2nd Workshop on Recent Advances in Behavior Prediction and Pro-active Pervasive Computing

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Abstract
The 2nd Workshop on recent advances in behavior prediction and pro-active pervasive computing focuses on contributions that target recent challenges of context prediction and on applications of context prediction. The main challenges are a lack of benchmarks and common data sets, as well as a lack of development frameworks and that the main focus of context prediction still remains location prediction. Since context prediction is a key requirement to enable proactive applications, the workshop aims to intensify the discussion about the state and direction of context prediction research and to facilitate collaboration among research groups focusing on context prediction.

Author Keywords
context awareness; context prediction; ubiquitous computing, pervasive computing.

ACM Classification Keywords
H.5.m Miscellaneous

General Terms
Algorithms, Measurement, Human Factors

Rationale

Context prediction breaks the border from reacting on past and present stimuli to proactive anticipation of actions. Initiated by the pioneering work of Mayrhofer et al. [1], researchers have for about one decade now considered the prediction of context to enable pro-active context computing. Research directions range from applications for context prediction [2] to event prediction [3], architectures for context prediction [4, 5, 6], data formats [7], and algorithms [8]. Recent work focuses on three main challenges:

1. Prediction mostly limited to location
2. No benchmarks and common data sets
3. No common development framework

While there have been contributions targeting some of these challenges, we still see them as unsolved and in the following will further elaborate on these challenges.

First, several authors have studied aspects of future context with the aim of enabling proactive behavior in applications. Applications considered are diverse and range across basically all aspects of daily life. Still, the survey of Voigtmann and David shows that a great share of context prediction research so far concentrates on location prediction [9]. Recently the research on location prediction tends to focus on new approaches for indoor location, e.g. [10, 11] and the use of social networks as data source [12].

We expect a significant potential for the use of context prediction in applications to enable sustainability, e.g. applications for energy efficiency. An important building block for this is the prediction of user preferences. Since preference settings in many applications tend to be complicated and have important implications, for example on the user's privacy, predicting the user's preferences was shown to solve the problem of too lax preference settings [13]. Also, important to enable applications for sustainability and energy efficiency, is the prediction of user routines, e.g. [14].

Secondly, regarding missing benchmarks and data sets, although utilized by numerous algorithms, a comprehensive comparison of their strengths and weaknesses on benchmark data sets is yet missing. To raise context prediction to a professional level at which it might be integrated in commercial applications,

- we need to establish common, widely accepted data sets,
- develop and disseminate accepted benchmarks
- and provide more general descriptions of algorithmic performance not only restricted to specific applications but to a whole class of applications utilizing input data with similar properties. One promising approach is to utilize data that users share over social networks [12].

And last, although, several authors have considered architectures for context prediction [4, 6], a common methodology or platform has not yet crystallized. Application developers are forced to start from scratch. One reason for this is that previous authors seldom provided usable sources of their applications that could be extended. In order to foster the integration of

context prediction into applications, support for application developers has to be greatly improved.

We envision AwareCast 2013 to attract contributions that target these three challenges and that focus on applications of context prediction for sustainability.

Objectives

After a successful first workshop at Pervasive 2012 with 25 participants, the workshop will bring together researchers of this field for the second time to address the three challenges outlined above. Thereby we encourage contributions that especially target the *potential of context prediction in sustainability applications*:
Context prediction is a key requirement to enable proactive applications. As a picturesque example of sustainability, the proactive adjustment of heating, ventilation, and air conditioning in buildings, as well as the proactive control of other appliances promises greater energy savings than reactive adjustments. With current research challenges in sustainability and new possibilities such as crowd sourcing and mobile sensing, it is the time to advance context prediction further and improve, for instance, prediction of room level location/room occupancy, prediction of traffic condition, prediction of air quality, and prediction of energy demands.
A second objective of the workshop is to intensify the discussion on *novel research directions for context prediction*:
Since context prediction used to focus heavily on location prediction and prediction accuracy, future research may have to focus more on the incorporation of new sensors, collaborative approaches and consideration of computational complexity in prediction approaches. We hope to discuss this and more ideas on how to go on with the promising research on context prediction.
Finally, the workshop will *facilitate collaboration* among research groups focusing on context prediction.

