The Eighteenth International Symposium on Artificial Life and Robotics 2013 (AROB 18th '13),
Daejeon Convention Center, Daejeon, Korea, January 30-February 1, 2013

Design of a user-support system for finding the other person talking on smart phones

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Abstract: In this paper, we have designed a user-support system for finding the other person using smart phones. When users of this system talk over smart phones, it displays a map on the screen showing locations of both talkers as they share position information (GPS information) via a support server. Using this system, the user can check where to wait for other persons. It also enables the user to search for a lost child or to search for an illiterate person who wandered off and can't return. In our system, the position of searchers is also displayed on the terminal of the person being searched for, so the child or illiterate person can check the searcher's position on the screen of the smart phone in real time while talking.

Keywords: User Support System, Smart Phone, GPS

1 INTRODUCTION

Recently, many multifunctional cellular phone terminals, such as smart phones (e.g., Androids and iPhones), have been developed as a result of the evolution of the computer, network infrastructure, and lightweight battery technology. Thus, the number of users is rapidly increasing [4]. The smart phone is equipped with various sensor systems (e.g., GPS, an acceleration sensor and an infrared sensor). Furthermore, easily programmed applications acquire input from each function. Various research activities and services are provided by a smart phone using such features [1, 2, 3, 6]. Examples are the study of service applications using the GPS function such as car navigation systems and store searching services, so various location-based services have been developed [6]. In addition, one service can locate the person being talked to on a map through advanced mutual registration among users. These services are realized by making maximum use of the GPS function in a smart phone, but the telephone call function is not utilized. A user checks where the other person on the phone or a telephone call location is after completing the telephone call.

We have therefore designed a user-support system for finding the other person using smart phones. When users of this system talk over smart phones, it displays a map on the screen showing locations of both talkers as they share position information (GPS information) via a support server. Using this system, the user can check where to wait for other persons. It also enables the user to search for a lost child or to search for an illiterate person who wandered off and can't return. In our system, the position of searchers is also displayed on the terminal of the person being searched for, so the child or illiterate person can check the searcher's position on the screen of the smart phone in real time while talking.

In this research, we designed a function to manage the position information using the smart phone's GPS, a function to manage a telephone call, and a support server that enables information sharing between smart phones. The function to manage a telephone call records the telephone number of the caller and the called persons. The support server recognizes the connection as a key for the telephone number information and determines the positions by sharing GPS information. A map showing the caller's position and that of the called person is then displayed on the screens of the smart phones during the telephone call.

2 SMART PHONE

In our study, we use HTC Desire SoftBank X06HT as a smart phone (Android phone). The smart phone is similar to a small laptop personal computer. However, a smart phone has a telephone call function, and it is easy to carry because it is small and light. Its display is rather small, and it does not have a keyboard. Moreover, the development of an Android smart phone is comparatively easy because the development language basically conforms to Java in the Android application. In our research, we regard a smart phone as a general portable computer terminal that has a telephone call function, and enable cooperation with the various personal computer terminals that the user uses.

2.1 Communication Facility of the Smart Phone

Some kinds of communication facilities can be used with the smart phone. The wireless LAN is a wireless communications function that can communicated at a maximum speed of 54Mbps, which the computer terminal uses. Its use requires a connection to a wireless LAN router. 3G high speed

is basically a communication facility intended for the cellular phone, and the wireless communications function can communicate at a speed of 7.2Mbps or less. Its use requires a contract with the communication enterprise, and the cost corresponds to the wire traffic. Bluetooth is a wireless communications function that connects to a computer terminal by a PtoP connection and can communicate at a maximum speed of 2.1Mbps. Connection requires paired setting with a connected terminal (only once).

2.2 API for Telephone Use

By using API [5], the Android application can call another phone and recognize the use state of its own phone. Additionally, API (android.telephony.TelephonyManager) dynamically identifies calling and receiving, and the following information can be collected.

- Ringing State (CALL_STATE_RINGING):

  The ringing state is the state by which a telephone call is received. The calling person's telephone number can be identified.

- Off-hook State (CALL_STATE_OFFHOOK):

  When the telephone receiver is raised in response to a received call, the ringing state changes to the off-hook state. It can be assumed that the smart phone is calling another phone when the idle state changes to the off-hook state.

