Mobile Social Software for Cultural Heritage Management

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Abstract. In the past several years, the World Wide Web has experienced a new era, in which user communities are greatly involved and digital content explodes via the Internet. Community information systems have been highlighted with the emerging term "Social Software". In this paper, we explore the impact of social software on the community of cultural heritage management. Furthermore, mobile and ubiquitous technologies have provided capabilities for more sophisticated approach to cultural heritage management. We analyze these features of mobile information systems for cultural communities. We also present a mobile community framework with mobile Web Services to enable professionals to collect, manage and retrieve cultural heritage information in wide user communities.

Keywords: Social Software, Cultural heritage management, mobile Web Services, Web 2.0.

1 Introduction

At the very beginning of the 21st century, a lot of new technologies have emerged. Most of these terminologies always end with *computing*, such as *distributed*, *public*, *grid*, and *social computing*. Among them social computing, also known as *social software*, has been booming due to the simplicity, intuitions and the community base.

Moreover, web technologies have been ready for the second boom after the downfall of the dot-com bubble between 1997 and 2001. Nowadays, a general travel planning scenario should not be alien for any one as an Internet user. Your flight or train tickets are printed at home, since you have booked the tickets online. You get the confirmation message on the cell phone. You surfed at Google earth to have a virtual tour previously and so on.

Impacts of social software technologies have also outreached various communities such as the cultural communities for heritage management. However, the development is still at the beginning stage, initiated by cultural scientists. The quick dissemination in the cultural communities shows the essentials of social software, the

sociality. However, the cultural communities have more professional requirements on social software. Thus, we aim at social software to support professionals to research, collaborate and communicate within cultural communities.

The rest of this paper is organized as follows. Section 2 pertains to the impact of social software especially on cultural heritage management. In Section 3, mobile aspects are discussed. A mobile community framework for cultural heritage is proposed. The design and implementation of mobile Web Services which is an innovative technology for the proposed mobile community are introduced in Section 4. Section 5 gives a summary of the paper and discusses the upcoming work.

2 Cultural heritage management and social software

Cultural heritage is a kind of public goods that includes artefacts and archaeological areas, monuments, group of buildings, single building and the other [24]. We generalize cultural heritage into movable items (artefacts) and geographic heritage (sightseeing). Movable items, also called artefacts, can be preserved and exhibited in museums. So they are generally museum objects.

From the technical point of view, social software technologies are based on Web 2.0. A widely accepted definition of Web 2.0 is an emerging collection of Internet-based social services that provide online collaboration features such as RSS, blogs, wikis, and mashups [22].

2. 1. The impact of social software

Lee Bryant has featured social software with smart, simple and social [3]. Web 2.0 - based social software enables communities to collaborate and communicate via the Internet through *smart* idea and *simple* user interface, aiming at *socialization*.

The collaboration of users in online communities ranges from different fields. In the scientific field, the SETI@home Project at the University of California, Berkeley [19] can be seen as the first attempt to involve wide user communities to perform a search for radio signals from extraterrestrial civilizations. In the industrial field, Enterprise 2.0 has emerged [4, 21]. In this, the advocated measures are to move the responsibility of the content manage systems of the companies from administrators to employees' weblogs. Such a bottom-up approach to content organization and delivery is being tested in a controlled experiment at Ernst & Young. 50 employees use Web 2.0 technologies such as blogs and wiki to faster collaboration. Correspondingly, e-learning 2.0 refers to e-learning systems using Web 2.0.

Moreover, in the field of personal information management, personal information and personal activities can find dominating innovative Web 2.0 based social software technologies. Among them are mercora for music, del.icio.us for bookmarks, flickr for images, YouTube for videos, writely for documents, Weblogs for diaries, Google Calendar for calendars, 43things for goals, skype for telephones, instant message for e-mails, meeting friends at MySpace etc. Certainly, there is still some legacy from dot-com era: the Amazon. The most significant feature is *socializing by sharing*. But what is the impact of social software on cultural heritage management?

2.2. The impact of Social Software in cultural heritage management

The connection between the Web and the community of cultural heritage management is getting tight. The new applications of some social software or Web 2.0 have been influencing the field of cultural heritage management. For instance, how to create and update an entry in Wikipedia is discussed in [13]. New terminology like Museum 2.0 has emerged [2]. However, the discussion about the applications of Web 2.0 and social computing in museums is solely on how to observe these phenomena and how to use some technologies such as RFID, podcasting and folksonomy [6].

The state-of-the-art research work of Web 2.0 in cultural communities is listed in Table 1. The Steve.museum Project employs social tagging for management of exponents in many museums worldwide. Storytelling has also been employed in several cultural heritage management projects [7]. Since this approach has been used for years, it is hard to evaluate the influence by Web 2.0. Above all, the collaboration feature shows the sociality of Web 2.0. Wide employment of media sharing ideas such as Flickr has not been discovered in cultural communities yet.

