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Vehicle Localization, Monitoring and Automatic Toll Payment using RFID

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Abstract: GPS has been commonly used for vehicle localization. However, since GPS signals are very sensitive to terrain and interference, they may become unavailable in places such as lower layers of multilayer bridges, streets besides high buildings, tunnels etc. In this paper, Introducing a novel RFID-based approach for vehicle localization in GPS-less road environments, where passive RFID tags are deployed on the roads and readers are installed on vehicles. To achieve accurate vehicle localization, thus proposing an error-cognitive localization system. The RFID tags for calculating the distance travelled by the vehicle and automatic withdrawal of amount from the user's registered account while it passes through a toll gate. Using RFID tags a new vehicle is monitored that enters in the city by updating the details of the vehicle in the database.
Keywords: RFID Reader, RFID Tag, Toll Collection, prepaid account

I. INTRODUCTION

GPS has been commonly used for vehicle localization. But, GPS signals may be unavailable, very weak or highly distorted in places such as[1] tunnels, lower layers of multi-layer bridges, streets beside high buildings and areas of dense vegetation or foliage. Localizing vehicles in GPS-less environments has been extensively studied and techniques such as differential GPS, map matching, dead reckoning (DR), inter-vehicle collaboration, RSU based localization, vision-based method, road surface recognition and fingerprinting have been proposed. However, due to the dynamic nature of road environments, none of them are applicable to safety-critical and highly mobile vehicular network applications, such as Vehicle Collision Warning Systems (CWS), Advanced Driver Assistance Systems (ADASs) and Vision Enhancement, which require high localization accuracy with a meter or sub-meter error so as to give drivers a precise view of vehicles anywhere and anytime. To achieve such high localization accuracy, we propose to leverage the radio frequency identification (RFID) technology to set up an on-road inexpensive infrastructure to facilitate vehicle localization: RFID tags[2] are deployed on roads and their locations are stored in themselves; vehicles use on-board RFID readers to read tags that they pass by to know their locations. While passing the toll gate the RFID of the vehicles reads the tags and the payment for using the road is automatically deducted from the user's required account and the balance amount details are sent to the user's mobile phone as a message. The details of the new vehicles that enter into the city are registered in the database and provided with RFID, Such that using this RFID the vehicle can be monitored. The benefits of this method are queues will be short at toll plazas by increasing toll booth service rates, Fast and well-organized service, It can make payments by keeping a balance on the card itself, the use of postpaid toll statements minimize the fuel wastage, it reduced waiting time of vehicles in queue, and acceleration.

A. For Toll Operators, the benefits[3] include

1) Lowered toll collection costs
2) Better audit control by centralized user account
3) Expanded capacity without building more infrastructures

The idea behind implementing RFID Based Toll System is to reduce manual operation in toll booths and to avoid the long queues at toll booths using RFID tags installed on the vehicles. In addition we can also help the vehicle owners and system administrators from vehicle theft detection and can also track their vehicle's location.

II. LITERATURE SURVEY

According to the survey of Karnataka Government, in Sept.2012 they have proposed to get the annual toll collection about 2500 crores year. But in the present situation they are able to collect only 900 crores of the toll value. Means there is loss of 600 crores due to human errors. So, in this situation we have to control this leakage. Now the present system we have with us on the high ways takes 1 minute to complete the toll collection process for one vehicle. With this automatic process, it will take just less than a minute to complete the whole process. As there is reduction in time for completion of the process so indirectly there will be no traffic as

such as there is no traffic so no fuel wastage takes place & the purpose of designing the highways is achieved i.e. reduction in journey time & also the money loss will be reduced.

III. EXISTING SYSTEM

A. *Map Matching*

Road map knowledge[4] can help improve localization accuracy by limiting the estimated positions to roads or other places with vehicle access. This technique is called map matching which is mainly used by GPS-based navigation systems to accurately locate vehicle onto the map. However, the localization accuracy is still large due to the basic GPS errors (around 10 meters).

B. *Dead Reckoning (Dr)*

DR-based systems are typically used during short GPS outages by estimating the current position according to the last know position, serving as an enhancement technique for GPS-based systems.