- Idle State (CALL_STATE_IDLE)：

  A change from the ringing state to the idle state of the standby mode means no response to a call. A change from the off-hook state to the idle state means the telephone call ended.

The API is a function basically intended for receiving; when sending, not much information can be obtained. The obtained information involves calling and ending only, and the telephone number and whether it was possible to talk over the telephone cannot be confirmed. Therefore, it is necessary to acquire information about the calling telephone number and the calling person's response after the end of telephone call by using the API (android.provider.CallLog.Calls) to acquire the vita information prepared for the Android phone.

2.3 GPS Function and API of the Android Phone

The Android phone has a GPS function and a variety of other sensor systems (e.g., acceleration sensor, brightness sensor, and temperature sensor). GPS and each sensor can confirm a change of sensor value by using the sensor manager API (android.location.LocationManager, android.hardware.SensorManager, etc.). It is also possible to use android API (com.google.android.maps.*), which displays its location information on a map easily in combination with a Google map.

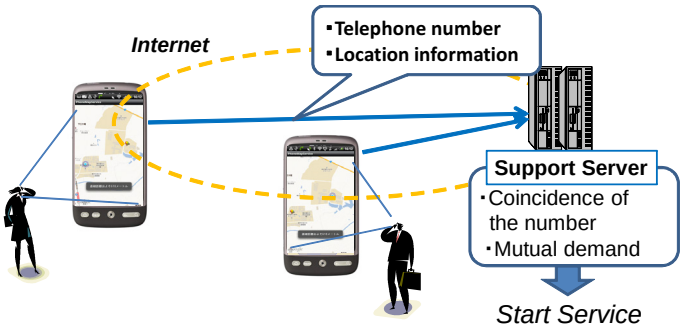

Fig. 1. Illustration of using our system

3 SYSTEM ARCHITECTURE

In our research, we designed a user-support system for finding the other party using smart phones. When users of this system talk over smart phones, the system displays a map on the screen showing locations of both talkers as they share position information (GPS information) via a support server (such as Fig. 1). Using this system, the user can determine where to wait for other persons. In our system, the position of searchers is also displayed on the terminal of the person being searched for, so the user and other person can check each other's position on the smart phone screen in real time while talking.

In this research, we designed a function to manage the position information using the smart phone's GPS, a function to manage a telephone call, and a support server that enables information sharing between smart phones. The function to manage a telephone call records the telephone number of the caller and the called persons. The support server recognizes the connection as a key for the telephone number information and determines the positions by sharing GPS information. A map showing the caller's position and that of the called person is then displayed on the screens of the smart phones during the telephone call.

Figure 2 depicts the structure of the user-support system for finding the other party using smart phones. The modules in this system have the following roles.

- The Telephone Monitor Module monitors the transmission and reception of a telephone. This monitor informs the User Support Module when a telephone call is transmitted or received; it also informs the User Support Module when the call is terminated.

- The User Support Module transmits a request for map-sharing service to the Support Server by using the

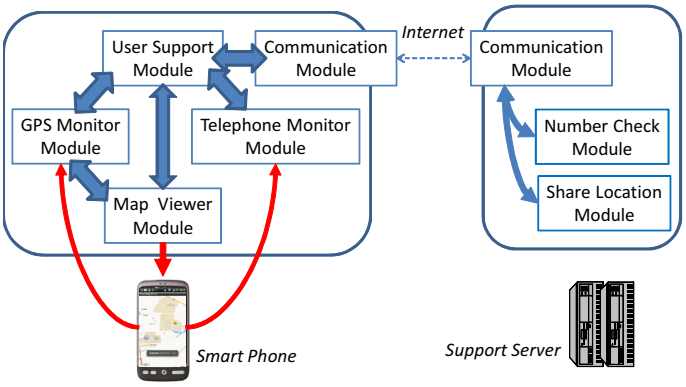

Fig. 2. Structure of the user-support system for finding the other party talking over smart phones

caller's and the called person's telephone number as a key when transmission or reception information is received from the Telephone Monitor Module. During map-sharing service, the partner's GPS information is received from the Support Server, which it then transmits to the Map Viewer Module. This module receives the caller's GPS information from the GPS Monitor Module and transmits it to the Support Server. This module terminates map-sharing service when the telephone call is terminated.

