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A New Approach of RFID and GSM Assisted Navigation System for VANETs

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***Abstract*—In this paper, we propose a systematic approach to designing and deploying a RFID Assisted Navigation System (RFIDANS) for VANETs. RFID-ANS consists of passive tags deployed on roads to provide navigation information while the RFID readers attached to the center of the vehicle bumper query the tag when passing by to obtain the data for navigation guidance. We analyze the design criteria of RFID-ANS and present the design of the RFID reader in detail to support vehicles at high speeds. We also jointly consider the scheduling of the read attempts and the deployment of RFID tags based on the navigation requirements to support seamless navigations. The estimation of the vehicle position and its accuracy are also investigated.**

***Index Terms*—RFID assisted navigation system, vehicle system, system design**

I. Introduction

RADIO Frequency Identification (RFID) has attracted considerable attentions in recent years for its broad applications in ubiquitous computing. In this paper, we propose a RFID Assisted Navigation System (RFID-ANS) with GSM for VANETs. RFID-ANS consists of RFID readers installed on vehicles and passive RFID tags deployed on roads. As the maintenance for a passive tag is easy and its cost is less than a dollar, it is feasible to deploy a large number of passive tags for a relatively low cost over a broad area that is full of roadways.GPS cannot achieve lane level positioning and can provide information regarding the traffic direction in the current lane. By using RFID-ANS with GSM, it is achievable.

Intuitively,RFID-ANS complements to the current GPS navigation system when GPS signals are not available (such as in tunnels) or if the GPS position is ambiguous to a vehicle. Moreover, even combined with map-matching technologies, nevertheless, this information are necessary to prevent vehicles from entering a wrong way when roads are under construction or lanes are temporarily borrowed by the traffic along a different direction. Our RFID-ANS with GSM is designed to address such problems. Its convenience and benefits give incentives for users to install RFID readers on their vehicles. Additionally, RFID-ANS can be configured to provide electrical traffic signals.Itmight be essential to future autonomous vehicle systems as this system can provide more precise real time road information for traffic scheduling. Note that the RFID reader attached at a vehicle is independent of the vehicle model, and it can be easily upgraded to guide driving. Therefore, RFID-ANS could play an important role in the future complex driving environment that contains autonomous, semiautonomous, and man-controlled vehicles.

RFID-ANS is a ground navigation system that is designed for the lane level navigation. The issues relevant to a practical RFID-ANS in a complex vehicular environment have never been addressed before. To our knowledge, this is the first work that provides a systematic approach to designing a RFID-ANS. Our RFID-ANS with GSM provides efficient navigation for autonomous vehicles system. Our multifaceted contributions are stated as follows

- We provide an analysis on the design criteria of RFID-ANS. These criteria serve as guidelines for the design of the RFID readers and the deployment of the RFID tags. We present the relationships among these design criteria, and investigate how they should be used cooperatively to achieve the objectives of the navigation system. Based on these criteria, we identify the parameters that are important for the RFID-ANS design.
- We present the design of the RFID readers for RFIDANS in detail. The ranges of the critical parameters for the RFID readers are derived according to the requirements of the navigation system and the tag deployment.
- We jointly consider the design of the RFID reader's read interval and the deployment of the RFID tags, such that the cost and energy consumption can be optimized as long as the requirements of the navigation system are satisfied. The proposed methods for read attempt scheduling and tag

deployment are robust and adaptable to dynamic road environments.

- We propose methods to estimate the vehicle position. The accuracy of the estimated position and the Performance of the designed RFID-ANS is analyzed.

II. RELATED WORK

A RFID system is composed of RFID tags and RFID readers. A RFID tag stores data, and a RFID reader accesses the tag to collect the data through wireless communications. There exist two types of RFID tags: active tags, which contain power modules to support wireless communications, and passive tags, which power their transmissions through the energy absorbed from the radio waves of the RFID readers. Compared to active RFID tags, passive RFID tags are easier to maintain as they do not need power, and their cost can be as low as several cents. Therefore, passive RFID tags are more appropriate for applications that require a large number of tags.

Traditionally, RFID tags were designed for commercial applications to replace the bar codes for asset counting [1], [2] and identification [3]. One important challenge in such applications is how to handle the read collision problem that occurs when one or more RFID readers query multiple RFID tags roughly simultaneously in a small area. As a result, most existing research focuses on anti-collision protocol design to schedule the reader's read requests and the tag's responses [4], [5], [6]. In RFID-ANS, read collision is not possible as our design guarantees the one-to-one coupling of a RFID reader and a tag in a restricted area.

