FacebookAgent – an Agent-Enhanced Social (Mobile) Network Application

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Abstract: Over the past years, a new kind of understanding and utilization of Internet services has emerged. People successfully form online communities and contribute actively. Facebook is one example for such an online social network (OSN) which has attracted millions of Internet users within a very short time period. In this paper we follow the idea to expand the virtual world spanned by OSNs into the user's real world. To achieve this goal, we apply the mobile agent paradigm as a connector concept to strengthen the integration of users. As an example for OSNs we rely on Facebook.

1 Introduction

As we have moved further into the virtual world that started with the World Wide Web in its initial version we are now a couple of years into the Web 2.0 era. In the seamless transition from "Web 1.0" to Web 2.0 communication and organization have changed drastically. Today, the Web is the most popular communication channel for accessing and sharing information. At the beginning, and to some degree even today, the Web was highly unorganized. The start-up period of Web 1.0 was characterized more by data assembling than information organization, which followed no general standard. We now see a more standardized Web enhanced by semantic meta data and network services. Using network services, the entire media spectrum is becoming available in a standardized fashion and replaces the browsing of plain Web pages. Network services open a way to retrieve and combine data items into new media and information aggregates. Online social networks (OSN) like Facebook [Fac] and MySpace [Incb] are ready to announce network services as new media. Thus, we see that there is a shift from what could be called vertical to horizontal communication. Even users participating in online social networks are empowered to announce their own services. Moreover, everyone now has a voice and the possibility to spread news, rumors, photos and links at tremendous speed easily into the public community sphere.

In this article we used Facebook as the basis for a new kind of OSN extension. The online social network Facebook enables its users to present themselves in an online profile, accumulate friends and view each other's profiles. Facebook members can also join groups based on common interests and create their own environment by adding Facebook extensions and sharing them with their friends. The idea of the FacebookAgent application is

based on the results of the joint research project called MobiSoft that was run by Friedrich Schiller University Jena (FSU), the agent factory GmbH, and Godyo AG. The project was funded by the Thuringian Ministry of Economy, Technology and Labor. In MobiSoft we aimed at different application scenarios of personal assistants (on mobile devices) that range from information retrieval and control of legacy systems in industry to the support of human interactions in all places where people come together [EKR+08]. Especially those scenarios focused on the support of human interactions and communities attracted further research interests. With MobiSoft and our industrial strength research in the field of mobile agents (Tracy), a technological infrastructure for mobile agent based community applications was established: The Tracy agent system executable on Java-enabled (mobile) devices, with a set of possible add-on features, and Tracy agents which are able to make multiple hops between Tracy-enabled networked devices.

The integration of mobile devices into community systems is challenging. Typically the usage of a mobile device happens at the spur of the moment. Social-mobile applications must, therefore, be simple to use. Mobile agents are well suited to provide essential support in this matter, due to their autonomous nature.

The rest of the paper is organized as follows. Within the next section we discuss the evolution of online social networks and analyze assistant integration. In section 3 we highlight FacebookAgent. In section 4 we review the approach and present our related results. Finally we give a conclusion.

2 Related Work

Online social networks have been the global consumer phenomenon of 2008. Nielsen Online points out, that social network and blogging sites are now the fourth most popular activity on the internet ahead of personal emails [Com09]. The story is consistent across the world and dates back to the early days of computer networks. Following the SixDegrees.com experience in 1997, the doyen of social network sites, that allowed its users to create profiles, invite friends, organize groups, and surf other user profiles, hundreds of social networks spurred online [AG06, Gob09]. The growth of popularity is motivated in an Internet community where people spend their time interacting with others. Like micro blogs people generate news feeds about their daily lives that cultivate friendships.

In our daily life mobile communications has a most important value. Thereby, mobile communication devices and applications are primarily designed to increase efficiency and productivity, as well as to manage our fast way of life. However, that growth in popularity of mobile communications is only half the story. For many people, particularly younger users, cell phones, smart phones, and other handhelds primarily have a social function [EP05]. A few small companies are beginning to exploit the growing demand for social-mobile applications and start a new market of mobile social-software services (MSS). One of the first definition of social-mobile application was given by Lugano (TeliaSonera Finland) as mobile-social software (MoSoSo), defined as a class of mobile application whose scope is to support social interaction among interconnected individuals [GL:07].

