A Real-Time Social Network- Based Traffic Monitoring & Vehicle Tracking System

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***Abstract*—Social networking has become an essential part of our daily lives. tTe integration of social networking communication model and Internet of Things (IoT) provides the users with a greater advantage than the benefit of using each one alone. This paper presents a real-time traffic monitoring and vehicle tracking for the public or private transportation sectors. The proposed system uses a social network service to provide traffic monitoring for individual users. A fully functional prototype model is developed and presented to demonstrate the system operation and to evaluate its performance.**

***Keywords*—Internet of things, social network, traffic monitoring system. vehicle tracking system**

I. Introduction

Traffic Monitoring (TMS) [1] is responsible for collecting, processing, analysing, summarizing, and disseminating urban road traffic data. The main goal of TMS is to provide drivers with a real-time update of the traffic flow status and traffic congestions of different areas.

Vehicle tracking systems [2] cover a range of products that use a combination of technologies to identify a vehicle and its real-time location and then displays this information to vehicle trackers on a remote server through the internet. Fleet managers frequently use vehicle tracking systems for fleet management activities, such as vehicle routing, fleet distribution and security. Some applications provide extra services, such as monitoring driver behaviour. Vehicle tracking systems are also popular in the market for theft prevention and rescue device. The police department can simply follow data sent from the tracking system and locate the stolen vehicle.

Social Network websites [3], such as Twitter and Facebook, have millions of users. Most of them have integrated these websites into their daily activities. Currently, there are many social networks with different technological techniques supporting a wide range of interests and practices. The core feature of social networks is that they help people who are apart easily communicate based on their shared interests, political views, or activities. Social networks do not merely connect people who are friends or know each other in real life but they also connect strangers based on a common language or racial, religious, or nationality-based identities. Almost all social networks combine new information and telecommunication tools, such as mobile communication, blogging websites, and photo/video sharing.

In this paper, we present a real-time traffic monitoring and vehicle tracking for the public or private transportation sectors. The proposed system uses a social network service to provide traffic monitoring for individual users. A fully functional prototype model is developed and presented to demonstrate the system operation and to evaluate its performance.

The remainder of this paper is organized as follows. Section II presents the work that has been done on the literature. The proposed system is presented in section III. The proposed system testing is the focus of section IV. Finally, conclusions and Future work are presented in section V.

II. Related Work

Numerous research studies have evaluated social networks as easy, accessible user interfaces for traffic monitoring systems and vehicle tracking systems.

ElShafee et al. [4] presented a vehicle tracking system that uses Twitter as a user interactive interface to track a vehicle. The system locates a vehicle using Google maps; each vehicle has an account that contains posts of Google maps that display the vehicle location in real-time. The current proposed solution is an advancement of the author’s previous research.

Hao Wang, et al. [5] presented real-time monitoring of the security system of commercial vehicles. The authors used an incident detection algorithm combined with GPS and on-board sensors to monitor vehicle routing and security conditions. The proposed system was simulated and tested in a microscopic simulation model and provided results in detecting abnormal driving conditions

Kunal Maurya, et al. [6] proposed a vehicle tracking and anti-theft system. The system is an electronic device based on an AT89C51 microcontroller that is serially interfaced to a GSM Modem and GPS Receiver. The vehicle position (latitude and longitude) is directly sent to the user’s mobile device upon request as a SMS.

Pravada P. Wankhade at al. [7] discussed the design and development of an anti-theft vehicle system based on GSM and GPS technologies. The user interacts with the vehicle through the SMS service by requesting its location or sending commands to control the ignition and engine.

Montaser N. Ramadan et al. [8] presented an anti-theft system based on GSM and GPS technologies. The system uses Google Earth to locate the vehicle. The user can interact with his vehicle through a SMS service to obtain the vehicle location and send commands to the control vehicle engine.

III. PROPOSED SYSTEM

This paper provides a vehicle tracking and road traffic monitoring system that works under various road conditions, including chaotic, dense and unstructured traces, and different types of vehicles. The system is cost efficient, easy to deploy and requires minimal maintenance. The system uses a well-known social network to interact with users on various types of mobile phones. The system is suitable for public transportation and enables users to follow their buses and determine their current locations in real-time mode. On the other hand, the system collects information from different public transportation buses and vehicles and updates the social network users with the traffic status and traffic congestions areas.

