Abstract

Social Networking applications have gained immense popularity amongst students in the last few years. Unfortunately, all such services currently require internet connectivity which inhibits their usefulness when a person is on the move. In this paper we describe a mobile platform, Marauder’s Map which enables social networking on the go, by allowing users to keep track of their friends and their activities in a peer to peer fashion using a novel human-based social network routing protocol.

1. Introduction

Social Networking applications have gained immense popularity amongst college students in the last few years. This has been fuelled by the need to constantly try and locate one’s friends either for serious matters such as getting together for a group study session, or for social occasions such as organizing a party. Unfortunately, all the social networking services currently available like Face Book [1] and Orkut [2] require the user to have access to the Internet whenever he or she wants to use them. Students on campus during school hours, spend most of their time either attending classes, studying in the library, rushing between classes or hanging out in crowded places like the Food Court. In situations like these it might be extremely infeasible for them to get Internet access especially when they are constantly moving around campus, thereby limiting the usefulness of these applications. With the widespread use of cell phones among students, one might assume that simply placing a call could immediately lead to information regarding one’s friends’ whereabouts. But in a campus environment, cell phones are invariably either switched off or put on silent mode during classes and their ringing sometimes either cannot be heard over the din of a crowded and busy campus or proves distracting when somebody is, for example, busy studying in the library or talking to another friend.

In this paper we present a mobile platform which allows students to keep track of their friends and their activities on campus while they are on the move, in a peer to peer ad hoc fashion using a human-based social network routing protocol. We have named this application, ‘The Marauder’s Map’ since among other things, it provides the user with a map of the campus which shows current and past locations of all the friends he or she is looking for, very much like the magical artifact owned by Harry Potter [3].

2. Related Work

MapWiki [4] by Teranishi et.al., provides a map-based collaboration environment which allows users to publish Wiki contents specifying location information. While it enables a wide group of users to share map information in real-time, information is stored centrally on a single server and users are required to manually enter the information into the system. Hodes and Katz describe an architecture in [5] which enables ad-hoc location based services for heterogeneous mobile clients by allowing them to adapt their functionality to new services that become available, when they move into a new environment. Ad-hoc Positioning System [6] proposed by Niculescu and Nath employs a distributed positioning algorithm which provides location of mobile nodes by using distance vector routing combined with GPS positioning. This system however, is designed for use in ad-hoc deployments where nodes do not have high mobility.

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1 This project was sponsored by Microsoft Corporation as part of the 4th UF Mobile Killer App Competition
Face Book and Orkut are currently two of the most popular online social networking services. Both however require users to have internet connectivity in order to access them which make them unsuitable for highly mobile environments.

3. Features and Functionality

We decided to incorporate the following basic principles into the design of Marauder’s Map: 1. The footprint of the software platform has to be robust yet small enough to run on handheld devices; 2. The interaction between various users must be in a peer-to-peer fashion without a centralized backend; 3. To implement a true social network, the user must be the most important part of the system.

Guided by these principles, it was decided that Marauder’s Map will provide the following three basic functionalities, namely, 1. It will announce the Presence of its user to all his or her friends within range; 2. It will display the past location information of one’s friends and based on this suggest possible current locations; and 3. It will provide a mechanism for delivering short messages or announcements to all the friends with best effort.

The Presence of a person is used to represent a person’s whereabouts. In Marauder’s Map, the Presence is broadcast periodically by the PDA owned and carried by the person. It is considered to be the most fundamental service in a social network. Simply being aware of one’s friends’ presence in the vicinity enables many actions such as getting an update of their status, exchanging messages, finding out where they have been recently etc. The following scenario gives a better description of these functionalities.

