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AUTOMATIC VEHICLE IDENTIFICATION AND TOLL COLLECTION USING RFID

Sahil Bhosale[1], Rohit Chavan[2], Sunil Bhadvan[3], Prajakta Mohite[4]

[1, 2, 3] *Student, Electronics and Telecommunication Engineering, Holy-Wood Academy's, Sanjeevan Engineering and Technology Institute, Panhala, Maharashtra, India*

[4] *Assistant Professor, Department of Electronics and Telecommunication Engineering, Holy-Wood Academy's, Sanjeevan Engineering and Technology Institute, Panhala, Maharashtra, India*

Abstract - *AVITC is an Automatic Vehicle Identification and Toll Collection used for collecting toll tax automatically. This paper focuses on an Electronic Toll Collection (ETC) system using Radio Frequency Identification (RFID) technology. In this system we do identification of vehicle with the help of radio frequency. Each vehicle will hold an RFID tag or card. This card is nothing but unique identification number assigned. This will be assigned by RTO or traffic governing authority. In accordance with this number we will store all basic information as well as amount he has paid in advance for the TOLL PLAZA. The tax amount will be deducted from his prepaid balance. As vehicle doesn't have to stop in the queue, it assures time saving, fuel conservation and also contributing in saving of money.*

Key Words: AVITC, ETC, RFID Reader, RFID Tag, TOLL PLAZA

1. INTRODUCTION

Considering the present toll collection system where each vehicle has to stop and pay taxes. Suppose the manual toll collection system is very efficient then for one vehicle to stop and pay taxes total time taken is 60 seconds. And suppose 100 vehicles cross the toll plaza. Then, time taken by one vehicle with 60 second average stop in a month is : 60x30= 1800 seconds.

Yearly total time taken = 1800x12= 216200 seconds = 6.0 hours.

On average each vehicle that passes through the toll plaza has to wait 6.0 hours in engine starts condition yearly. The figure is staggering if on an average we take 100 vehicles pass through the toll plaza each day, then yearly 36000 vehicles pass through the toll plaza. And each year 36000 vehicles just stand still for 6.0 hours in engine start condition thereby aiding pollution and wasting fuel and money. This study is if the system is very efficient but what if the vehicle has to wait for 5 minutes? This is a figure considering one toll plaza. If considering 50 toll systems the above figure will drastically increase and the wastage of fuel, money will increase and pollution will also increase.

Electronic Toll Collection (ETC) is a technology enabling the electronic collection of toll payments. It has been studied by researchers and applied in various highways, bridges, and tunnel requiring such a process. Research on ETC has been around since 1992, during which RFID tags began to be widely used in vehicles to automate toll processes [1]. This system is capable of determining if the car is registered or not, and then informing the authorities of toll payment violations, debits and participating accounts [2]. The most obvious advantage of this technology is the opportunity to eliminate congestion in tollbooths, especially during festive seasons when traffic tends to be heavier than normal. It is also a method by which to curb complaints from motorist regarding the inconveniences involved in manual making payments at the tollbooths. Other than this obvious advantage, applying ETC could also benefit the toll operators.

1.1 General Terms

ETC system commonly utilizes Radio Frequency Identification (RFID) technology. RFID is a generic term used to identify technologies utilizing radio waves to automatically identify people or objects [3]. RFID technology was first introduced in 1948 when Harry Stockman wrote a paper exploring RFID technology entitled, "Communication by Means of Reflected Power" [4]. RFID technology was evolved since then, and has been implemented in various applications such as in warehouse management, library system, attendance system, theft prevention, and so on. In general, RFID is used for tracking, tracing, and identifying objects.

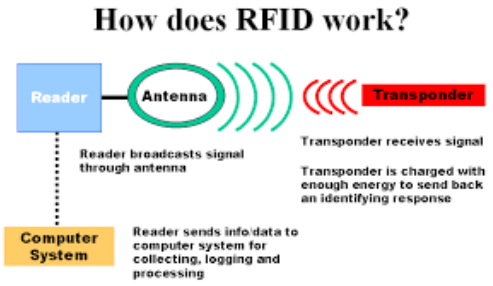

Fig -1: How Does RFID Work?

RFID is an automated data-capture technology that can be used to electronically identify, track, and store information contained on a tag. A radio frequency reader scans the tag for data and sends the information to a

database, which stores the data contained on the tag. A complete RFID system consists of a transponder (tag), reader/writer, antenna, and database [5].

1.2 RFID Tag

The transponder, better known as tag, is a microchip combined with an antenna system in a compact package. The microchip contains memory and logic circuits to receive and send data back to the reader [6]. The antenna which is attached to the microchip transmits information from the chip to the reader. Typically, a larger antenna indicates a longer read range. The tag is attached to or embedded in an object to be identified, such as a product, case, or pallet, and can be scanned by mobile or stationary readers using radio waves.

