A Multi-Agent Event Calculus Based Framework for Ambient Assisted Living

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I. Introduction

In recent years, Pervasive Healthcare, Ambient Intelligence, and Ambient Assisted Living have emerged as fields where ICT can improve the quality of life of the world's population. The proposed solutions must adapt to the needs of the users and learn their habits, in order to be effective health monitors, daily activity helpers, and virtual personal assistants [1].

In our vision, while state-of-the-art deep learning algorithms can be the base for a natural voice interaction and for the recognition of daily activities in a smart home environment, a rule-based engine can monitor the compliance of such activities and events with a series of users' requirements. Thus, in this abstract, we present the architecture of a rule-based framework for the real-time monitoring of a home environment: it is a Multi-Agent System based on the Event Calculus formalism.

Since logic-based systems including reasoning on time events usually limit the amount of data that can be used, we also plan to evaluate three different implementations of the system.

II. Our approach

The framework we present performs monitoring tasks inside a smart home environment. Hence, a continuous stream of events detected by sensors are the inputs for the framework, which stores them in a text-based log form. The framework checks whether each new logged event violates any of the user-defined constraints and requirements, expressed with the Event Calculus formalism.

The monitoring framework that we envision consists of four main components:

- sensors that provide events to the framework;
- an interface component, which is meant to be an interpreter between the framework and the outside world data representation;
- the Online Monitoring Agent, based on deductive reasoning and Event Calculus formalism, which receives event logs and logic rules from the interface, and sends back any alert or rule violation;
- the Offline Monitoring Agent, based on both forward and backwards reasoning techniques, which receives an higher level domain representation from the Online Agent, and checks if there is any contradiction with the encoded rules, or other inconsistencies within the analyzed scenario.

The health personnel can be considered the fifth component of the framework. In fact, the health personnel allow the framework to run, by providing the domain specific rules (to be translated into logical constraints) for the agents reasoning engines. However, the health personnel are the receivers of the framework output, i.e. the generated alerts or rule violations.

III. Conclusions

To actually implement the framework, we plan to use MAGPIE, a Multi-Agent platform already used for pervasive healthcare [2]. However, since the use of rule engines based on Event Calculus usually restrict the possible number of events and rules to be applied in a monitoring scenario, we are currently evaluating three different implementations of the agents' rule engine, in order to cache and retrieve events when actually needed. These are based on:

- Cached Event Calculus: that catches the maximum validity intervals for fluents by moving computational complexities from query to update time.
- *k-d* trees & interval trees: as data structures used to index the events and the maximum validity intervals for fluents, so that the query time becomes appropriate for live stream processing.

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References

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