

“GLOBE TRACKER” - A WIRELESS TRACKING SYSTEM

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ABSTRACT

The GPS (Global Positioning System) is currently the most favoured tool for location determination and navigation. Combined with mobile phones, it has gained rapid acceptance among the wider community. The integration of mobile phones and GPS receivers has provided a very powerful tool with great potential for devolvement into future mobile applications. The proposed “GlobeTracker” system exploits the large potential that exists in the combination of GPS and J2ME to develop a navigation system. The whole system uses the J2MEMAP API to locate the server of different map providers, then displays the current user location and tracks its users in real time. This new proposed application is developed based on the “GlobeTrotter” system. In this paper, we first present a brief discussion of J2ME and GPS devices. The design and implementation of “GlobeTracker” is then described in detail. This project shows the enormous potential of J2ME based applications and provides innovative ideas for their further development.

KEYWORDS

J2ME, J2MEMAP API, GPS, GlobeTracker, Tracking

1. INTRODUCTION

The last one and half decades have seen an unprecedented amount of growth in the mobile industries. This rapid growth is fuelled by an increasing number of applications that can be handled by mobile devices. Development has progressed from devices with simple telephony capabilities to smart PDAs that are more or less like PCs.

GPS devices and mobile phones are two modern technologies that have rapidly started to gain acceptance among the wider community, and their integration has provided handy mobile devices that can be used for navigation and location determination.

To provide a platform for the development of mobile based applications Sun Microsystems considered the constraints associated with small devices and introduced J2ME (Java 2 Micro Edition). The J2ME based architecture is used extensively in many mobile applications and allows platform independent applications to be implemented for mobile devices.

Nowadays, almost all mobile phones available on the market support the programming language Java for Java 2 Micro Edition (J2ME). Many J2ME games already exist and enjoy great popularity, especially among youth. Java has become the object oriented programming language that developers use to implement new applications [1]. Applications which utilize the potentials of integrated GPS receivers and mobile devices are developed based on the J2ME architecture.

2. J2ME

At the Java One conference in June 1999, Sun Microsystems introduced J2ME for the purpose of developing special Java programs that are expressly designed to meet the needs of small mobile devices. Java Micro Edition (Java ME) is a collection of technologies and specifications that enables users to create platforms that take problems such as limited memory, display, power capacity and processor speed constraints associated with small mobile devices into consideration.

In order to support the kind of flexibility demanded by the mobile device market, the architecture adapted for the development of J2ME is modular and scalable. This modularity and scalability are defined by J2ME as three layers of software built upon the *Host Operating System* of the device.

3. BASICS OF GPS

The global positioning system (GPS) is a satellite-based navigation system consisting of a network of 24 orbiting satellites that are eleven thousand nautical miles in space and in six different orbital paths. The satellites are constantly moving, making two complete orbits around the Earth in just less than 24 hours [6]. Each Medium earth orbit satellite transmits precise Microwave signals. These GPS signals contain a 'pseudo-random code', ephemeris and almanac data. The pseudo-random code identifies which satellite is transmitting - in other words, an I.D. code. Ephemeris data is constantly transmitted by each satellite and contains important information such as the status of the satellite, current date, and time.

To determine a position, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received by the GPS receiver. The time difference tells the GPS receiver how far away that particular satellite is. It then adds distance measurements from a few more satellites, and triangulates the position. With a minimum of three satellites, a GPS receiver determines a latitude/longitude position. With four or more satellites, a GPS receiver can determine a 3D position which includes latitude, longitude, and altitude [6]. One of its biggest benefits over previous land-based navigation systems is that GPS works in all weather conditions [6]. Due to this, it has many applications - not only for military purposes such as target tracking but also for civilian purposes such as land surveying, and studying the precise motion of faults in earthquakes (Plate movements).

4. SYSTEM CONFIGURATION

To implement the "GlobeTracker" system, the following software is required:

- Java Development kit (JDK) version 1.5.0_13
- Eclipse Software Development Kit (SDK) version 3.3
- Eclipse ME version 1.7.6 or later
- Java Wireless Toolkit for CLDC version 2.5.1

5. GLOBETROTTER

GlobeTrotter [2] is a mobile based system which was developed to overcome the difficulties associated with changing maps and the charges that users need to pay in order to access the latest information. The developed "Globe Trotter" system is based on the J2ME architecture and its components. It combines different technologies such as GPS, NMEA 0183 and Google Maps to show the user's current location on a PDA's digital map using the Sun wireless Toolkit. The system displays the user's current location on a map such as Google Maps, Yahoo! Maps, MSN

Maps or Ask.com Maps on the screen of a mobile phone emulator by using a server library J2MEMAP on the server of <http://www.8motions.com>.