Table 1. Web 2.0 technologies in cultural communities

Terms	Web 2.0	Cultural communities
Folksonomy, social tagging	Flickr, delicious	Steve.museum Project (The Metropolitan Museum of Art, Guggenheim Museum, Denver Art Museum, etc.)
Wikis	Wikipedia	Semapedia, Placeopedia
Storytelling	--	Collaborative storytelling
Media sharing	Flickr, Zooomr	--

The quick influence of social software on the cultural communities shows the sociality feature definitely. However, there are still rare cases of social software applications in cultural sites and monuments (sightseeing), such as Google Maps. On the one hand, sightseeing concerns with location information, so that the common information systems can not handle the geographic coordination information well. More complicated geographic information systems are required. On the other hand, mobile technologies may play an important role in providing some location-based services. Consequently, Mobile Social Software (MoSoSo) [9] is highly demanded by user communities. In our work we attempt to explore mobile social software for management of cultural sites and monuments within cultural communities.

3 Cultural community goes mobile with standards

Usability and sociability are two essential measurements to evaluate online communities [26], which are also key issues for mobile communities. The communities with mobile devices are much larger than the desktop communities.

In this section we discuss the main two approaches. First, the professional cultural community is standardized with metadata. Second, cultural community goes mobile. With both approaches we attempt to define a mobile social software framework for a mobile community of cultural heritage management.

3.1. Standardization with metadata standards

Featured with smart and simple, social software is small in its component. However, it should be scalable in user communities of different scales. It should be able to work with other social software, together accomplishing some complicated tasks. To that end, metadata for description, preservation and administration could play a major role. The wide adoption of RSS feeds by Web sites demonstrates metadata feeds items successfully. At the same time, RSS feeds can be easily syndicated, which proves the concepts of smart and simple of social software.

Two categories of metadata are related to cultural heritage managements: metadata for digital preservation and metadata for cultural heritage. The state-of-the-art metadata standards for digital preservation are systematically surveyed in [8]. The standards are closely associated with some museum-, government- or library-based projects. A comprehensive overview of the related work in this area is reported monthly by the online D-Lib Magazine. Cultural heritage standards include standards for museum objects and location-based sightseeing. Examples of metadata standards are listed in Table 2.

Table 2. Metadata standards in cultural communities

Digital preservation (digital library) [8]	**Cultural heritage** [17]	
	Museum objects	Cultural sites
ISO OAIS model, MARC, RLG, Dublin Core	CIDOC, Object ID, SPEKTRUM	MIDAS, Core Data Index, Core Data Standard

Many projects and initiatives in cultural communities have developed new standards or extended some existing standards. There are still no dominating metadata standards in cultural heritage management, after decades-long development. Unlike the quick propagation of the Web 2.0 and the social software wave, standardization is a very long tedious process.

3.2. Mobile communities

Mobile devices have been widely used as digital guides in museums. Moreover, in [23] Headquarter, Mobile Camp and Operative Team build up a hierarchical network. Mobile devices are frequently employed in the level of Operative Team, which collects information on-site. Yet, mobility is still a new topic for cultural communities. The advantages of mobile devices will be increasingly advanced in the aspects of location awareness, one-handed operation, always on and universal alerting device [27].

In addition, recently the capabilities of the wireless devices like smart phones, PDAs are expanding quite fast. This is resulting in their quick adoption in domains like mobile banking, location based services, e-learning, social systems etc.

With these developments, we foster the importance of mobile devices for the cultural communities, based on following reasons. Firstly, more users use cell phones than the Internet over desktops. Secondly, the Internet connection on site might be unavailable sometimes. The professionals can only make use of UMTS, GPRS and

the other mobile networks. Thirdly, a distributed system is employed to make backup and replication easily. So the security of the system is enhanced. Finally, usability should not be designed from the viewpoint of the system designers but of communities. User-friendly user interfaces are one of the key points [25].

3.3. Services for mobile cultural heritage communities

After the discussion about the two approaches above, we aim at designing a mobile community for professionals, using metadata standards. The target groups are professional cultural communities who work on management of cultural sites and monuments. The experiences of developing a desktop-based community information system for cultural heritage management in Afghanistan are also useful [16].

From the technological front, Service Oriented Architecture (SOA) [5] is the latest trend in distributed information systems engineering. Every piece of functionality delivered by any entity in a distributed system can be exposed as a service to the external systems. This concept has been employed in enterprise systems and business processing systems. Web 2.0 and social software are extensions to the SOA concept and can be seen as the first success story of SOA in wide-spread user communities.

