Information analysis in mobile social networks for added-value services

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Abstract

The emerging evolution of technology has changed the role of mobile phones which apart from being communication devices are also powerful devices for uploading and consuming content. This fact poses new challenges for the mobile industry, which needs to develop and adapt useful and appealing services for the users in order to enhance the role of the mobile phone as a mainstream device. Adopting and using mobile social networks sites and other Web 2.0 services is expected to be inline with such a mobile technology trend. Current mobile web technologies offer a computer-like user-experience since a user can easily generate and share digital content from his/her mobile. However, current services and applications do not include techniques for analyzing this mass user-generated input (e.g. content, annotations), user interactions (e.g. ranking) and social interactions (e.g. relationships). Knowledge extracted from this massive user contribution and interaction can offer personalized added-value services enabling more efficient mobile usage. Our goal is to outline this *information analysis gaps* in existing services and going one step further to suggest possible solutions. Aiming at social networks we discuss novel methods for analyzing users' actions and modeling users' social relationships. The goal from these suggestions is to extract the underlying knowledge from users' tagging activities, users' generated content and users' social relationships within a social network. We present our points with indicative example services.

1. Introduction

Mobile phones progressed and became popular in a speedy manner since they facilitate and improve communication among people in an impressive way. It is foreseen that the future mobile phone will advance their current role by becoming a device that will act as an organizer, a financial task manager, an entertainment platform, a security center, etc. The evolution of communication (3G, GPS, Wi-Fi, WiMax, etc.) and hardware (microprocessors, storage space, touchscreens, etc.) technologies offer mobile industry a scene to develop many useful user-oriented services, which are able to "collaborate" with existing Web technologies and services. Today's mobile phone offers a computer-like and on-the-go user access to the Web with browsers that support current web technologies (HTML, CSS, Javascript, Java, etc.).

Web 2.0 and evolving technologies have increased interest in socializing and user-contributed content and Web-based social sites have been followed by their mobile adaptations or development of specific ones for mobile devices. Mobile web-browsing is becoming more and more popular as reported in ABI research [1] which states that 'mobile social communities' currently count nearly 50 million members worldwide, a number that is expected to reach 174 million in 2011. Additionally, Juniper research [2] estimates that the total value of the user generated content (UGC) services market, related to the mobile phone industry, is positioned at around $576 million for 2007, while it is expected to rise to some $5.75 billion by 2012. At the same time, the worldwide mobile advertisement spending will reach $11.35 billion by 2011, according to Informa Telecoms & Media research [3]. These numbers verify that the mobile social sites are progressing fast and many companies are trying to take advantage of these trends with the development of new devices, new software products and new appealing services (Nokia with Symbian[1], Apple with iPhone[2], Google with

[1] http://www.symbian.com/
[2] http://www.apple.com/iphone/

Android[3], Microsoft with Windows Mobile[4], Yahoo! with Yahoo!Go[5] etc.). Such a mobile socializing and content interaction reality indicate that there room for more and better services exploiting this user-contributed information and activities, which could be proposed and developed jointly by the academia and the industry.

More specifically, while advances in technology allow easy and fast user content generation and sharing over mobile devices, user-related activities such as searching, personalised recommendations and information sharing either have inefficient results or they are not available. This is because, existing services and applications, in their majority, do not include advanced techniques for analyzing this mass user-generated input (e.g. content, annotations), user interactions (e.g. ranking) and social interactions (e.g. relationships). Current data analysis methods on mobile social networking are not mature enough and we claim that effective mining and data analysis methodologies can and will improve social mobile activities such as information sharing,searhing,-personalised recommendations, users interactions and communities formation etc.

Towards this objective, the WeKnowIt [4] European Union's Information and Communication Technologies 7th Framework Programme Integrated Project aims at contributing in filling such an *information analysis gap*. The main objective of the project is to develop novel techniques for exploiting multiple layers of intelligence from user-generated content, which together constitute 'Collective Intelligence', a form of intelligence that emerges from the collaboration and competition among many individuals who interact under a variety of technologies. To this end, input from various sources is analysed and combined: from digital content items and contextual information, massive user feedback, and users social interaction so as to benefit end-users and organisations. The automatic generation of Collective Intelligence constitutes a departure from traditional methods for information sharing, since for example, semantic analysis has to fuse information from both the content itself and the social context, while at the same time the social dynamics have to be taken into account. Such intelligence provides added-value to the available content and renders existing procedures and workflows more efficient. The proposed advancement of research and technology in user-contributed content analysis can be inspiring for the mobile industry towards developing more efficient user services.

