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Automated Toll Collection System Using RFID

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Abstract : *ATCS is an Automated Toll Collection System used for collecting tax automatically. In this we do the identification with the help of radio frequency. A vehicle will hold an RFID tag. This tag 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 the amount he has paid in advance for the TOLL collection. Reader will be strategically placed at toll collection center. Whenever the vehicle passes the toll naka, the tax amount will be deducted from his prepaid balance. New balance will be updated. Incase if one has insufficient balance, his updated balance will be negative one. To tackle this problem, we are alarming a sound, which will alert the authority that this vehicle doesn't have sufficient balance and that particular vehicle can be trapped. As vehicles don't have to stop in a queue, it assures time saving, fuel conservation and also contributing in saving of money.*

Keywords – *ATCS, RFID Reader, RFID Tag, Toll Collection, prepaid account.*

I. 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 1 vehicle with 60 second average stop in a month is: 60x30= 1800 seconds
Yearly total time taken = 1800x12 = 216200seconds = 6.0 hours

On average each vehicle that passes through the toll plaza has to wait 6.0 hours in engine start 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.

1.1 General Terms

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.
The main technology components of an RFID system are the tag, reader, and database.

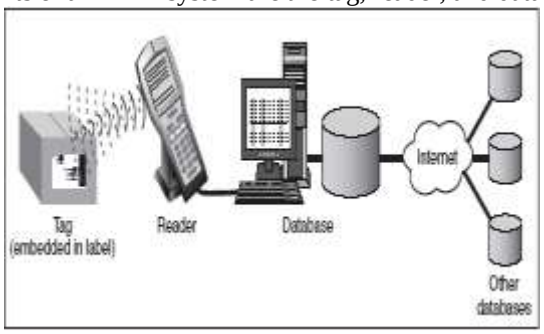


Fig. 1 Components of RFID System

1.1.1 RFID Tag:

An RFID tag, or transponder, consists of a chip and an antenna. A chip can store a unique serial number or other information based on the tag's type of memory, which can be read-only, read-write, or write-once read-many(WORM). 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 Internal structure of RFID Tag

1.1.2 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 the results to a database. A reader uses its own antenna to communicate with the tag. When a reader broadcasts radio waves, all tags designated to respond to that frequency and within range will respond. A reader also has the 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. Readers can process multiple items at once, allowing for increased read processing times. They can be mobile, such as handheld devices that scan objects like pallets and cases, or stationary, such as point-of-sale devices used in supermarkets.

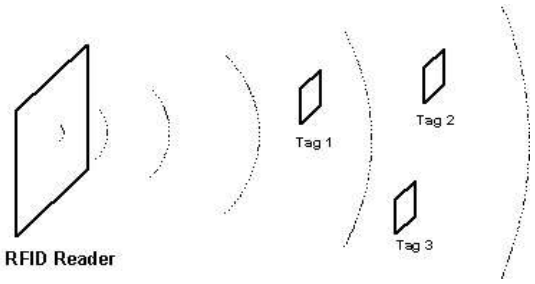


Fig. 3 RFID Reader

II. SOLUTION PROVIDED

ATCS 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 the 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.

AUTOMATED TOLL COLLECTION SYSTEM (ATCS) is an automatic collection system 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.

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 not having the tag will be billed at their residence or via mail.

The abovementioned losses can put huge burden on Government and the citizens. Reducing these losses is the ample reason for which the need for ATCS is there.

The loss of time puts in a lot of frustration in everyone having to wait for their turn to pay the tax. Most of us want a speedy transport without any obstruction.

When it is a 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 witch off the engines while waiting and so fuel emission is most at this level. This is a major contributor to the already increasing pollution.

So there is need for ATCS which will cut down on every loss and make it possible to achieve a speedy and non obstructed transport.

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 vehicle that pass through one system yearly= 100 x 30 x 12 = 36,000.

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

Table 1. Vehicles 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.	75/- RS
3600000	3600000 lit.	270,000,000/- RS

Assuming cost of 1 liter fuel = Rs.75

Total cost of fuel consumed by 36, 00000 vehicles = 75 x 36, 00,000 = Rs. 270,000,000/-

The above is the money wastage under the consideration that the vehicle stops for 60 second 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.

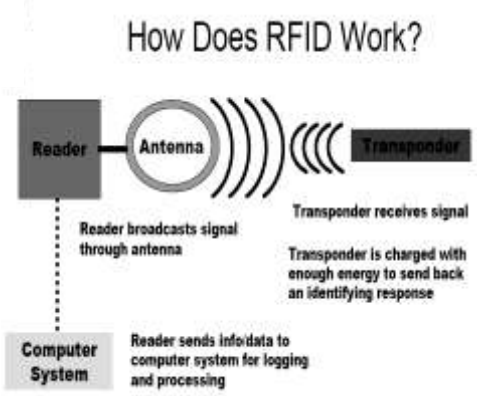
Speed	10	20	30	40	50	60	70	80
Fuel	21.00	13.00	10.00	8.00	7.00	5.90	6.30	6.95

Speed	90	100	110	120	130	140	150
Fuel	7.57	8.27	9.03	9.87	10.79	11.77	12.83

2.3 TECHNOLOGY USED IN ATCS

RFID (Radio Frequency Identification) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. An RFID tag is a small object that can be attached to or incorporated into a product, animal, or person. RFID tags contain silicon chips and antennas to enable them to receive and respond to radio-frequency queries from an RFID transceiver. Passive tags require no internal power source, whereas active tags require a power source.

