Towards Ontology-based Context Aware Mobile Social Networks

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Abstract. Due to the increasing progress of context-aware computing, we expose the importance of using context-aware mobile technologies to access social networks. Exploring knowledge in the social networks is a challenge caused by the exploding size of data in these networks. Thus, using ontologies better fits this challenge. We propose, in this paper, an approach to combine these technologies (context, mobile and ontology) together to have a contextualized ontology helping to assist a mobile user in his information retrieval from the social networks. We end up by giving emphasis to our future works.

1 Introduction

Social networking provides progress, particularly in communication and self-expression. Since then, millions of people connect to social networks. In fact, users find a space for sharing information and can follow the news of friends and family. This space is proved in social networking sites. The emergence of social networking sites allows companies to promote their products and services. Social networking sites can easily group users by their information. The publicity is much easier for companies because they can target users. Job seekers and those who want to make their online promotions have also used social networking as a means to achieve their goal.

Social networking applications are changing the way of communication by using user's context-information. For example micro-blogging has become a smart way of conveying the current situation and activity by using user context. There is currently a significant difference between using social networking applications on a static computer compared to a mobile device, even if current mobile devices are powerful and have good connectivity. The difference is primarily related to the mobility aspect since the user contexts may change more frequently and the user may not be able to interact with the mobile device.

Researchers and industry are oriented toward the use of social networks via mobile technology, given the exponential growth of mobile devices. Conversion to mobile version enables customers to a company to benefit from their expertise and Smartphone instant access to the services of this company. A multitude of benefits characterizes mobile devices. Certainly, they combine practicality, ergonomics and simplicity. They are also powerful and allow easy and instant accessibility to information. Then, these mobile devices enable instant access to social networks and news.

For Smartphones with Android, they provide easy access to social networking sites and good integration with Google products such as Gmail and Google Maps.

Knowledge representation is an issue troubling and confusing because of the problems that encounter it. Social networks contain a lot of personal information about users (name, date of birth, etc.) as well as information on their friendship and their interests. Many works are required to represent this information by graphs. Fan [7] proposed a framework of preserving the query graph compression, which preserves only the information needed to answer a certain query class of choice for users. Some research has used the RDF graphs to model semantic social networks. Erétéo [6] proposed a framework to exploit directly the RDF representations of social networks by using the semantic search engines on the Web. Other researchers, such as Corby [4] used the SPARQL query language to find paths between semantically related to RDF resources based on graphs.

A whole based on graphs theory is used. Graphs allow structuring concepts and relations between them. Moreover, they allow better visualization. However, the graphs do not maintain the semantics of the concepts they represent. They do not formalize the information contained in these social networks. In contrast, ontologies utilization keeps the semantic relationships between concepts with a better knowledge representation. Indeed, ontologies are used for the specification of concepts and relationships associated with a given domain. Social networks are composed initially of entities and relationships. Thus, domain ontologies can represent these entities and relationships. Ontologies do not allow modeling conflicting information and the validity of the information encoded by reasoning. In addition, ontologies can infer new information through the inference.
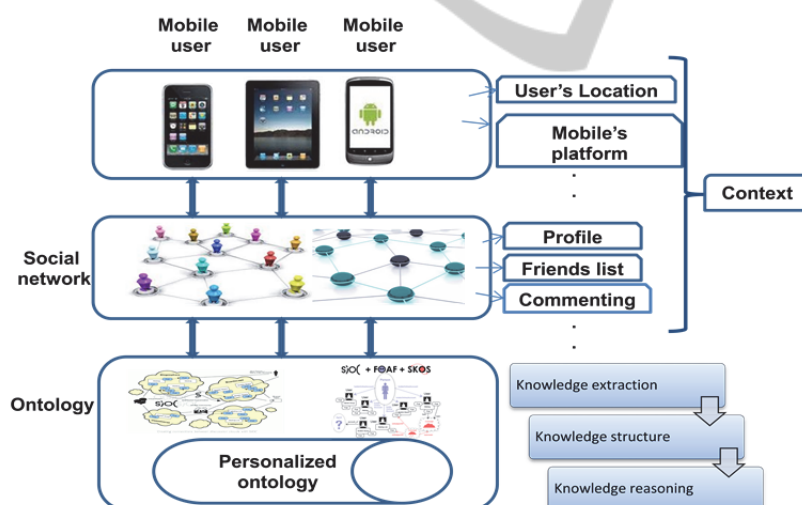

Fig. 1. State-of-the-art study's presentation.

