A General Architecture of Mobile Social Network Services

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ABSTRACT

The widespread use of cellular telephones and the availability of user-location information are facilitating personalized location-based applications. The subscribed services that exist today have aimed to address the needs of entertainment, blind dates, and finding friends or family. In this study, we explore the possibilities of mobile social network services (MSNSs) in the context of social services. The research was started with an aim to use mobile social network services as a measure to increase social connectedness and improve the quality of life for the majority of otherwise employable persons who remain unemployed, rarely access appropriate community services, and are socially isolated. An interactive, multimedia, location-based application approach has been proposed to address the needs that frequently arise in the field work of providing supportive social services. Combining location aware search technology and personnel profile matching, the proposed modular and general architecture enables social workers, their colleagues, and other participating professionals to keep each other connected, informed, and organized as a mobile community and a supportive network for those in need. One of the advantages of the proposed architecture is that no new location modules have to be implemented inside the Wi-Fi distribution network or cellular's core network. Furthermore, mash-up of web services is used; this approach makes the architecture more modular and easier to leverage existing web services. A prototype has been implemented and the results are presented.

Keywords

Social Services, Ubiquitous Computing, Mobile Social Network Services, Cognitively Impaired, Matching Algorithms.

1. INTRODUCTION

In this paper, we study a general architecture for building mobile social network services (MSNSs). Social networks are personal or professional sets of relationships between individuals. MSNSs are technology-enabled services that adopt wireless and mobile communications to increase the closeness of one's social networks. Social networks represent both a collection of ties between people and the strength of those ties [1]. People often seek information by asking other people in their social network even when they have access to vast reservoirs of information such as the Internet and libraries. This is because people are great sources of unique information, especially that which is location-specific, community-specific and time-specific [2]. Often used as a measure of social "connectedness", recognizing social networks assists in determining how information moves throughout groups, and how trust can be established and fostered. As Watts, J Duncan puts it [3]: "In the connected age, what happens and how it happens depend on the network." Mobile communication technology enables ubiquitous access which has the potential to create scenarios of increased human interactions in forms of computer mediated communication.

In the recent years, metropolitan Wi-Fi network projects have been launched in many cities and towns worldwide. Access Points (APs) become part of triangulation schemes in location technology. In the meanwhile, Global Positioning System (GPS) and cellular network assisted location technology is becoming mature and affordable. The combination of wireless communication and location technologies makes it possible to develop location based services (LBSs).

New methods of collecting data on social networks have emerged with the prevalence of the Internet and ubiquitous mobile social network services [4, 5]. User-location information is frequently used in mobile social network services. Although LBSs have been existing for some time, most of these applications are carrier-triggered where the user subscribes to the services and the system decides to send text messages when a predetermined condition is met. The availability of user-location information makes a difference between today's applications and the ones considered in our architecture. Most current mobile social network services work on a "push" basis; the system sends information, which is related to the user's location, to the user. The user normally does not have the capability to query for the information that is provided by someone or

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the user at some specific location. Therefore, the messages received can become occasionally irrelevant. For examples, one can receive traffic congestion alerts about Taipei while on a business trip to Tokyo.

Therefore, this paper proposes a general architecture capable of supporting location-based, personalized, interactive mobile social network services using mainly metropolitan Wi-Fi networks in the context of social services. The research was started with an aim to use mobile social network services as a measure to increase social connectedness and improve the quality of life for the majority of otherwise-employable persons who remain unemployed, rarely access appropriate community services, and are socially isolated. One of the advantages of the proposed architecture is that no new location modules have to be implemented inside the Wi-Fi distribution network or cellular's core network. Furthermore, mash-up of web services is used; this approach makes the architecture more modular and easier to leverage existing web services.

The rest of the paper is organized as follows. In the following section, we review the existing research and commercial operation of mobile social network services. Then we describe the main components of the proposed architecture and the interactions among its modules for mobile social network services in the context of social services. Implementations and experimental results are presented next. Conclusions are discussed in the last section.

2. RELATED WORK OF MOBILE SOCIAL NETWORK SERVICES

It has been shown that the use of Short Message Service (SMS) often leads to face-to-face meetings [6]. Also a recent study into the effects of integrating a SMS function to an online community has shown SMS can be effective in increasing cohesiveness and engagement in that community [7]. It has also been noticed that the use of PDAs can facilitate social interaction [8].