The purpose of an RFID system is to enable data to be transmitted by a mobile device, called a tag, which is read by an RFID reader and processed according to the needs of a particular application. The data transmitted by the tag may provide identification or location information, or specifics about the product tagged, such as price, color, date of purchase, etc.



In a typical RFID system, individual objects are equipped with a small, inexpensive tag. The tag contains a transponder with a digital memory chip that is given a unique electronic product code. The interrogator, an antenna packaged with a transceiver and decoder, emits a signal activating the RFID tag so it can read and write data to it. When an RFID tag passes through the electromagnetic zone, it detects the reader's activation signal. The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer.

2.4 SPECIFICATION, DESCRIPTION AND DESIGN OF HARDWARE

2.4.1 GP20:

Fig. 5 RFID reader used in ATCS.

Product Name: GP20 Proximity Reader
PROXIMITY 125 KHz readers are high performance proximity readers featuring long range and small dimensions. The readers run from any voltage from 5 to 12.5 VDC and feature high read range at as low as 5 volts making it ideally suited to a wide variety of applications, particularly access control. The same basic unit can be configured to output most of the common interface formats, including Wiegand, Magstripe, Clock/ Data and RS-232 serial ASCII output, making it easy to upgrade existing installations.

2.4.2 Standard clamshell card

Fig. 6 Standard Clamshell Cards

CSC-125, 125 KHz RFID Clamshell cards are water proof and provide best reading range with 125 KHz RFID readers. Clamshell cards are very popular in Access control applications but can be used in wide range of RFID applications. They are lowest cost RFID cards available currently in the market.
They have 26bit factory written ID that cannot be changed, though selected number sequences can be supplied for volume orders. These are Read only tags.

2.5 REQUIREMENT SPECIFICATION

2.5.1 Software requirement

Framework : .NET 3.5
Software Package : VISUAL STUDIO .NET. 08
Language for Development: C# .NET
Database : SQL Server 2008

2.5.2 Analysis

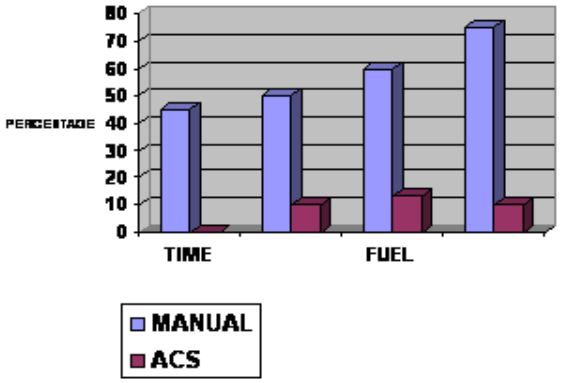


Fig. 7 Analysis Graph

III. DIAGRAMS

3.1 Data flow diagram

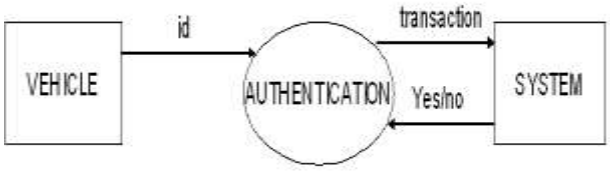


Fig. 8 Level – 0 for ATCS

3.2 Functional block diagram:

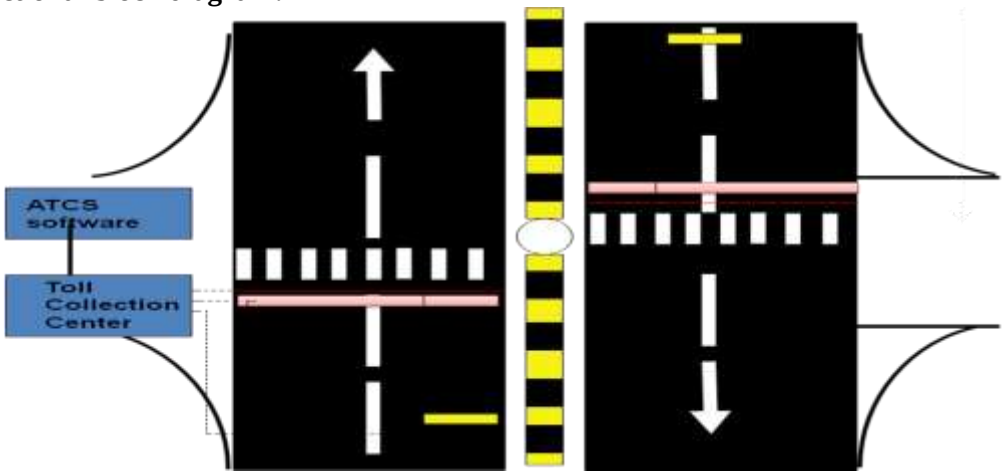


Fig. 9 Functional Diagram of ATCS

IV. FEATURES

ATCS is an automatic collection system used for collecting tax automatically. In this we do the identificationwith 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 very simplified. RFID technology together with a very secure database yields into a highly efficient and secure system.

Following are the features and advancement of ATCS 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

4.1 Flexibility of implementation

The main power of ATCS is the technology which is used, that is the RADIO FREQUENCY IDENTIFICATION. The basic power of this technology is that it's very flexible. Even with the slightest of change in ATCS, the product can be shaped into a completely different implementation and all that can be because RFID is independent of every other hardware that can be used to boost up the system's performance.

RADIO FREQUENCY has vast 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.

V. CONCLUSION

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 solutions. 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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