- The GPS Monitor Module continues monitoring own GPS location information during map-sharing service. When location information changes, this module reports the change to the Map Viewer Module and the User Support Module.

- The Map Viewer Module displays a circumference map during map sharing service, and displays the location of the caller and the called party on the map. This module also displays the distance brtween the parties.

- The Communication module functions as an agent between the Smart Phone and Support Server through the Internet.

- The Number Check Module receives the request from the User Support Module of the Smart Phone in the Support Server. This module determines which Smart Phone made the telephone call by detecting the combination of the caller's called party's telephone numbers and starts the map-sharing service.

- The Share Location Module exchanges location information between the Smart Phones engaged in the telephone call during map-sharing service.

4 SYSTEM IMPLEMENTATION

In order to achieve the system depicted in Fig. 2, we implemented each module on the smart phone (Android phone) and a server machine. Each module in the Android phone can be implemented using Android SDK [5] via a computer terminal. Since the programming language is basically similar to Java, we used Java language for implementing all modules.

4.1 User support tool on the Android Phone

The telephone monitor module dynamically monitors the telephone call using the Android telephone API described in section 2.2. When the situation changes, this module sends information to the user support module with additional information (e.g., telephone number).

The GPS monitor module dynamically monitors the location of the smart phone using the Android GPS API described in section 2.3. This module checks location information (latitude and longitude) for every second.

Based on the caller's and called party's location information, the map viewer module creates a map and displays it on the smart phone screen. Map information is created and displayed using the Android GPS API described in section 2.3. The map scale is automatically adjusted so that both parties in the telephone conversation can be indicated on the map.

The user support module consists of the state change rule for starting map sharing service automatically according to the use situation of a user's telephone. By recognizing telephone call transmission or reception, this module requests the support server to initiate the map-sharing service through the communication module. In addition, in the present configuration, the user support module judges whether the service is used for the caller her/himself. After service starts, this module shares location information with the other party through the communication module and the support server.

The communication module exchanges messages with the support server using socket communication (a smart phone becomes the client side of socket communication). This communication can use either Wi-fi or 3G communications.

4.2 Support Server on a Server Machine

The number check module compares the telephone numbers of the caller and the called parties and uses the telephone numbers to specify the intended user. This is possible because the telephone monitor module can identify both the caller's and the called party's telephone number.

The share location module exchanges position information over the smart phones identified by the number check module. This function terminates when the telephone call ends.

The communication module exchanges messages with the support server using socket communication (the Support Server becomes the server side of socket communication).

(a) Start (b) moving (c) Finding and meeting

Fig. 3. Flow of our system. The users can check the location of the other party on the map while talking and moving, until they find each other and meet.

4.3 Flow of User Support via Map Sharing

By using our user support system, the called party can access the map sharing service during the telephone call as in figure 3. Figure 3 depicts using our user support system to meet a new enrollee at the main front gate of our university. At this time, the new enrollee has arrived at another gate instead of the main gate (Fig3(a)). The user talks to the enrollee over the telephone and moves around the campus (Fig. 3(b)) until finding and meeting the enrollee (Fig. 3(c)).

Figure 3 is displayed on both caller's and the called party's smart phone, so the called party can confirm that the user her/himself approaches talking over the telephone. Moreover, the separation distance can also be displayed, so it is possible to estimate the time of meeting. In general, such service is useful and also enables the user to search for a lost child or for a mentally incapacitated person who has wandered off and can't return by themselves.

5 CONCLUSION

In this paper, we have designed a user-support system for finding the other person using smart phones. When users of this system talk over smart phones, it displays a map on the screen showing locations of both talkers as they share position information (GPS information) via a support server. Using this system, the user can check where to wait for other persons. In our system, we designed a function to manage the position information using the smart phone's GPS, a function to manage a telephone call, and a support server that enables information sharing between smart phones. The function to manage a telephone call records the telephone number of the caller and the called persons. The support server recognizes the connection as a key for the telephone number information and determines the positions by sharing GPS information. A map showing the caller's position and that of the called person is then displayed on the screens of the smart phones during the telephone call. It also enables the user to search for a lost child or to search for an illiterate person who wandered off and can't return. In our system, the position of searchers is also displayed on the terminal of the person being searched for, so the child or a mentally incapacitated person can check the searcher's position on the screen of the smart phone in real time while talking.

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