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RFID and UIVN Based Vehicle Toll Collection System and Tracking

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ABSTRACT: Radio frequency Identification(RFID) technology is having a major impact on the vehicle industry by attaching radio frequency tags to different entities. RFID technology can provide identification, tracking, location, security and other capabilities.The goal of this paper is to show how RFID technology can be used to track the theft vehicle and identifies it, this technology also enables us to monitor the logs of our vehicle and also used for electronic billing in toll gates.

KEYWORDS: RFID; Unique identification of vehicle number (UIVN); Automatic toll collection system;

I. INTRODUCTION:

The main idea behind implementing RFID BASED VEHICLE SYSTEM is to track and identify the vehicles and to automate the toll collection process thereby reducing the long queues at toll booths using the RFID tags installed on the vehicle. In addition to this, it can not only help in vehicle theft detection but also can track vehicles crossing the signal and over speeding vehicles. This system is used by vehicle owners, system administrator. Other general advantages for the motorists include fuel savings and reduced mobile emissions by reducing or eliminating deceleration, waiting time and acceleration. Meanwhile, for the toll authorities also get the benefits mentioned below,
The benefits for the motorists include:
1. Fewer or shorter queues at toll plazas by increasing toll booth service turnaround rates.
2. Faster and more efficient service (no exchanging toll fees by hand)
3. The ability to make payments by keeping a balance on the card itself
4. The use of post paid toll statements (no need to request for receipts)
5. Lowered toll collection costs
6. Better audit control by centralized user account and
7. Expanded capacity without building more infrastructures

II. RELATED WORK

Active wave has currently deployed a system of active tag vehicle monitoring solution. Active wave vehicle products have a range of 30 meters and operate in the 916 –927 MHz for the transmit operations and 433 MHz for the receive link. Active wave products are currently equipped with 256 Kbits of fixed memory. The tag is powered with a replaceable 3V battery and the total weight is 14 grams. Elementary signals are shown with the help of blinking LEDs and beeping sounds. Smart key Access Control systems have a client – server model based system with an SQL server handling multiple systems. They have designed a user interface using the Microsoft .NET Framework. Smart key also operate in the 900MHz band but have a small range of 30 meters. RFID based toll collection system uses active.
RFID tag which uses car battery power. The implementation is divided into the design of two modules the Vehicle Module (Active Tag) and the Base Module. The two modules communicate via RF modem connected to each module. These RF modules communicate over the ISM Frequency Range of 902 – 928 MHz.

Limitation of existing system:

- The current toll collection system is manual so it required a large time.

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- The manual toll collection system has less efficiency and accuracy.
- The manual toll collection is required large time so traffic jam at toll plaza

This project deals with the simplification of procedure followed by passengers to pay toll at toll collection booths, like making it automated, vehicle theft detection etc. All these activities are carried out using single smart card (RFID tag UIVN tag), thus saving the efforts of carrying money and records manually.

Automatic Toll Collection: The RFID Readers mounted at toll booth will read the RFID tags and UIVN tag fixed on vehicles and it compares both have an unique 8 digit code and if the code is same then automatically respective amount will be deducted from the owner of the vehicle. If the tag is removed from the vehicle then we can able to detect that the vehicle is theft. Since every vehicle registration ID is linked to users account, toll can be deducted from the account bank directly.

Vehicle Theft Detection: When vehicle is stolen the owner registers complaint on the website with its registration ID and unique RFID tag number. Now when stolen vehicle passes by the toll plaza, the tag fixed on it is matched with the stolen vehicle's tag in the database at the toll booth.

III. PROPOSED ALGORITHM

Whenever any person buys a vehicle, one first needs to get his or her vehicle registered at the RTO office. RTO officials will not only assign a number plate to it but also will give a RFID enabled smart card or a tag. This card will have a unique ID feasible to use with that vehicle only. They will also create an account for the use of that particular smart card and maintain transaction history in database. User needs to deposit some minimum amount to this account. Every time a registered vehicle approaches the toll booth, first the Infrared sensors will detect the presence of the vehicle. It will in turn activate the RFID circuit to read the RFID enable smart card fixed on the windscreen of the vehicle. Transaction will begin, depending upon the balance available toll will be deducted directly or the vehicle will be directed towards another lane to pay tax manually. The software further updates the details in the Centralized database server. It also triggers mechanism to generate the bill and will be sent to user as a text message.