We present here only a brief survey of the currently most popular social software services, which is only a selection of the upcoming boom. For our approach the challenge is the aspect of facilitating, augmenting, and promoting human social interaction by electronic personal agents in the daily mobile life.

One of the most popular MSSs applications is dodgeball [Inca], a New York-based social-mobile network with thousands of users across the US. After a registered user enters the network friends receive a text message indicating the check-in location and time in case they want to get together. The service will also notify a user if a friend, or friend of a friend is checking in. In the UK, rummble [Rum] helps mobile users locate nearby friends, friends of mutual acquaintances, or even strangers with matching preferences. Yet another is Plazes [gG] a location-aware interaction system that helps mobile users hook up with friends or other like-minded people anywhere on the globe. With match2blue [mUI] there is a social-software service under development based only on mobile phones. The service allows to access profile matchers wherever mobile social network users happen to be. Users can make contact with other mobile phone users who share similar interests. Jambo Networks [Net] focuses on widely-used mobile devices like 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. However, in a nutshell we could not find any further support by personal assistants.

Additionally, over the past years, Intel Research Seattle has designed, studied, and built several social applications like Houston [CESL06, oWS, Smi05], an application designed to investigate the utility of mobile social-support networks. Houston is oriented towards physical fitness and weight management, but the general principles apply to many other areas where friends share experiences and generate mutual support. With Houston, group members share step counts from their pedometers automatically via mobile phones for example, "Joe made it to 10,000 steps today!". We are already sharing our daily life experiences with the community, as with twitter, where prominent events like "There's a plane in the Hudson. I'm on the ferry going to pick up the people. Crazy." are posted. [Kru09]. Given by a selection of most popular social services, we are in the starting blocks to use online social networks as living social communities. The number of social networks is growing fast. These sites account for one in every 11 minutes going online [Com09] and people spend more and more time online, managing by hand their social communities.

In [EKR+08, KBR06] Erfurth and Kern present as an alternative social mobile assistants as way to manage MSSs. Porkahr et al. endorse this path by proposing "Agents: Technology for the Mainstream?" [PBL05]. A combination of these two fields – OSNs and mobile agents – could not be found in literature and in OSNs we analyzed. There are no facilitating, augmenting, and promoting human social interactions assisted by personal agents. However, we expect efforts there within the next years.

3 FacebookAgent

FacebookAgent is a social-mobile application for the OSN Facebook. With FacebookAgent a Facebook member is linked with Facebook via a personalized mobile software agent. This agent is a virtual substitute for the member and is able to update the member's personal data (e. g. current location) autonomously and inform the user on events arising at the Facebook site. FacebookAgent is also runnable on mobile devices to support mobile community members. It uses Facebook features and carries them to the user's device. Additional community features outside of Facebook are also possible (e. g. finding interesting people nearby) but not yet implemented.

For our agent-based community experiment we choose Facebook as an OSN due to the fact that it is very popular, especially with younger people. Facebook, created in 2004, reports to have more than 175 million active users. The site is used on a very regular base by its users: The typical user spends about 20 minutes a day on the site, and two-thirds of users log in at least once a day [Cas06]. After its success among college students, Facebook launched a high school version in 2005. In the following year, the company introduced communities for commercial organizations, a feature that was used by 22,000 organizations within the same year [Smi06].

Facebook itself has a number of community features. The *Wall* is a space on every user's profile page that allows friends to post messages and attachments for the user. The *Pokes* feature allows users to send a virtual "poke" to each other (a notification that tells a user that they have been poked). Photos and albums can be uploaded with the *Photos* feature. There is also a *Status*, which informs user's friends of their whereabouts and actions. The Wall of a user is visible to other Facebook members who are able to see that user's profile (depends also on user's privacy settings). *News Feed* on every user's homepage shows configurable information like upcoming events and birthdays related to the user's friends. The mentioned Facebook features are, or rather can be, utilized by the FacebookAgent application. The content is controlled or modified by agents on behalf of the user.

