Vehicles Localization System using GPS and RFID Technologies

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***Abstract*—Localization systems have become a common technology in various fields and a tool to assist with the recreation resource management. Such technologies allow real-time tracking and monitoring of tourists and modeling their movement on Google Map. This paper introduces a system that can track a vehicle usingGlobal Position System (GPS) and Radio Frequency Identification (RFID). The proposed system includes two main parts; datacenter and vehicles . The datacenter collects data related to the vehicles location as well as drivers' identification data through RFID tags (cards). The second part of the system is related to the vehiclwhere the location of the vehicleand the driver's identifications are sent through Arduino, (GPS) shield, RFID reader and Global System Mobile (GSM) shields fixed on the vehicle. All the locations of vehicles and RFID tags information are stored in a database at the server of datacenter for more reporting and actions. Different software have been used, such as PhP, MYSQL server and Arduino IDE.**

***Index Terms*—GPS Arduino shield, GSM Arduino shield, RFID**

INTRODUCTION

Highlight a section that you want to designate with a certain style, and then select the appropriate name on the style menu. The style will adjust your fonts and line spacing. **Do not change the font sizes or line spacing to squeeze more text into a limited number of pages.** Use italics for emphasis; do not underline.

I. INTRODUCTION

Diverse technologies can be utilized to fulfill the purpose of vehicles tracking. The RFID (Radio Frequency Identification) technology is recognized for real-time identification and tracking. Because of its precise and express identification, RFID is used extensively to asset tracking [1]. The GPS is the most common technology that used to obtain the position information in outdoor environments. Constantly GPS is assisting for tracking of vehicles over a broad geographical area. With simultaneously information received from four satellites and typical conditions and least of Ionosphere, users can calculate an object's position included latitude, longitude, and altitude. This powerful combination of data and advanced technologies allows tracking objects accurately [2]. Moreover, wireless communication systems have been used to transmit and receive information between the stations. The most prevalent used communication system is GSM. This is due to inexpensive cost and accessibility around the covered area and its reliability [3].

Manuscript received November, 2018.

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In terms of data centers, several software and algorithms have been used to reach the object tracking systems. Moreover, the data center includes some intellectual property have to be preserved in a secure environment to emphasize confidentiality and availability [4]. The database is used to store the data and assist managers to produce different reports related to events. It is essentially to note that all the applications are built as a webpage based to be universal and can be accessed from different places [5].

In the proposed system, the boats of tourists are monitored and tracked by the data center. The investigated system consists of two main parts, which are data center and boats of tourists. The task of data center is explained previously, while the boat of tourists includes the hardware equipment which uses the microcontroller of Arduino added to GPS, RFID reader and GSM shields. The GPS shield is used to get the present position of boat, while the RFID reader identify tourists by the cards attached to tourists and finally the GSM shield is utilized to transmit the GPS and RFID readings periodically to the data center for processing and decision. Many software environments have been used and web based data base built.

II. RELATED WORK

Researches in the field of localization and tracking of individuals and objects such as vehicles are a very effective area. Generally these researches not only interested in the field of tracking and monitoring but also concern with safety, security, control and management issues. Many monitoring systems have been designed; each varies with some of its properties, merits and abuses. Some of those systems will be reviewed:

In [6] cargo based GPS presented for petroleum transportation tankers. The system collect different types of information related to cargo and sent them to a data base by GSM technology. Moreover, the system supported with a security technique for overall operation.

In [7] authors presented a methodology to analyze the spatial behavior of tourists based on tracking data. This method was applied during a field study in the city of Go¨rlitz at the east border of Germany. Global Positioning System (GPS) was used to know the places (which sights, shops, restaurants, events, etc.) and times (at which daytime, in which season, etc.) tourists visit.

In [8] vehicle terminal system was proposed to realize continuous monitoring and tracking the location of cargos or goods loaded on board for digital logistics. The embedded design of the terminal system was combined both the RFID with GPS technologies. The ultra-low power 16-bit RISC microcontroller is used as the central control unit considering both small size and high efficiency. The vehicle terminal

system can give the automatic identification of cargos load, the real-time vehicle location, the data and voice communication, and continuous monitoring. The results specify that the combination of RFID and GPS can provide the reliability of the system, which further improve the accuracy and efficiency of digital logistics management.

