

Extended Abstract:

Modelling Explanation-Aware Ambient Intelligent Systems with Problem Frames

Jörg CASSENS^{a,1}, Anders KOFOD-PETERSEN^b

^a*IMIS, University of Lübeck, Germany*

^b*Norwegian University of Science and Technology, Trondheim, Norway*

1. Introduction

When designing and implementing real world ambient intelligent systems, we are in need of applicable information systems engineering methods. These should supplement the knowledge engineering tools we can find in the intelligent systems area.

The work presented here focuses on explanation-aware ambient intelligent systems. The ability to explain it's reasoning and actions has been identified as one core capability of any intelligent entity [1]. The question of what is considered a good explanation is context dependent [2], leading to the necessity to design the explanatory capabilities of an ambient intelligent system together with the contextual modelling.

We target the requirements elicitation, analysis, and specification processes by making use of a pattern-based approach in form of Jackson's problem frames [3]. His set of basic problem frames can be extended to be better able to model domain specific aspects. We have previously suggested additional problem frames for explanatory capabilities [4].

2. Problem Frames and Ambient Intelligence

Applying the definition of ambient intelligence by Ducatel et al. [5], an ambient intelligent system can be modelled with a regular *Required Behaviour* [3] problem frame. But some cases exist where explicit user interaction is required other than through *behavioural interfaces*. For example, explaining the system's behaviour may require suitable interaction mechanisms, such as graphical user interfaces. In addition, the user should have the option to explicitly request an explanation of the system's behaviour. We propose a problem frame to capture this aspect.

Following Hall and Rapanotti [6], we use the *User Interaction Frame*. We propose to combine these two frames into an *Interactive Ambient Intelligence Frame*. Here, interactive, explanatory capabilities are combined with the environment controlling aspects of

¹Corresponding Author: IMIS – Institute for Multimedia and Interactive Systems, University of Lübeck, Ratzeburger Allee 160, DE-23562 Lübeck, Germany; E-mail: cassens@imis.uni-luebeck.de.

ambient intelligent systems. This aggregation differs significantly from the original *Required Behaviour Frame*. The behaviour of the ambient intelligent system is not mainly guided by explicit input from the user, but is a result of the pro-activeness of the system and implicit interaction (for example the location of the user). The frame also opens up for direct interaction, for example the user requesting an explanation. This will, however, not command the whole behaviour of the system directly, but only a small part of it.

3. Hospital Ward System

We have performed an ethnographic study to elicit the requirements for an ambient intelligent hospital ward information system. The persons involved deal with different activities, like ward rounds, pre-ward round meetings, and different forms of examination. The main goal was to have a system that makes the information sources needed in different situations (such as test results and treatment plans) available pro-actively. Explanatory capabilities were not explicitly included in the first design specifications. However, the socio-technical theory used in the study design allowed us to elicit the possible explanation goals users of the system might have, making a re-design possible.

The expanded analysis pointed towards the necessity to support four of the five different explanation goals introduced by Sørmo et al. [1], namely *transparency*, *justification*, *relevance*, and *conceptualisation*. This can be expressed in design specification documents which explicitly include the explanatory needs. Looking at the existing application, we could see that it supported only the *transparency*, *conceptualisation*, and *justification* goals, the latter even only being supported partially. The use of problem frames in general and explanation problem frames in particular helped us in identifying the deficiencies of the existing design, understanding and communicating explanatory needs, as well as exploring possible solutions to overcome these deficiencies.

In requirements analysis, introducing explanation frames facilitates the explication and formalisation of the findings of our ethnographic study and deepens our understanding of the problem domain. Problem frames aid us in checking the completeness of the specification and help us incorporating explanatory needs which could otherwise be overlooked. If the original system specification had been done using problem frames, the missing support for the *relevance* goal would have been uncovered.

References

- [1] Sørmo, F., Cassens, J., Aamodt, A.: Explanation in case-based reasoning – perspectives and goals. *Artificial Intelligence Review* **24** (2005) 109–143
- [2] Leake, D.: Goal-based explanation evaluation. In: *Goal-Driven Learning*. MIT Press, Cambridge, MA (1995) 251–285
- [3] Jackson, M.: *Problem Frames – Analysing and Structuring Software Development Problems*. Addison-Wesley, Boston, MA (2001)
- [4] Cassens, J., Kofod-Petersen, A.: Designing explanation aware systems: The quest for explanation patterns. In Roth-Berghofer, T.R., Schulz, S., Leake, D., eds.: *Explanation-Aware Computing – Papers from the 2007 AAAI Workshop*. Number WS-07-06, Vancouver, BC, AAAI Press (2007) 20–27
- [5] Ducatel, K., Bogdanowicz, M., Scapolo, F., Leijten, J., Burgelman, J.C.: *ISTAG scenarios for ambient intelligence in 2010*. Technical report, IST Advisory Group (2001)
- [6] Hall, J., Rapanotti, L.: Problem frames for sociotechnical systems. In Mate, J.L., Silva, A., eds.: *Requirements Engineering for Sociotechnical Systems*. Idea Group Publishing (2005) 318–339