Location Tracking Strategy Indicating Sufferers' Positions under Disaster in the Buildings

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Abstract. The advancement of location-based services now covers indoor location positioning. Under disaster in the building, the sufferer might faint, be wounded, or enclosed by structures in the dark. In the cases, the sufferer could not let the relief team know her position in the building. The LBS server provides location tracking or positioning of her device for quick relief. In the service UltraWideBand is used by its good penetrability. In dead-reckoning operation that the device is lost on the sensor network, the relief team traces logged profiles of location tracks. The strategy regards the privacy concerns.

Keywords: Location Based Service, Ultra Wide Band, Disaster and Relief, RFID, Sensor Network.

1 Overview

Location-based Services, LBS, have been developed from outdoor ones to one for indoor ones. Most of outdoor LBS employed Global Positioning System, GPS, and equipped on vehicles and vessels. From the conveyance-oriented application of vast ranges, the issues of LBS have covered to the human-oriented application of narrow domains nowadays in the paradigm of ubiquitous networking. During indoor life, there have been many disasters including collapse, fire, and flood. Under the disaster, the location tracking or positioning of the sufferers is essential for quick relief.

Indoor LBSs are distinguished by several wireless communication technologies including WiFi, Infrared, Supersonic, Bluetooth, RFID and UitraWideBand. In WiFi, the device measures the signal strength of RF signal. Microsoft RADAR[1], Ekahau[2], Intel Placelab[3] adopted WLAN. AT&T Lab.'s Active Badge[4] uses Infrared, and Active Bat[5] uses Supersonic technologies. Bluetooth exploits RSSI(received signal strength intensity). SpotON[6] uses RFID, and Ubisense[7] Ubitag uses UWB. Among the wireless communications, UWB has appropriate characteristics such as low consumption, wide spectrum frequencies, high resolution and most importantly, good penetrability for indicating sufferers' position behind non-metal structures. Furthermore the signal reaches near 50*m*, which is considered to be a suitable distance to LBS in the buildings.

While wireless communication is alive, indicating sufferers' locations is positive, but while it is not, alternative-indicating method should be necessarily prepared. For

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dead- reckoning operation, one alternative method is logging profiles of location tracking. A LBS server logs a profile of the device's movement in the building only. The device's location is traced along the logged profile in dead-reckoning operation.

2 Location Tracking to Indicate Sufferers' Positions

The calculation task of the sufferer's position could be processed in ether the device or the LBS server. If the task is processed in the device, the device may consume its power earlier and it is not desirable situation under disaster. Thus the LBS server takes calculation tasks of the devices. The device merely transmits its beacon signal at regular intervals. Fig 1. depicts the location positioning of the devices.

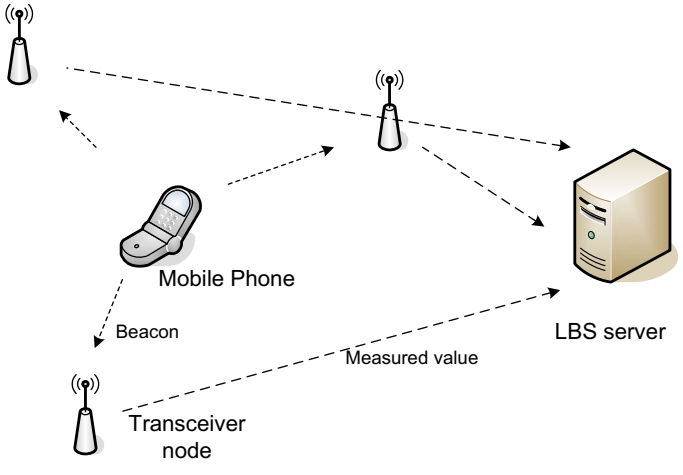

Fig. 1. The LBS server calculates the positions of the devices

Under disaster, the relief team moves with the location tracking devices, *Indicator PDA*s, to find the sufferers out. The Indicator PDA calculates its position not to burden the LBS server important for finding out the sufferers. In this situation, the transceiver also transmits their beacon signals to send their status. For the locations of some transceiver nodes might be changed by disaster, more than 3 transceiver nodes are used in location positioning of multiple trilaterations with multiple sets of 3 nodes. The Indicator PDA sends its calculated position for logging of their positions. Fig. 2 depicts the location positioning of the Indicator PDAs.