This position paper emphasizes the need for effective data analysis in mobile social sites and demonstrates the added-value services that can be possible as the result of this analysis. Section 2 outlines the current mobile social networks and content sharing sites. Section 3 gives an overview of the limitations of the current analysis methods in the scope of social sites and proposes directions for an efficient analysis of user-generated content. Conclusions are presented in Section 4 and, finally, in the appendix a number of example applications are presented in which the proposed analysis approaches are able to provide an enhanced user experience.

2. Added-value Mobile Social Networking Services

Web 2.0 popular applications such as blogs (e.g. Wordpress), micro-blogs (e.g. Twitter), social tagging systems (e.g. Flickr), social networks (e.g. Facebook) exhibit capabilities of creating and sharing content, socializing within virtual communities and exploring new information spaces. The initial development plans for Web 2.0 applications was mainly computer-based oriented, but as mobile phones became more popular, new needs and challenges arrive on the scene, making mobile-based Web 2.0 applications a new trend [5]. Web 2.0 services on-the-go is a new reality and the social networking services providers understand that there is a demand for mobile-based applications.

The 'mobile world' is already exploiting social networking services either by adapting existing services and applications to mobile devices or by developing specific applications, which also integrate additional functionalities available to mobile phones like the usage of camera, voice recognition and GPS receiver.

However, current services, in most cases, enable access to the services and content and in few cases, are results of flat analysis techniques of user actions and user-contributed content within a social network. Deeper, semantic analysis of content enables efficient applications that can drive the user to interact more

[3] http://code.google.com/android/

[4] http://www.microsoft.com/windowsmobile/en-us/default.mspx

[5] http://mobile.yahoo.com/go

with the social networking sites (e.g. submit content) and allow personalised consumption (e.g. recommendations).

For example, in emergency circumstances it is important to have services which enable the emergency response organizations to construct a quick and accurate view of the situation and on the other hand provide useful information to the users quickly and accurately. It is nowadays very common for users to take photos or videos of emergencies (e.g. accident, fire, etc) using their mobile and upload this content to a social networking service. The service could analyze the user-generated content (as explained in the *patterns, trends and facts* extraction topic in the nest section), generate a global view for the emergency, for example by combining a number of geo-located photos and provide that *"this is a fire covering one building block between streets..."*, make this information available to the emergency personnel and on the same time provide the users with personalized information regarding the optimum evacuation route. Furthermore, by analyzing the social relations (*social-oriented mining for mobile* devices in the next section) of the user of the services, would be able to provide useful to other users as well.

To make such services possible, WeKnowIt aims at developing novel analysis methods taking into account the amount of shared content and the complex and dynamic structure of networks. The goal of this analysis is to harness the 'Collective Intelligence' (e.g. co-participation, massive user feedback etc) that occurs in social networks and offer new added-value services to the users. Figure 1 depicts the contribution of WeKnowIt in the analysis of information related to social networks.

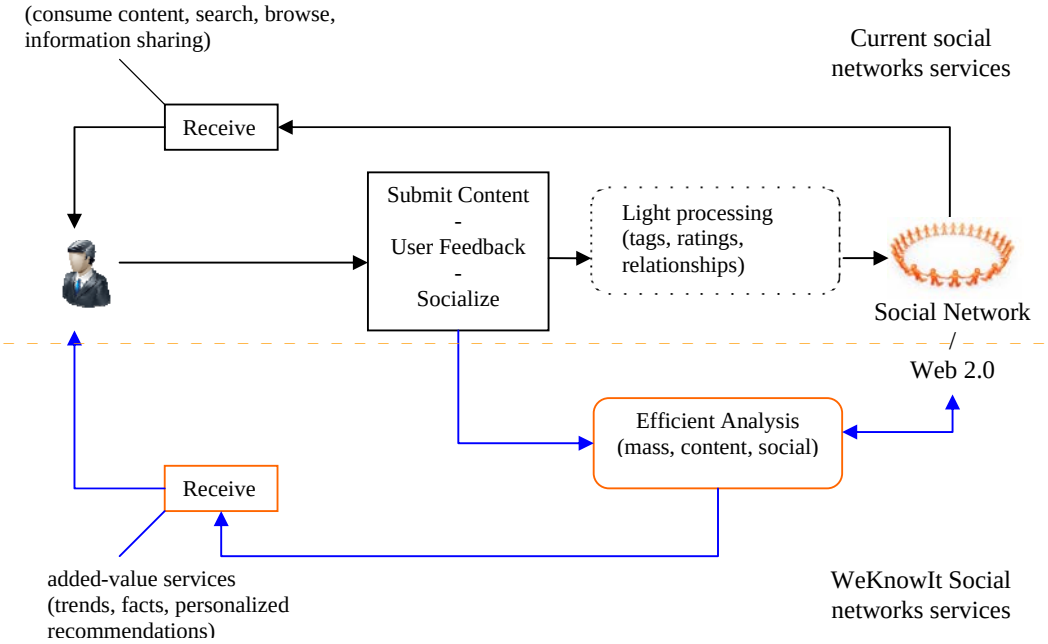

Figure 1 – WeKnowIt efficient analysis in Social Networks

In the next section we outline the main research topics and directions for analyzing mobile social networking related content.