In [9] authors used GSM & GPS based system for Vehicle Tracking and Employee Security System. It consists of car unit, emergency button and company unit. Car unit is placed inside the car. When the car picks up the employee; he/she needs to swap the RF card. The micro controller matches the RF card number. with its database records and sends map. The system's efficiency is depending on the sufficiency of the used communication network.

In [10] a hybrid RFID-GPS tool used, allowing for the real-time location of humans. This tool tracks the location of humans using GPS within 100 meters range and RFID within 2 meters range. The tool that ensures security and monitors the location along with watch over a suspicious person or prisoners with human tracking of cared ones in case of emergency.

III. PROPOSED SYSTEM

The architecture of the proposed system design is shown in Figure (1). The embedded system fixed in each vehicle consists of Arduinouno as a microcontroller, GPS Arduino shield to get latitude and longitude (GPS signals) for tracking purposes, RFID reader to identify the drivers by their attached tags and GSM Arduino shield to send location of a boat and RFID tags related information to data center. The database, which is web based one, is built to store the information of vehicles' trips and tags readings. It is important to note that the data center contains the database, administration computer and server.

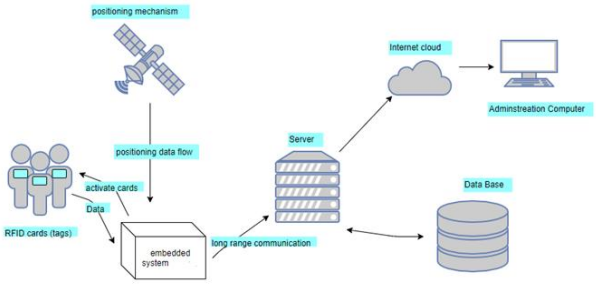


Fig.(1) Default Vehicle Localization System Block Diagram

The specifications of the component used in proposed system can be summarized as follows:

A. Arduino UNO Board:

In this paper, Arduinouno is used as a microcontroller for its high flexibility with additional shields, such as GSM, RFID and GPS. See Figure (2). These specifications making it easy to connect with other electronic devices and using GSM as internet provider and RFID as identification tool.

Fig.2. Arduino Uno Board [11]

B. Arduino GPS Shield:

Another component is used in this work is Arduino GPS Shield which utilized as a navigation system, see Figure (3). It provides the location and more data in various conditions for different applications, like vehicles.

Fig.3. Arduino GPS Shield [12]

C. Arduino GSM Shield:

Arduino GSM shield shown in Figure (4), allows an Arduino board to connect to the internet, send and receive SMS, and make voice calls using the GSM library.

Fig.4. Arduino GSM Shield [13]

D. RC522 RFID module:

RFID module shown in Figure (5), consists of card reader and cards (tags). The microcontroller and card reader uses SPI for communication (chip supports I2C and UART protocols). The card reader and the tags communicate using a 13.56MHz electromagnetic field. (ISO 14443A standart tags).

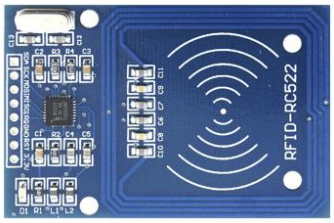


Fig.5. RC522 RFID module [14]

IV. THE PROPOSED SYSTEM IMPLEMENTATION

The proposed system consists of two parts; the embedded system (hardware) and data center (software). The hardware part consist of Arduino, GPS, RFID reader and GSM Arduino shields, all exist in the boat as embedded system (unit). The job of this part is collecting the GPS signals and RFID tags' data then sending them to the data center using GSM network at a scheduled time (periodically). Concerning the data center, software environments are utilized to build a database for data storing and tracking the vehicle. For more explanation, this part can be illustrated as follows:

i) (Hardware) Part:

The utilized hardware components (Arduino Uno, RC522 RFID module, GPS Arduino shield and GSM Arduino shield) are explaining in Figure (6). GPS shield is connected to the Arduino and GSM shield using pins of 0 and 1 and RFID module through pins 9 and 10.The space collected GPS signals and RFID data are sent to the data center by GSM

network to be saved in the database.

