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RFID and Universal Number Vehicle Monitoring, Tracking and Traffic Free System

[1]R. Vinston Raja, [2]K. Gopinath, [2]K. Hemapriya and [1]R. Agnel Joe

[1]Department of IT, Panimalar Institute of Technology, India
[2]Department of CSE, Panimalar Institute of Technology, India

Abstract: Radio frequency Identification (RFID) technology is having a major impact on the vehicle industry by attaching radio frequency tags to different entities. UIVN is the updated version of vim used in the 19th century, VIN is a visible plate whereas UIVN is invisible and it only emits the radiations which could be read by the reader placed in the toll gates and signals. RFID and UIVN can provide identification, tracking, location, security and other capabilities. The goal of this paper is to show how RFID and UIVN can be used to track the theft vehicle and identifies it, this technologies also enables us to monitor the logs of our vehicle and also used for electronic billing in toll gates and to detect traffic density.

Key words:

INTRODUCTION

The main idea behind implementing RFID and UIVN 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 and UIVN tags installed on the vehicle. In addition to this [1], 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 reducing or eliminating waiting time and acceleration. Meanwhile, for the toll authorities also get the benefits mentioned below,

The benefits for the motorists include:

- Fewer or shorter queues at toll plazas by increasing toll booth service turnaround rates.
- Faster and more efficient service (no exchanging toll fees by hand)
- The ability to make payments by keeping a balance on the bank account itself
- The use of mobile phone alert statements (no need to request for receipts)
- Lowered toll collection time and burden.
- Better audit control by centralized user account.

Existing System: 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 [2]. 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 [3]. 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.
- The manual toll collection system has less efficiency and accuracy.

Corresponding Author: R. Vinston Raja, Department of IT, Panimalar Institute of Technology, India.

- The manual toll collection is required large time so traffic jam at toll plaza.

Proposed System: 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) [4], 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 [5]. 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.

Methodology: 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. UIVN tag is inbuilt in the vehicle; 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 his bank account. Every time a registered vehicle approaches the toll booth, first the Infrared sensors will detect the presence of the RFID and UIVN tags in the vehicle. It will in turn activate the RFID circuit to read the RFID and UIVN tags fixed on the vehicle [6]. 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.

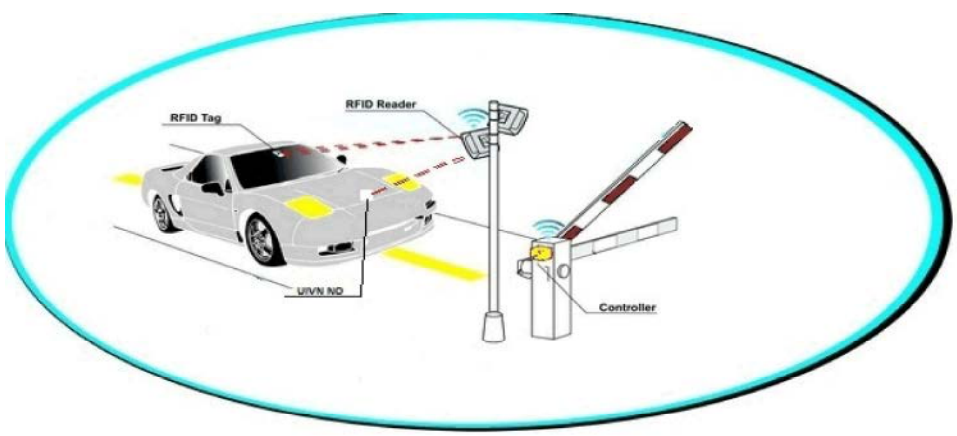


Fig. 1: Methodology

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 [7]. 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.

Axiomatic Design of the Vehicle Tracking System

Axiomatic Design Process: According to the analysis above, besides tracking a vehicle, a vehicle tracking system now should meet other requirements, some of which like anti-theft tracking are generated by the internet of things. These other needs are actually applications based on obtaining the position of vehicle [8], here defined as extended requirements which can be integrated into the basic requirement, tracking vehicles, to satisfy the independence axiom. Thus, in the highest level, the FR, *FR*1 is tracking vehicles, the corresponding DP_C*DP*1 is the vehicle tracking system based RFID.