Some applications of social network services on the Internet have grown famous and recruit significant number of members. Buzz-oven [9], Myspace [4], GoPets [10], Friendster [11], Dodgeball [5], Plazes [12], Jambo Networks [13], and playtxt [14] are just a few examples of commercialized operations. Plazes [12] is a location-aware interaction system that helps mobile users hook up with friends or other like-minded people anywhere on the globe. Jambo Networks [13] uses Wi-Fi-enabled laptops, cell phones, and PDAs to match people within walking distance who have similar interests and would like to meet face to face. In the UK, playtxt [14] helps mobile users locate nearby friends, friends of mutual acquaintances, or even strangers with matching preferences. Reno [15] mobile phone application users can query other users about their location and disclose their own, either in response to another query or unprompted.

A study into the effects of a wireless on-line community network on social capital has shown student representatives of a college student union increase their engagement and participation in campus student affairs with the use of Wi-Fi enabled handhelds and access to campus-wide wireless community network [16]. The on-line community network in [16] consisted of an instant messenger service, a SMS service, a forum (which was moderated), a personal information section featuring photographs and personal details of all participants in the experimental and student union groups, and a feedback section. The primary reason for this is that Internet use enhances social relationships [17].

In terms of architecture, the location-based services in [20] are based on Common Object Requester Broker Architecture (CORBA) and the Java-based Remote Method Invocation (RMI). In addition, the location-based information has to be processed and transported in the carrier network in the so-called LBS application programming interface (API) server. Therefore, their architecture is tightly coupled with telecom operator's core network; the implementation of CORBA and RMI over cellular networks can be costly and time-consuming. On the contrary, our architecture sees Wi-Fi and cellular networks as TCP/IP pipes; no new API has to be implemented inside the Wi-Fi distribution network or cellular's core network. The proposed architecture uses mash-up of web services instead of the middleware platform such as CORBA or RMI. Therefore much fewer APIs are actually needed. This approach makes the architecture more modular and easier to leverage existing web services such as Google Maps.

3. MSNS SYSTEM ARCHITECTURE

Based on the context of social services, the proposed system architecture is shown in Figure 1. It consists of four main components: the Client Devices; the Wireless Access Network; the Internet and its hosts; and the Server Side that accommodates database and application-specific servers required in our system.

There is a location module at the client devices. The module handles the end-system device hardware and returns the requested user-location data to the application, regardless of the type of technology or method of implementation that actually calculates the user's location. For example, Wi-Fi or GPS are commonly used to estimate the current location of the user. GPS requires a clear view of sky to function properly. Therefore, for the need of social services that take place indoors, Wi-Fi location technology is selected instead of GPS. An indoor positioning system using wireless LANs has been proposed and implemented in [19].

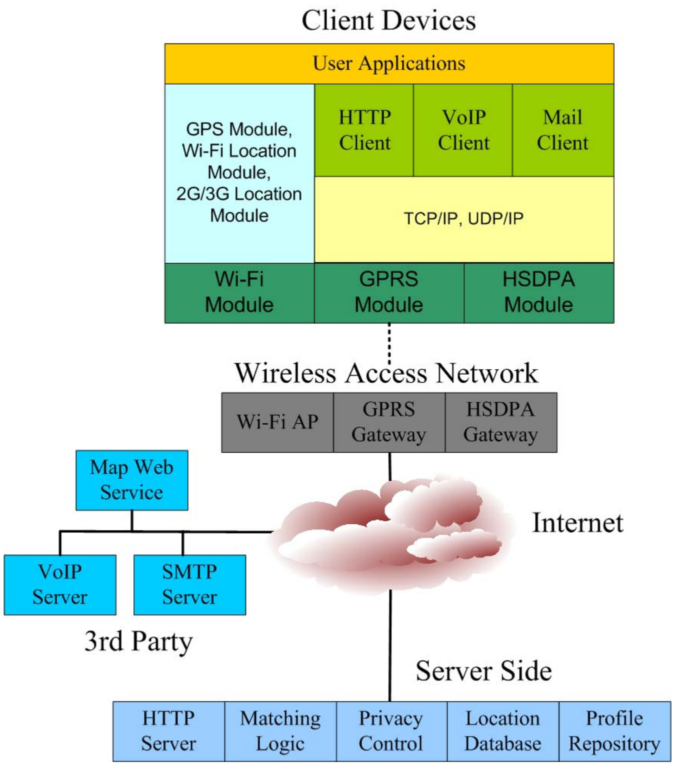


Figure 1. System architecture for mobile social network services in the context of social services.

By using Web service technology, the location module can be queried by any Web application to obtain a handheld's location without having to install any third-party software on the client devices. When queried by a Web application, the location module returns the location of the handheld in an Extensible Markup Language (XML) format to the Web server that initiated the request. Furthermore, the client devices provide instant messaging, email, web access, and Voice over IP (VoIP) on Wi-Fi or cellular data connectivity.