The question that remains how the context is detected in social networks and how we can represent the knowledge, extracted from the social networks, by ontologies. We expose our state-of-the-art study in the figure 1. In this figure we present mobile users who interact with social networks. In their interaction, they are in contact with

contextual information. These information are produced by two sources. The first source is the mobile phone which has some features like the used platform or screen, user's location, etc. The second source is the information about the user itself as his profile, his friends list, his comments, etc. In the objective to represent the knowledge extracted from the social network, we use ontologies. By means of ontologies, we have three steps to reason about the extracted knowledge: knowledge extraction, knowledge structure and knowledge reasoning. The ontologies which can be employed can be a personalized ontology that we create with/without adding an existing ontology as SIOC and FOAF.

The rest of the paper is organized as follows. Section 2 presents related work concerning the user classifications in social networks, the importance of context in social networks, the usability of mobile devices in ubiquitous computing and some existing ontologies to represent social networks knowledge. We propose an approach, in section 3, to assist a mobile user in his information retrieval from the social network. Finally, we talk about some of our future works and draw conclusion in section 4.

2 Related Work

A social network consists of people or groups connected by a set of social relationships, such as friendship, co-working or information exchange [8]. Lately, social networks have become an important mean of communication and interaction between people over the Internet. They provide many services offered online: email, instant messaging, file sharing, etc. Social networks are now being used as well in academia [17] and business communication not only in free time. A common property of Web 2.0 technologies is that they facilitate collaboration and sharing between users with low technical barriers on sites and with a limited amount of information. The basic features of a social network are profiles, friend listings, and commenting, often along with other features such as private messaging, discussion forums, blogging, and media uploading and sharing [5]. A user profile, in the social network context, is a collection of personal data associated with a specific user. A user profile can store the user's interests, gender, birthday, religious beliefs, and other characteristics of the user. In the next sub section, we present some classifications of social networks' users and the importance of context in social networks.

2.1 Users Classification in Social Networks

A first classification split the social networks into two parts, i.e. users and the contents produced by them. If we take a closer look at the users, it is natural to view it as a combination of consumer and producer from a marketing perspective. Consumer refers to the individuals who only read or watch but never post anything. Some studies also call them lurkers [16]. Producer encompasses creation and publication of one's personal contents such as text, images, audio, and video. Furthermore, some studies go deep into the classification of users in online environment.

Another classification, is done in Porter's Funnel Model, identified four types of users which are interested readers, first-time users, regular users, and passionate users

based on the extent of user's participation [15].

Nakakoji defined users' roles in social networks communities as classified in 8 groups including: passive user, reader, bug reporter, bug fixer, peripheral developer, active developer, core member, project leader [14].

Mao used the data mining techniques to illustrate the user's categories in online community as reader, learner, responder, contributor, and leader [13].

2.2 The Importance of Context in SN

Brézillon [2] enumerates the importance of using context in social networks. He underlines the importance of context explicitation to provide a global view of the main aspects of social networks. First, the explicit consideration of contexts could improve notably the collaborative work processes in an enterprise. Secondly it is interesting to simultaneously consider the paradigms of context and social network. Thirdly, different types of context account for the flux of information between groups as well as inside each group are shown.

Joly [10] demonstrates the opportunities offered by the use of context in social network. First, it is interesting to leverage context information to assist sharing of information such as get tips from friends when travelling (context: location). Secondly, it is practical to use the context information to assist contact management and awareness. This is due to that context-awareness can improve the social networking experience by bringing more relevance in social awareness towards more effective communication.

After exposing the importance of context in social networks, we present the use of mobile platforms having the ability to detect the context. Smartphones are a new trend of mobile phones. They are rapidly becoming the central device in people's lives. Importantly, today's Smartphones are programmable and come with a growing set of cheap powerful embedded components. Now phones can be programmed to support new sensing applications [11] such as sharing the user's real-time activity with friends on social networks keeping track of a person or monitoring a user's well being.

2.3 Using Mobile Device in Context-aware Computing

The use of Smartphones is growing at an unprecedented rate and is projected to soon pass laptops as consumers' mobile platform of choice. The proliferation of these devices has created new opportunities for mobile researchers. The recent years have seen an enormous growth in the popularity and visibility of Smartphones. Some researchers use the profile of the mobile user to know his context. In this context, Li [12] proposes semantics-based mobile social network, a framework of a fully functional mobile ad hoc social network that incorporates semantics of users' social data. This framework provides effective and efficient solutions to social network construction, semantics-based user profile matching, etc. Another element which can contribute to context-aware computing is the location of the mobile user. There are many Smartphone platforms such as Android, iPhone, etc. As the technologies of these platforms continue to improve and used in large numbers of devices, location sensing in mobile devices will undoubtedly become ubiquitous. Also, it has been shown, that

context is useful at different levels within a mobile device. At systems level, it can be exploited for example for context-sensitive resource and power management. At application level, context-awareness enables both adaptive applications and explicitly context-based services. And at the user interface level, the use of context facilitates a shift from explicit to implicit human-computer interaction, toward less visible if not invisible user interfaces [18].

