Extended Abstract:
Modelling Explanation-Aware Ambient Intelligent Systems with Problem Frames

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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 its 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 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

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ambient intelligent systems. This aggregation differs significantly from the original Re-
quired 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 intel-
ligent hospital ward information system. The persons involved deal with different activi-
ties, 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 explana-
tion 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 dif-
ferent explanation goals introduced by Sørmo et al. \[1\], namely transparency, justifi-
cation, relevance, and conceptualisation. This can be expressed in design specification
documents which explicitly include the explanatory needs. Looking at the existing appli-
cation, we could see that it supported only the transparency, conceptualisation, and jus-
tification 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 defi-
ciencies 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 under stand-
ing 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 over-
looked. If the original system specification had been done using problem frames, the
missing support for the relevance goal would have been uncovered.

References

ficial Intelligence Review 24 (2005) 109–143
Wesley, Boston, MA (2001)
[4] Cassens, J., Kofod-Petersen, A.: Designing explanation aware systems: The quest for explanation pat-