Consider Linda, an undergraduate student, who is trying to find her boyfriend Steve. She comes across a mutual friend, who tells her that she saw Steve near the gym one hour ago. Further on, she meets another acquaintance who, in addition to informing her that he spotted Steve getting coffee at Starbucks about 30 minutes ago, also lets her know that he plans to host a party tonight. Using these pieces of information and the fact that she knows her boyfriend has a psychology class within the hour and is most likely working on his homework, she deduces that Steve is probably in the coffee shop and manages to get hold of him.

The Marauder’s Map employs this gossiping mechanism to allow users to automatically keep track of their friends’ presence all over campus. Using peer-to-peer ad-hoc communication, users can not only provide information regarding presence and activities of their mutual friends to others, but also pass on any announcements that might be of interest, for instance, information related to parties or study groups.

For such a positioning system to work, devices or services, such as GPS or WiFi and GSM triangulation must be employed. For Marauder’s Map, any of these systems can reasonably pinpoint one’s location, but since this pilot project is more focused on distribution of location information and the social aspect of such a mechanism, we decided to use Active RFID tags to position users.

We stored names of campus buildings and important landmarks on Active RFID tags and attached them to their respective locations. Depending on the size of each building or landmark, single or multiple tags were used. Active RFID tags typically have a long battery life, a detection range of over 100 feet and require no maintenance once they are installed; features which make them especially suitable for our application. The PDAs which run Marauder’s Map are equipped with RFID readers, hence when an RFID tag is detected, the landmark information stored on the tag is read and the current location of the user is updated.

Equipped with Marauder’s Map, Linda takes out her PDA, which detects the presence of her friend Tom, who happens to be nearby. It registers Tom’s presence and the current location, and also downloads any announcements that Tom may have. It also queries Tom’s PDA to check whether it has any record of Steve’s whereabouts. If Tom did run into Steve earlier, the information about where and when Steve was last spotted is automatically stored on his PDA. Combining these historical records with Steve’s on-campus schedule stored on Linda’s PDA, Marauder’s Map suggests possible places where Steve might be found. All known and suggested locations are superimposed on a campus map. This interface also has the side benefit of allowing even newcomers to find their way around a large campus easily.

4. Mechanism

We decided to build Marauder’s Map using Konark [7] as the underlying communication mechanism. Konark is a XML-based service discovery and delivery platform designed specifically for ad-hoc, peer-to-peer networks. Utilizing a tree-based data structure, clients and servers on mobile devices can request, register and advertise services using descriptive templates. Konark supports both pushing and pulling of services, which proved to be advantageous for the design and implementation of Marauder’s Map. Building the application on top of Konark allowed us to focus our efforts in designing a human-based social network
routing protocol, without expending much effort in lower level infrastructure such as service discovery and delivery, underlying ad-hoc network protocols or data structures to support template matching. Visual C# .NET was used to implement Marauder’s Map and HP iPAQ Pocket PC running Windows Mobile 5.0 was chosen as the hardware platform.

4.1. Fundamental Services

The Presence service and the Spotted service are the two fundamental Konark services defined by Marauder’s Map.

The Presence service is the digital representation of every user who is using Marauder’s Map. This service puts a user on the map, literally speaking. Presence encompasses spatial and temporal information of the user, including the name, current location and time, which are stored as part of the service definition. The Presence service is then advertised periodically via push mechanism, so that every friend within range is made aware of the presence of this particular user. The capability to identify and record one’s presence is the foundation of all other functionalities, including location tracking and prediction, as well as message exchange. Users can piggyback a short message or announcement on top of the Presence advertisement. These messages, such as party invitations or latest campus gossip, are intended to be broadcast to all of his or her friends.

The Spotted service is created and registered dynamically whenever Marauder’s Map picks up the Presence advertisement of a friend in the vicinity. The Spotted service is not meant to be advertised proactively, but when requested, can be used to provide information regarding where a common friend was last ‘spotted’. It contains all the information derived from the friend’s Presence advertisement, such as where and when he or she was spotted.

4.2. Initial Start-up

When the Marauder’s Map starts up for the first time, it loads the user profile and creates and registers a Presence Service based on the profile information.