The developed system, as illustrated in Figure 1, reads in single NMEA 0183 sentences delivered by the GPS receiver and analyses them. The latitude and longitude format received from the GPS receiver is in the degree format of the World Geodetic System 1984(WGS84). WGS84 is the geodetic reference system used by GPS and was specified in 1984. A data conversion has been done since all maps (such as Google Maps, Yahoo! Maps or MSN Maps) use decimal longitude and latitudes. The “GlobeTrotter” system then establishes an Internet connection over which it sends HTTP requests to the 8motion server, providing it with the required map name, zoom, latitude and longitude. The emulator then simulates the received maps from map servers via the 8motion server and embeds the received maps into the screen around the user’s current location [2].

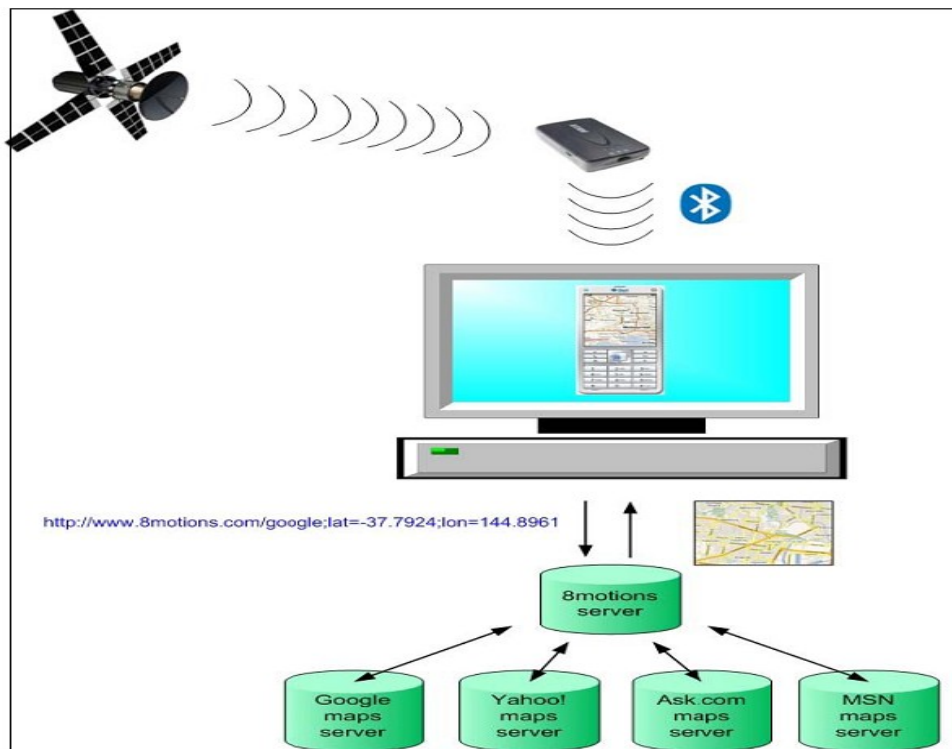


Figure 1. Functionality of “GlobeTrotter” [2]

6. DESIGN AND IMPLEMENTATION OF “GLOBETRACKER”

The “GlobeTracker” system is a further development of the “GlobeTrotter” system. The basic architecture remains the same but the implementation has been improved with some new added functionality. The system consists of a client application “GlobeTracker” running on the emulator using a server library J2MEMAP API on the server of <http://www.8motions.com/>. The data transferred by the GPS receiver is translated into a format recognizable to the specific map provider. The positions are stored in a database file in the memory of the devices using the RMS database management system.

The developed system reads the database file and tracks by using positions stored in the database file when requested by the user. The location of each user is shown on the map, with each user being represented by their corresponding numeric digit.

The “GlobeTracker” system also stores the current position in a KML file which is used to transfer the user’s location with an ID to a dedicated server. This server can also be used to determine the location of any user in a particular user group. The users of same group are assigned the same ID. The activity diagram for this implementation is shown in Figure 2. The system continuously listens to the port and each time it obtains new position data, it asks the user to update data in the file system of the device, as shown in Figure 3.

