

Mobile Virtual Communities

Key terms: communities, virtual communities, interaction, mobile applications, mobile virtual communities, wireless applications, connectivity.

INTRODUCTION

The establishment of collective relationships is a native characteristic of individuals. Living in a reclusive way cannot be considered part of human nature. Individuals have always been organized in *communities* in which they establish relationships with other individuals, which usually live in one particular area. Proximity among individuals is one of the characteristics that motivate the creation of communities.

Communities are also created when individuals have common interests. Some examples are: religious communities, such as Catholic and Jewish ones; and communities comprised of people having the same job, such as scientific and medical communities. In these examples, the distance among individuals is not an obstacle to the creation of communities, since individuals have common interests. In spite of living in different places, members of these communities have periodic meetings in which collective relationships are established.

The popularization of the Internet after the 1990s along with the well established use of personal computers have allowed the creation of a new form of community, the well known *virtual communities*. They have enabled individuals to communicate through e-mail, forums, instant messaging, and videoconference. People living in different countries have interacted and communicated through Internet enabled personal computers. Distance learning and software users groups such as Linux users and Java developers are some examples of relationships that have been improved by virtual communities.

Mobile virtual communities are the most recent advance in the establishment of collective relationships, mainly due to the progress in mobile devices and wireless communication technologies. Connectivity among wireless mobile devices enables individuals to exchange information and knowledge, anytime and anywhere. These communities are created in an ad hoc way: individuals with common profiles, carrying connected mobile devices, can constitute a community and access/provide information according to their authorization degree. There are various applications of mobile virtual communities, such as workflow management, mobile learning, healthcare communities, personal assistants in academic conferences, and applications for communication among students on campus, among others.

This article introduces the field of mobile virtual communities, describing the main issues that have culminated in the creation of this research area such as the Internet, personal computers, mobile devices and wireless communication technologies. Applications domains of mobile virtual communities and works that support the development of these applications are also presented.

MOBILE VIRTUAL COMMUNITIES

In the book “The Virtual Community”, Rheingold (1993) defines virtual communities as social groups whose interaction is mediated by computers. These communities increase the establishment of collective relationships among individuals, since computer-mediated interaction allows creating communities constituted by geographically dispersed people. In

order to support interaction among members of these communities, various computational tools are used, such as e-mail, forums, whiteboard, audio/video conference sessions, and instant messaging, among others.

Rheingold (2003) enumerates some characteristics of virtual communities. He defines virtual communities as:

1. Organized around affinities, shared interests, bringing together people who did not necessarily know each other before meeting online.
2. Many to many media. Unlike few-to-many (broadcast) or one to one (telephone or SMS) media, virtual communities enable groups of people to communicate with many others.
3. Text-based, evolving into text plus graphics-based communications. For decades, online communities were built with nothing more than unformatted text. Web-based media brought inline graphics, animations, video, sounds, formatted text, links into the conversation.
4. Relatively uncoupled from face to face social life in geographic communities. People communicating worldwide about shared interests most often do not live close enough to meet regularly face to face.

It is important to point out the relevance of item 1 for characterizing virtual communities. The absence of shared interests among participants makes unfeasible the constitution of these communities. The similarity among the preferences of individuals is responsible for the establishment of these groups.

Virtual Communities evolves into Mobile Virtual Communities

The presence of various *portable* computational devices in our everyday lives is incontestable: mobile phones, notebooks, handhelds, smartphones, tablet PCs, etc. All these devices allow the *connectivity* among their owners through wireless technologies such as Wi-Fi, GPRS, WAP, and Bluetooth. This scenario of mobility and connectivity has increased the establishment of interactions among individuals, allowing the emergence of Mobile Virtual Communities.

Fremaux (2000) considers mobile communities the natural evolution of virtual communities. Mobile communities can be seen as virtual communities to which mobile services are added. In what follows, two important differences between mobile communities and “traditional” web-based virtual communities are presented (Fremuth, Tasch, & Fränkle, 2003, p. 2):

- Mobile communities can be accessed by mobile devices like mobile phones, smart phones and PDAs. This could lead to a more spontaneous communication in a community.
- Mobile community platforms offer enhanced communication services for their users, made possible by the 2,5 and 3rd generation of mobile networks: *ubiquitous access*, allowing an anytime-anywhere connection to their communities; and *location based services*, through the use of positioning technologies (Hazas, Scott, & Krumm, 2004) such as infrared, GPS, Bluetooth, and Wi-Fi.

