Activity Context Representation: Techniques and Languages

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ABSTRACT
The second international Workshop on "Activity Context Representation: Techniques and Languages" (http://www.activitycontext.org) at IUI 2012 is being organized to help discover novel techniques at the intersection of AI and HCI to solve critical problems in developing activity context aware systems. The workshop will explore task and context modeling issues of capture, representation, exchange, standardization and interoperability, encountered in creating context-aware and activity-based assistive tools for supporting knowledge work in next generation digital workspaces. Exploration of solutions of these outstanding problems will lay the groundwork for smart digital workspaces that "know" what the user is doing (activity structure, context, goals), how are they doing it (methods), what resources are they using (allocation and discovery), when (time) and where (location, application, device) are they doing it, who are they (profile, history), what is their role (responsibility, security, privacy) and who are their collaborators (social network), all the while observing, recording this context of work (institutional tribal knowledge). These smart workspaces to be developed in the next five years, will let the users seamlessly move between applications and devices without having to remember or copy what they did earlier (activity context transfer and exchange), proactively show them steps others took in meaningfully similar situations before (semantic task reasoning), quickly find and show them directly related information and present answers to questions based on what they mean (proactive semantic extraction and search), in the context they need it, with access to provenance, quality and derivation of information, connect them to insights of experts within the organization and beyond, helping them reason and decide faster, with greater confidence, within a framework for managing, semantically dividing, tracking and enabling distributed work.

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Author Keywords
Activity Context, Task Representation, Context Representation, Task Analysis, Semantic Reasoning, Task Semantics, Task Modeling, Intent Modeling, Context-aware Systems, Next Generation Digital Workspaces and Consumer Playspaces

ACM Classification Keywords
H.5.2 [Information Interfaces And Presentation]: User Interfaces - Interaction styles;

INTRODUCTION
Pervasive context-aware computing technologies [3] are essential enablers for next generation applications for the digital workplace, consumer electronics, research, education, government and health-care. These enhanced technologies are expected to be in the mainstream in the next five years. Context-aware cognitive support [12] requires activity and context information to be captured and, ever more often, moved across devices - securely, efficiently and with multi-device interoperability.

As computers have become more powerful, the tools from AI and applications in HCI have come much closer. This workshop builds on the groundwork laid at the first workshop at AAAI'11 to create systems that capture, transfer, and recall activity context [5, 9] across multiple devices and platforms used by people individually and collectively. The workshop is intended to explore techniques to represent activity context using a synthesis of these approaches to reduce demands on people, such as the cognitive load inherent in activity/context/device switching and enhance human performance within activities.

The scope of the workshop includes finding techniques for creating activity context driven systems providing end-user value through monitoring, exchange and support on activities which can be performed better with help of computational devices than otherwise. The consortium and workshop interest is focused on using AI techniques to improve the human-computer interface for better human performance of knowledge work [14]. Therefore, applications in machine-to-machine systems (manufacturing, smart grid, load balancing), standard data mining and web-based behavioral analytics are kept out of scope. To help human users, the tools should enable proactive finding of unknown knowns

and unknown unknowns, as shown in Figure 1, based on activity context.

Figure 1. Finding Knowns and Unknowns Based on Activity Context

BRIEF HISTORY

The first workshop (http://www.activitycontext.org) was organized in August 2011 at AAAI in San Francisco, by Henry Kautz (Rochester, President, AAAI), Lokendra Shastri (Chair), Tim Finin (UMBC), James "Bo" Begole (PARC) and Matthai Philipose (Intel Corp). Gerrit van der Veer (ACM SIG-CHI President) was on the program committee and helped with publicity. Paul Lukowicz delivered a keynote, and invited speakers included Jakob Bardram, Philippe Palanque, Schahram Dustdar and Dan Diaper. There were valuable presentations from Tim Berners-Lee's team and Max Muhlhauser's team apart from people in the industry, including AT&T, Qualcomm, Vodafone, Telecom Italia and Aptima. The research papers were published as a AAAI Technical Report:

http://www.aaai.org/Press/Reports/Workshops/ws-11-04.php.

Selected proposals and position papers are available from AAAI at:

http://aaai.org/ocs/index.php/WS/AAAIW11/schedConf/presentations.

SPECIFIC ISSUES

This workshop will explore task and context modeling issues of capture, representation, exchange, standardization and interoperability for creating context-aware and activity-based assistive tools. The discussion at the workshop will focus on the following topics and their corollaries.

Activity Modeling, Representation, Recognition, Detection, and Acquisition: Which (low-level) human activities can be reliably learned and detected? How indicative are those for human tasks and intent? Which granularities of activities could be chosen for creating an extensible hierarchy of human activity? What types of, and to what extent, context information can be captured and incorporated in activity models? What are the most effective and efficient methods for incorporating context information in activity models?

Context Representation within Activities: What machine languages are most suitable for activity representation to enable activity and context switching and context recall across devices, platforms and technologies? Do we need user-device specific activity and context dialogue sub-languages?