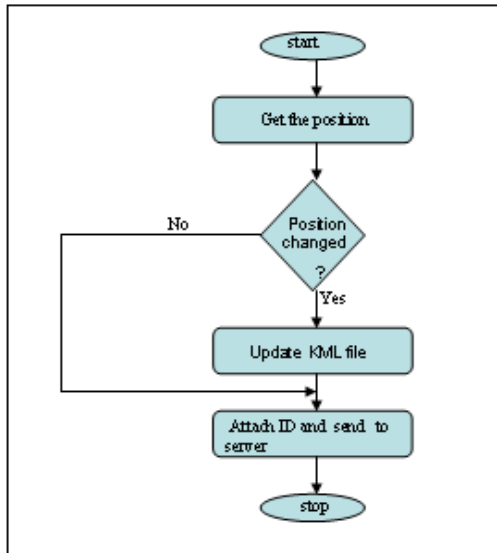


Figure 2. Flow chart for position locator

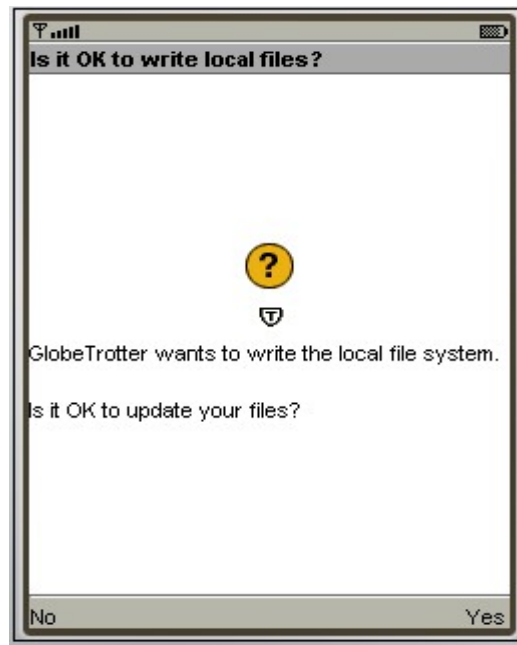


Figure 3. Access Control Diagram



Figure 4. Track points on Google map

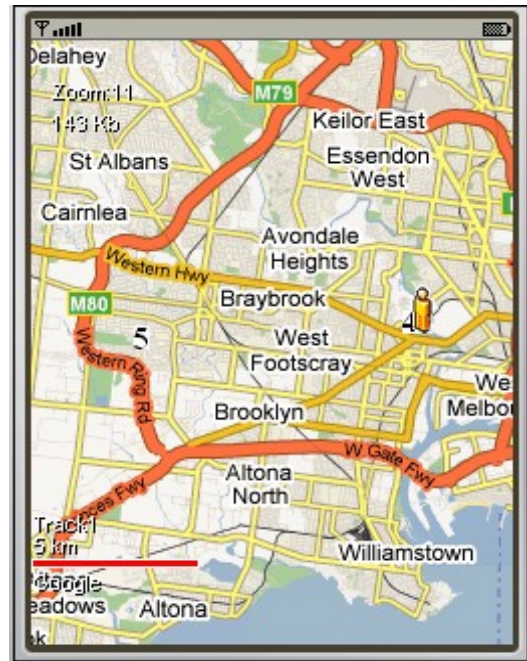


Figure 5. Track points on a large scale

7. EXPERIMENTAL RESULTS

To demonstrate the “GlobeTracker”, tracking performance representative position data has been collected at different locations in Victoria University. The tracked position can be displayed with just showing the current user location along with nearest tracking point such that zoom remains what user requests. Figure 4 shows five tracking points near Footscray Park campus. In some cases, not all tracking points can be seen at one time, as shown in Figure 5 at Footscray campus, because of zoom level restrictions on a small mobile device screen.

8. CONCLUSION AND FUTURE WORK

In this paper the design and Implementation of a new proposed “GlobeTracker” system has been presented. The entire system has been successfully tested and executed using the J2ME wireless toolkit and is ready for installation on mobile devices. This tracking system allows the determination of tracks travelled and displaying them on small mobile devices with the use of Google! Maps, MSN Maps or Ask.com Maps in real time.

This paper lays a path for the future development of a position locator system in real time with the help of a server. The implementation of the proposed system will provide a very handy small device for determining the position of users within the same group. The small mobile devices can be also used to locate children and elderly people in emergency situations.

ACKNOWLEDGEMENTS

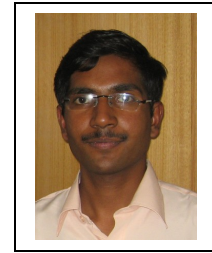
The authors would like to thank Faculty of Health, Engineering and Science, Victoria University, Australia for providing the three months internship in 2008.

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