Agent Based Intelligent Transportation System Software Based GPS Tracking Modules as Agents

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ABSTRACT

In terms of ecology, economy and society, the development of public transportation networks is a major issue. Essentially the transportation of hazardous materials can have negative impact on human health and the environment quality. The urban networks must increase their quality in terms of punctuality and vehicle frequency to improve its attractiveness while decreasing the management cost. Intelligent Transportation Systems (ITS), based on synergy between new information technologies for simulation, real-time control, and communications networks are an alternative to improve available resource management. Different artificial intelligence methods are used to deal with this problem. The best way to model efficiently these functionalities will be to use a multi-agent paradigm. This paper proposes an efficient cost effective software based agent system using GPS enable mobile devices for intelligent transportation system. Result from the research shows that mobile devices having GPS module together with web server provides the cheapest form of facility of intelligent transportation system.

KEY WORDS: component; Agent based systems, intelligent transportation system, GPS, mobile devices.

I. INTRODUCTION

Intelligent transport system entails a system that deals with the remote sensing as well as internet and multimedia access on the move [13]. In the last few years it is clearly evident that traffic congestion caused by rapid growth of mobility demand with respect to transportation systems has become a severe problem which has impacts not only on the economy but also for the ecological aspects involving pollution, noise emission and many more[14]. Intelligent transportation systems (ITS) have been proposed as a global solution for maintaining mobility and planning future needs. The field operation test (FOT) [15] which drivers may use for the knowledge regarding an ITS, their short- and long-term effects and how system performance can be optimized. Agent based system begins with the individual actors (agents) and defines their potential interactions; the simulated interactions of the actors generate the system-level (end) behavior [15]. Another perspective is to think of agent based model (ABM) as "bottom-up" modeling, as contrasted with "top-down" modeling shown below.

Due to the nature of the communication for ITS the communication must be established and completed in a very short period of time and at very high speed. Wifi and ad hoc networks, as wireless enabled handhelds with its increasing popularity also becoming widely used together with GPS modules to provide relevant information to the driver. So, we could used them as on board units that may be used to carry out the task of communication between road to vehicle and possibly vehicle to vehicle. GPS tracking systems offer a wide variety of useful applications related to data collection techniques. A few prominent among the many applications include: vehicle tracking system comprising of either one vehicle or a fleet of vehicles, monitoring and management of assets, equipment and property, surveillance of persons such as a child, an elderly, or a teen. The potential uses for GPS tracking are endless, but in contemporary world, no other industry needs to utilize this new technology more than the mass-transit industry. Often, due to reasons beyond control, such as traffic jams, construction or maintenance work, accidents, etc, public transport vehicles tend to fall off-schedule causing misery and frustration among the customers. This paper proposes an efficient and a cost-effective tracking system which allows customers to track their means of transport anywhere. It achieves the fact that a GPS tracking system for public transport which constantly tracks a vehicle's position in real time. The data acquired should then be displayed to the customer thorough a user-friendly website, which can be accessed through any internet-enabled handheld device.

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II. METHODOLOGY

During the initial phase of the research two major approaches for the development of this project were formulated. First approach was to create a GPS system using a microcontroller and interfacing it with a GSM/GPRS Module (for internet connectivity) and GPS Module (for obtaining coordinates). Whereas, the basic idea behind the second approach was that, instead of creating a GPS module from scratch, a GPS-enabled phone should be utilized as the primary tracking device. The second approach seemed more efficient and cost-effective due to the fact that there would be less equipment required and thus less hardware related issues to tackle. For the second approach, software needs to be developed for GPS-enabled phone which would be responsible for obtaining the data from the GPS module and sending it to a remote server via internet. Ultimately, whether a module with an embedded MCU is used, or a GPS enabled phone, they both obtain the GPS coordinates and transmit the data to a server. The server interprets the data and displays it in a user-friendly manner. The second approach of using a GPS enabled mobile device offers far more advantages compared to the first approach in terms of higher efficiency, reliability and cost-effectiveness, therefore this approach was utilized for the development of the system. In order to develop a GPS tracking system which offers real-time tracking, a web-server is required which extracts data from the mobile phone and display it on a web mapping service application such as Google Maps or Virtual Earth. This entire system required a large set of code written in various different languages for both the mobile application and the web-server. Therefore, it was ensured for all the codes and applications to be in synchronization or uniformity with each other.

A. Design Procedure

This whole big task is divided into two major parts:

1. Design and Development of Windows Mobile Application for obtaining GPS coordinates (latitude and longitude) along with speed and time.
2. Display GPS data onto a web mapping service application. This can be divided into two subparts:
    2.1. Create a web-server where the GPS data will be sent via internet and then stored in a database.
    2.2. The data will then be extracted from the database and displayed on Microsoft's Virtual Earth in real-time.

