Workshop Proceedings of the 9th International Conference on Intelligent Environments
J.A. Botía and D. Charitos (Eds.)

doi:10.3233/978-1-61499-286-8-110

Social Awareness in Pervasive Communities for Collaborative Work

Christopher LIMA[1], Mário ANTUNES, Diogo GOMES and Rui AGUIAR
Instituto de Telecomunicações
Universidade de Aveiro, Aveiro, Portugal

Abstract. Future pervasive environments will take into consideration physical and digital social relations. Nowadays it is important use to collective intelligence, where the interpretation of context information can be harnessed as input for context-aware applications, especially for group collaboration. The use of collective intelligence represents new possibilities but also new challenges in terms of collective information for adaptability and personalization in intelligent environments. This paper presents a collaborative context-aware framework focusing on social matching capabilities for session formation in collaborative activities.

Keywords. Pervasive computing, social matching, collaboration.

Introduction

With the advent of Web 2.0, various social networking sites emerged in the present scenario of the internet (E.g. Facebook, LinkedIn, Twitter, etc.). The information retrieved from these social sites can be useful for pervasive or ubiquitous systems, where the changes of environment and/or context are important to offer powerful ways of working and communicating.

Ambient intelligence has matured greatly, mainly due to mobile devices and sensors evolution. Combining ambient intelligence with social networks creates a pervasive environment in which real-world and virtual social information can be utilized as context information. The context refers to a set of conditions (e.g. temporal, presence, location) that may be used by applications to dynamically adapt its behaviour.

Environments such as smart spaces are aware of context, enabling users to access computing resources to perform their activities [1]. In addition, several of these activities in smart spaces may involve multiple users collaborating in common tasks. The CSCW (Computer Supported Cooperative Work) field has various types of applications for group tasks including conference, development and workflow environments. However, context-aware CSCW applications research has only reached recently pervasive systems. The trend is towards the use of collective intelligence, where interpretation of context information related to the group relations should be harnessed as input for such collaborative applications in these environments.

[1] Instituto de Telecomunicações, Universidade de Aveiro - Campus Universitário de Santiago, P-3810-193, Aveiro – Portugal; Email: cviana@av.it.pt.

While the pervasive environments can support large and small groups, usually collaborative activities happen often in small groups of up to 10-15 people [2]. A survey applied by SOCIETIES project in April 2011 at Intel's Lab, Ireland indicate that small dynamic groups based on criteria such as location are a desirable feature to the majority of interviews [3]. The questionnaire also demonstrates that almost all participants agreed to share their professional information such as: business cards, LinkedIn profile, educational information and expertise areas.

Take into account an enterprise scenario, where many researchers and projects have workshops at an IT company campus. A community can be created for IT campus staff and a smaller community for each project. For this scenario, our framework will provide, for instance, an integrated support system to optimize the infrastructure for collaborative work as session meeting management and dynamic groups' formation for breakout sessions.

In this paper we present a social matching for pervasive communities focusing in support collaborative sessions. The social matching component is part of a framework that provides adaptability for communication, coordination and relationships to CSCW in enterprise scenarios. The goal is to demonstrate that CSCW activities can benefit from using individual information merged with social computing in collaborative activities for enterprise environments.

1. Pervasive Communities

A smart space community envisages the integration of pervasive and social areas to provide personal smart spaces that can move along the users providing group capabilities following the users' interests. Figure 1 illustrates three pervasive communities where the community one comprises community two and three.

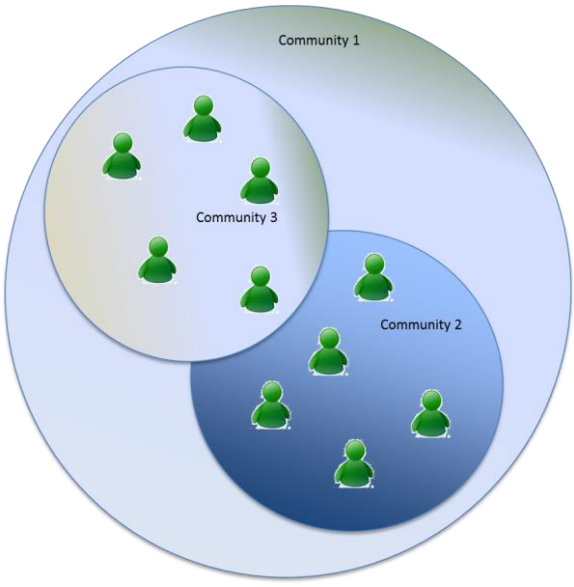

Figure 1. Example of three pervasive communities

The SOCIETIES[2] project is researching the intersection of both areas to design a system with features such as single/multi-user pervasiveness, personalization, dynamic community formation, privacy, context management and social networking as context sources.