3.1 Applications integration on the Facebook platform

Facebook offers a sophisticated plug-in system, which gives the opportunity to integrate your own applications into the platform. This way it is possible to integrate other applications, platforms or services with Facebook and – if the installing user permits this – access the user's data and other services from those. Applications can be found using the search function in Facebook. Alternatively the user can choose from the product directory. Additionally one might recommend an application to friends, when installing, though most application adds seem to stem from the profile boxes [Smi07].

Facebook's REST-like interface can be used by multiple client libraries or APIs, that are usually provided as open source. Official libraries are offered for PHP and JavaScript, but there are various third party libraries available for Java, C#, Ruby and many more [Fac08a]. In order to connect to the Facebook Server every application has to be registered

Figure 1: Navigation **A**, canvas **B** and profile **C**

with Facebook via the Facebook Developer application which generates a unique API-key and secret. These are used to authenticate the application when connecting.

Once the application is ready, it can be published to the Application Directory where it is made available and can be found and installed by other users.

Installed applications are accessible via their icon in the navigation menu (A in Fig. 1), that links to the application's main page also called canvas (B in Fig. 1). This part is only visible to application users and usually provides a user interface and configurations for the application. The canvas contains the output of the server running the application. Facebook uses a special evolved subset of HTML called FBML for layout and control. In addition to the canvas page an application can provide a profile box (C in Fig. 1), which is visible to other people visiting the a user profile. The contents of this box are cached by the server and have to be explicitly written using the API.

3.2 Facebook and Agent Interplay

The FacebookAgent application combines mobile agents and social networks. Thereby agents take over the role of a connector between community members, which are not logged in, and the OSN. Especially those scenarios are of interest where the member is connected with the community via a mobile device. This way the integration of people into OSN is improved. The resulting infrastructure for the FacebookAgent application consists of:

- The social network - in this case Facebook - which provides data about social con-

nections, the users status and other information. In addition it is used as the starting point of the installation.

- The Tracy agency, which handles and manages the incoming requests by the mobile agents.
- The mobile device, where the user can access the functions provided by the mobile agents.

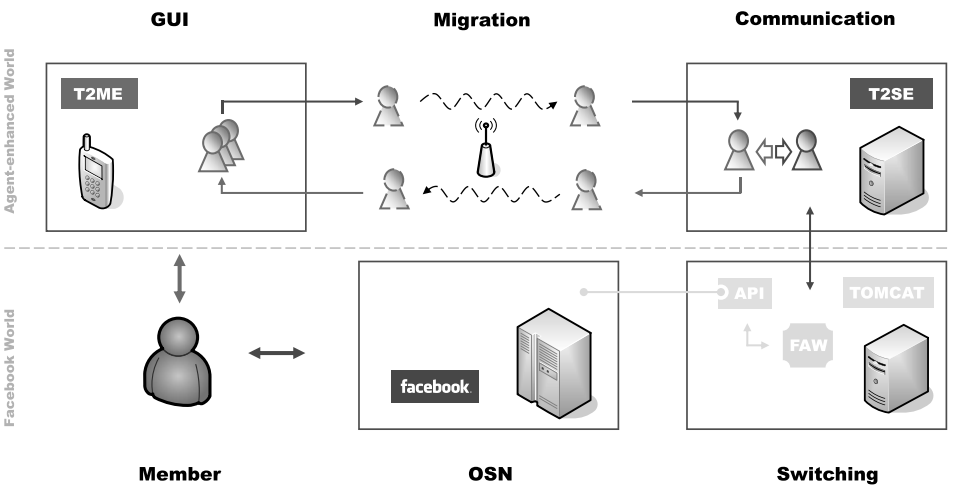

Figure 2: System architecture

Fig. 2 gives an overview of the main players and their interplay. For the communication between Facebook and a ”remote” user, mobile agents on mobile and standard devices are executed. As Facebook doesn't provide an interface for storing data on their servers, the new Facebook application has to be installed on a separate system to be able to store its own application data. FacebookAgent is connected with Facebook via the Faceboook API. For enabling agents to access the Facebook features and the new application features, a plug-in within the agency is provided as an interface. This plug-in forwards requests from agents to our Facebook application and thereby to Facebook (and vice versa).

