

Daniel Schall

Vienna University of Technology

Argentinierstrasse 8/184-1

1040 Wien

Austria

T +43-1-58801-18453

F +43-1-58801-18491

✉ schall@infosys.tuwien.ac.at  <http://www.infosys.tuwien.ac.at/staff/dschall/>

Research Statement

In this document I present research I performed in the course of my PhD thesis "Human Interactions in Mixed Systems - Architecture, Protocols, and Algorithms" (2009a) covering areas from human interactions in service-oriented systems to link-based interaction mining techniques in social networks. A high level summary is presented followed by results and publications in these areas.

Web-based collaboration platforms have been evolving towards Web services-based architectures. In such platforms, collaborations include both humans and software services. The challenge of composing these new type of services – user-driven contributions as services and software services – is that interactions are highly dynamic and context-dependent. A fundamental issue is that existing collaboration platforms do not support the provisioning of *human capabilities and expertise as services*. User-defined services can be used as interfaces to interact with people in a service-oriented manner. Furthermore, humans need different ways to denote their availability and desire to participate in collaborations. The problem is that current systems lack the notion of human capabilities in SOA. The challenge is to support the user in designing and providing services. Such services are called Human-Provided Services (HPS) (2008c) and can be discovered like software-based services. However, humans must be able to offer HPSs and manage their interactions in pervasive environments. Moreover, in open and dynamic collaborations, for example crowdsourcing environments, a large number of people collaborate and interact by using different socially-enhanced tools and platforms. It is important to determine the *expertise and skill level* of users. Somebody seeking help or advice on how to solve a given problem needs to be able to find the right expert.

The expertise and importance of users typically changes depending on performed tasks and interactions with other users. In social networks, people typically gain knowledge by collaborating and exchanging information with other users. Expertise recommender algorithms must consider an expert's interest in a certain area. As an example, a scientist may have done research in a certain field; however, the scientist might change his/her principle research domain over time. Thus, the *interest and activity level* of a person in a specific field must be considered. We believe that expertise ranking models should not only rely on profiles or skill information that need to be maintained and manually updated by users. It is unlikely that a single skill- or expertise-ontology is sufficient to capture the concepts and requirements of various collaboration domains. Tagging mechanisms as found in Web 2.0 environments can be used to classify information and to derive the context of interactions. Tags provide (i) input to derive skills and user-interests; and (ii) the context of activities and interactions. The challenge is to devise a ranking model that is able to capture these dynamic, context-dependent properties.

Research Topics

Interaction Models

Work in the area of activity-centric collaboration and related interaction models appeared in "Human Interactions in Dynamic Environments through Mobile Web Services" (2007a) and "VieCAR - Enabling Self-adaptive Collaboration Services" (2008d). The concept of activities and actions using SOA has led to the definition of Human-Provided Services. Initial use cases of HPS were published in a book chapter "Context-aware Mobile Computing" (2007c). Furthermore, we gave a brief introduction of HPS and the relation to activity-centric collaboration in (2006a).

Tagging Models

An initial tagging model that associates task information as annotations with, for example, email messages, was presented in "Pattern-based Collaboration in Ad-Hoc Teams Through Message Annotation" (2007b). The work provided the basic ideas for the interaction-based social recommendation algorithms to support the design of Human-Provided Services.

HPS Framework

The most important publications discussing the HPS framework as well as HPS interaction models were published in

- ICWS'07 (2007a): focusing on the notion of activities and the mapping of such activities to interactions with HPS. In the paper we focused on mobile collaboration scenarios and context-aware discovery of HPSs. The work was performed based on results of Web Services on Embedded Devices (2006b) and Wireless Internet Applications (2007d).
- IEEE Internet Computing (2008c): presenting Human-Provided Services and selected use cases showing how HPSs can be utilized in service-oriented collaborations (e.g., crowdsourcing platforms like Amazon's Mechanical Turk). An overview of the HPS framework was given.
- IEEE'08 (2008b): we presented the HPS framework and a detailed description of HPS related XML collections. Here we discussed detailed discovery and interaction mechanisms.
- WESOA'08 (2008a): A novel approach to the design of Human-Provided Services was presented. Our approach focused on a tagging model for activities and services to recommend resources in the design process. We presented a social recommendation algorithm based on collaborative tagging of resources in SOA.

Mining and Ranking

We presented a ranking approach for activities, context information and services at SEAA'08 (2008d). Furthermore, the publication contained a description of VieCAR (Vienna Collaborative Activity and Resource Management Framework), which is an OSGi-based middleware; see (2008d, Section 2). In (2009b), we introduced the *Dynamic Skill- and Activity-aware PageRank (DSARank)* for estimating the relative importance of users based on the concept of eigenvector centrality in collaboration networks.

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