The system has many objectives, amongst which are the following ones:

- Development of a user friendly and easily accessible road TMS.
- Development of a user friendly and easily accessible vehicle tracking system
- Enhance the public transportation services by enabling the tracking service and making use of the trip information of public transport vehicles to generate traffic status reports that can contribute to solving traffic congestion problems.
- Gain the power of the social network in vehicle tracking and traffic monitoring by integrating them as an interactive user interface.
- Gain the power of the Google maps service in the public transportation sector.

Fig. 1. Proposed system layout

The proposed system consists of the following three main components

- In-vehicle unit
- Application server
- Social network interface

In-vehicle unit

A hardware module is installed in the vehicle. Its main function is to capture the vehicle's location (latitude and longitude) from the GPS module and send it to the application server on a timely basis. The vehicle location is saved in the application server database that is associated with the capturing time (server local time). Such data are transmitted to a server through the internet using the GSM network.

The unit consists of the following major components:

- Processing & control unit
- GPS module
- GPRS module

Processing and control unit

The Arduino Uno microcontroller board [9] was selected as the processing and control unit of the in-vehicle module because of its ease of programming; wide range of supporting modules, such as a GSP shield; and large amount of available library space, which makes the implementation of the hardware project easier and more efficient.

GPRS module

The in-vehicle unit uses a SIM900 GPRS shield [10], as a bridge between the vehicle and internet through the GSM network. The module is fully compatible with Arduino / Uno and Mega. Arduino communicates with the GPRS module using the UART protocol and controls it using simple AT commands (GSM 07.07, 07.05 and EFCOM enhanced AT Commands).

GPS module

The in-vehicle unit uses the SKYLAB GPS module "SKM53" [11], which is used to capture the vehicle's current location (latitude and longitude) to send it to the applications server.

The SKM53 GPS Series has an embedded GPS antenna that enables high performance navigation even under the most difficult condition and provides a solid fix even in rugged GPS visibility environments.

In-vehicle Unit Software routine Design

A software program, written in the C language, was compiled and uploaded to the processing and control unit (Arduino Microcontroller). Figures 2 and 3 show the in-vehicle unit software use cases and scenario.

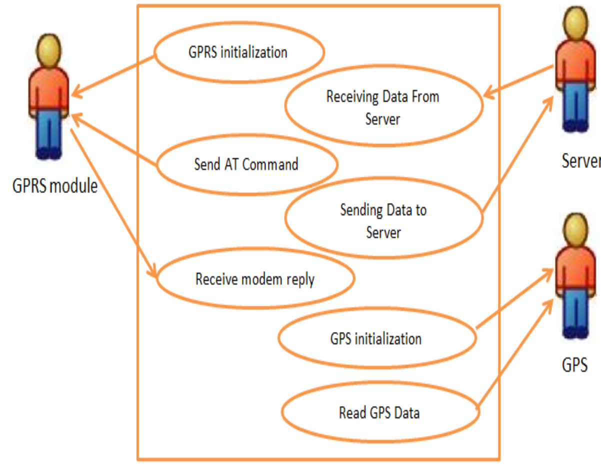


Fig. 2. In-vehicle unit software use cases

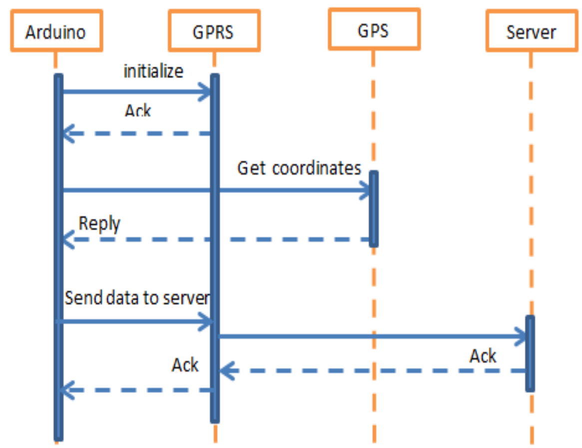


Fig. 3. In-vehicle unit software scenario

Application server

The application server receives location information from all of the in-vehicle units installed in different vehicles; then, the server stores the received data in a database. Upon receiving a location update from an in-vehicle unit, the server posts the updated location to the social network account of the vehicle, which is associated with a Google map presentation of the vehicle's current location and a time stamp. The server makes use of the APIs of Google maps to obtain the area name and street address of the vehicle on a predefined public transportation route. On the other hand, the server analyses the updated location of the vehicle that corresponds to the last updated location (saved in the database); then, it calculates the distance moved and time taken for that movement. The server calculates the average speed of the vehicle on each area and street. The sever posts the traffic status as an average speed in certain areas or the streets on the vehicle route.