RFID systems have been deployed for VANETs, in which RFID tags are installed on vehicles while RFID readers are deployed on stationary infrastructures. For example, in a typical Electronic Toll Collection (ETC) system [7], automatic toll RFID readers are installed at the gate. A RFID tag (attached to the E-ZPass on a vehicle) is read by the reader when a vehicle passes by the gateway. The toll system identifies the vehicle through the data obtained from the RFID tag, and automatically charges to the vehicle's or the driver's account. A similar system is established for parking fee collection in [8]. Compared to these systems, RFID-ANS contains stationary tags on roads while readers move with vehicles at high speeds.

The most related work to RFID-ANS are reported in [9], [10], [11]. Chon et al. [9] propose the idea of using stationary RFID tags deployed on roads to localize vehicles when passing by. The feasibility of utilizing RFID tags for navigation when vehicles move at high speeds is investigated through an experiment in which a RFID reader reads the data in a tag when the tag is dropped down to the ground. Lee et al. [10] study the relationship between the tag read latency and the vehicle's speed, and evaluates their results on a test road. These two works demonstrate the feasibility and practicality of applying commercial RFID tags and readers in the vehicular environment. But none of them considers critical issues such as tag deployment and read scheduling, which are important to the design of a practical RFID-ANS as they mainly focus on the concept and feasibility study. In the Road Beacon System proposed in [11], RFID tags serving as traffic signs are deployed in the pavement and vehicles get the road information through reading the tags. The technical details of this work are unavailable to our best knowledge.

III. RFID-ANS WITH GSM IN VANETS

Providing vehicles' position is essential in VANETs. Currently, GPS positioning is widely used, but the accuracy is not adequate for emerging safety applications. In order to provide accurate positioning, this paper proposes RF-GSM, a RFID-assisted localization system that reliably supports lane-level position accuracy. It improves accuracy of the GPS system by employing a DGPS-like concept. It also allows vehicles with GSM to compute their position by contacting GSM servers and equipped neighbors by making use of adhoc networking.

IV. VEHICULAR NAVIGATION, TRACKING AND IDENTIFICATION OF ROAD BLOCKS

The main aim of this project is to provide vehicular navigation, vehicular tracking and road blocks in paths The vehicular navigation is achieved by using passive RFID tag and the RFID reader. A Tracking and road block in paths is achieved by making use of GSM receivers. Care should be taken so that the authorized persons should be able to track and gather information about vehicles current position and the path.

Thousands of years ago nobody could even dream of such a thing as GPS. Sailors and travelers coped well with navigation using a compass, maps, the sun and the stars. It's the digital era now but nevertheless, there are many ways to determine the location without using global positioning systems.

No doubt, GPS is a great thing, but what if you don't have a receiver? Not everyone has a cell phone with a built-in GPS chip and the car owner doesn't necessarily has bought it either. So what to do in that case? There're three main things you can do considering no rare and exotic options:

- You can determine your IP address and then use a special database to get the location of your city. Those databases often include city's longitude and latitude.
- You can determine the location of the next-door GSM / UMTS base station. This thing works only if you have the towers coordinates and identifiers database.
- You can also use the nearby Wi-Fi access points to calculate the latitude and longitude. You just have to send a certain request to a special server including their characteristics

V. WORK DESCRIPTION

Transmitter and Receiver sections

The Transmitter and receiver part and consist of RFID receiver and passive RFID tag and the LCD display. The RFID receiver access information from the passive RFID tag and the whole system is controlled by the microcontroller Atmel89s52. The entire information is processed and displayed on the LCD screen.

The block diagram of the transmitter and the receiver section is shown below, it consist of transceiver Circuits which is used for vehicle navigation.

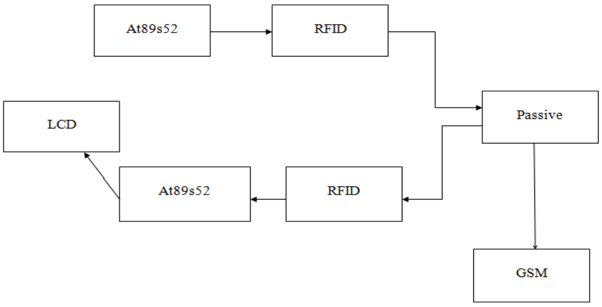

Fig .1.(a) Block Diagram of Transmitter and Receiver

As shown in the block diagram, there doesn't contain two Atmel At89s52 microcontrollers and RFID readers. Instead there is only one microcontroller and RFID reader .But they perform dual functions of accessing passive tag during transmission and collecting information and process data and display the output in LCD display.

The Tracker section consists of same controller and the GSM Receiver but an interface module to support PC configurations.