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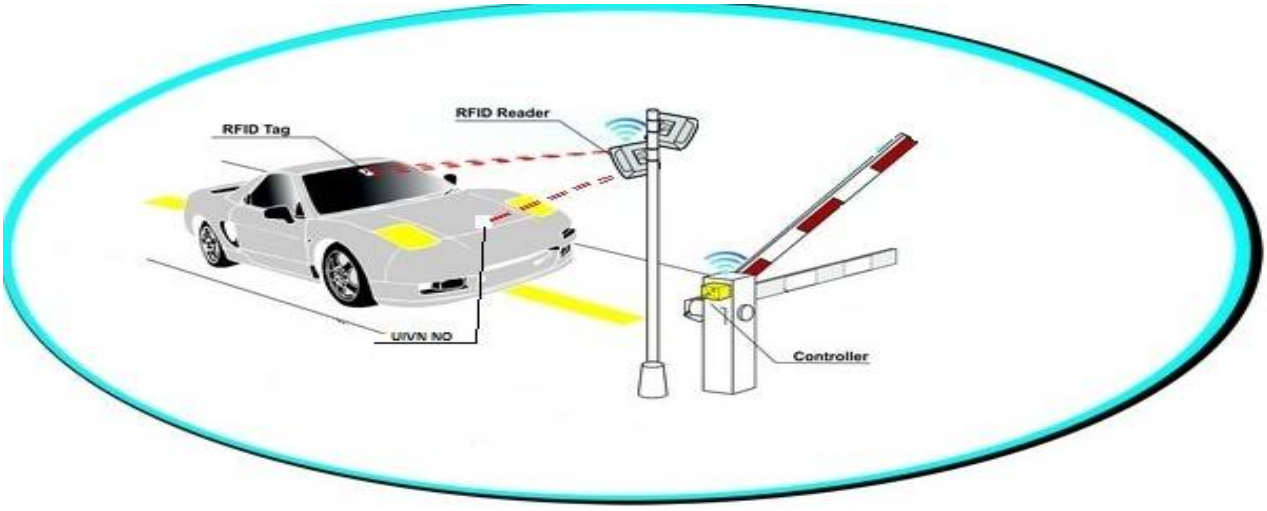

On the other hand, whenever any vehicle owner registers a complaint to RTO office regarding theft respective entry is made in the database. Now any vehicle arriving at toll booth with same ID as already present in stolen vehicle category will be easily identified as the ID assigned with it is unique. All the toll plazas will be connected to each other along with the centralized server in the form of LAN. Updates of any sort of transaction will be immediately updated to local database and centralized server.

Collision Algorithm Descriptions:

The system uses a binary searching algorithm, the tag reader in the work area continues to be divided into P subsets(P> l), and then a subset of the same division is continuously divided into a subset of the more or fewer within the tag number to achieve a successful identification tag reader, until the number of tags within a subset of 1. When the tag is read being completed within a certain subset, the reader will search back using other waiting to read the label. This can be seen as a process of tag grouping by all labels according to the grouping scheme from the root to leaf nodes and processing diversion layer by layer. Only all leaf node labels are searched, can the process be successfully read out.

Performance analysis of algorithms:
To find a separated tab is required to repeat from relatively large number of labels. The average search depends on the number of readers within scope of the total number of tags which is identified as n:

$I = \log 2\, n + 1$ (1)
In the N pending identification tags, average recognition algorithm requires a label search. Obviously, the identification tag within the read range will be reduced to number of completed tag, and total required search cable time BS of identification N is:

$IBS = (\log 2n + 1) + [\log 2(n-1) + 1] + \ldots + (\log 22 + 1) + (\log 21 + 1) = n + \log 2(N)$
$BBS = IBS * k = (n + \log 2(n!)) * k$ (2)