Topics

Most prominent topics discussed throughout AwareCast 2012 were benchmark datasets and the use of topic models. Throughout the last year, some advances have been made regarding these aspects while other new questions arose and further remained relevant. For AwareCast 2013, we expect submissions focusing, among other topics, on

Accurate prediction of seldom events: Important events are frequently also seldom events. How can we train a system on events which are not likely covered by training data sets?

Identification of actions and situations suitable for context prediction: User behavior is noisy and not necessarily contains patterns, which can be predicted. In particular, predictable patterns are frequently interleaved with non-predictable patterns. Inherently, the underlying (stochastic?) process has to feature some regularity or trends.

Continuous learning: User behavior and habit changes over time. To guarantee constant accuracy, the approach must be able to 'forget' patterns, which become unimportant.

Development frameworks: To pave the way for a broader use of context prediction in applications, robust

and easy to use frameworks are in need. These frameworks should simplify the development of context prediction applications and preferably be available as open source.

Novel applications: As discussed above, research on context prediction used to focus heavily on location prediction. While contributions dealing with location prediction are welcome, when they address at least one of the other topics, we like to see novel application of context prediction, with a focus on sustainability and energy efficiency applications.

Multi-User and Multi-Sensor Prediction: Since humans tend to behave similar, the context time series of other users may be helpful to increase the accuracy of context prediction for similar users. Additionally the utilization of multiple sensors may affect the robustness of the prediction approaches.

Data sets and benchmarks: Currently, comprehensive data-sets are created for context-computing [7, 8, 15, 16]. However, these data-sets are hardly sufficient to be applied for context prediction applications. In particular, data has to be sampled over longer time-spans and cover stochastic processes, which are inherently predictable.

Privacy and trust: Shared time series but also the fact that context time series might cover events and actions of remote entities raises questions of privacy and trust.

REVIEW PROCESS

Papers are peer-reviewed by 2-3 member of the Technical Program Committee each and are selected based on their merit and relevance to the workshop.

EXPECTED PARTICIPANTS

The expected participants include researchers both from academia and industry whose research interest is related to proactive computing, Pervasive Computing, Ubiquitous computing, Context prediction, context-aware computing, smart environments, organic computing and wireless sensor networks.

TECHNICAL PROGRAM COMMITTEE

Christos Anagnostopoulos, Ionian University
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Workshop Organizers

The organizers of the AwareCast 2013 workshop have a different research background due to their affiliation with different institutions in Europe, the United States and Asia. They are strategically well positioned to appeal to and solicit papers from different research communities.

Klaus David, Kassel University, Kassel, Germany. Research Interests: context awareness, context prediction, indoor location prediction, car2x, mobile applications, future internet, and sustainability through context awareness.

Bernd Niklas Klein, Institute decentralised Energy Technolgy, Kassel, Germany. Research interest: Context-Prediction, Context-Prediction use in sustainability applications, Software architecture for Ubiquitous Computing applications, Context-aware applications

Sian Lun Lau, Sunway University, Bandar Sunway, Petaling Jaya, Malaysia. Research Interests: mobile computing, context-awareness, user-centric computing, activity recognition and applied machine learning.

Stephan Sigg, National Institute of Informatics (NII), Tokyo, Japan. Research interests: Context Prediction, Development, Analysis and Optimization of Algorithms for mobile ubiquitous environments, Self-adaptation and self-optimization of distributed adaptive beam forming in wireless sensor networks

Brian Ziebart, University of Illinois, Chicago, US. Research Interests: machine learning techniques for structured data and artificial intelligence applications, learning and forecasting decisions and strategies in sequential decision and game settings for assistive technology and robotics applications.

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