The Wireless Access Network serves as TCP/IP pipes over their underlying infrastructure. For example, a carrier network can use High Speed Downlink Packet Access (HSPDA) or General Packet Radio Service (GPRS) to facilitate data traffic. The proposed architecture simplifies carrier networks by removing carrier assisted positioning as proposed in [18] to minimize the changes made to the core cellular network.

The Internet component consists of third party application servers such as SMTP Mail Server, VoIP Server, and Map Server. Map Server provides Map Web Service that processes the user's location and displays it on a geographical map viewed on a Web page. There are publicly available map servers that can be utilized for this and that provide well-defined, albeit proprietary, APIs. The application servers in the Internet component can also be deployed in the Server Side.

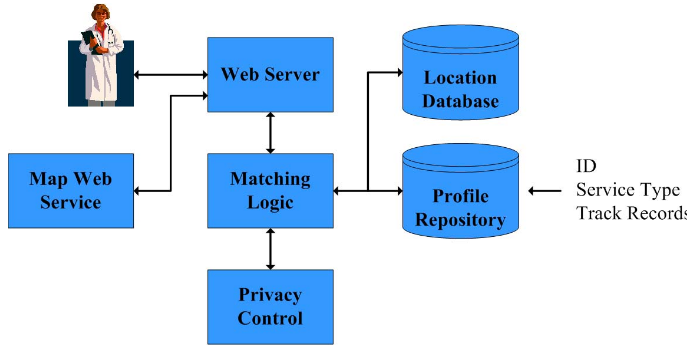


Figure 2. The modules at the Server Side interacting with each other and web services from the Internet.

There are five modules at the Server Side: Web Server, Location Database, Profile Repository, Matching Logic, and Privacy Control. As shown in Figure 2, Web Server that runs the http protocol is the data bearer that handles requests from the user and provides responses to it. Web services on the Internet, such as Google Maps, can be mashed up with the application-specific services at the Server Side. Location Database is responsible for storing AP and Base Station (BS) location coordinates so that the client devices can use to estimate their current locations based on the beacons from nearby APs/BSs.

In Figure 3, the sequence diagram of the complete interactions is depicted in detail. At Phase I, a service user logins, the location module within the user device tells the Server Side the IDs of APs/BSs that the device detects, and then it retrieves those AP/BS's location data managed by Location Database. Based on the returned AP/BS's location data, the location module computes the user's current position. The position is updated when the nearby AP/BS's change. The device periodically, say per minute, tells the Server Side its current position. For reasons of privacy, the user can choose to turn off the reporting of positions anytime. After the login, the user can also designate the service type. The location is only one of the attributes for service requests. Screening irrelevant location information and proper isolation are designed through profile matching at Phase II. Profiles consist of personal traits, experiences, qualifications, service track records, and so on. The matching logic module is responsible for picking out desired locations of persons whose profiles match the requested service. People are matched with certain information they provide and also with the service type they related to. After people are matched, they could examine each other's qualification to determine whether to proceed to interact with each other.

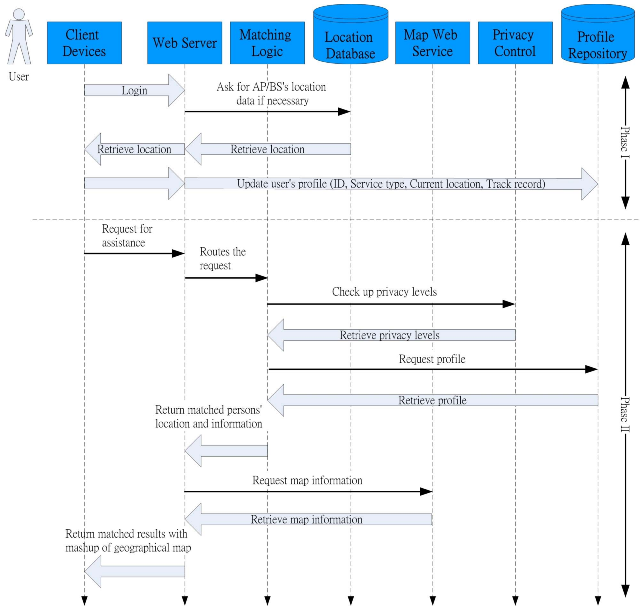
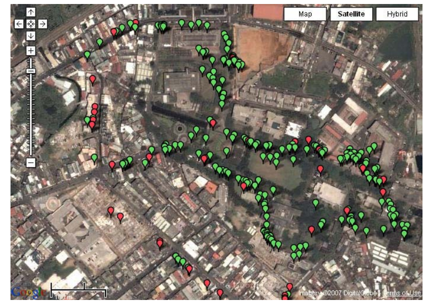


Figure 3. The sequence diagram of the complete interactions among modules at the Server Side, user involvement, and Web services from the Internet.