There are several criteria's that can be used to form a community of individuals or organizations such as sharing same location, have same or similar preferences, share interest and share social relationships. All the users by default need to accept beforehand the privacy policies of the specific community to participate (e.g. age, location). The policies can be defined by the community creator or by the administrator elected by the users.

2. Related Work

Opportunistic social matching is a class of systems that matches users independently of a user request [4]. The matching is typically done based on shared interests and similarity found among the individuals, where people are considered good matches with high affinity in common. Differently from group recommenders systems, social matching systems focus on suggest people instead of items. Some system attempt to tackle groups in pervasive environments in the literature [5], [6], [7]. However, these solutions do not take into consideration the possible synergy between physical world and virtual social interaction.

In this regard, group detection methods in the literature are usually based on graphs where nodes represent the individuals and the links some interaction or similarity among the individuals. The relationship behaviour in this type of networks is categorized into static and dynamic [8]. The static analysis the relationships at a particular time to group individuals through the links available, while the dynamic study the network to find modular structures along the time. The second is a challenging task since it is important to take into account many aspects as links and nodes appearing/disappearing at different time points [9].

3. Social matching for Collaborative Work

We implemented a framework to deal with collaborative session's formation on the pervasive communities. Generally, pervasive systems such as PERSIST[3], C-CAST[4] have a specific component to manage context, allowing the system to capture and retrieve user information. The framework is responsible for gathering context information from the users through heterogeneous sources that can range from mobile sensors to SNS (Social Networking Site). The mobile devices for instance provide location and availability. On the other hand, SNSs can provide information related to user profile such as interests, professional position and company. Thus, the main focus of the framework resides in context management, knowledge extraction and automatic adaptation, abstracting the concern to deal with context information sources.

[2] http://www.ict-societies.eu/
[3] http://www.ict-persist.eu/
[4] http://www.ict-ccast.eu/

4. Framework Design and Implementation

In [10] we present some relevant context information categories appropriated for the framework describing three enterprise scenarios. Some of the categories which may be used include: geographic location, current availability, current computational (mobile/desktop) resources and professional interests.

To model the individuals and interaction we choose represent them in graph. As a tool we adopted the Neo4j[5] which offers a graph-oriented model for data representation. In this way, the graph analysis occurs dynamically, enabling the data be updated over time by the context sources.

We divide the information into separate categories: long-term and short-term. The long-term information is comprised by data that does not change often such as: job position, areas of interests, skills. While short-term information comprises data that changes frequently such as location and availability (e.g. user busy, away).

The collaborative sessions in the framework are composed of members, roles and applications in common (e.g. chat, audio conference). A set of rules manages when a session needs to start and invite the participants. For instance, if at least two people are in the same location and work at the same department and have the same interests then start a session. The framework session is part of a community is in charge to check context information changes in different intervals for long-term or short-term types.

Additionally, the rules are dynamic and can be created by the administrator before the sessions start or in runtime.

Figure 2. Participants with same similarity are invited to join the collaborative session[6].

Figure 3. Using information available from SNS and the individual the social match mechanism verifies the similarity among the members[6]

Figure 2 exemplify a user profile that belongs to a community. Figure 3 presents a suggestion example based on location and data provided from SNS in the user's tablet device. In this case for example it is possible to start a collaborative session inviting the users for an online chat.

In order to extend the context information collected from the context sources, the framework performs an enrichment of context depending on the nature of the data. The

[5] http://neo4j.org/

[6] Taken from http://www.ict-societies.eu/files/2011/11/D8.1_public.pdf.

information can be expressed in numeric or text values. The numeric values can be enriched using historical information available, as an example it can be used to generate temporal series. This is helpful in case certain events to not occur regularly.

While in text values it is possible to assign similarities among the persons in graph. This similarity enables to associate weights between person nodes and is calculated by dividing the matched information by the total available. This is applied for both and the result is divided by two as represented below:

$$S = ((matched\ context/context\ node1) + (matched\ context/context\ node2))/\ 2 \quad (1)$$

In addition, the texts values are submitted to externals sources of Natural Language Processing (NLP) for semantic analysis, returning synonymous words that are aggregated with the existing information. This enrichment provides knowledge to create rules decision that occurs in the adaption layer. Figure 4 presents the individual nodes after the analyses. As an example, the two nodes on the top of figure 4 has value 0.33 with ((1/3) + (1/3))/2.

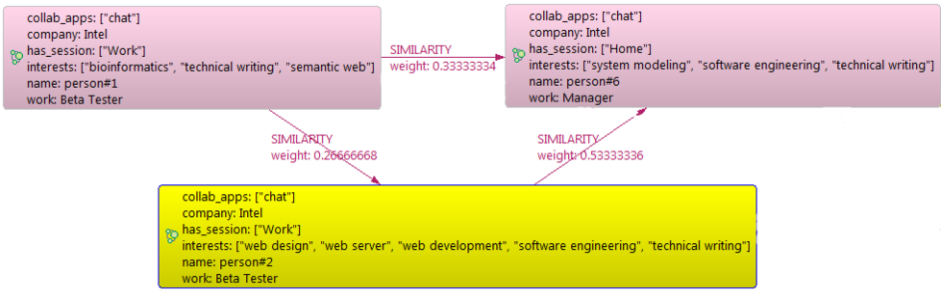

Figure 4. Sample of graph individuals and their similarities.