A single server running both the Tracy agency and an Apache Tomcat server containing the new Facebook application is the minimal configuration to deploy the system. The Tracy agency is able to support more than one social network connection, as the agents communicate with a generic plug-in. However, Tracy and Apache Tomcat do not necessarily have to be hosted on the same server and may also be distributed to independent systems and in different networks.

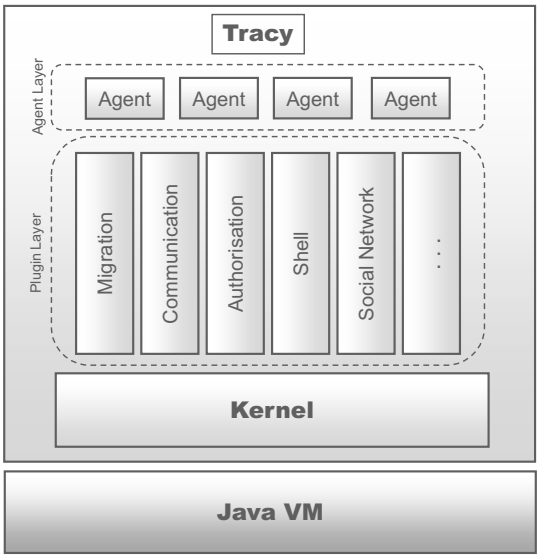

Figure 3: Tracy Architecture

3.3 Agent System Toolkit

Over the past years, we've developed the Agent System Toolkits Tracy as version named Tracy2SE and Tracy2ME. The latter one naturally benefited from our experiences with the Tracy2SE version being a lightweight version of the former for mobile devices. Tracy2SE relies on a micro kernel architecture, compare Figure 3, whereas its predecessor applied a strict 3-tier design which proved to be far to monolithic in action. On top of the kernel, a number of plug-ins provide the actual functionality of a Tracy system. For example, message exchange among agents, agent migration, or several security mechanisms are realized as plug-ins. As with all plug-ins, the kernel is responsible to control the agent life cycle and to coordinate interactions among agents and plug-ins. Over the last years, this highly modular and extensible architecture proved to be useful, as it is very easy to adapt a base Tracy system to custom needs by simply defining the set of necessary plug-ins and corresponding agents. One of the main aims of the mentioned MobiSoft Project [EKR+08] was to port Tracy2 to the Java Micro Edition environment to allow for the usage of agents and agent migration on mobile devices. MobiSoft targeted to host agents on mobile devices and has enabled agent migration between mobile phones via Bluetooth and to distant hosts over GPRS, UMTS or Wi-Fi.

Looking at the architecture, Tracy is divided into three major components: the agent layer, the plug-in layer and the kernel as their foundation. Plug-ins and agents follow specific design rules described in [BR05] and [Sch08]. Both Tracy2SE and Tracy2ME provide at least one agency, which is used by different kinds of agents. In our FacebookAgent application, there are two different agent-types: Multiple mobile Tracy2ME agents, that im-