Privacy control is an essential function required to ensure the secure process of interacting with others. Mobile social network services handle the location information of service requesters and users based on the express consent of both parties to protect both sides from malicious users. In case of needs for face-to-face contact, the participants can decide whether they would meet based on the credit information retrieved from the profiles. Participants should have full control over their preferred anonymity. That is, personal information should be set into different levels of privacy. The participants can classify the potential or known targets into different level of "relationships closeness" so that these targets could range from having only limited to full access to the information that the participants would like to disclose.

4. PROTOTYPE IMPLEMENTATION AND RESULTS

Many applications can be developed utilizing the proposed MSNS architecture. A MSNS prototype system is currently being developed in Taiwan to help social workers with the field work. As more and more social workers find themselves nomadic, mobile social network services deployed in the context of services reduce hassle and bustle by saving trips and phone calls and making essential information available anytime and at any place. The project team consists of psychologists, social scientists, welfare policy researchers, social workers, engineers and professors with IT industry practices and experiences.

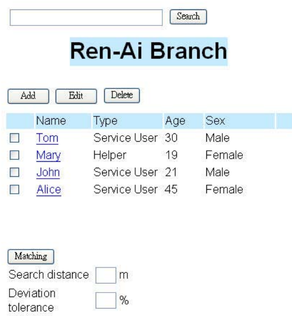


(a)

(b)

(c)

(d)



(e)

(f)

(g)

(h)

Figure 4. A prototype system.

The majority of otherwise-employable persons with mental disorder remain unemployed, rarely access appropriate community services, and are socially isolated. The prototype system is designed for job coaches at several Taipei-based rehabilitation institutes funded by a government-sponsored social work program. The job coaches, who work with adults with mental disorder to support them in learning new jobs and maintaining paid employment, may work for weeks helping a person learn how to travel to and from the work, and even then, the individual may at times still require assistance. To relieve the job coaches from labor-intensive aids with wayfinding, a PDA is carried by the individual who has difficulty in taking public transit to and from work. The PDA shows the just-in-time directions and instructions by displaying spot photos [20], triggered by pictures of geo-coded QR codes taken by the built-in PDA camera. However, the persons who carry the wayfinding PDAs may at times need assistance when they find themselves lost somewhere and cannot make themselves understood where they are. The server at the heart of the prototype detects the person who has deviated from the preset route to and from the work, and then the matching module tries to locate the job coaches who are within a distance from the lost person. The alerts are sent to the PDAs of the matched job coaches, and one of them may confirm with the availability of coming to the help.

In Figure 4 (a), a testbed with 410 APs is shown on a campus map where the location information is provided with the Google Map [21]. Each AP is represented by a dot on the screen. Secured APs are in red while unsecured ones are in green. The PDA is equipped with Wi-Fi, Bluetooth, GPS, and a built-in camera with 2 million pixels. The Wi-Fi location module installed in the PDAs consists of Navizon [22] APIs, which are GPS-free location software package. In Figure 4 (b), the QR-code picture is placed to be taken by the PDA camera to guide the individual with mental disorder. In Figure 4 (c), the just-in-time direction is shown on the wayfinding PDA. In Figure 4 (d), the lost person is located and shown on the Web interface as a red bubble. The matched job coaches are marked in blue. The accuracy of Wi-Fi positioning is a critical factor to the success of the prototype.

In the evaluations, four observations of deliberately lost persons are made, one in the Quad of the campus, another at the front of Main Library, yet another outside the Administration Hall, and the other at the entrance of College of Humanity Studies. For the reason of viability, low-cost of handhelds with Wi-Fi but no GPS or cellular positioning capabilities are used in the evaluation. In each observation a professional handheld GPS of accuracy within 10 meters is used separately to measure the observed coordinate readings from the prototype. The errors within 10 meters in accuracy are 44, 7, 7, and 7 meters respectively.

The help providers and service users of certain service type can be defined as a group managed by the supervisor of the social service, as shown in Figure 4 (e). The matching criteria are defined by the supervisors according to professional knowledge and experiences as well as feedback from practice results. In Figure 4 (f), all the service types can be viewed or modified, and new groups can be added by the system owner of the prototype.

5. CONCLUSIONS

User-location information along with advances in information technology and communications are facilitating the development of many personalized, multimedia, interactive, mobile social network services that will add convenience and welfare to people's everyday lives. This paper has described a general MSNS architecture utilized to support these types of applications. The proposed architecture can support both indoor and outdoor positioning, function without changes to the core cellular network, use mash-up of web services, and take into account the issues of mobile social network services in the context of social services.

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