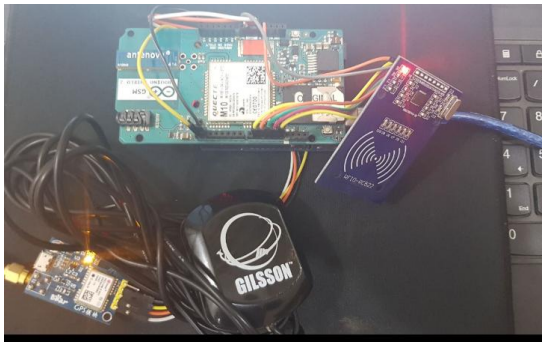


Fig.6. The Component of System Hardware.

Hardware working steps can be summarized as shown in the flowchart of Figure (7), where RFID reader should read N number of tags in a specified interval due to its ability to read just one tag at a time.

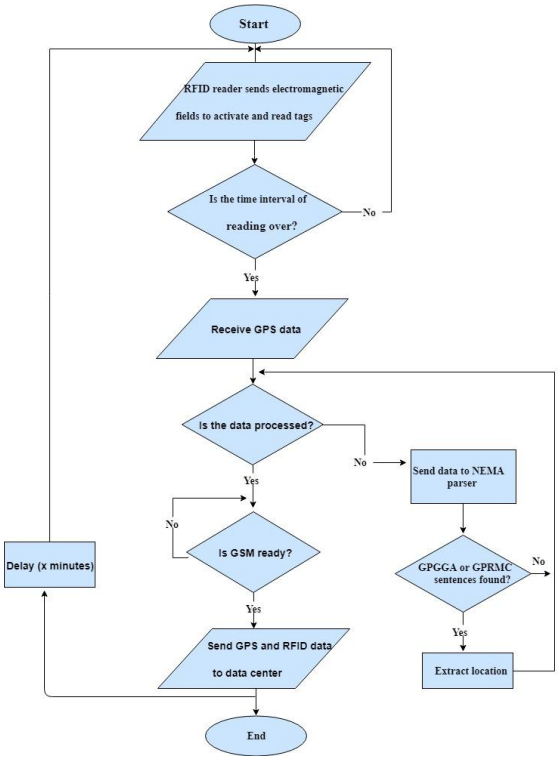


Fig.7. RFID and GPS Parsing Flowchart

ii) Software part (Data base building):

This part consists of a data base building steps to complete supporting the hardware so that a complete system will be achieved. An entity relationship diagram (ERD) illustrates the relationships of entity sets saved in a database, which represents the logical structure of databases as shown in Figure (8).

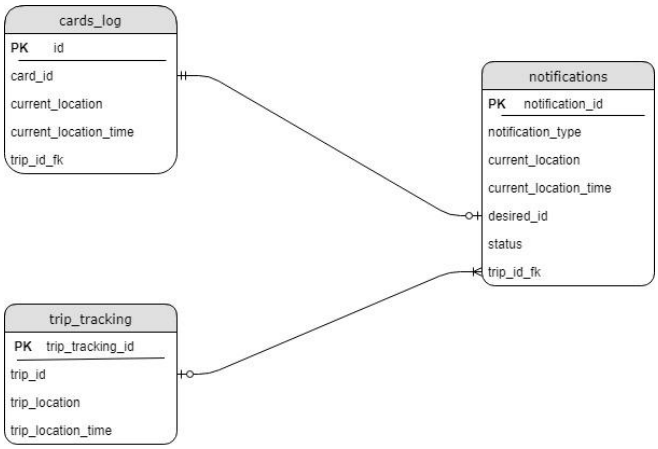


Fig.8. ERD of the proposed data base

The first table (Cards_Log) represents the data comes from RFID reader fixed in the vehicle which read the ID information from cards (tags) attached to the drivers.

The second table (Trip_Tracking) shows the current location of the vehicles obtained from GPS device while the last table (Notifications) specifies various types of notification messages related to the following cases:

1. Notification Type1: explains the case of vehicle ideal
2. Notification Type2: explains the case of driver missing
3. Notification Type3: explains the case when the vehicles exceeds the allowed borders
4. The next section shows the results that have been taken as a real case study.

V. RESULTS

The proposed system is tested in Al-Jadrya area in Baghdad which has been taken as a prototype and we receive the following data are obtained:

The table, shown in Figure (9), represents the saving step of the current location of vehicle received from the hardware part and stored in the datacenter is called "Trip¬_ Tracking". Moreover, in this table the data of numerous boats can be stored that includes four columns: trip_tracking_id, trip_id, trip_location and trip_location_time.