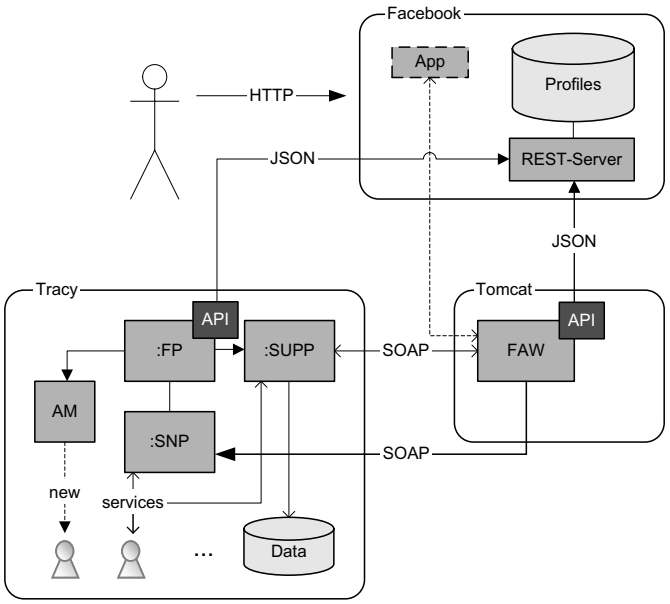

Figure 4: Communication system

plement one function per agent and the corresponding GUI, and one stationary Tracy2SE agent, that is able to communicate with the ME-agents and use the *SocialNetwork* plug-in (see Sec. 3.4) to communicate with Facebook.

3.4 Plug-in System and Communication

For the FacebookAgent application three different Tracy plug-ins have been developed to couple Facebook with our agents. The main plug-in is *SocialNetwork* (SNP), which is designed as a generic social networking solution. It makes use of the platform-specific *Facebook* plug-in (FP) that uses the facebook-java-api (see [Fac08b]) to access Facebook data and functions. The third plug-in *SocialUserProfiles* (SUPP) is used to store information about the user, his connections and the corresponding agent in a user profile. As Facebook requires user interaction during the login process even when using the API, the *Facebook* plug-in acts like a scripted browser to circumvent the manual, that is browser driven login process. That way, agents can login in a fashion that is transparent for the user.

The Facebook application *Facebook AgentWall* (FAW) can be used to configure the agents behaviour and represents the system towards other Facebook users. It's the starting point of the installation process and communicates with the *SocialUserProfiles* and *SocialNetwork* plug-ins through Web services to store and retrieve configuration data. Additionally

it spawns a new Tracy2SE agent during the installation, which is needed for the communication with the mobile Tracy2ME agents. It's implemented as a Java servlet and uses FBML-containing Java server pages as templates.

4 Assessment of FacebookAgent and Related Endeavors

With the exemplary combination of Facebook and mobile agents we target our research on a seamless integration of human life and OSNs with a special focus on mobile users. With other words, mobile agents can be used to expand the virtual world spanned by OSNs into the user's real world. Humans which like to be part of an online community do not need to be online in person. Personalized agents care for their integration. Thinking further, persons who get in contact offline can be connected online too by exchanging OSN contact details, using mobile agents. Agents can also be used to manage personal information provided in OSNs. In the case where humans belong to different communities, agents may deploy this information and may care for consistent data on the OSNs.

In another student project we have developed a combination of Second Life and mobile agents. In such a virtual world characters monitored or controlled by agents can react to inquiries or forward these to humans. Agents are even able to take over the execution of simple tasks within the virtual world or/and within the networked OSNs.

For future mobile community applications more non-technical aspects in the social area of potential users are also relevant e. g.

- Has usability reached an appropriate level for ad hoc mobile device usage?
- Is there a correlation between age and gender of potential users and the acceptance of mobile application usage?
- Is the usage of mobile devices as a community interface accepted?

Consolidated findings in this interdisciplinary area are essential for a successful application of future technologies in the mobile sector. The user is the central element in ubiquitous computing. As part of the MobiSoft project, we made a survey on campus to investigate the acceptance of personal electronic assistants. We received over 1000 submissions of the online questionary (70% from students, 23% from staff). We asked the participants to rank the importance of possibly available new services when using software assistants. For 70% of the participants services with software assistants in the library sector (one application scenario in the project) were rated as important or very important. In contrast to that, 61% of participants stated that it would be less important or not important at all to have assistants for cafeteria menu information on mobile devices (another sample scenario).