To track a vehicle, it is essential to get its real-time position information and display it on the map, as well record it for further applications. Amid, the position information of vehicle is not handling directly by collecting modules of the position information but generally transferred to top programs. Therefore *FR*1 can be decomposed into *FR*11 (collecting position information of vehicles), *FR*12 (transforming the position information), *FR*13 (transferring the position information) and *FR*14 (handling the position information). *DP*1 is defined as *DP*11 (information gathering module), *DP*12 (transformation module), *DP*13 (transfer networks), *DP*14 (data center including database). And then the design equation relates to these FRs and Descant be expressed by:

$$\begin{bmatrix} FR_{11} \\ FR_{12} \\ FR_{13} \\ FR_{14} \end{bmatrix} = \begin{bmatrix} X & 0 & 0 & 0 \\ X & X & 0 & 0 \\ 0 & X & X & 0 \\ 0 & X & 0 & X \end{bmatrix} \begin{bmatrix} DR_{11} \\ DR_{12} \\ DR_{13} \\ DR_{14} \end{bmatrix}$$

This equation indicates the decomposition satisfies the independence axiom, but *FR*11 to *FR*14 areal not leaf parameters. So more detailed decomposition needed to satisfy design requirements. *FR*11, according to vehicles identifiers, mainly collects their position information in ascertain form at different time by responding the collecting devices, which has sub-functions including *FR*111 (identifying vehicles), *FR*112 (responding) and *FR*113 (timing). There are many ways to identify a vehicle such as RFID tags, bar codes and common numbers. Here we chose FID tags because of more advantages mentioned above over other ways. Since RFID tags depend on RFID readers, when a reader reads a tag [9], it means responding between the tag and reader takes place. Accordingly the position of responding is supposed to be that of the vehicle, no matter it is moving. This makes it available to gather the position of a vehicle by the location of the RFID reader just reading its tag, on condition that the reader is deployed in advance at spots where vehicles are required to scanned, for example, the sides of roads and its location is saved in database. Thus the whole design solutions are described as follows.

$$\begin{bmatrix} FR_{121} \\ FR_{122} \\ FR_{123} \end{bmatrix} = \begin{bmatrix} X & 0 & 0 \\ 0 & X & 0 \\ 0 & 0 & X \end{bmatrix} \begin{bmatrix} DP_{121} \\ DP_{122} \\ DP_{123} \end{bmatrix}$$

Here, *DP*111 is RFID tag, *DP*112 is RFID reader, *DP*113 represents controller which adds a timer to the position information. It is obvious that RFID technology plays roles of both identifier and positioning in our solutions.*FR*12 inputs the position information from *DP*112, then checks and turns it into a valid form to send by *DP*13, at the same time outputs control information from the data center. It has the following sub-functions: *FR*121 = inputting position information, *FR*122 = data filtering, *FR*123 =formatting, which are maintained by the parts of *DP*12, *DP*121 (connection interface), *DP*122 (filter program) and *DP*123 (formatting program). The related DM is:

$$\begin{bmatrix} FR_{121} \\ FR_{122} \\ FR_{123} \end{bmatrix} = \begin{bmatrix} X & 0 & 0 \\ 0 & X & 0 \\ 0 & 0 & X \end{bmatrix} \begin{bmatrix} DP_{121} \\ DP_{122} \\ DP_{123} \end{bmatrix}$$

*FR*13 receives and transfers the data or information on positions of vehicles or control between *DP*12 and *DP*14 with networks such as Ethernet, Wife, GPRS, the data running on which should be consistent with their protocols. The decomposition of *FR*13 and its solution is formulated by:

$$\begin{bmatrix} FR_{131} \\ FR_{132} \end{bmatrix} = \begin{bmatrix} X & 0 \\ X & X \end{bmatrix} \begin{bmatrix} DP_{131} \\ DP_{132} \end{bmatrix}$$

where *FR*131 is receiving and sending out data, *FR*132 is transferring data, *DP*131 is network terminals and *DP*132 networks. The network terminals depend on the type of network chosen, including ones for Ethernet and wireless networks. Generally, wireless terminals close toinformation gathering module is supposed to give more priorities to decrease the cost and difficulties.