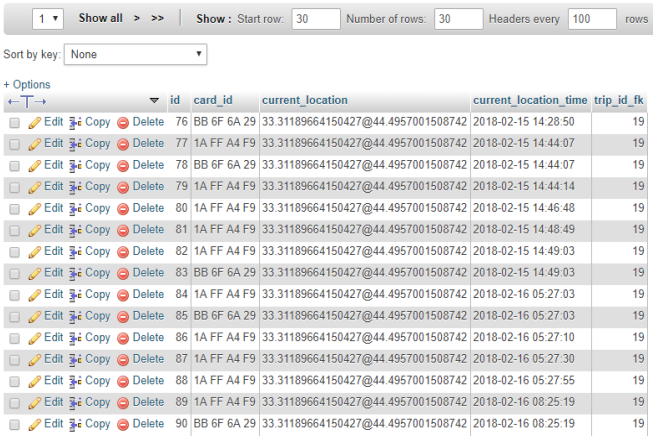
+ Options

←T→	trip_tracking_id	trip_id	trip_location	trip_location_time
Edit Copy Delete	43	19	33.31189664150427@44.4957001508742	2018-02-14 15:32:51
Edit Copy Delete	44	19	33.31189664150427@44.4957001508742	2018-02-14 15:33:01
Edit Copy Delete	45	19	33.31189664150427@44.4957001508742	2018-02-14 15:33:13
Edit Copy Delete	46	19	33.31189664150427@44.4957001508742	2018-02-14 15:35:20
Edit Copy Delete	47	19	33.31189664150427@44.4957001508742	2018-02-14 15:37:37
Edit Copy Delete	48	19	33.31189664150427@44.4957001508742	2018-02-14 15:38:31
Edit Copy Delete	49	19	33.31189664150427@44.4957001508742	2018-02-14 15:38:53
Edit Copy Delete	50	19	33.31189664150427@44.4957001508742	2018-02-14 15:41:37
Edit Copy Delete	51	19	33.31189664150427@44.4957001508742	2018-02-14 15:42:55
Edit Copy Delete	52	19	33.31189664150427@44.4957001508742	2018-02-15 01:44:54
Edit Copy Delete	53	19	33.31189664150427@44.4957001508742	2018-02-15 01:46:13
Edit Copy Delete	54	19	33.31189664150427@44.4957001508742	2018-02-15 12:39:34
Edit Copy Delete	55	19	33.31189664150427@44.4957001508742	2018-02-15 12:39:49
Edit Copy Delete	56	19	33.31189664150427@44.4957001508742	2018-02-15 12:40:17
Edit Copy Delete	57	19	33.31189664150427@44.4957001508742	2018-02-15 12:40:46
Edit Copy Delete	58	19	33.31189664150427@44.4957001508742	2018-02-15 12:41:31
Edit Copy Delete	59	19	33.31189664150427@44.4957001508742	2018-02-15 12:41:36
Edit Copy Delete	60	19	33.31189664150427@44.4957001508742	2018-02-15 12:42:16
Edit Copy Delete	61	19	33.31189664150427@44.4957001508742	2018-02-15 12:42:20
Edit Copy Delete	62	19	33.31189664150427@44.4957001508742	2018-02-15 12:42:55
Edit Copy Delete	63	19	33.31189664150427@44.4957001508742	2018-02-15 12:43:27

Fig.9. "Trip_ Tracking" Table Representation

The table, shown in Figure (10), represents the storing (saving) the cards number received from the RFID reader at the vehicle. This table is called "Cards_ Log" and includes

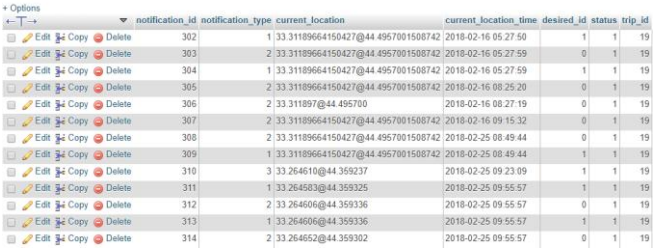
five columns that are: id, card_id, current_location, current_location_time and trip_id_fk.