Because each request is passed to the tag reader by instruction, its argument is the length of the entire sequence number, so the binary bits to be transmitted to the reader is kth in the total number of searching algorithm and the product serial number length is labelled as:
$LBS = IBS * k = (n + \log 2(n!)) * k$ (3)

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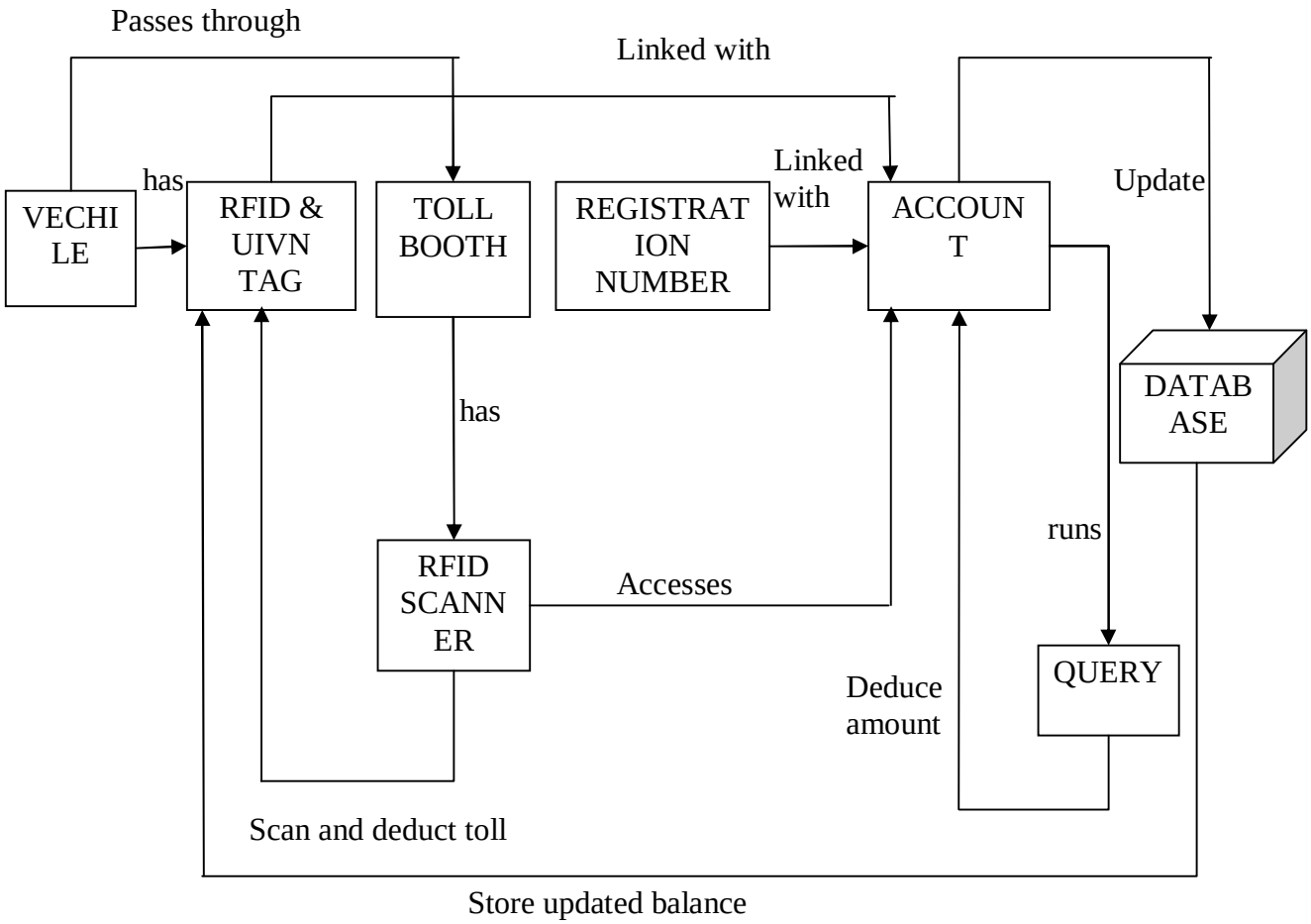
IV. PSEUDO CODE