Vehicle Tracker Section and Road block in paths

The Tracker section consists of the GSM module,

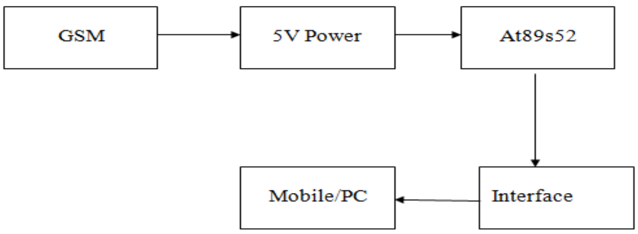

Fig.1. (b) Block Diagram of Tracking Section

Atmel89s52 microcontroller and the interface module. It gives complete information about the current position and also about source and destination locations. Similarly the road block in current path or alternative path is intimated through GSM to the tollgate and that will be displayed in LCD mentioning that this path is been blocked take diversion whenever the vehicle gets accessed to the RFID reader which is been placed at beginning of the path or toll gate. The block diagram of this section is shown below.

As shown in the block diagram, the GSM receiver gets information from the transceiver section and the Atmel controller is controlled by a 5V power supply and using the serial port cables, it's interfaced with PC.Then the current location and also the source and destination locations, Road block information are sent making use of their GSM

Thus the navigation, tracking and road block status is achieved by making use of transceiver and the tracking sections.

VI. SIMULATION

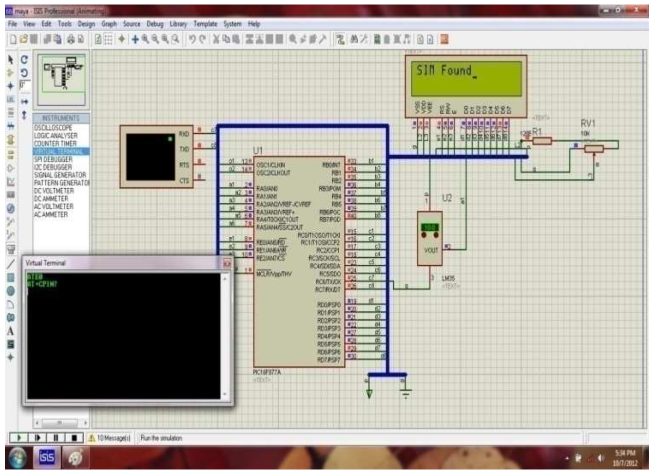

Fig.2. (a) GSM Detection

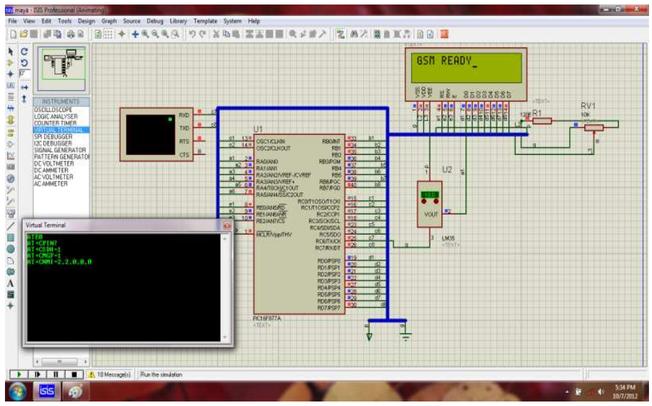

Fig.2. (b) GSM Activation

As shown in the above figures, the first simulation window detects the GSM is activated in the transceiver sections. This is indicated by LCD display in both the sections giving the message "SIM Found". After the GSM receiver is activated, the message from the tag is sent to the receiver and thereafter the incoming message is processed by the At89s52 controller and the resulting place is displayed in the LCD.

The second simulation window gives the message that the GSM starts transmitting to the authorized user. This in turn gives the starting and the destination points covered by the vehicle. Different tags are assigned different programs and hence the exact position of the vehicle in meters is estimated and hence this method is more efficient than the other navigation and the vehicle tracking systems.

For realistic performance we have simulated our work using tool known as Lab VIEW in which we have considered three paths. Here path 1 illustrates information about traffic, path 2 illustrates information about accidents and path 3 illustrates information about road blocks. Whenever disturbance occurs in either of these three paths the information is sent to the tollgate or beginning of the path through GSM where the tags are placed so that as soon as the tags get accessed by the vehicle the information about the disturbance is displayed in LCD that is placed in car or tollgate and diversion can be taken accordingly. This system is shown below