The server application was developed using the PHP language and is hosted in a Linux based web hosting service provider. Two different programs were developed; each is issued by an in-vehicle unit, one for updating the coordinates of the vehicle in the database and posting the new coordinates to the social network. The other program analyses the data of the vehicle, generates the traffic status and then posts it to the social network. Figures 4 and 5 show the server application use cases and scenarios. Figure 6 shows the ER diagram of the application server database.

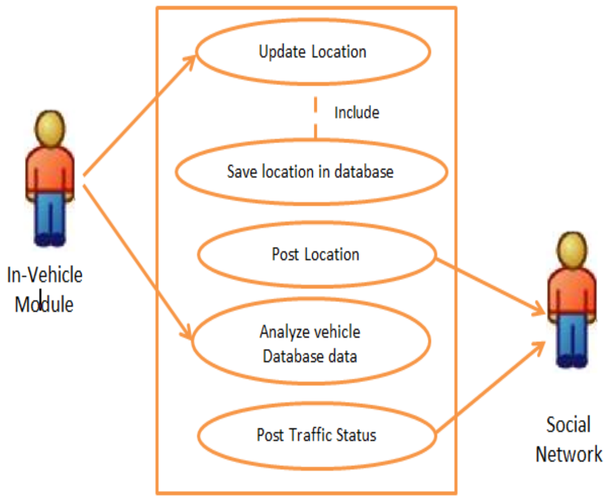
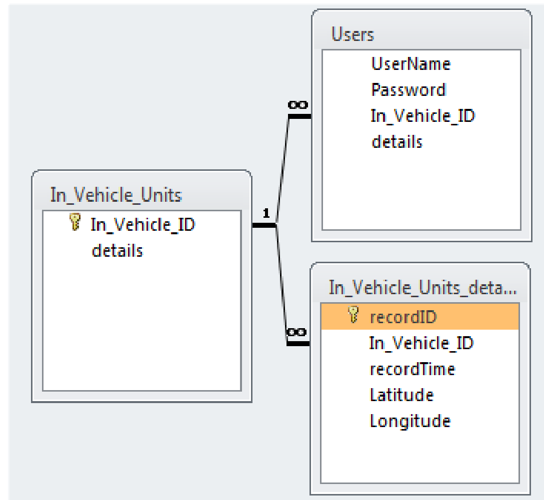


Fig. 4. Server application use cases

Social network interface

Twitter is one of the best social networks for applying the proposed solution because of the following features:

- Real-time results; breaking news spreads immediately on Twitter.
- Twitter's real-time search tools; the user can obtain a quick pulse of public threads.
- Wide reach; Twitter is one of the most powerful and useful social networks worldwide.
- Direct feedback; the user hears exactly what other people say.
- Easily integrated with PHP applications; OAuth 2.0 authorization framework [12], which enables a third-party application to obtain limited access to an HTTP service.