Semantic Activity Reasoning: How to model and represent activities, objects, resources, actions and their semantics in their context during task performance? How do we design activity/context models to enable the searching of repositories of previous activities that have behaviorally and semantically similar components to current activity requirements?

Security and Privacy: What features must be designed into activity /context models for information exchange across enterprise or private domain boundaries to enable masking, security and privacy measures without compromising user experience?

Information integration and Exchange: How can we integrate and exploit the growing amount of information available from devices, services, the environment and general background knowledge to support activity context recognition tasks? What common ontologies or data vocabularies will be useful? What exchange techniques and formalisms will be most effective in specific domains? How can the externalized cognitive state transfer be properly affected?

What are the relevant use-case scenarios and collaboration environments? What are suitable software architectures, user interfaces, developer tools, benchmarking tools for activity-based computing [2, 11]? What kind of text, context and behavioral analytics is needed?

Context Capture: How far can the context capture be automatic and to what extent will it require collaborative meta-dialogue between people and devices? What might be ways of determining the most relevant elements of context for a given task and for an activity/context switch? Below is a suggestive list of context elements in an activity based on fundamental interrogatives [See Figure 2]:

User: Users work within a role, permissions, preferences, bringing past and immediate history, memory, skills, goals and perceptions.

Type of Activity and Domain: People create diverse activities in multiple domains, including but not limited to office work, healthcare, education, and entertainment.

Social: Users have the support of collaborators, connected devices and adjacent networks.

Spatial and Temporal: People may be at a certain geo-location, experiencing local conditions (weather, traffic, network connectivity). Tasks may be synchronous or asynchronous.

Resources Available: Users may have access to other people, databases, multiple applications, networks, related datasets, transportation methods, non-electronic resources (tools, paper etc.).

Devices and Interfaces: People may work on a variety of devices such as laptops, desktops, netbooks, tablets, cell phones, using multiple applications, operating systems and interfaces.

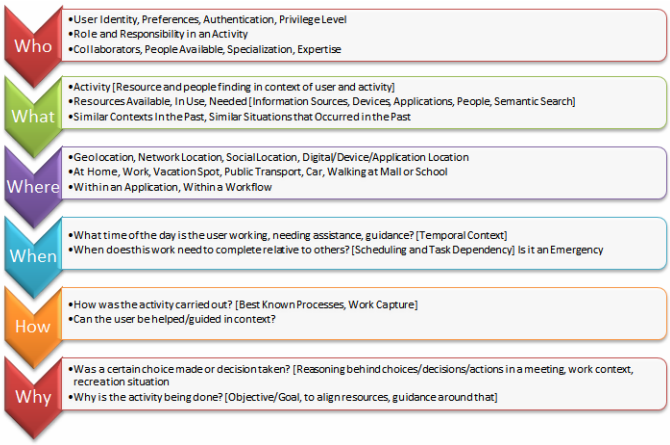

Figure 2. Some Examples of Context Elements in an Activity

Objectives and Intended Results

1. Discuss and review/revise initial drafts of structure of potential Activity Context Representation and Exchange Languages which will be made into draft Requests for Comments (RFCs) by the industry consortium. This will include identification of use cases, list of domain-specific instantiations needed along with owners and draft of initial reasoning schemes and algorithms, based on previous work. Results from creation of solution architectures and proposals for languages, data structures, operations to enable top use-case categories, will be discussed.

2. Review papers/proposals for new research areas and review work building on key research themes with specific opportunities for collaborative work in the next five years in this academically and commercially important area, with topics including, but not limited to semantic computing, task modeling, context representation, and activity recognition.

3. Augment the core research group, identify new collaborations, and formalize the international academic and industrial consortium to significantly augment existing standards/drafts/proposals and create fresh initiatives to enable capture, transfer, and recall of activity context across multiple devices and platforms used by people individually and collectively. Create an adoption plan addressing likely barriers such as critical mass, privacy, not-invented-here and implementation complexity.

This research effort will create multiple domain specific and some domain independent examples of activity context managers, exchanges, representation techniques and translation techniques, as shown in the center box in Figure 3:

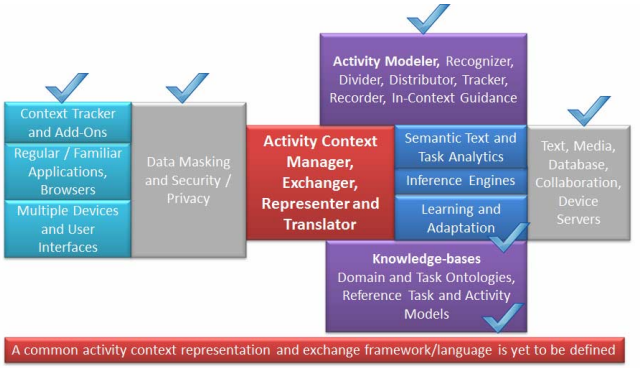

Figure 3. An example of a Next Generation Digital Workspace Architecture with the missing piece in the center.