For *FR*14, it receives, splits the data from networks and judge the position of current vehicle at current time based on database, where the coordinates of RFID readers are stored, then displays it on GIS, as well records the position information of vehicles. Additional, other extended applications are based on *FR*14 like intelligent charging. It can be implemented as follows

$$\begin{bmatrix} FR_{141} \\ FR_{142} \\ FR_{143} \\ FR_{144} \\ FR_{145} \\ FR_{146} \end{bmatrix} = \begin{bmatrix} X & 0 & 0 & 0 & 0 & 0 \\ X & X & 0 & 0 & 0 & 0 \\ 0 & X & X & 0 & 0 & 0 \\ 0 & X & 0 & X & 0 & 0 \\ X & 0 & 0 & 0 & X & 0 \\ X & 0 & X & X & 0 & X \end{bmatrix} \begin{bmatrix} DP_{141} \\ DP_{142} \\ DP_{143} \\ DP_{144} \\ DP_{145} \\ DP_{146} \end{bmatrix}$$

Here *FR*141 is preprocessing and outputting data which, *FR*142 splitting and judging position,*FR*143 displaying position on the map, *FR*144 recording the position data in database, *FR*145controlling vehicles, *FR*146 extended applications, *DP*141 interface program, *DP*142 position inquiryprogram,*DP*143 map and displayer, *DP*144 database and saving connector, *DP*145 control implementation program and *DP*146 is further application collection including cargo tracking, anti-theft tracking and so on, whose details are referred in above figure.

Architecture

Vehicle Tracking: According to the design above, there are RFID and UIVN tags, fixed RFID Readers, network terminals, databases, application servers and maps. All these physical parts can be extended according to actual applications also can collaborate with other tracking techniques like GPS. In this project, there will be a toll gate system administrator who monitors the vehicles when they pass the tollgate, only if both the RFID and UIVN tags are matched the system gets automatically linked in to the bank account of the user, else if the tags are not matched or RFID tag is removed, then the toll gate system administrator will find that the vehicle is a theft vehicle. The toll gate administrator will send information about the theft vehicle to the police station and send message alert to the owner's mobile number.

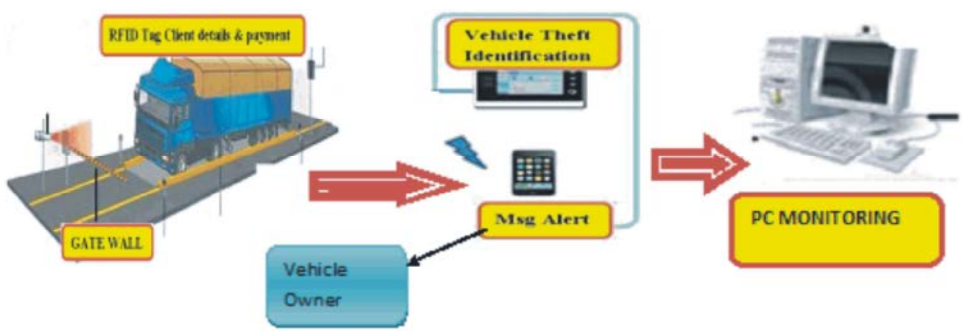
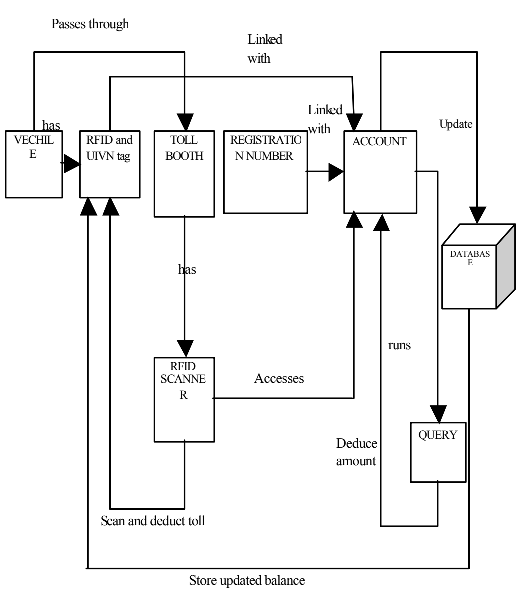


Fig. 2: Vehicle Tracking:

Toll Collection System: The main system components are as follows:

- RFID and UIVN tagged vehicle
- Toll booth equipped with RFID scanners
- Vehicle registration plate
- Centralized database
- Cameras
- Laser transponders



Automatic Vehicle Identification: The tags present in the car contains the information about the vehicle, when they pass the toll gate, the reader reads the tag and the information about the vehicle had been identified automatically.