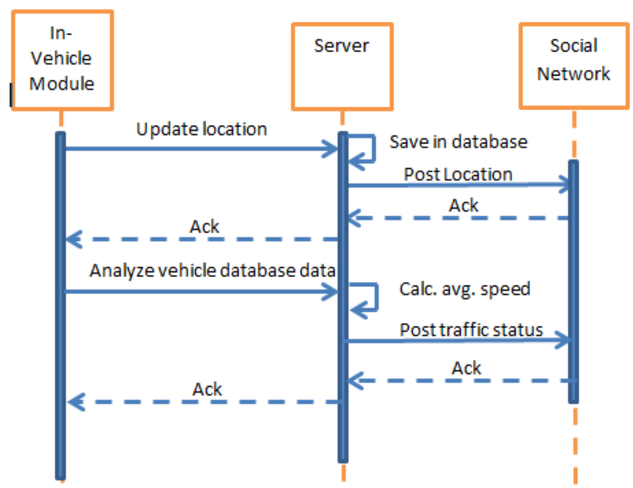


Fig. 5. Application server Scenario

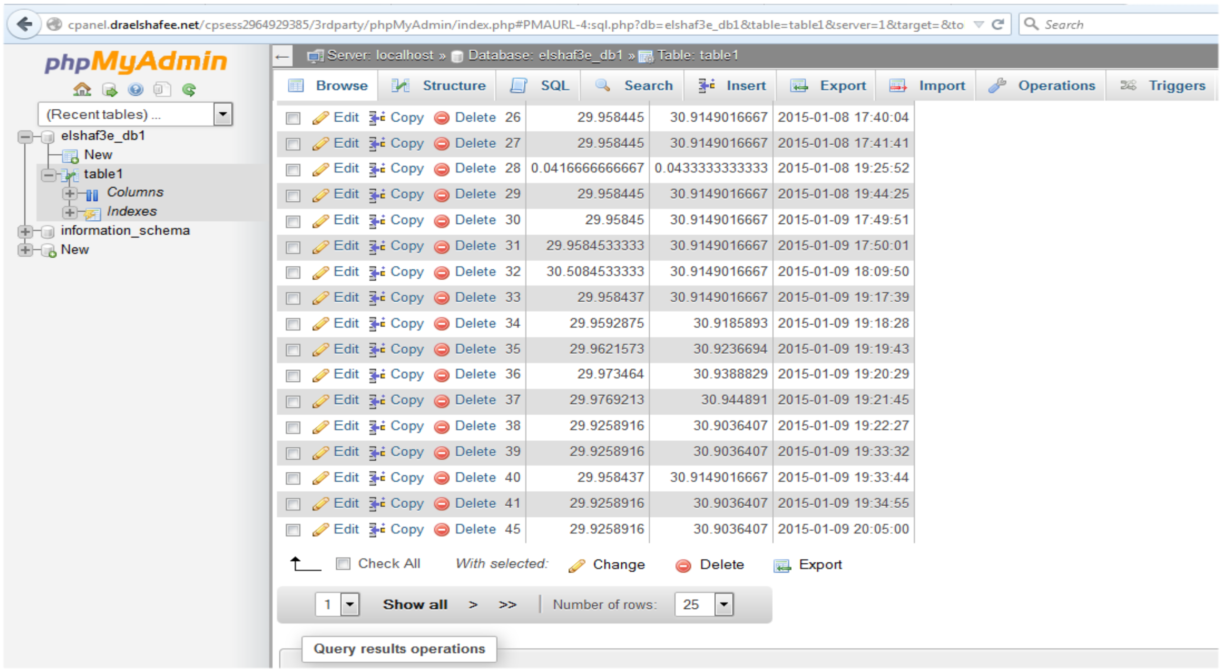
Fig. 6. Application server Database ERD

Each in-vehicle unit has an account on twitter. The vehicle posts its location coordinates (latitude and longitude) via the application server. The server analyses the vehicle locations that are saved in the server database to calculate the average vehicle speed and then posts the traffic status to the area of the vehicle on twitter.

The vehicle's followers automatically obtain the vehicle's location as well as the traffic status (average speed) on the route vehicle's real-time basis.

IV. Proposed System Testing

The proposed system has been tested. Figure 7 shows the database backend user interface. Figure 8 shows the vehicle's tweets on its twitter account. Figure 9 shows the Google map associated with the vehicle's tweet. Figure 10 shows the traffic status for an area on the vehicle's route.



Edit	Copy	Delete	26	29.958445	30.9149016667	2015-01-08 17:40:04
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Edit	Copy	Delete	37	29.9769213	30.944891	2015-01-09 19:21:45
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Edit	Copy	Delete	39	29.9258916	30.9036407	2015-01-09 19:33:32
Edit	Copy	Delete	40	29.958437	30.9149016667	2015-01-09 19:33:44
Edit	Copy	Delete	41	29.9258916	30.9036407	2015-01-09 19:34:55
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Fig. 7. Database backend interface

V. Conclusions and Future Work

This paper introduced a new traffic status monitoring and vehicle tracking system that empowers social network features as a user interactive interface. Both vehicle tracking and traffic status monitoring are executed in the real-time mode. The system consists of three major components: In-Vehicle unit, application server, and social network interface. The vehicle location information (coordinates captured by GPS module) is transferred to the application server through internet using a GPRS module, which uses the GSM network infrastructure to access the internet. Upon receiving location updates, the application server saves the acquired information in its database and then it posts the location and time associated with a Google map to the vehicle's account on a social network. The server analyses the vehicle's information, grouped by the vehicle located area (assisted by Google maps API), and calculates the average speed on the different area. The server then posts the discovered traffic status to the social network. Additionally, the proposed scheme can be considered an efficient method for the vehicle tracking and traffic monitoring.