In runtime the framework is requested to report which the thresholding should be used to select relevant persons for the given similarity. This method is called automatic thresholding and it is often used in image processing for segmentation [11]. The thresholding mean value is calculated based on the weights assigned previously. The weights values can be verified in the arrows among persons as illustrated in Figure 3.

The context information is checked automatically and periodically by the awareness monitor framework, depending on their nature. Long-term is verified in longer intervals, while short term is observed in real-time.

An important aspect raised by the interviewees in the survey is regarding the privacy. First, they highlighted the importance to review group's members before joining a session, avoiding being automatically added and causing offence by removing themselves from the group afterwards. Secondly, is related to users or services trying to access their context information.

The first issue was addressed presenting an invitation to join a session presenting the context information used to match the person by the framework. In cases where the session already exists, it is possible to present who previously joined session, however for cold starts sessions it is possible to introduce the members in which have been invited. For the second issue the SOCIETIES platform presents a notification asking whether the user allows or denies the access of specific context information. At first glance this could cause problems for the framework retrieve information, however as described in Sections 2 almost all users agree to share their professional information.

5. Conclusions and Future Work

We are developing a framework using context information and reasoning techniques. The framework will be applied in collaborative tasks for pervasive communities. The main focus will be on enterprise domain, especially taking advantage of information available on SNS and real-world interaction. The framework shall support sessions, coordination, tools, hierarchies and role of users to be able to provide recommendations, suggestions and pro-activity behaviour.

As future work we will conduct case study in a real enterprise scenario, specifically in a conference. The conference will be held in Intel's Campus, Ireland. The enterprise scenario analysis will be collected in September 2013 and will comprise a chat application for the participants. The scenario has been designed from a storyboard refined by a questionnaire that was conducted with Intel employees in 2011. Many challenges remain for interpretation of existing context related to individuals and groups for CSCW. In the future, the authors intent to investigate other relevant methods for interpretation and analyses of context. Another future work is to focus in the session management and the floor control aiming to provide an intelligent dissemination mechanism.

Acknowledgements

The authors wish to thank colleagues of SOCIETIES project, without whom this paper would not have been possible. The presented research is supported by FCT - Fundação para a Ciência e a Tecnologia (SFRH/BD/69381/2010).

References

[1] I.Roussaki, N. Kalatzis, K. Doolin, N.K.Taylor, G.Spadotto, N.Liampotis and H.Williams, Self-Improving Personal Smart Spaces for Pervasive Service Provision. In Towards the Future Internet, IOS Press, (2010), 193-203.
[2] B. Farshchian, M. Divitini. Collaboration Support for Mobile Users in Ubiquitous Environments. Handbook of Ambient Intelligence and Smart Environments, (2010), 173-199.
[3] SOCIETIES Public Deliverable-Trial Report - http://www.ict-societies.eu/files/2011/11/D8.1_public.pdf.
[4] T. Terveen and D. W. McDonald. Social Matching: A Framework and Research Agenda. ACM Trans. Comput.-Hum. Interact. 12, 3 (2005), 401-434.
[5] Kumar M., et al., PICO: A Middleware Framework for Pervasive Computing. IEEE Pervasive Computing, Vol.2, No.3, (2003).
[6] E.M. Meyer, D. Wichmann, H. Büsch, S. Boll, Location-based Mapping Services to Support Collaboration in Spatially Distributed Workgroups. 4th International Conference on Collaborative Computing: Networking, Applications and Worksharing, (2008).
[7] S. Foell, P. Boessling, D. Linner, I. Radusch, S. Steglich. Self-Organizing Pervasive Online Communities. Autonomous Decentralized Systems. 8th International Symposium, (2007), 403-410.
[8] S. Fortunato. Community Detection in Graphs," Physics Reports, vol. 486, no. 3-5, (2010), 75-174.
[9] H. Sundaram, Lin Yu-Ru, M. De Choudhury, A. Kelliher. Understanding Community Dynamics in Online Social Networks: A Multidisciplinary Review. Signal Processing Magazine IEEE, vol.29, no.2, (2012), 33-4.
[10] C. Lima, D. Gomes, R. Aguiar. Pervasive CSCW for Smart Spaces Communities. Pervasive Computing and Communications Workshops (PERCOM Workshops), (2012), 118-123.
[11] Sahoo P. K., Soltani S. and Wong A.K.C. A Survey of Thresholding Techniques. Computer Vision, Graphics and Image Processing, vol. 41, (1988), 233-260.