Fig -2: RFID Transponders (Tags)

These tags are classified as either active or passive tags. Active tags have internal batteries that allow a longer reading range, while passive tags are powered by the signal from its reader and thus have shorter reading range [7]. Tags could also be classified based on the content and format of information. A chip can store a unique serial number or other information based on tag's type of memory, which can be read-only, read-write, or write-once read-many (WORM). The classifications range from Class 0 to Class 5. These classes have been determined by the Electronic Product Code (EPC) Global Standard.

1.3 RFID Reader

In order for an RFID system to function, it needs a reader, or scanning device, that is capable of reliably reading the tags and communicating results to a database. A reader uses its own antenna to communicate with the tag. An antenna is used to transmit as well as receive data from the tag. When a reader broadcasts radio waves, all tags designed to respond to that frequency and within range will respond. A reader also has capability to communicate with the tag without a direct Line-of-Sight, depending on the radio frequency and the type of tag (active, passive or semi passive) used. The reader also contains a decoder and an RF module. Readers can process multiple items at once, allowing for increased read processing times. It could be mounted or built as a portable hand held device. They can be mobile, such as hand held devices that scan objects like pallets and cases, or stationary, such as point-of-sale devices used in supermarkets.

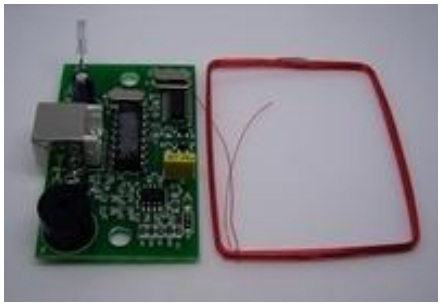

Fig -3: RFID Reader

2. SOLUTION PROVIDED

AVITC is a toll tax collection implementation system that will save time, space and money. Taking the case study of manual toll tax collection system, we came to conclusion that if the system is made completely automatic, the time require for collection of tax will be reduced, there will not be need for any vehicle to stop, thereby enlarging the space and the system can be efficiently implemented on a large scale with low capital.

Automatic Vehicle Identification & Toll Collection (AVITC) system is based on RFID i.e. Radio Frequency Identification where every vehicle will have a tag (RFID) with a unique tag identification number. This identification number will be associated with the complete information such as Vehicle Number, Owner etc. and also most importantly with a Cost Value. This value will be deducted automatically every time the vehicle passes the collection unit. No one will have to wait for any time. This cost value can be recharged at the recharge center.

Fig -4: Electronic Toll Collection

This system can be effectively implemented on a highway or freeway, where vehicle with a RFID tag will be allowed to pass by deducting an amount from the tag balance. For the vehicles that do not have the tag, their identification will be sent along with the description of the vehicle to the control center identifying an illegal entry, thereby action can

be taken. Then it can be done that, the particular vehicle that not having tag will be billed at their residence or via mail.

The loss of time puts in a lot of frustration in everyone having to wait for their turn to pay tax. Most of us want speedy transportation without any obstruction. When it is known fact that oil is depleting day by day, just standing waiting and wasting oil does not make any sense. Loss of fuel is most at reduced speed. So there is a need for continuous motion. When a number of vehicles have to wait nobody bothers to switch off the engines while waiting and so fuel emission is most at this level. This is a major contributor to the already increasing pollution.

The above mentioned losses can put huge burden on Government and the citizens. Reducing these losses is the ample reason for which the need for AVITC system is there. So there is need for AVITC system which will cut down on every loss and make it possible to achieve a speedy and non obstructed transportation.

2.1 SCOPE OF THE PROJECT

Whenever the matter of Integration of systems comes to mind, we think of a system having the following important features viz.

Accuracy: All the functionally bonded logical dependencies must be integrated.

Efficiency: The whole system should work under all circumstances and on a long run it should work efficiently irrespective of their proprietary format.

Cost Effectiveness: As our software do not require any special software for implementation hence is less costly as compared to other existing system.

Any Prerequisite for the use: As the existing systems are not altered, and integration is done at the background hence there is no need for any training.

2.2 FEASIBILITY STUDY

Suppose, If there are 100 manual toll-taxes system and everyday 100 vehicles cross through each system, then

No. of vehicles that pass through one system yearly = 100 x 30 x 12 = 36,000.

No. of vehicles that pass through 100 system yearly =100 x 36,000 = 36,00,000.

Table -1: Vehicle Passed Away from Toll Booth in 1 year

Vehicle	Days	Toll Booth
100	1	1
36000	30 x 12	1
3600000	30 x 12	100

This figure indicates that in one year each of the 36,00,000 vehicles just stand still for about 6.0 hours in engine start condition creating pollution and burning fuel. Suppose that in 6.0 hours a vehicle uses 1 liter fuel.

So Total fuel used by all the vehicles: 36,00,000 x 1 = 36,00,000 liter.

