to be implemented in Malaysia. It can also significantly improve the efficiency of toll stations and the traffic abilities of the toll road.