	id	card_id	current_location	current_location_time	trip_id_fk
Edit Copy Delete	76	BB 6F 6A 29	33.31189664150427@44.4957001508742	2018-02-15 14:28:50	19
Edit Copy Delete	77	1A FF A4 F9	33.31189664150427@44.4957001508742	2018-02-15 14:44:07	19
Edit Copy Delete	78	BB 6F 6A 29	33.31189664150427@44.4957001508742	2018-02-15 14:44:07	19
Edit Copy Delete	79	1A FF A4 F9	33.31189664150427@44.4957001508742	2018-02-15 14:44:14	19
Edit Copy Delete	80	1A FF A4 F9	33.31189664150427@44.4957001508742	2018-02-15 14:46:48	19
Edit Copy Delete	81	1A FF A4 F9	33.31189664150427@44.4957001508742	2018-02-15 14:48:49	19
Edit Copy Delete	82	1A FF A4 F9	33.31189664150427@44.4957001508742	2018-02-15 14:49:03	19
Edit Copy Delete	83	BB 6F 6A 29	33.31189664150427@44.4957001508742	2018-02-15 14:49:03	19
Edit Copy Delete	84	1A FF A4 F9	33.31189664150427@44.4957001508742	2018-02-16 05:27:03	19
Edit Copy Delete	85	BB 6F 6A 29	33.31189664150427@44.4957001508742	2018-02-16 05:27:03	19
Edit Copy Delete	86	1A FF A4 F9	33.31189664150427@44.4957001508742	2018-02-16 05:27:10	19
Edit Copy Delete	87	1A FF A4 F9	33.31189664150427@44.4957001508742	2018-02-16 05:27:30	19
Edit Copy Delete	88	1A FF A4 F9	33.31189664150427@44.4957001508742	2018-02-16 05:27:55	19
Edit Copy Delete	89	1A FF A4 F9	33.31189664150427@44.4957001508742	2018-02-16 08:25:19	19
Edit Copy Delete	90	BB 6F 6A 29	33.31189664150427@44.4957001508742	2018-02-16 08:25:19	19

Fig.10. "Cards_ Log" Table Representation

The table, shown in Figure (11), represents the notifications that display various types of error messages that demonstrated above. This table is called "Notifications" and includes seven columns that are: notification_id, notification_type, current_location, current_location_time, desired_id, status and trip_id.



	notification_id	notification_type	current_location	current_location_time	desired_id	status	trip_id
Edit Copy Delete	302	1	33.31189664150427@44.4957001508742	2018-02-16 05:27:50	1	1	19
Edit Copy Delete	303	2	33.31189664150427@44.4957001508742	2018-02-16 05:27:59	0	1	19
Edit Copy Delete	304	1	33.31189664150427@44.4957001508742	2018-02-16 05:27:59	1	1	19
Edit Copy Delete	305	2	33.31189664150427@44.4957001508742	2018-02-16 08:25:20	0	1	19
Edit Copy Delete	306	2	33.311897@44.495700	2018-02-16 08:27:19	0	1	19
Edit Copy Delete	307	2	33.31189664150427@44.4957001508742	2018-02-16 09:15:32	0	1	19
Edit Copy Delete	308	2	33.31189664150427@44.4957001508742	2018-02-25 08:49:44	0	1	19
Edit Copy Delete	309	1	33.31189664150427@44.4957001508742	2018-02-25 08:49:44	1	1	19
Edit Copy Delete	310	3	33.264610@44.359237	2018-02-25 09:23:09	1	1	19
Edit Copy Delete	311	1	33.264583@44.359325	2018-02-25 09:55:57	1	1	19
Edit Copy Delete	312	2	33.264606@44.359336	2018-02-25 09:55:57	0	1	19
Edit Copy Delete	313	1	33.264606@44.359336	2018-02-25 09:55:57	1	1	19
Edit Copy Delete	314	2	33.264652@44.359302	2018-02-25 09:55:57	0	1	19

Fig.11. "Notifications" Table Representation

VI. CONCLUSION

A tracking system for vehicles using GPS and RFID devices was presented. The proposed system includes two parts; vehicle part and data center. The vehicle contains the hardware unit that collects the GPS signals and RFID readings to be sent to the webpage of the datacenter in which they saved in database later. The datacenter saved the database for other processing purposes. Different software environments have been utilized, such as PhP, and SQL server. The proposed system was tested as a prototype in real-time experiment in Al-Jadrya area.

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