Step 1: start.
Step 2: Detect the rfid tag and check for stolen vehicle. If vehicle is stolen then report to the Police.
Step 3: check balance, has enough balance deduct the toll amount from the tag .else go to 7
Step 4: update database and tag balance.
Step 5: send text message to the user.
Step 6: recharge account & go to step 4
Step 7: end

V. MODULES

VEHICLE TRACKING: According to the design above, there are RFID tags, fixed RFID Readers, network terminals, databases, application servers and maps in the new VT system based on RFID. All these physical parts can be extended according to actual applications, also can collaborate with other tracking techniques like GPS, for instance, portable RFID readers can be imported to remotely check goods in transportation. The databases and the application servers compose the data handling center of the new vehicle tracking system. This system can classified logically into six layers, as shown in Figure, namely, from bottom to top, Database Layer, Physical Layer, Network Layer, Enabled tools Layer, Application Layer and User Layer. The database layer, enabled tools layer, application layer and user layer are all implemented by the data handling center.



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TOLL COLLECTION SYSTEM: The main system components are as follows:

1) RFID and UIVN tagged vehicle
2) Toll booth equipped with RFID scanners
3) Vehicle registration plate
4) Centralized database
5) Cameras
6) Laser transponders

1. Automatic Vehicle Identification -- The automatic vehicle identification (AVI) component of this system refers to the technologies that determine the identification or ownership of the vehicle so that the toll will be charged to the corresponding customer.

2. Automatic Vehicle Classification -- Vehicle type and class may have differentiated toll amount. The vehicle type may include light vehicles like the passenger car or heavy vehicles like recreational vehicles. A vehicle's class can be determined by the physical attributes of the vehicle, the number of occupants in the vehicle, the number of axles in the vehicles and the purpose for which the vehicle is being used at the time of classification (or some combination of these determinants). Some toll agencies use as many as 15 or more vehicle classes to assess tolls, although for toll collection applications, four or five classes are more typical.

VI. SIMULATION AND RESULTS

Compared with past vehicle tracking systems, the new one based RFID presented in the design above mainly uses RFID technology as the core part. There are RFID tags, RFID readers, network terminals, databases, application servers for the data center, GIS or maps, and so on. In order to locate the vehicle positions by RFID, it is assumed that the RFID readers have been deployed on roads or at key spots, whose deployment information is combined with maps, RFID tags have been equipped onto the tracked vehicles, all the information.
RFID readers and the vehicles have been stored into the database. Sequently the vehicle positions can be obtained by checking the combined information of RFID tags, readers and maps.

As a matter of fact, the information about the tracked vehicle can described by a triple *TD* (*T*,*R*,*t*), here *T* is the vehicle tag information including tag serial number, vehicle number and others, *R* represents the unique number of the RFID reader identifying the current tracked vehicle, which is stored in the control part of the reader, and *t* is the time to get the vehicle information. These three parts of the *TD* are integrated into one group by the control part of the RFID reader according to the processing and encoding rules, then are transmitted to the closest data center, where the combined data *TD* will be checked to attain the position of the tracked vehicle.

The following steps are involved to track a vehicle, as shown in below Fig.

(i) identify the vehicle tag information *T* by a RFID reader on the roads.
(ii) combine *T* with *R* and *t* ,then get a *TD*.
(iii) send the *TD* to the closest data center by networks.
(iv) get the *TD* and check if the *TD* is valid. The data check steps depend on the pattern of data transmitting. Two patterns of RFID data transmitting are proposed as described in section 2 in this method. For pattern 1, since all transmitted data have been filtered, here only to check the the gotten data is integral or modified. For pattern 2, in addition to checking the integrity of the gotten data, it is necessary to search the vehicle data in the gotten data, because there is possibility of taking other types of RFID data like cargo information.
(v) get the RFID reader's number *R* through splitting the *TD*.
(vi) get the RFID reader *R*'s position *G* through inquiring GIS or RFID reader database by *R*. The *G* is also the vehicle's position on *t*.
(vii) show the position on the map or do further handling.