Outcomes

This workshop will create a strong collaborative team of AI and HCI researchers to deliver the techniques and solutions needed for context-aware computing systems that reduce cognitive load on users by providing an intelligent interface and toolset for knowledge workers. This focused team will work with industry and academia to create fast moving domain-specific standards for application and device context transfer via peer-to-peer and services in the Cloud. The results from this workshop will be taken back to the AAAI '12 workshop to build on the AI/HCI synergies. The community will remain engaged via the website, ongoing standard and techniques creation activities and research focus-groups. The international consortium will serve as the forum for research funding and engaging industry.

The workshop expects to make serious progress in key research areas identified for longer term focus:

1. User/Intent Modeling [17]
2. Activity Recognition [8], Detection, Acquisition, Observation, Recording Tacit Knowledge[10] and Cognitive State Transfer
3. Activity Context Analysis [15], Modeling [6, 7, 13], Representation[9], and Ontologies[4]
4. Developing Use Cases/Scenarios [18], Defining User Interfaces, Identifying Collaboration Tools, Software Architectures, Developer Tools, Benchmarking Tools for Activity Based Computing [1].
6. Text, Context and Behavioral Analytics
7. Security and Privacy [16]

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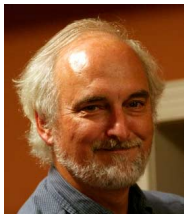
Organizers

We include brief bios of the organizers here for reference.

Lokendra Shastri (Chair), Associate Vice President and Head of Research, Infosys Labs, Infosys Limited, India. Email: lokendra_shastri@infosys.com; Phone: +91-80-4116-4232.

Dr. Shastri leads research in Next Generation Digital Workspaces, Fast Scalable Inference Systems and Semantic Extraction and Reasoning Systems at Infosys Labs. Prior to joining Infosys, Dr. Shastri was a Senior Research Scientist for fourteen years at the International Computer Science Institute (ICSI), a research organization affiliated with the Computer Science Division of the University of California, Berkeley, and on the faculty of the Computer and Information Science Department, University of Pennsylvania for eight years. Dr. Shastri has consulted for SRI International, Cognitive Technologies Inc., the NSF, and the UNDP. He received a B.E. (Honors) in Electronics from BITS, Pilani, an MS in Computer Science from the Indian Institute of Technology, Madras, and a PhD in Computer Science from the University of Rochester (1985).

Dr. Shastri chaired the first workshop on Activity Context Representation at AAAI'11.



Tim Finin, Professor, Computer Science and Electrical Engineering, University of Maryland, Baltimore MD.

Tim Finin was a key organizer at the first workshop at AAAI'11. Dr. Finin is a member of the UMBC ebiquity group where he is working on projects involving social media, the semantic web, intelligent agents, and pervasive computing. He has over 30 years of experience in the applications of AI to information systems and intelligent interfaces and is currently working on social media, the semantic web, intelligent agents and mobile computing. He holds degrees from MIT and the University of Illinois and has held positions at Unisys, the University of Pennsylvania, and the MIT AI Laboratory. He has authored over 270 refereed publications and an editor in chief of the Journal of Web Semantics. He helped lead the development of the KQML agent communication language and participated in the design of the OWL language for the Semantic Web. He has organized several major conferences, chaired the UMBC Computer Science Department, and served as a AAAI councilor and member of the Computing Research Association board of directors.

Munindar P. Singh, Professor, North Carolina State University, Raleigh NC USA.

From 1989 through 1995, Munindar was with the Microelectronics and Computer Technology Corporation (MCC). Munindar's research interests include multiagent systems and service-oriented computing, wherein he addresses the challenges of trust, service discovery, and business processes and protocols in large-scale open environments.

Munindar is widely published and has over 250 articles (including 35 IEEE Internet Computing columns) to his name. Munindar's 1994 book Multiagent Systems, was published by Springer-Verlag. He coedited Readings in Agents, which was published by Morgan Kaufmann in 1998. Munindar edited the Practical Handbook of Internet Computing published by Chapman & Hall / CRC Press in October 2004 and coauthored a text, Service-Oriented Computing published by Wiley in 2005.

Munindar was the editor-in-chief of IEEE Internet Computing from 1999 to 2002. Munindar is a founding member of the editorial boards of IEEE Internet Computing, Journal of Autonomous Agents and Multiagent Systems, Journal of Web Semantics, and Service-Oriented Computing and Applications. Previously, Munindar served on the founding steering committee for the IEEE Transactions on Mobile Computing. He serves on the founding board of directors of IFAAMAS, the International Foundation for Autonomous Agents and MultiAgent Systems. Munindar was general cochair of the 2005 International Conference on Autonomous Agents and MultiAgent Systems and a program co-chair of the 2008 IEEE International Conference on Web Services.

Munindar is a Fellow of the IEEE. Munindar's research has been recognized with awards and sponsorship by (alphabetically) Army Research Laboratory, Cisco Systems, DARPA, Ericsson, IBM, Intel, Joint Oceanographic Institutions, and the National Science Foundation.

Munindar obtained a B.Tech. in Computer Science and Engineering from the Indian Institute of Technology, Delhi in 1986 and a Ph.D. in Computer Sciences from the University of Texas at Austin in 1993.