Table -2: Fuel Consumption and Amount

Vehicle	Fuel Consumed	Amount
1	1 lit.	70/- Rs.
3600000	3600000	252,000,000/- Rs.

Assuming cost of 1 liter fuel = Rs. 70/-

Total cost of fuel consumed by 36,00,000 vehicles = 70 x 36,00,000 = Rs. 252,000,000/-

The above is the money wastage under the consideration that the vehicle stops for 60 seconds at the toll system, and 100 vehicles pass through the toll plaza each day and there are 100 toll plazas. These figures are all in minimum.

One additional stop every 10 km increases the fuel consumption by approximately 35%. If we consider 10 stops and accelerations per 10 km, then increase in fuel consumption is 130%.

Table -3: Speed Vs Fuel Consumption

Speed	Fuel		Speed	Fuel
10	21.00		90	7.57
20	13.00		100	8.27
30	10.00		110	9.03
40	8.00		120	9.87
50	7.00		130	10.79
60	5.90		140	11.77
70	6.30		150	12.83
80	6.95			

3. FEATURES

AVITC is an automatic collection system used for collecting tax automatically. In this we do the identification with the help of radio frequency. Flexibility is the main feature and with the slightest change this can be converted to a completely new implementation. With the help of the latest technology (RFID), the implementation of this project is a very secure database yields into a highly efficient and secure system.

Following are the features and advancement of AVITC over presently existing system:

[1] RFID tag cannot be cloned, so cannot be cheated.
[2] Very efficient saving of time.
[3] Wastage of money reduced.
[4] Consumption of oil is reduced
[5] Pollution is reduced to a large extent.
[6] Speedy transport.
[7] Less congestion on the roadways.
[8] Comparatively less maintenance cost.

3.1 FLEXIBILITY OF IMPLEMENTATION

The main power of AVITC is the technology which is used, that is the Radio Frequency Identification (RFID). The basic power of this technology is that it's very flexible. Even with the slightest of change in AVITC, the product can be shaped into a completely different implementation areas in medical, defense and many latest products that are being developed is based on RFID solution. The main areas is animal tracking, human implants, vehicle tracking, speed tracking, physical implementation.

3.2 FUTURE SCOPE

Internet banking as well as SMS banking can be used for recharging the account of the user to make it convenient. We can also attach the RFID number to motorist bank account so the balance deduction is made online through bank account of motorist. So there is no need to made separate accounts for Toll payments.

We can also add GSM module to provide balance deduced information to the motorist when the vehicles just pass through Toll Plaza. So the motorist is always up to date with his balance.

In addition to the current work, image processing can be combined with the RFID system to make the system more reliable and secure. By installing CCTV we provide more security on highways with this technology. By combining the positives of the two we can eliminate any possible discrepancies in the system.

4. CONCLUSION

In this we do the identification with the help of radio frequency. In AVITC system as vehicle doesn't have to stop in the queue, it assures time saving, fuel conservation and also contributing in saving of money. Consumption of oil is reduced on toll plazas so Pollution is reduced to a large extent. This system provides faster transportation because Less congestion on the roadways. So this system has very efficient time saving than ordinary toll collection system.

RFID is not replacement of BAR CODE but it is a technology offering various features. RFID offers highly reliable data collection in harsh environments. RFID technology can provide new capabilities as well as an efficient method to collect, manage, disseminate, store, and analyze information. It not only eliminates manual data entry but also inspires new automation solution. It fundamentally changes how processes are managed and how businesses operate. RFID's attributes provide greater automated tracking capability than existing technologies, and thus create the opportunity to reduce abhor, improve inventory management and generate better market intelligence, leading to lower operational costs and increased revenue generation.

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BIOGRAPHIES

Sahil Bhosale is a student in the Electronics & Telecommunication Department, Holy-Wood Academy's, Sanjeevan Engineering & Technology Institute, Panhala. He is pursuing Bachelor of Engineering Degree from Shivaji University, Kolhapur, Maharashtra, India.

Rohit Chavan is a student in the Electronics & Telecommunication Department, Holy-Wood Academy's, Sanjeevan Engineering & Technology Institute, Panhala. He is pursuing Bachelor of Engineering Degree from Shivaji University, Kolhapur, Maharashtra, India.

Sunil Bhadvan is a student in the Electronics & Telecommunication Department, Holy-Wood Academy's, Sanjeevan Engineering & Technology Institute, Panhala. He is pursuing Bachelor of Engineering Degree from Shivaji University, Kolhapur, Maharashtra, India.

Prof. P. U. Mohite is an Assistant Professor in Electronics & Telecommunication Department, Holy-Wood Academy's, Sanjeevan Engineering & Technology Institute, Panhala. She has completed Bachelor of Engineering from Mumbai University, Mumbai, Maharashtra, India and Master of Engineering from Shivaji University, Kolhapur, Maharashtra, India.