B. Design Approach

Three different approaches were devised for the development of this project:

First approach was to

- Use GPS-enabled mobile device
- Create application for the phone to obtain GPS data.
- Create server and store the received GPS data in a database
- Display data in either Google Maps or Virtual Earth

In second approach all aspects are the same except to use a third-party application to obtain GPS data

In Last one all aspects are same except to use a third-party application to obtain GPS data along with third-party server to store the data. Eventually, the first approach seemed most appropriate in terms of gaining the most learning experience. Fig. 2.1 illustrates the basic design aspects of the GPS tracking system.
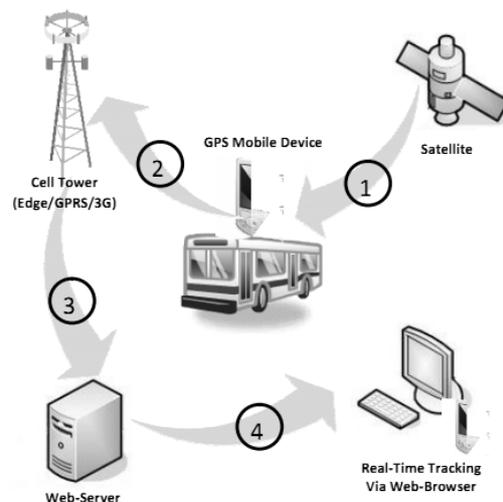

Fig. 2.1: GPS system design aspects

1. GPS Mobile Device
2. Cell Tower
3. (Edge/GPRS/3G)
4. Real-Time Tracking
5. Via Web-Browser
6. Satellite
7. Web-Server 10

An application is developed for the mobile device which interacts with the built-in GPS hardware in order to obtain GPS coordinates. Once the GPS hardware has been turned on, it would automatically start the processes of establishing a link with a satellite. As soon as the connection has been established the Mobile device would start receiving GPS data which would then be displayed onto the device's display screen.

The application is also capable of sending the GPS data to a remote web-server as long as the mobile device is within a cellular network and can access the internet via Edge, GPRS or 3G.
The web-server could either be created online through a web-hosting service or it can be set-up onto a personal computer. The web-server would consist of a database, programming files, and the Virtual Earth API. A program would be developed which would obtain the GPS data from the mobile device and then insert and store it within a database. Another program would be responsible for extracting the data from the database and displaying onto Virtual Earth. The web-server would be linked to a domain name, i.e.www.gpstrackingsys.com which could be accessed using a web-browser via any device which offers internet connectivity. The user would finally be able to access the Virtual Earth API and experience real-time tracking of the vehicle.

III.   RESULTS AND DISCUSSION

Constant problems were encountered throughout the development of this app in terms of debugging the VB code, linking the GID with the main code within Form1.vb, defining and interfacing the functions for the various options and menus within the GUI of the app with the main code, deploying application onto the device using Windows Mobile Center software, etc. Fortunately, all these issues were overcome and the following result was obtained. Fig. 3.9 shows the successful deployment of the application onto HTC Tytn II running on Windows Mobile 6.1 OS. Once the application is launched, the default message, "Application Loaded", is displayed onto the MainPage tab as specified. In order to start tracking process, the Start Track button is pressed, as illustrated in Fig. 3.1.
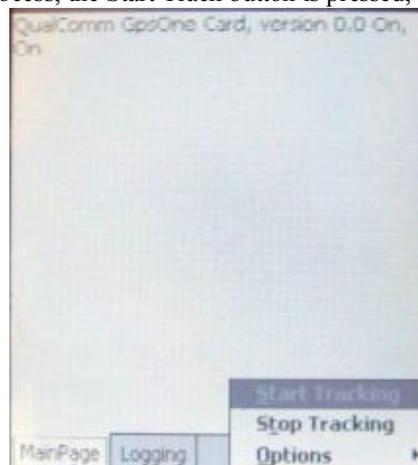

Fig. 3.1 Application Startup

This initializes the GPS hardware and the following message appears onto MainPage tab: "QualComm GpsOne Card, version 0.0 On, on." The message indicates the name of the built-in GPS hardware and the condition of its state in terms of whether it's on or off. As soon as the GPS receiver hardware is enabled, it constantly attempts to establish a link with the GPS satellite. This process may take some time, depending on the location of the Mobile device. If the device is inside a room or any other enclosed environment, the possibility of establishing a link is severely affected, whereas, in an open environment this process takes far less time. Fig. 3.2 and Fig. 3.3 show the result of a successful link and thus, the GPS data is displayed onto the MainPage tab. 24
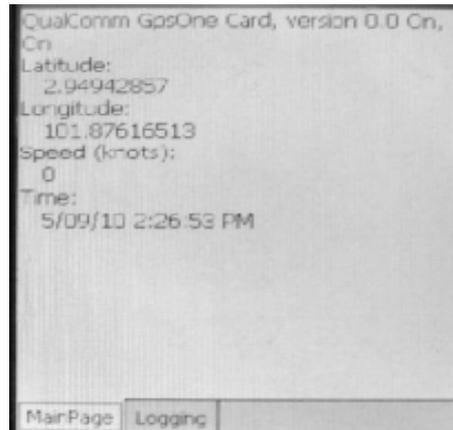
Fig. 3.2 Receiving GPS data

The received latitude (2.949) and longitude (101.876) coordinates correspond to the following location on the map.