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.

Trafficdensity Detection: Through the two RFID readers placed in the signals, calculate the time taken by the car1 to cross signal B from signal Aand also calculate the time taken by the car2 to cross signal B, compare these two timings and alert the user if it is highly traffic region.

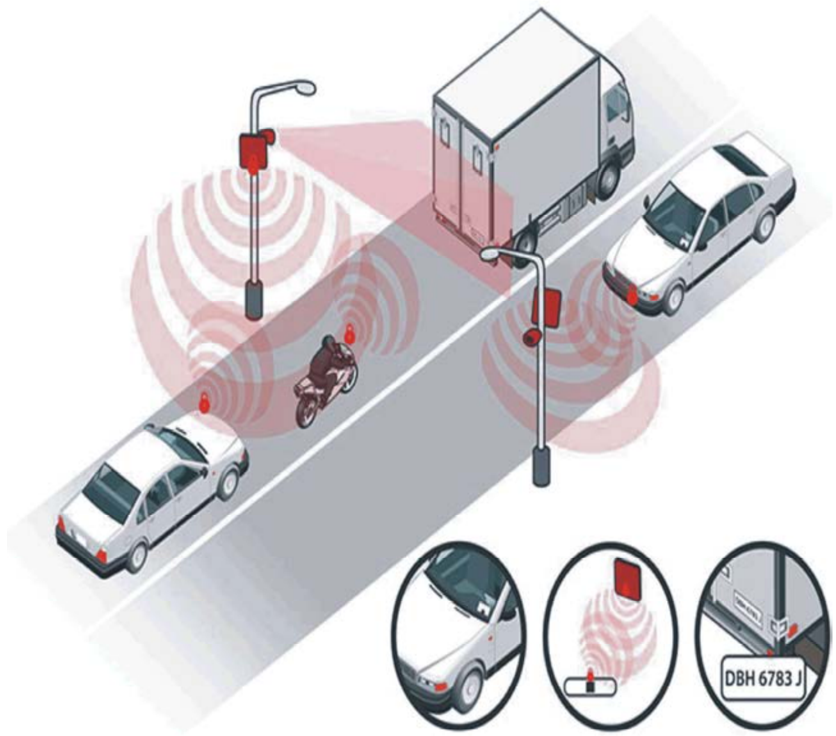


Fig. 3: Basic Steps of Vehicle Tracking based on RFID:

Compared with past vehicle tracking systems, the new one based RFID presented in the design above mainly uses RFID and UIVN technology as the core part. There are RFID and UIVN tags, RFID readers, network terminals, databases, application servers for the data centre, GPS, maps and so on.

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

- Identify the RFID vehicle tag information on the car by a RFID reader on the toll gate.
- Identify the UIVN number.
- Check whether both the tags has unique match code.
- If the code or number of two tags doesn't match, then the system administrator in the toll gate will declare that it is a theft vehicle.
- 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.