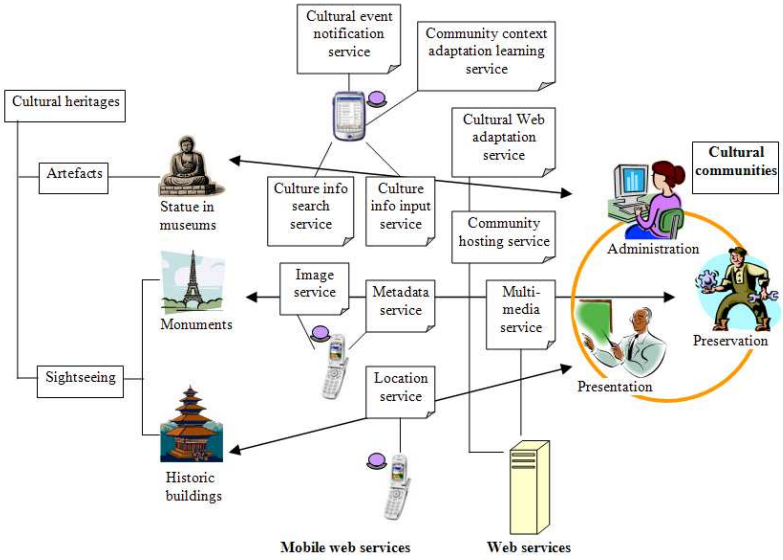

Fig. 1. Professional support for cultural communities through the mobile service framework

The services that are to be provided in a cultural community can be defined as follows (cf. Figure 1). In order to support professionals in cultural heritage management efficiently and flexibly, some services are deployed onto servers, while some services are deployed onto mobile servers such as cell phones and PDAs.

In case that the services need more computing and storage capacities, they can be realized with usual Web Service technologies [32] on work stations or servers. For example, a *cultural Web site adaptation service* needs to be defined to adapt usual cultural Web site for cell phones and PDAs according to the display capacities. *Multimedia services* are to be responsible for multimedia management, e.g. multimedia search on site of historic buildings and other sightseeing. A *community hosting service* is used for user management including new users registration, log in and user profile management, and multimedia access right management (cf. [28]).

The rest services based on cultural heritage or communities can be deployed on mobile servers. In the aspect of cultural heritages, there are mainly *cultural information input services*, *cultural information search services*, and *metadata services*. A *cultural information input service* provides professional users to input data with selected standards according to users' wish. A *cultural information search service* enable users to search site descriptions in text. Since there are lots of standards in the field of cultural heritage management and most of the standards are based on texts, the file size of the application is not very big. A *metadata service* can be defined to do mappings among different standards.

In the aspect of cultural communities, the defined services are *location service*, *cultural event notification service*, and *community context adaptation learning service*. A *location service* can be used to locate professionals at fieldwork. A *cultural event notification service* is to send alerts onto mobile devices to inform professionals about cultural events as well as the presence of the community members in the neighbourhoods. A *community context adaptation learning service* is deployed to deliver professionals learning stuff with regard to the community context. This use case is proposed in detail in [18]. An *Image service* is provided for picture upload.

These services can be mainly accessed by the mobile devices. To realize these requirements, we employ an approach of mobile Web Services [29], which will be introduced systematically in the next section. With mobile Web Services the mobile devices can participate in service consumption as well as service delivery.

3.4. Summary of mobile cultural communities

Summarily, the benefits to employ mobile Web Services are, on the one hand, the flexibility and that service provider and service consumer can be on the same devices. On the other hand, the deployment can be executed via mobile devices, if the mobile network is available. However, there are several potential problems and challenges. First, the instability exists. Services might be easily removed by the mobile device owner. Next, the capacity is still quite limited despite the rapid development of hardware. Last, it lacks a business model to control the charge of the services.

Technical companies together with W3C have agreed on mobile Web rules lately, in order to solve the problems of low visits of mobile Web sites. Google has also just launched its mobile personalized site in Europe. Although all these measures provide some soft conditions, it is still hard to let user communities pay for mobile content services as willingly as for phone calls.

However, our mobile community framework tries to employ new technologies to promote more mobile use cases. To support such mobile social software, mobile Web

Services alone can not meet all requirements. The framework using usual as well as mobile Web Services can make good use of the advantages of both services. Thus, such a piece of mobile social software can perform the tasks more efficiently and flexibly.

The following section explains the details of mobile Web Services and the realization details of social software services. The discussion has to get into some technical detail, but we believe that this kind of approach can also carry over to many other of the forthcoming pervasive applications of mobile information systems in social networks and may therefore be worthwhile presenting here.

4 Mobile Web Services

Service Oriented Architecture is the latest trend in information systems engineering. It is a component model, presenting an approach to building distributed systems. SOA delivers application functionality as services to end-user applications and other services, bringing the benefits of loose coupling and encapsulation to the enterprise application integration. A service having a neutral interface definition that is not strongly tied to a particular implementation is said to be loosely coupled with other services. SOA is not a new notion and many technologies like CORBA and DCOM at least partly represent this idea. Web Services are newest of these developments and by far the best means of achieving SOA.