3. Which analysis is feasible over mobile social networks?

The core social networking activities involve tagging, social-oriented interactions, content sharing and outsourcing. Currently, services involve only "light" analysis including clustering at the level of results of image search engines [16], exploitation of geo-tagged photos for sharing and browsing purposes [17], visualization techniques as a tourism information analysis tool [18]. Therefore, there is a need to develop analysis techniques which fully exploit the information available in these activities and content. More specifically, we put emphasis on the following research topics and we pose the questions raised in terms of their extension and applicability to the mobile social networking:

- *social-oriented mining for mobile devices*: earlier social mining (clustering in particular) efforts have focused on techniques that have been experimented under Web datasets which refer to either resources or tags as well as usage. Such indicative clustering methodologies have been proposed in [7], [8] where co-clustering exploits joint groups of related tags and social data sources by simultaneous considerations of social and semantic similarities and furthermore by low-level features derived by content analysis techniques. Such techniques allow tag disambiguation for more efficient access to content. Are these mining approaches suitable or enough for mobile scenarios? Should we consider new mining approaches which will consider social characteristics in conjunction to mobile communication ground (such as location, inter-platform technology requirements etc)?
- *patterns, trends and facts extraction:* investigation of the patterns of user activities emerging in such systems, e.g. the evolution of popularity for online stories or the shape of distribution that the intensity of user activity presents (e.g. power-laws). Topic structure revealing in the tag networks that are created from the co-occurrences of tags attached by users of these applications to the respective web resources, e.g. photos, questions, etc. This problem is tackled either by means of traditional clustering schemes (e.g. agglomerative clustering, co-clustering) or by graph-based community detection methods. How can such extracted information based on massive user feedback be integrated to mobile services?
- *semantics and social information integration*: the use of ontologies has become quite popular since it facilitates the incorporation of semantics in tagging activities. Users' actions in online communities can be modeled with SIOC ontology [13] which is a combination of lightweight ontologies. By using SIOC ontology one can model user associations with his/her content (SIOC Core ontology), social relationships (FOAF ontology [12]), user tagging activities (MOAT ontology [9]) and incorporation of metadata to content (Dublin Core Ontology [14]). SIOC usability can be easily extended by more lightweight ontologies. The question here is whether these ontologies are useful and can be easily managed under mobile device frameworks?
- *feature-driven mobile data management*: data analysis methods can be exploited for developing novel methods of fusing information from different modalities, contextual information (e.g. time, location), personal context (e.g. user profiles and preferences) and social context (e.g. tagging, ratings, relevant content collections). Exploitation of the data features has been proven beneficial in earlier efforts as in [10] which exploits spatial (e.g. regions), temporal (e.g. related neighbouring images) and image capture condition (e.g. flash, exposure time etc) context for semantic classification scene or in [11] where contextual information is used to improve knowledge-assisted image analysis. Can we apply such techniques on mobile data types? Is it computationally feasible to capture these characteristics on the go and to proceed to effective mobile data management?

4. Conclusions

In this position paper, we analyse the need for deeper analysis of social networking user generated content, which can be used to provide new added-value personalised services. We describe a number of research topics and directions to enable such services and we give first examples of applications, which could exploit such research results. The adaptation of these research topics for mobile applications and the way they can be integrated to existing and new applications is among the main issues our position paper raises.

Appendix: Applications Scenarios

Visual Similarity Based Geo-Location

One of the most common activities of current internet users is uploading photos to social networks. As the use of the web via mobile phones increases, more photos are being uploaded on the move. Users could be facilitated by services which offer content-based image analysis. For example, by uploading a photo of a tourist attraction to such a service the user can retrieve information regarding its name, history and location. The service works by using the uploaded photo to locate and create a cluster of other photos with visually similar content and uses the geo-tagged ones to retrieve the location and name of the attraction in the original uploaded image. In this case, this service is of particular use for mobiles which don't have a GPS receiver or when the GPS is providing inaccurate results. This service makes use of the *feature-driven mobile data management* research topic results, which combines geo-tags with analysis methods.

Trend extraction for entertainment

In social networks users share content regarding their entertainment activities. They also appreciate receiving recommendations and reviews of places they haven't been to. Uploaded photos could be used by a centralized analysis service to provide such recommendations. Such a service could generate statistics of popular bars, clubs, restaurants and cafes, including peak hours and which people choose to visit them. An efficient analysis of mass user contributions –reviews, ratings, comments, tags, content - is required to provide these statistics and recommendations exploiting the *patterns, trends and facts extraction* theme described above.

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