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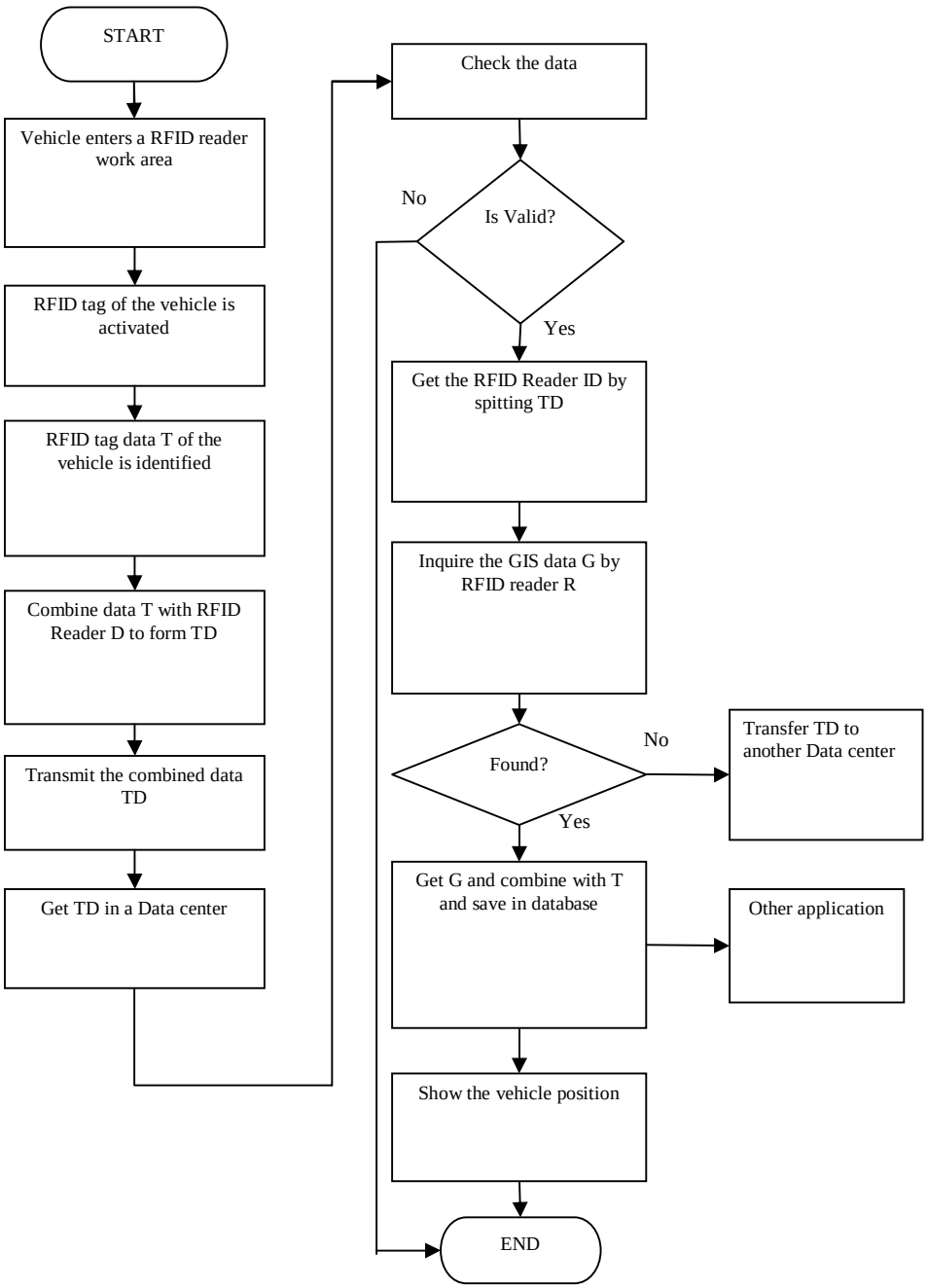

WORKING: The below flowchart indicates the working of Toll collection and Theft detection system:

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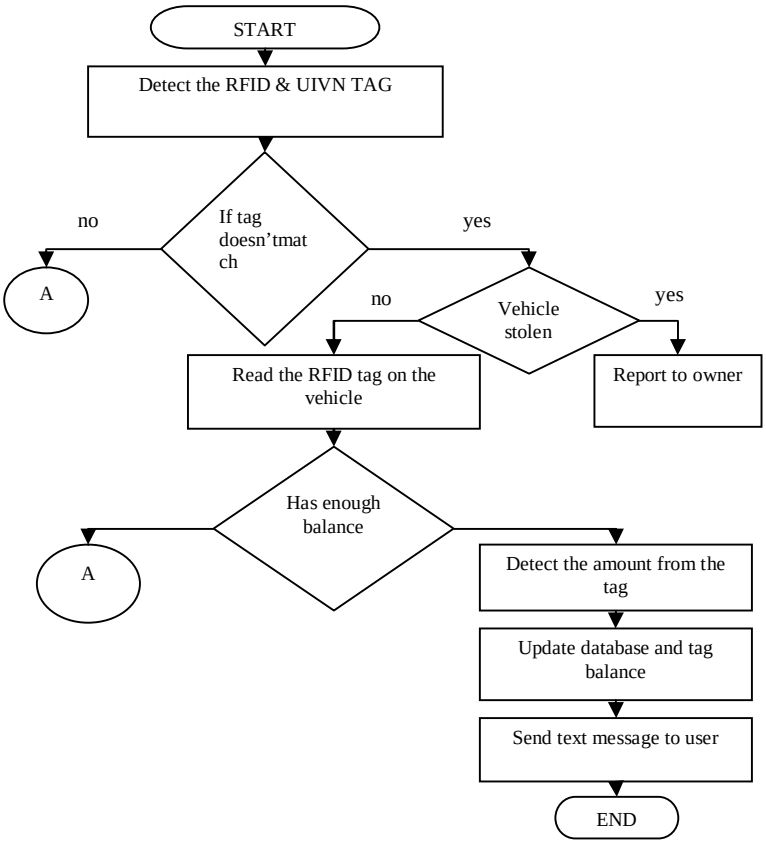
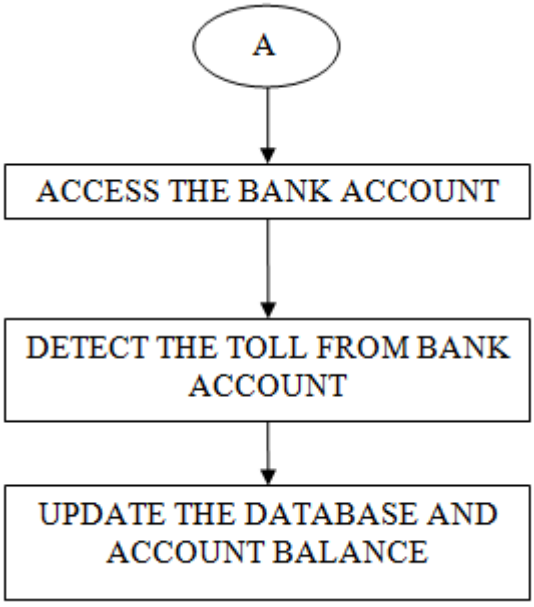
Flowchart 1:



Flowchart 2 (cont) :



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VII. CONCLUSION

The RFID Automatic tollgate system designed could automatically detect the identities of the vehicles and performed the billing in accordance to the identity of each vehicle as pre-recorded in the database. The system could automatically open and close the gate as well as automatically emailing the owners of the vehicles. These were the major achievements met in the project, among other objectives also achieved which include tracking of the vehicles and remote database connection. However proper demonstration of some of the objectives did not yield to the wanted extent due to lack of resources for example remote database connection needed a pre-set Virtual Private Network and automatic synchronizing software which was not readily available. Reading items and objects in motion can be done accurately using RFID. A system developed with a log in windows enables security and the overall cost of implementing the system may seem high but after a year of running the system, very high benefits will be realized. With consideration of proposed architecture we design a automated toll collection system which gives a result as deduction of toll from users unique account And secondly if the vehicle is stolen then successful compliant to the police.

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