C. *Differential Gps*

GPS receivers that are geographically close to each other tend to have correlated localization errors pointing in the same direction. Based on this observation, Differential GPS (DGPS) proposes to install a GPS receiver in an already known fixed location and calculate the errors. Then, it notifies nearby GPS receivers of these errors, based on which they can correct their position errors. Although DGPS can achieve accurate positioning, it needs expensive roadside stations and cannot work during GPS outages.

D. *Inter vehicle Collaboration*

By measuring RSSI, a vehicle without GPS estimates[5] the distance from its neighbors equipped with GPS, and also exchanges this distance information with other vehicles through inter-vehicle communication.

E. *Disadvantages*

With such information, a vehicle can locate itself and also the vehicles in its vicinity by either using triangulation, or iteratively refining and calibrating location. However, these RSSI-based approaches suffer from noise and thereby may not be accurate and reliable enough for vehicular network applications.

IV. PROPOSED SYSTEM

A. *Techniques Used*

1) RFID Tag and RFID Reader
2) Web Camera
3) ZIGBEE Transmitter And Receiver
4) Cloud Server

B. *RFID*

RFID is an automated data-capture technology that can be used to electronically identify, track [6] 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.

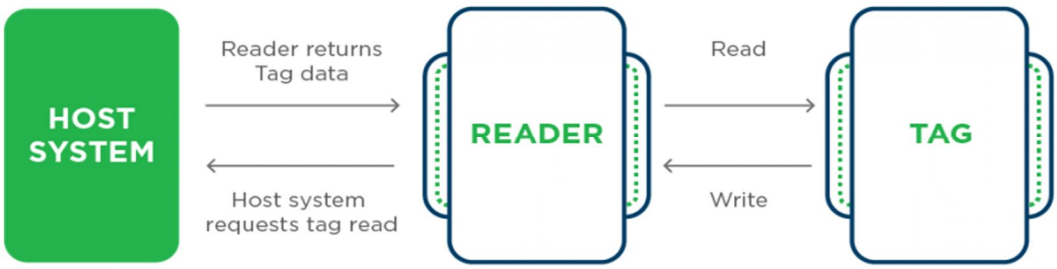

Fig 1: Components Of Rfid System

C. 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 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.

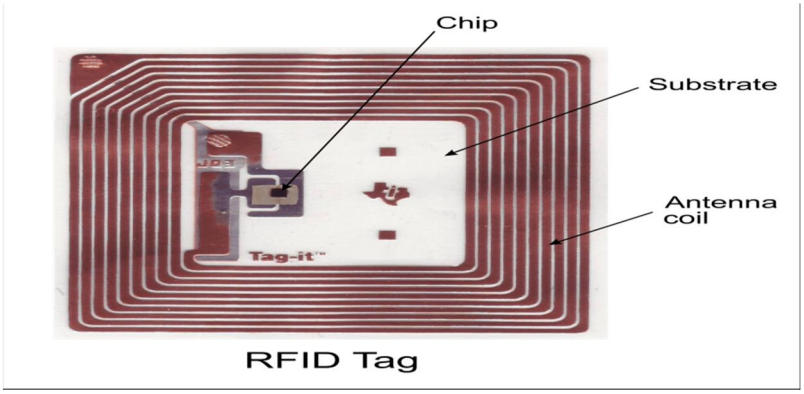

FIG 2: INTERNAL STRUCTURE OF RFID TAG

D. 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.

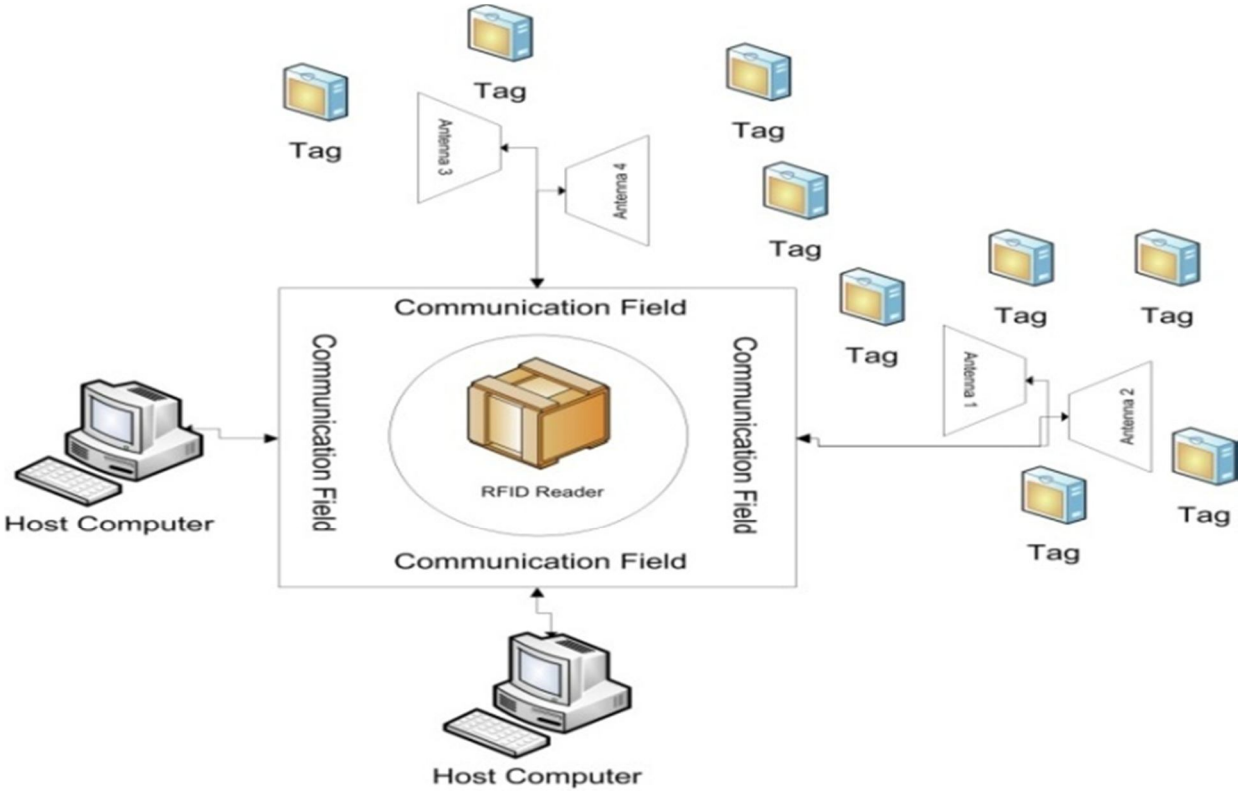

FIG 3: RFID READER

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E. Web Camera

It is used to monitor the movement of the vehicles. The web camera [6] that was fixed in the streets are very useful to identify the location of the vehicle at the current situation.