Social-mobile assistants are generally ranked as at least partially important. The readiness of use is ranked nearly identical for all application areas. Despite of the fact that the new technology of mobile personal assistants is not yet well known, about 50% of the

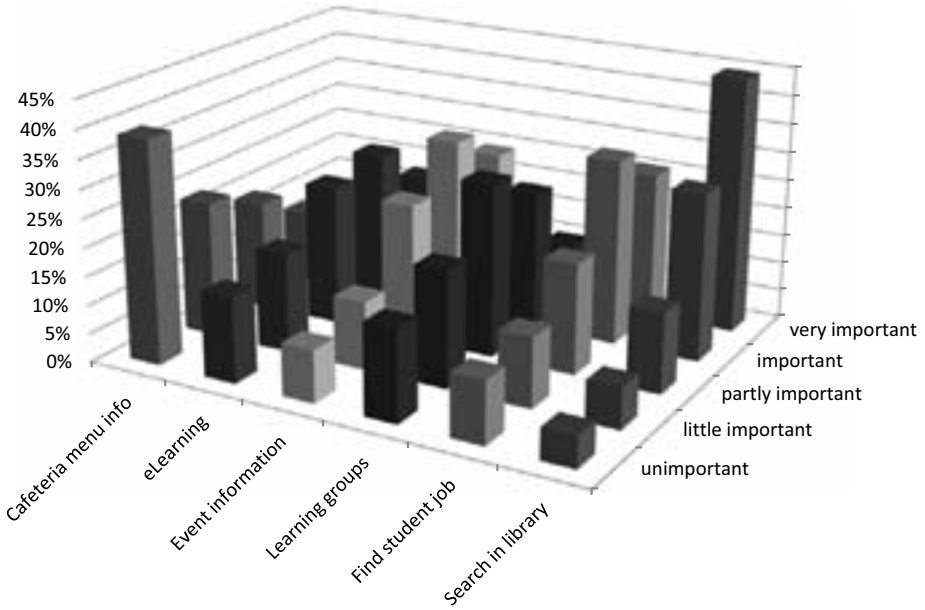

Figure 5: Survey Results: Importance of Selected Mobile Applications

interviewed persons answered that they would perhaps use assistants. Fig. 5 presents the results of the question to rank the importance of a possible application of mobile software assistants in selected areas typically found at a university. Apparently the scenario "learning groups" is a strong community application. About 1/3 of interviewees answered that this scenario would be very important or at least important. Another third of the population sees this scenario as partly important.

The aim and the systematic approach of MobiSoft, whereupon this work is based, we introduce in [EKR+08]. The results of the questinary helped and motivated us to investigate the combination of mobile agents and communities in more detail. For sure the questionary is no evaluation for our experiment. However, we did not go into an evaluation of the FacebookAgent because it is hard, or even unclear, how an evaluation could look like. For such a community application, only the community can evaluate new features and accept or discard them. This is similar to applications in the Web 2.0 area which are often released as beta versions and improved if worthwhile.

5 Conclusion

FacebookAgent is one scenario to investigate the application of mobile agents in the context of community systems. As mentioned above, the MobiSoft project has already established a suitable technological basis in this context and has delivered a first experience in

the community field. The experimental prototypes we used focused on the usage of agents on mobile devices to support mobile and distributed communities. With FacebookAgent an example for the combination of mobile agents and OSNs is realized. Taking this combination and the results of the MobiSoft project, the usage of OSNs by mobile community members can reach a new level: With personalized mobile assistants the integration of OSN community members in every day life is strengthened. Up-to-date information can be provided within OSNs by electronic assistants autonomously and – vice versa – users will be well-informed by their assistants.

Since 1998 we have been continuing our strategy in autonomous operating agents. Initial start-up given by Prof. Rossak we achieved our first goal in 2000 and 2003 by releasing our Agent System Toolkits Tracy. Designed as a flexible system driven by services new functions are integrated by service plugins[BER00, BMG+04a, BMG+04b]. Along with MobiSoft we transformed Tracy into a lightweigh Agent Toolkit running on mobile devices. Henceforth agents are able to operate into the mobile life [EES07]. By now we are on the cusp of interdisciplinary agent work learning about social workflow compositions (like MSSs, OSNs and domain specific knowledge) and experiencing with the idea of life (genetic algorithm) to come closer for autonomous operating agents.

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