Characteristics of Mobile Virtual Communities

In a general way, mobile virtual communities present the following characteristics (Rheingold, 2003):

- Many to many, desktop and mobile, always on. Virtual communities and the resources of the Internet are instantly available to people and their software agents wherever people are located - at their desks, in transit, at home.
- Used to coordinate actions of groups in geographic spaces - teenagers swarm in malls, young adults club-hop, activists mobilize on the street.
- Game environments, social arenas, artistic media, business tools, political weapons - like other virtual community media, mobile virtual communities will start with young people as means for entertainment and light social interaction, then diffuse into other institutions.

Two more characteristics are present in applications for mobile virtual communities. (1) These applications are deployed in different *varieties of computational devices*, with different memory size, processing power, and display capability. In this way, such diversity should be considered during the development of software for this domain. (2) This apparent problem is minimized by the use of *information regarding the context* in which individuals are situated. Through such information, applications can be adapted based on the preferences of the user, on the configuration of the device or on the location of the individual.

APPLICATION DOMAINS

Some application domains in which mobile virtual communities have been applied are presented in this section. Characteristics of each application domain are described in order to justify using mobile virtual communities to develop applications for these domains.

Healthcare Communities

Healthcare can be defined as “the prevention, treatment, and management of illness and the preservation of mental and physical well-being through the services offered by the medical and allied health professions” (Dictionary.com, 2006). Beside these professionals, other institutions also offer these services, such as hospitals, non-governmental organizations, insurance companies, etc (Leimeister, Daum, & Krcmar, 2002). These services are mainly used by patients, who interact with health professionals and institutions that constitute the healthcare systems.

According to some researches, the demand of patients for information increases when they receive diagnosis or treatment (Sheppherd, Charmock, & Gann, 1999). Researches also revealed that patients also need to communicate with other patients in order to exchange experience and receive emotional support, mainly when they are attacked by bad diseases.

Patients participate in activities of self-help groups in order to get information and establish interactions. These groups are an example of communities, since their members establish relationships with each other and have common interests — the discussion about diseases.

Although the participation of patients in these groups is important for helping the treatment of diseases, some problems can complicate the integration of patients in these communities. One of these problems is the incompatibility between the schedules of patients

and the meetings of the self-help groups. Another possible problem is the difficulty that patients can have in moving to the meeting place of the self-help groups (Leimeister, Daum, & Krcmar, 2002).

The previously mentioned problems are solved when patients establish collective relationships through applications of mobile virtual communities. These applications enable patients to communicate anytime and anywhere. Besides the resolution of these problems, the use of these applications enables patients to receive contextual information, according to their location, such as the address of the nearest pharmacy/doctor and notifications of the presence of other patients that are located in a near area. It is important to point out that these communities should not substitute the self-help groups; on the contrary, these communities should aid the self-help groups through the expansion of the methods used for interacting.

Mobile Learning

Recent advances in the manufacturing of wireless mobile devices have allowed the expansion of the methods used for distance teaching and learning. Through mobile learning applications, individuals sharing interest in learning any subject can establish communities in which they interact in order to acquire knowledge. Interactions among these individuals can occur regardless of their location, for example, on the bus, in the waiting room, or in the queue for tickets.

Common methods of distance teaching and learning, such as corporate universities and distance undergraduate course, can be benefited from mobile learning applications. The application of the concept of mobility in learning communities constituted at corporate universities enables to accomplish the training of employees not only within the organization limits, but also during the activities performed outside of the organization. Distance undergraduate courses are usually taken by people who have difficulty in adapting their time to the inflexible timetable of learning institutions. To address this problem, these courses can use the concept of mobility in order to allow students to perform the learning activities regardless of their location, adjusting the time to suit their convenience.

Traditional learning activities can also be benefited from mobile learning applications. The following scenario, presented by Alexander (2004), describes some possible experiences. "For example, suppose a first-year student sees the recent film *Master and Commander* and becomes interested in the world of eighteenth-century sailing. With no guidance, the student might hit Amazon.com for other novels by Patrick O'Brian, watch a History Channel program about sailing, or conduct a Google search and find a few related Web pages. Or instead, the college could set up an environment in which the student finds that one history professor regularly teaches 'the great age of sail' in several classes, has Web pages on the 1790s naval wars, and might answer an e-mail or office-hours query; that the library has digital and print resources ready at hand; that several other students share this curiosity and chat about it with IM; and that a staff member sailed on a rebuilt eighteenth-century vessel last summer and would be delighted to discuss the experience" (pp. 32-33).

Although all these experiences enrich learning activities, mobile learning applications should not replace attended teaching activities. Even in distance undergraduate courses, a number of lessons must be taken in attended meetings.