2.4 Existing Ontology to Represent Social Networks Knowledge

The Semantic Web is an extension of the current Web. It well defines the meaning of information, better enables computers and people to work in cooperation [1] and provides required representation mechanisms for portability between social media sites. An ontology, which is a semantic web technology, is defined by Gruber as "a shared and common understanding of a domain" [9]. Therefore, we use ontology to represent user and resource profile. The ontology-based representation is more expressive and less ambiguous [12]. In addition, the ontology provides formal, machine-executable meaning on the concepts. Moreover, ontology standards support inference mechanisms that can be used to enhance semantic matching.

The FOAF initiative provides a way to represent social network data in a shared and machine-readable way, since it defines an ontology for representing people and the relationships that they share. While the SIOC project was initially established to describe and link discussion posts taking place on online community forums such as blogs, message boards, and mailing lists. By using agreed-upon Semantic Web formats like FOAF and SIOC to describe people, content objects, and their connections, social media sites can interoperate and provide portable data by appealing to some common semantics [3]. As discussions begin to move beyond simple text-based conversations to include audio and video content, SIOC has evolved to describe not only conventional discussion platforms but also new Web-based communication and content-sharing mechanisms.

3 Ontology-based Context-aware Mobile Social Networks

We propose an approach in order to assist the mobile user in his search on social network which is presented in figure 2. This approach is composed of five steps. First, we extract knowledge from social network. In this context, to achieve this step, we use a tool and/or an API associated to the chosen social network. This step allows extracting diverse form of knowledge explicit, implicit, contextual and non contextual. Second, we will process this amount of knowledge which contains additional information not useful for our work to keep only the wanted data.

After that, we build an ontology from this processed data to profit from the advantages of sharing knowledge and keeping semantics of ontology construction. The ontology will contain the main concepts of social network, their properties, their relationships and some axioms controlling the structure of the ontology. This step is followed by contextualizing the constructed ontology. Indeed, detecting the mobile user's context is necessary to assist him in searching persons or services in the chosen

social network. The next step consists of comparing the different user profiles and the contextual information of mobile user. This comparison is achieved by using tools and algorithms to choose the best result of the user query. The last step permits assisting the user, by mobile interface. The result should suit the mobile performance (size of the screen, size of memory, etc).
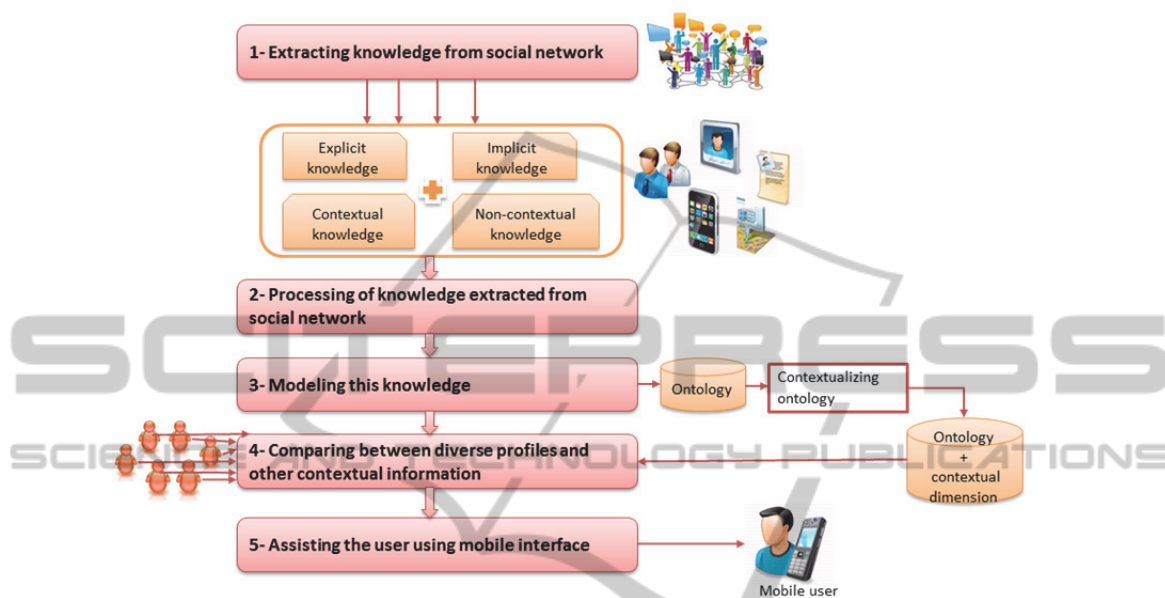
Fig. 2. Our proposed approach to build an ontology-based context-aware mobile social network.