Fig. 3.3 Location from GPS data 25

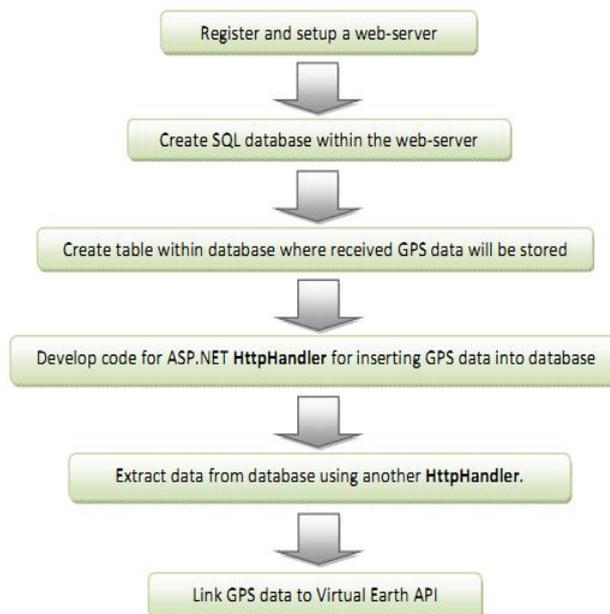Result shows the process of web server functions in the Fig. 3.4.

Fig. 3.4 Web-Server Development Flow diagram

- Register and setup a web-server
- Develop code for ASP.NET HttpHandler for inserting GPS data into database
- Create SQL database within the web-server
- Create table within database where received GPS data will be stored
- Extract data from database using another HttpHandler.
- Link GPS data to Virtual Earth API 26

As an alternative to Google Earth, Bing Maps or Virtual Earth is a mapping platform developed by Microsoft. Apart from providing maps and satellite images, Virtual Earth offers various SDKs which contains the code which developers can use to create custom mapping APIs. The SDK for 'Bing Maps AJAX' control API was downloaded and used for this project. AJAX control API contains a java-script file which contains map data along with various functions, and a default.aspx file which has the built-in GUI for Virtual Earth. These API resources allow developers to integrate Virtual Earth Maps and its interactive controls within their website.

The java-script code for Virtual Earth API could be altered to specify the default location and the zoom-in level. Using the specific latitude and longitude coordinates the code was modified to show Taman Tasik Semenyih as the default location. Fig. 3.5 shows the default location once http://gpstrackingsys.somee.com is loaded.

Fig. 3.5 Modified default location

In order to show real-time tracking of the GPS Mobile device onto the Virtual Earth API, the following procedure needs to be followed: First of all, the java-script needs to access the GPS data within database. In order to do this the java-script file would make an XMLHttpRequest to the web-server to execute another web-handler. An XMLHttpRequest (XHR) is a function available for scripting languages to make HTTP requests directly to a web server. The server response data can then be sent back directly into the script. [11] In this case the XMLHttpRequest would be made to execute a web-handler or ASHX file responsible for extracting the data from the database and send it to the java-script file for real-time tracking. 34 The basic operation of the java-script code is described below:

- The Map data is loaded with default location as Taman Tasik Semenyih
- Shape layers are loaded which would point to the location of the GPS device being tracked.
- Interval is defined at which the location of the device will be updated.
- A function to automatically resize the Virtual Earth map is defined in case the size of the web-browser is changed.

VI. CONCLUSION AND FUTURE RECOMMENDATIONS

New ideas and applications based on GPS tracking systems are gaining popularity every day. Among these applications, vehicle tracking systems are the most prominent. In this project an attempt is made to provide a customer with convenient means of tracking a public transport vehicle. Various methods and approaches were devised to design and develop an efficient and cost-effective tracking system which would provide the vehicle's location in real-time through a user-friendly website. GPS-enabled Mobile Phone with Windows Mobile OS proved to be the best option to tackle this issue. Furthermore, this work also opens new doors for the research in the areas of intelligent traffic routing for general and specific purposes. Also communication between vehicle to vehicle and

vehicle to road can be further made sophisticated for health care where diagnosis can be made even before reaching the health care facility in the vehicle carrying the patient(s).

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