The Web Service architecture defined by the W3C enables application-to-application communication over the Internet. Web Services are self-contained, modular applications whose public interfaces are described using Web Services Description Language (WSDL) [33]. Web Services allow access to software components through standard Web technologies and protocols like SOAP [34] and HTTP [12], regardless of their platforms, implementation details. A service provider develops and deploys the service and publishes its description and binding/access details (WSDL) with the UDDI registry [31]. Any potential client queries the UDDI, gets the service description and accesses the service using SOAP. [10] The communication between client and UDDI registry is also based on SOAP.

Web Services and its protocol stack are based on open standards and are widely accepted over the internet community. Web Services have wide range of applications and range from simple stock quotes to pervasive applications using context awareness like weather forecasts, map services etc. The biggest advantage of Web Services lies in its simplicity in expression, communication and servicing. The componentized architecture of Web Services also makes them reusable, thereby reducing the development time and costs.

The quest for enabling these open XML Web Service interfaces and standardized protocols also on the radio link lead to new domain of applications mobile Web Services. In this domain, the resource constrained mobile devices are used as both Web Service clients and providers. Figure 2 shows the deployment scenario of mobile Web Services, where mobile devices are used as both Web Service providers and clients. While mobile Web Service clients are quite common these days, the research with mobile Web Service provisioning is still sparse. To support this, during one of

our previous projects, we have developed and analyzed the performance of a mobile Web Service provider on smart phones. [1, 15, 29]

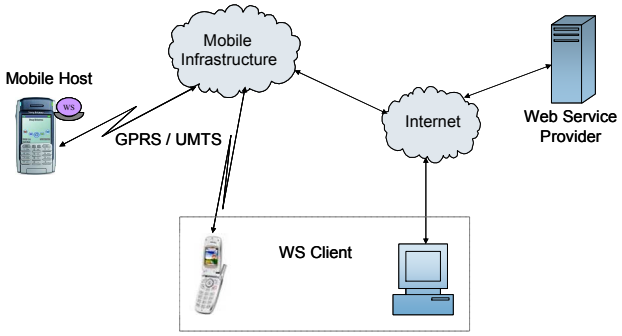

Fig. 2. Mobile Web Services scenario

Mobile Host is a lightweight Web Service provider built for resource constrained devices like cellular phones. It has been developed as a Web Service handler built on top of a normal Web server. The Web Service requests sent by HTTP tunneling are diverted and handled by the Web Service handler. Using HTTP tunneling it is possible to send data of any protocol through proxy over HTTP. The protocol messages are wrapped into the HTTP message body and are transferred as normal HTTP GET/POST requests. Detailed description of Mobile Hosts' design is beyond the scope of this paper and is available at [29].

The Mobile Host was developed in PersonalJava [14] on a SonyEricsson P800 smart phone. The footprint of our fully functional prototype is only 130 KB. Open source kSOAP2 [20] was used for creating and handling the SOAP messages.

The detailed evaluation of this Mobile Host clearly showed that service delivery as well as service administration can be done with reasonable ergonomic quality by normal mobile phone users. As the most important result, it turns out that the total WS processing time at the Mobile Host is only a small fraction of the total request-response time (<10%) and rest all transmission delay. This makes the performance of the Mobile Host directly proportional to achievable higher data transmission rates. Thus, the high data transmission rates achieved, in the order of few Mbps, through advanced mobile communication technologies in 2.5G, 3G and 4G, help in realizing these Mobile Hosts in the commercial applications [11, 35]. The Mobile Host was also successful in handling concurrent accesses for reasonable service like location data provisioning service.

Mobile Host opens up a new set of applications and it finds its usage in many domains like collaborative learning, social systems, mobile community support and etc. Many applications were developed and demonstrated using Mobile Host, for example in a distress call, the mobile terminal could provide a geographical description of its location along with location details. Similarly interesting scenarios like mobile expertise finder services, mobile learning media sharing services are possible in e-learning domain. Current research in this domain concentrates on adopting this Mobile Host feature into the social software systems. [30]

5 Conclusion and Outlook

The mobile community support for cultural heritage researchers is still in its early phase. The impact of social software on professional communities in various fields is significant. It is time to survey the adaptation of the requirements and design of social software esp. mobile social software from non-professional level to professional level.

In this paper we made an analysis of the relationships between social software and cultural communities. Standardization with metadata and mobility are main issues to provide professionals a mobile community for cultural heritage management. We have defined the basic services to support the community. The basics of mobile Web Services technology are also introduced. The upcoming tasks are to apply the mobile Web Services into the designed mobile community framework for cultural heritage management.

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