4 Conclusions and Future Works

During this paper, we exposed a state-of-the-art concerning the combination of different technologies which are social networks, context-aware computing, mobile devices and ontologies. First, we demonstrated that the Smartphones, due to their mobility, can contribute to more access to social networks. Then, we showed that managing context, in these devices, is necessary to improve their capabilities. Furthermore, we present some existing ontology which represents a means that permits to preserve semantics and formalization of social networks knowledge. Afterward, we introduced our proposed approach to assist the mobile user in his information retrieval from the social network. In our future works, we intend to contextualize our ontology through a method that extracts information from a social network using ontology.

References

1. Berners-Lee T., Hendler J., and Lassila O.: The Semantic Web. Scientific American,

284(5):34–44, May 2001

2. Brézillon P. and Marie Curie P.: A context approach of social networks. In proceedings of the Workshop on Modeling and Retrieval of Context, 2004.

3. Bojars U., Breslin J., Finn A., and Decker S.: Using the Semantic Web for Linking and Reusing Data Across Web 2.0 Communities. The Journal of Web Semantics, Special Issue on the Semantic Web and Web 2.0, 2008.

4. Corby O.: Web, Graphs and Semantics, Conceptual Structures. Book: Knowledge Visualization and Reasoning. In 16th International Conference on Conceptual Structures, ICCS 2008, held in Toulouse, France, in July 2008.

5. Domingue J., Fensel D., Hendler J. A. (Eds.) "Handbook of Semantic Web Technologies" Springer Heidelberg Dordrecht London New York 2011 DOI 10.1007/978-3-540-92913-0.

6. Erétéo G., Gandon F., Corby O. and Buffa M.: Semantic Social Network Analysis. Web Science (2009).

7. Fan W.: Graph pattern matching revised for social network analysis. Proceedings of the 15th International Conference on Database Theory, pages 8-21. New York USA, ISBN: 978-1-4503-0791-8 (2012)

8. Garton, L., Haythornthwaite, C. and Haythornthwaite, C., Studying online social networks, Journal of Computer-Mediated Communication, Vol. 3. 1997.

9. Gruber W.A., Boudreaux J.C. Intelligent manufacturing: programming environments for CIM. Springer-Verlag, London 1993

10. Joly A., Maret P., Daigremont J.: Context-Awareness, the Missing Block of Social Networking. International Journal of Computer Science and Applications 4(2):50-65, ISSN 0972-9038. 2/2009

11. Lane N. D., Miluzzo E., Lu H., Peebles D., Choudhury T., and Campbell A. T., College D. : A Survey of Mobile Phone Sensing. Ad Hoc And Sensor Networks, 2010, IEEE Communications Magazine, September 2010.

12. Li J., Wang H. and Khan S. U.: A Semantics-based Approach to Large-Scale Mobile Social Networking. Mobile Networks and Applications April 2012, Volume 17, Issue 2, pp 192-205

13. Mao B., You W.: Classifying model for virtual community members. Journal of Tsinghua University (Science and Technology) (S1) 46, pp. 1070-1073, 2006. (in Chinese)

14. Nakakoji, K., Yamamoto Y., Nishinaka Y., Kishida K., and Ye Y.: Evolution Patterns of Open-Source Software Systems and Communities. Proceedings of International Workshop on Principles of Software Evolution (IWPSE 2002), Orlando, FL, pp. 76-85, 2002.

15. Porter, J: Designing for the Social Web, Berkeley, CA: New Riders, 2008.

16. Preece, J., B. Nonnecke, and D. Andrews: The top five reasons for lurking: Improving community experiences for everyone. Computers in Human Behavior (2) 20, pp. 201- 223, 2004.

17. Pempek T. A., Yermolayeva Y. A., and Calvert S. L.: College students' social networking experiences on Facebook. Journal of Applied Developmental Psychology, 30(3), 227–238. Retrieved from http://dx.doi.org/10.1016/j.appdev.2008.12.010 (2009).

18. Schmidt A.: Implicit Human-Computer Interaction through Context, Personal Technologies 4(2&3), June 2000, pp.191-199.