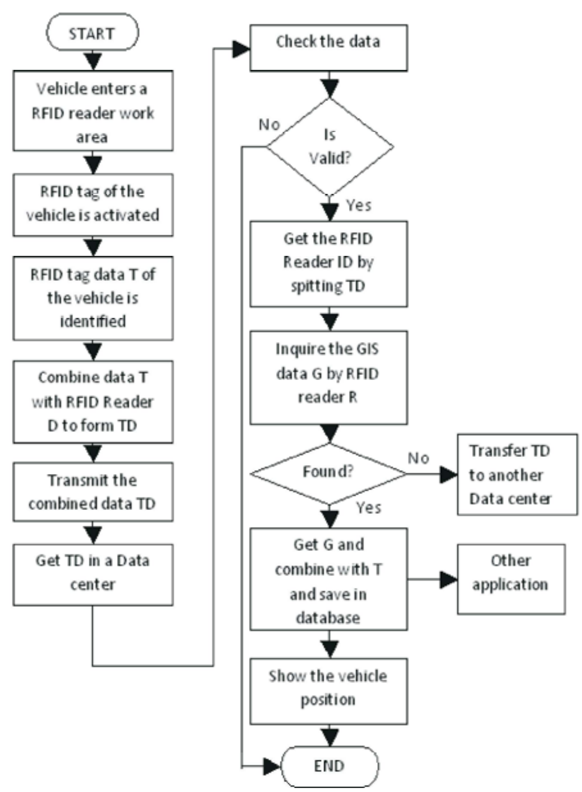
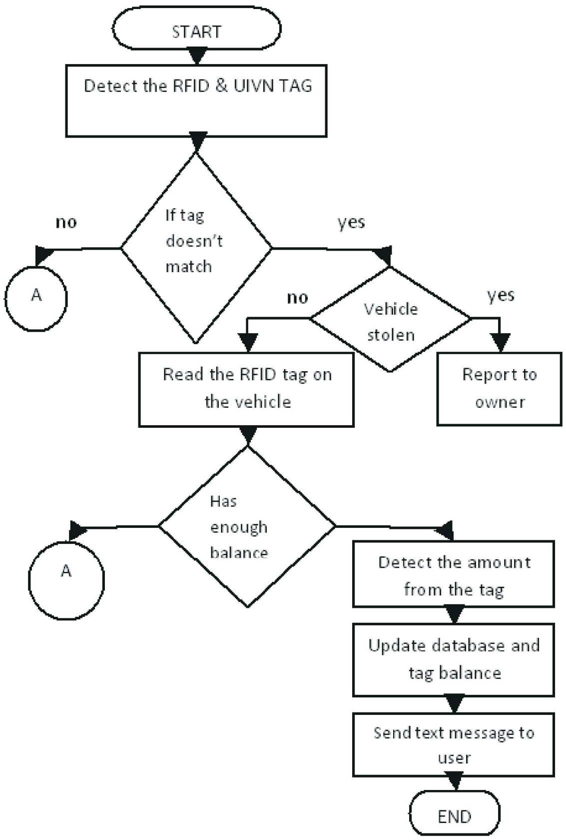


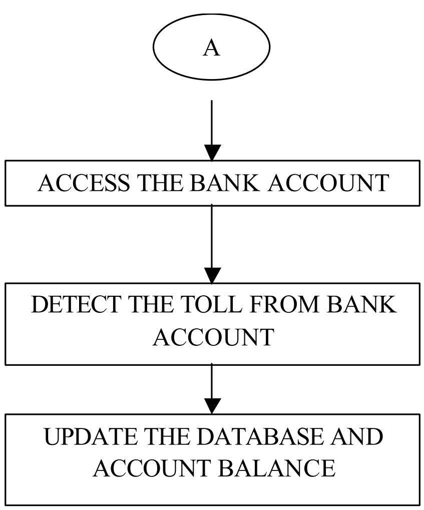
Fig. 4: Track a vehicle

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

Flowchart 1:



Flowchart 2 (cont):



Algorithm:?

Step 1: START.

Step 2: Detect the RFID and UIVN tag and check for stolen vehicle.

Step 3: If vehicle is stolen then report to the Police and the owner of the vehicle.

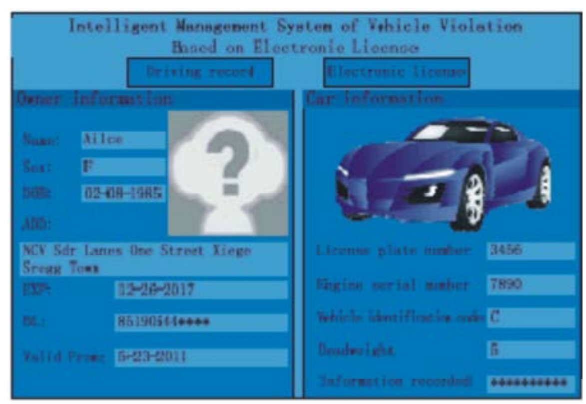
Step 4: Check balance, if the user bank account has enough balance and then deduct the toll amount from the owner's bank account.

Step 5: Send text message to the user.

Step 6: Using the two readers placed in the either side of the signals, traffic density of that region is detected & intimates it to the driver.

Step 7: END

Experiment: To execute our proposed framework we will set experiments. As our first step is giving unique ID to each user with RFID reader. We can perform the registration of all the users with all model numbers of vehicles. The police compliant of stolen vehicle is done with the proper database connectivity.



RESULT

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.

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.

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