The positions of other devices near are indicated on the Indicator PDAs. The console of the LBS server becomes a part of the command post. All the active devices and Indicator PDAs are shown on the console screen. In the case the LBS server is off-line, the indicator PDA should process the calculation task of its position together with other devices' positions transmitting their beacon signals. Therefore the team carries multiple Indicator PDAs.

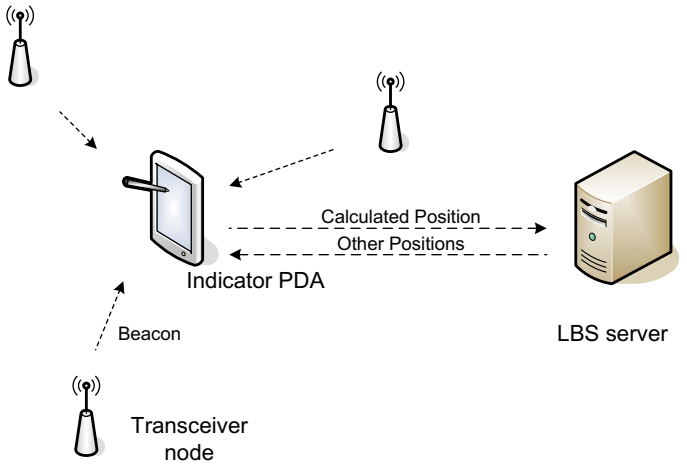

Fig. 2. The Indicator PDA calculates its position and sends it to the LBS server

3 Location Tracing in Dead-Reckoning Operation

Under disaster, there are many cases the device does not work. The sufferer may be located behind a metal structure. The required transceiver node may malfunction or not work within domain. The device could be lost or broken, and its battery could run out. For the cases, the LBS server logs a profile of the device's movement in the building only. The logged profile contains the ID assigned instantly during residence in the building, and positions along times. This profile is created on entrance, and deleted on exit of the building, for privacy concerns.

If there are IDs assigned but do not appear on the sensor network, the LBS server displays the IDs and shows their tracks and final locations. The relief team would deliver more transceiver nodes around the final locations. For the safety of logged profiles duplicating the LBS server is required.

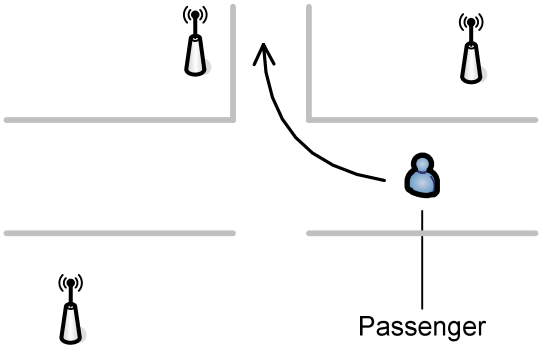

Fig. 3. Location tracking for use in dead-reckoning operation

For the people who don't carry any device, an RFID solution may be practical; allocating RFID tags at entrance and recollecting them at exit of the building. The transceiver nodes have RFID readers and sends location tracks to the LBS server as shown in Fig. 3. Those people are only traced by logged profiles. For example, the passengers of railway stations receive tickets with RFID tags. On departure, the passengers have exited the station and on arrival, the passengers have entered another station. They return their tickets with RFID tags and then disappear from the sensor network of the station.

It is crucial how wireless communications could be well transmitted under disaster including fire, flood, and collapse. Although UWB has a characteristic of good penetrability, there may be many obstacles to transmissions under disaster. The LBS system itself could be damaged, and thus a group of Indicator PDAs could be the only counted on. For this situation, the Indicator PDAs should form an ad-hoc network replacing the LBS server off-line.

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