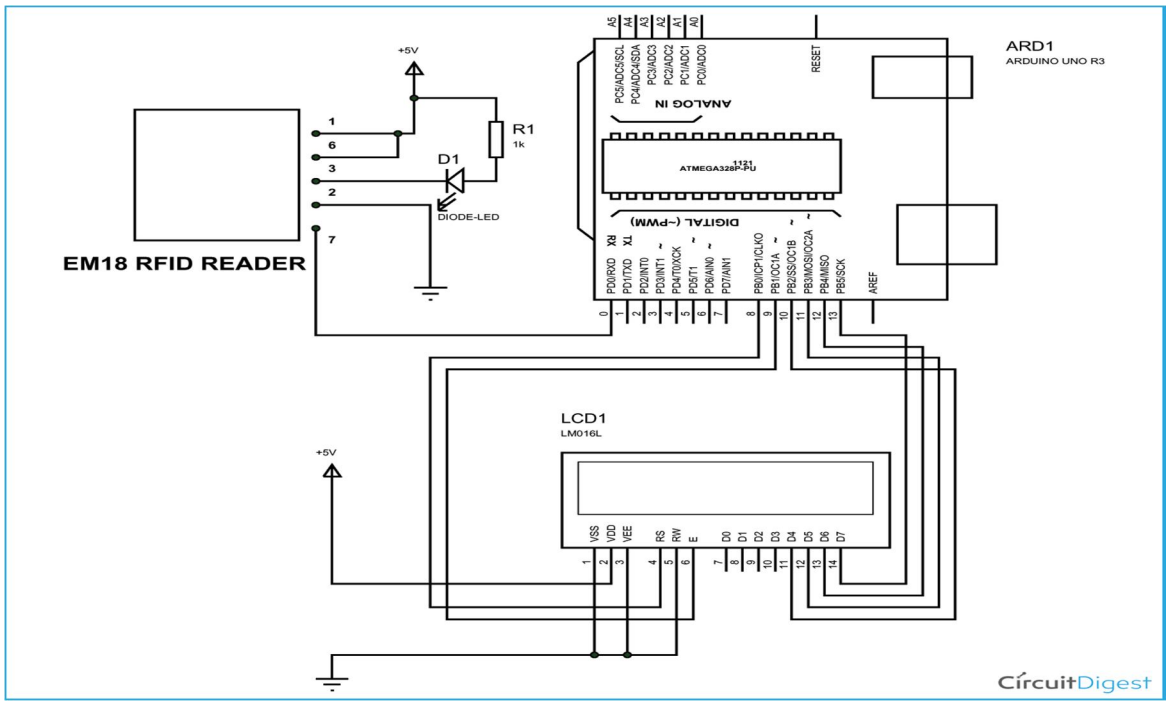

Fig 4: Interfacing Of Arduino With Rfid

Fig 5: Interfacing Of Arduino With Web Camera

V. PROPOSED ARCHITECTURE

A low-density and low-cost RFID infrastructure is used for highly accurate localization of vehicles, where a MATR based tag deployment strategy has been adopted to maximize tag-reading efficiency. By scanning RFID, the payment for the toll is processed automatically when the vehicle passes through the toll gate.A database is maintained at the toll gate to register and update the information[7] about the new vehicle that enters the city and a RFID is given to the vehicle such that using the tag, the vehicle can be monitored.

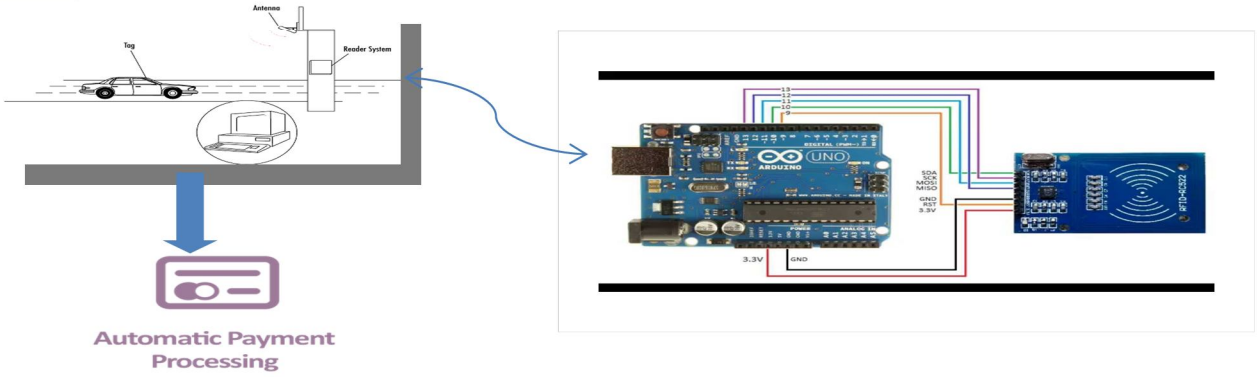

Fig 6: Architecture Diagram

A. Advantages

1) Automatic collection of toll tax
2) Free flow of traffic.
3) Time saving
4) Record maintenance.
5) Problems with pursuing toll evaders.
6) The vehicles can be efficiently monitored. Traffic overhead due to the payment procedure at toll gate can be reduced.
7) Maintenance of database for monitoring the vehicles will be very useful for security purposes.

VI. CONCLUSION

GPS has been commonly used for vehicle localization. However, since GPS signals[8]are very sensitive to terrain and interference, they may become unavailable in places such as lower layers of multilayer bridges, streets besides high buildings, tunnels etc. In this paper, Introducing a novel RFID-based[9]approach for vehicle localization in GPS-less road environments, where passive RFID tags are deployed on the roads and readers are installed on vehicles. To achieve accurate vehicle localization, thus proposing an error-cognitive localization system. The RFID tags for calculating the distance travelled by the vehicle and automatic Withdrawal of amount from the user's registered account while it passes through a toll gate. Using RFID tags a new vehicle is monitored that enters in the city by updating the details of the vehicle in the database.