Workflow Management

Workflow management systems are frequently used for modeling, monitoring, and controlling the coordinated execution of activities performed in various contexts (Dias, Casanova, & Carvalho, 2003). This application domain is characterized by the frequent interactions among individuals that are responsible for the activities, since these individuals need to collaborate in order to perform the activities.

The tracking of these activities can now be done directly in the place in which they are performed, due to the decrease in the acquisition costs of mobile devices. In this way, tasks can be coordinated even by teams located in different areas and whose members are constantly moving.

Consider, for example, a workflow management system that aids the execution of emergency plans in an oil company, a pipeline operation company and gas distribution companies (Dias, Casanova, & Carvalho, 2003). In this system, mobile devices are used by the emergency team members in order to register the execution of operations, allowing that other correlated operations could be performed after the conclusion of a main operation. For example, in the case of an oil spill, contention barriers must be launched, the oil pumping must be stopped, and cleaning procedures must be executed. Besides the help in the coordination of activities, team members have access to various information that are needed to execute the operations, such as the material resources that should be used in the execution of each procedure, maps, list of authorities to contact, etc.

SUPPORTING DEVELOPMENT OF APPLICATIONS

As in other application domains, the development of software for mobile virtual communities involves characteristics that are common in the majority of applications. In this way, it is important to use APIs, software frameworks, and infrastructures that ease the building of these applications. In this section we present some works that aim to support the development of applications for mobile virtual communities.

In (Rakotonirainy, Loke, & Zaslavsky, 2000), it is introduced a multi-agent approach for a high-level model of mobile and distributed systems, in terms of mobile virtual communities. This model uses concepts from the Reference Model for Open Distributed Processing (RM-ODP) (International Organization for Standardization, 2002) and from a CORBA-like component model (Object Management Group, 1998). Mobile communities are modeled by the composition of *roles* formed to meet an *objective*. Such an objective is expressed in a *policy*, which is a set of rules related to the *activities* performed by the community. The roles constituting the community are described with *component interfaces* that define the *interactions* of the community. The main focus of this work is on the modeling and specification of mobile virtual communities. It does not provide a prototype in order to help the implementation of applications for mobile virtual communities.

MOOsburg (Carroll, Rosson, Isenhour, Ganoë, Dunlap, Fogarty, Schafer, & Van Metre, 2001) is a community-oriented collaborative environment that models the town of Blacksburg. It provides a range of collaborative tools that provide access to shared content such as whiteboards, message boards, etc. In order to move towards a wireless virtual community, MOOsburg++ (Farooq, Isenhour, Carroll, & Rosson, 2002) has been proposed. It is an extension to MOOsburg that allows accessibility from mobile devices such as cellular phones, pagers, and PDAs. MOOsburg++ provides synchronous and asynchronous interaction with people and data. Each piece of data (people, places, things, and collaborative objects) in the environment is represented by a Java object and replicated across all interested clients

using the Content Object Replication Kit (CORK) (Isenhour, Rosson, & Carroll, 2001), a toolkit for building web-accessible interactive distributed applications.

ToothAgent (Bryl, Giorgini, & Fante, 2005) is a prototype of a multi-agent system for virtual communities support. This work proposes a general architecture with independent servers where multi-agent platforms can be installed and where agents can act on behalf of their users. Each server provides services related to the geographical area in which it is located (e.g. a server inside a university could offer the service of selling and buying textbooks), and users can contact their personal agents using their Bluetooth-enabled mobile phones or PDAs. Such an architecture is domain-independent since it does not depend on the specific services offered by the server.

CONCLUSIONS AND FUTURE TRENDS

In this paper we presented a timeline of events that culminate with the constitution of mobile virtual communities. We discussed the first communities organized around common interests, the creation of virtual communities through the popularization of personal computers and the Internet after the 1990s, and finally the constitution of mobile virtual communities through the dissemination of portable computational devices with wireless access.

Some application domains concerned with mobile virtual communities were described. Characteristics and examples of applications in these domains were presented. Also, we discussed some works that supports the development of applications for mobile virtual communities, highlighting their strengths and weaknesses.

The mentioned works aid the building of applications for mobile virtual communities since software is not developed from scratch. However, they do not provide a good support for services inherent in mobile virtual community such as authentication of individuals in communities, representation of the interests of individuals, algorithms for identifying individuals which have common interests, and control of access to information available in communities. In this way, the development of a software infrastructure that addresses all these issues is highly desirable for improving the building of applications for mobile virtual communities.

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