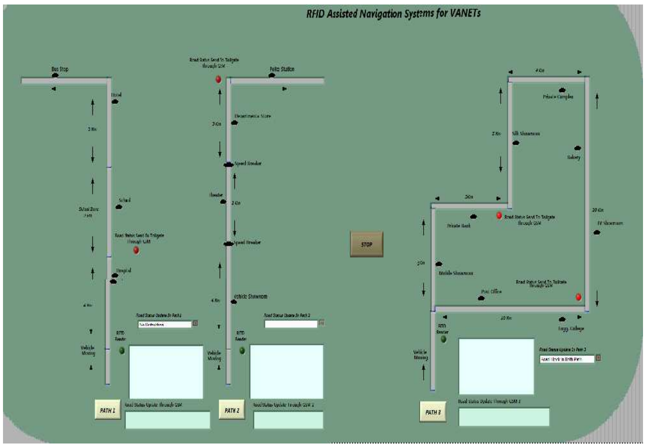

Fig.3 RFID Navigation using Lab VIEW

VII. HARDWARE IMPLEMENTATION

A. Tag Accessing and Navigation

The tag accessing consists of passive tag accessed by the RFID reader and the information is processed by the micro controller and then it is displayed on the LCD screen.

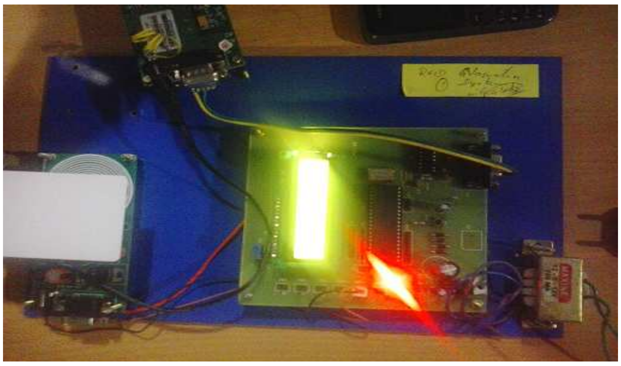

Fig.**4.(a)** Tag access

Fig.4.(b) Navigation information

B.Navigation, Tracking And Identification Of Road Blocks

The tracking consists of the navigation information sent to the authorized number by making use of the GSM receiver. Hence each place is mentioned as codes such as AAAA for Coimbatore, BBBB for Salem, CCCC for Athur and DDDD for Tirchy. Similarly the road block in current path or alternative path is intimated through GSM receiver in the tollgate and that will be displayed in LCD mentioning that" this path is been blocked take diversion" whenever the vehicle gets accessed to the RFID reader which is been placed at beginning of the path or toll gate.

Fig.4.(c) Tracking and road block information

Thus RFID and GSM assisted navigation system for Vanets is finally implemented in Hardware

VIII.RESULT

In the existing systems Navigation map,GPS are the most popular and widely used technique for vehicular navigation. But still we find some constraints on those technology.Given below table.I.(a) illustrates the merits and demerits of those technology.The demerits of the existing systems is recovered using RFID and GSM technology which is the proposed method.

Table I(a)Merits and Demerits of Existing Method

APPROACH	METHODOLOGY	MERITS	DEMERITS
Safe Navigation	Navigation Map, Proximity sensors	Accurate, works in Harsh environment	Limited operating range, detects only metallic targets
Vehicular Navigators	GPS	Faster, Improved mapping skills	Connectivity lost when passing through tunnels

The RFID technology uses tags and tags readers which do not take the data connectivity as that of GPS and overcomes loss of data connection when passing through tunnels. This technology also provides information which GPS lacks. for e.g.GPS can't provide traffic guidance, road blocks in paths but using RFID and GSM it is made at ease. Given below Table.I.(b) illustrates the comparison of several auto id systems in which that shows RFID is much efficient.

PARAMETERS	BARCODE	BIOMETRIC	SMART CARD	RFID
Typical data capacity	1~100	-	16~64 k	16~64k
Data density	Low	High	Very high	Very high
Readability by people	Limited	Difficult	Hard	Hard
Reading speed	Low	Very Low	Low	Fast
Reading distance	0~50cm	0~2m	Contact	0~30m
Cost of Readers	Very Low	Very high	Low	Medium
Unauthorized modification	Slight	Difficult	Tough	Tough

Tabel.1. (b) Comparison of auto id systems

IX. CONCLUSION

In this paper, GSM (Global System for Mobiles) is used along with RFID reader and passive RFID tag for vehicle navigation and tracking. It provides lane level and overall navigation even when the vehicle is on the road and also provides vehicular tracking when the vehicle comes out of the road. Navigation of vehicular position using LCD display and tracking of vehicle by the authorized person using VB coding is possible in this project. Thus this VANET using RFID-ANS and GSM is a unique and stand alone navigation and tracking system for future autonomous vehicular systems. This system has more advantage and can be implemented perfectly using suitable hardware circuits.

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