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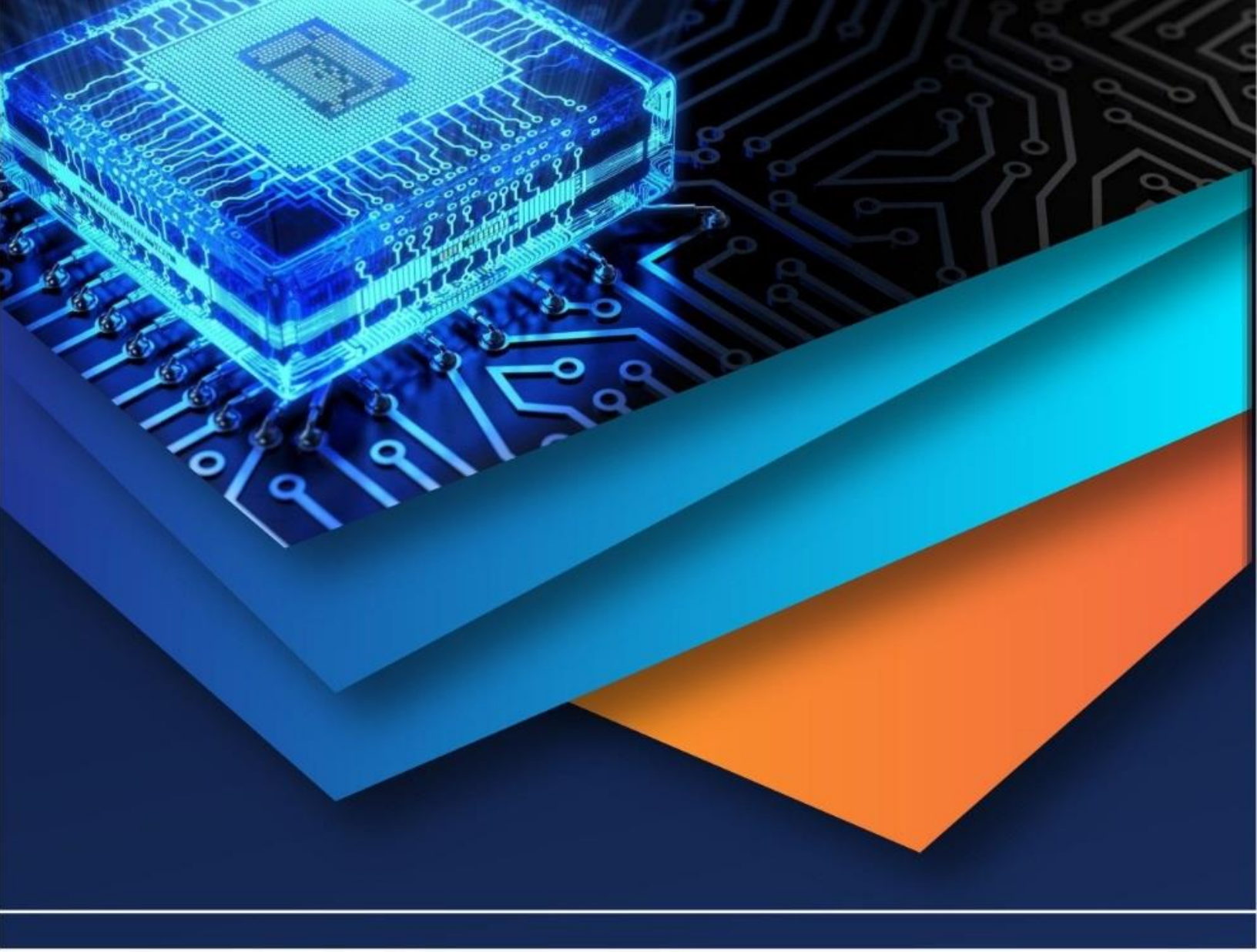

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