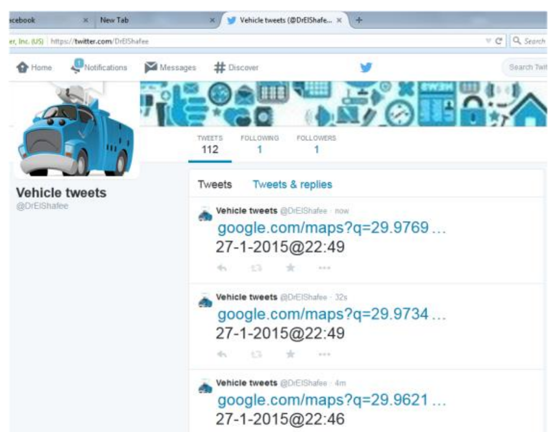

Fig. 8. Vehicle tweets on the vehicle's twitter account

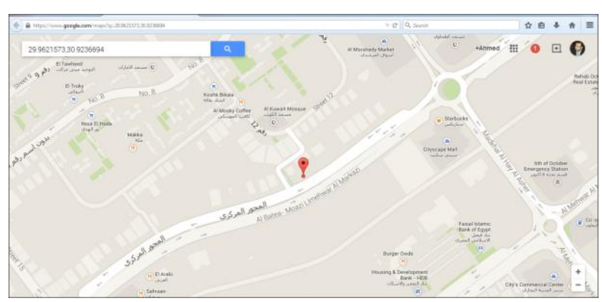

Fig. 9. Google map associated with the vehicle's tweet

Fig. 10. Traffic status for an area on the vehicle's route.

The system can be used in public transportation, which allows public transportation users to easily follow their transportation vehicles by following the vehicles' accounts on the social network. People who use the same route of public transportation vehicles can easily discover the traffic status by either following the public transport accounts or by searching the area's traffic status on the social network.

References

[1] Andrew Winder, Mark Brackstone, Paolo Delle Site, and Marco Antognoli, "Taffic Managment For Land Transport", Transport Research Knowledge Centre, Directorate - General for Energy and Tranport, European Commission, 2009

[2] Muruganandham , P.R.Mukes, "Real Time Web based Vehicle Tracking using GPS", World Academy of Science, Engineering and Technology 37 2010

[3] Chew, Chee H., and Vivek P. Gundotra. "Social network collaboration space." U.S. Patent No. 9,876,827. 23 Jan. 2018.

[4] Ahmed ElShafee, Mahmoud ElMenshawi, Mena Saeed, "Integrating Social Network Services with Vehicle Tracking Technologies", International Journal of Advanced Computer Science and Applications (IJACSA), Vol.4, Issue No.6, July 2013.

[5] Hao Wang, Ruey Long Cheu,"A Real-time Vehicle Tracking and Security Monitoring System for Logistics Companies", Asian Network for Scientific Information, Information Technology Journal l2 (17): 4323-4327,2013

[6] Kunal Maurya, Mandeep Singh, Neelu Jain, "Real Time Vehicle Tracking System using GSM and GPS Technology- An Anti-theft Tracking System", International Journal of Electronics and Computer Science Engineering, vol 1, issue 3, 2012

[7] Pravada P. Wankhade, Prof. S.O. Dahad, "Real Time Vehicle Locking and Tracking System using GSM and GPS Technology-An Anti-theft System", gopalax -International Journal of Technology And Engineering System(IJTES), Jan –March 2011- Vol.2.No.3.

[8] Montaser N. Ramadan, Mohammad A. Al-Khedher, and Sharaf A. Al-Kheder, "Intelligent Anti-Theft and Tracking System for Automobiles", International Journal of Machine Learning and Computing, Vol. 2, No. 1, February 2012

[9] "Arduino microcontroller", [online:] http://Arduino.cc

[10] "GPRS Shield V1.0", [online:] http://www.seeedstudio.com/wiki/GPRS_Shield_V1.0GPS

[11] boyd, d. m., & Ellison, N. B. (2007). Social network sites: Definition, history, and scholarship. Journal of Computer-Mediated Communication, 13(1), article 1.