It starts one service announcement thread in Konark which periodically broadcasts the Presence advertisement. It also starts two service listener threads; one for collecting incoming Presence advertisements, another one for listening in for search/discovery requests from other peers trying to locate a friend. A third thread is started for handling location updates from the RFID reader, whenever it detects a location tag.

![Fig. 1 Profile View](image1) ![Fig. 2 Detecting Presence](image2)

4.3. Handling Location Tags

Whenever the application receives information from an active RFID tag attached to a landmark, it checks if the tag indicates a different location from the previously recorded “current location”. If the user has moved to a new location, then the information stored in the Presence service definition is updated and subsequent Presence advertisements reflect this update.

4.4. Exchanging Profiles

In order to add a peer to one’s Friends List, a user needs to exchange profiles with that person. This is done face to face via the PDA’s IrDA port. The decision to use IrDA not only provides a reliable way of exchanging profile information but also ensures the security and authenticity of adding someone to the buddy list, since it has to be done personally in a face to face setting. User profiles contain not only the name and contact details of the person but also his or her schedule on campus and a list of favorite places where he or she likes to hang out. The information in the stored profiles, as shown in Fig.1, is used for operations described in Section 4.7.

4.5. Detecting Presence of Friends

Whenever an application receives an incoming Presence Service advertisement, it checks whether it is originating from one of the user’s friends (specified by the Friend’s List). If so, then it extracts the details of the friend’s location from the advertisement message,
timestamps it and creates a Spotted Service (as shown in Fig.2) corresponding to that particular friend, which is then registered into the Konark Service Registry.

4.6. Handling Discovery Requests

Whenever an application receives a discovery request from a peer, asking for the location of a mutual friend, it first checks whether a Spotted Service corresponding to that particular friend exists. If found then the service description of the Spotted service is sent to the requester, otherwise the request is ignored. The requester can then extract the necessary time and location information from the service description.

4.7. Handling Responses to Discovery Requests

Whenever an application receives a response to one of its discovery requests, it extracts the details of the Spotted service response including the name, location and time when the friend was spotted. It stores these details in a SpotsHistory description file and flashes a notification icon on screen to alert the user. If a short message is attached, a message icon is also displayed. A third icon shows the number of friends who have currently been detected in the vicinity. When the user clicks on the notification icon, a map of the campus is displayed showing all the locations where the friend was spotted using information from the SpotsHistory file. In addition to this, the map also displays that person’s favorite hang-outs in the vicinity of the spotting and the place where that person is scheduled to be present at the current time, based on that friend’s locally stored profile. The location of the owner of the PDA is also shown on the map to assist him in evaluating the relative positions of where he is and where his friend has been spotted. In Fig.3(a), the ‘X’s and lines connecting them show the history of spotting. The black square denotes the spot where his friend is scheduled to be present, the dots show the location of favorite hang-outs and crosshairs mark the owner’s current location. A List View is also provided where these details are presented in tabular form as shown in Fig.3(b).

5. Conclusion

Marauder’s Map is a novel mobile platform that enables social networking on the go. It possesses a number of desirable features. It harnesses the power of gossiping to enable social network applications. It works seamlessly both indoors and outdoors. It provides the capability of locating one’s friends with minimal distraction. The privacy of users is protected by giving them the option of stopping their presence from being advertised. Moreover, since it works in a peer-to-peer fashion, there is no central backend infrastructure which monitors all the events, thereby preventing abuse by organizations and other entities. This de-centralized approach also enhances scalability of the platform.

In this paper we have explored the basic capabilities of this platform and there is a lot of functionality that can be built on top of it. To further enhance the social networking experience, some of the features that are currently under development include: (a) More refined profile management which allows profile views to be differentiated based on categories such as close friends, classmates and casual acquaintances. (b) The ability to synchronize events and information with online social networking services such as Face Book.

6. References