Techniques for Group Management Application Development

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Abstract. A group management application is an Android application that monitors locations of students during field trips. This paper reviews existing group management systems. In the location-based service field, fleet management has been one of the most popular research topics. Group management is a kind of fleet management and fleet management is included in our review scope. Then, techniques for implementing group management systems such as indoor and outdoor positioning, database management, communication techniques, and Android application development techniques will also be discussed.

Keywords: Fleet Management, Group Management, Android, Mobile Application, Global Positioning System.

1 Introduction

A group management system provides many types of valuable services. For example, a teacher can be aware of current locations of all the students in real time during a field trip using a group management mobile application. In the early stage of location based service, fleet management was one of the hottest research topics. This paper reviews group management related research results.

Positioning, handling maps, handling a database and mobile programming are indispensable technologies for the development of fleet management systems. Usages of these technologies in fleet management system development are discussed.

2 Traditional Fleet Management

Traditional fleet management systems were location-based systems that managed a fleet of taxis, trucks, and vessels. Therefore, majority of them relied on the GPS (global positioning system) in order to obtain locations of moving objects. However, the civilian use GPS error was very big until several years ago. The differential global positioning system (DGPS) enhances the accuracy of GPS by using local reference base stations. A reference station knows the exact coordinates of the position where it...
is located. A reference station receives the GPS signal and calculates the difference between the exact coordinates and the received GPS coordinates. Then, it broadcasts the difference to the GPS users. These users adjust their GPS coordinates with the difference and achieve an accuracy of about 5 meters. Perez et al. [1] designed a base station that broadcasts the difference through VHF technology. An Intelligent Transportation System (ITS) monitors vehicles running in the nation and it can be considered to be a kind of fleet management system. In ITS, an autonomous vehicle location (AVL) attached on the vehicle is responsible to estimate the location of the vehicle. The AVL mainly relies on the GPS in determining its location and improves the accuracy with the dead reckoning technique. The AVL also uses the pre-defined points where it can always correctly determine its location [2].

3 Recent Fleet Management Systems

Backman et al. [3] proposed an idea of enhancing existing fleet management systems with the Internet of things (IoT) technology. A set of functionalities that the IoT-based framework for fleet management system should support are discussed. A fleet management system that improves road safety, energy efficiency and environment friendliness was proposed in [4]. In smart cities, fleet assets such as fire-engines, ambulances, trucks, drones, helicopters and so on should be efficiently managed in order to save lives and property in emergencies such as fires, traffic accidents, flooding, earth quakes, landslides, and so on. Polo et al. [5] proposed a location-based decision support system that efficiently manages fleet assets in order to maximize the utility of assets, minimize the dispatch time, and minimize the cost of operating assets.

Hajibabai and Ouyang [6] introduced a snow plow fleet management system that minimizes the cost for truck deadheading and repositioning while maximizes the benefits of plowing. The management problem was formalized as a dynamic programming. The approximate dynamic programming algorithm was used to solve the problem.

Lee et al. [7] proposed a wireless sensor network based group management application with which a guardian can monitor group tourists while they are visiting a large museum or an exhibition hall. This application service can be accessed by both mobile devices and desktops via the Internet. Every tourist in the group is supposed to carry a mobile device that is connected with each other by the wireless communication technology. The guardian's mobile device is also connected to the wireless network and collects location information of all mobile devices. The collected information is sent to the server. The server system informs the current location of the tourist to the parents of the tourist through the Internet. Using the ubiquitous medical sensor network, Tolentino and Park [8] developed a system that monitors patients all the time. This system collects vital sign data from patients. Medical doctors analyze the collected data. In the adverse health situations, they ask the emergency medical team to take care of the patient.

Won et al. [9] proposed a management system for a fleet of dangerous goods vehicles. The server system of this management system consists of the path, journey,
vehicle, accident management systems and is connected with the national intelligent transportation system to exchange information of road construction, accidents, and construction. The vehicles are equipped with a mobile device that checks itinerary, gives real-time alert for driving condition, displays points of interest, and monitors vehicle conditions.

Recently, it frequently happens that a very contagious animal disease such as foot-and-mouth disease and avian influenza rapidly spreads throughout the nation and leaves countless animal casualties. Kang et al. [10] proposed an Android application that can be used to prevent the spread of animal disease. The application system monitors vehicles and provides the information of "which vehicle visited or passed by which farm". This information can be used to minimize the damage made by animal disease.

### 4 Techniques to Implement Group Management Systems

Android system provides API (Application Program Interface) with which we can obtain the location of an Android mobile device. We have to specify permission in the manifest file.

```xml
<uses-permission android:name="android.permission.ACCESS_FINE_LOCATION"/>
<uses-permission android:name="android.permission.ACCESS_MOCK_LOCATION"/>
```

In the Android application, we invoke the requestLocationUpdates method in the LocationManager class. Before the invocation, the GpsLocationListener should have been implemented.

```java
mGpsLocMan = (LocationManager) getSystemService(LOCATION_SERVICE);
mGpsLocMan.requestLocationUpdates(LocationManager.GPS_PROVIDER, 5000, 3, GpsLocationListener);
```

For indoor positioning, we can use Android sensor values as the features of a fingerprint of a reference position (RP). In order to collect sensor values, we use the SensorManager class. There are many sensors installed on an Android smartphone. For example, in order to collect accelerometer value, we need to obtain an accelerometer sensor and register the listener as follows:

```java
mSM = (SensorManager) getSystemService(SENSOR_SERVICE);
Accelerometer = mSM.getDefaultSensor(Sensor.TYPE_ACCELEROMETER);
mSM.registerListener(this, …SENSOR_DELAY_FASTEST);
```

### 5 Conclusion

In the early stage of location-based service, fleet management was one of the hottest research topics. Cabs management system was one of the typical fleet management systems. When a customer makes a call to the taxi company, the cabs management
system finds the closest taxi to the customer and sends it to the customer. Since fleet management systems provide such useful services, similar services should be available in buildings. As an indoor version of fleet management system, this paper introduced a group management system and discussed technologies needed in development of group management systems. For the future work, we are developing a prototype group management system.

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References