Context-Aware MAS for Remote Elderly Care

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MULTI-AGENT SYSTEM (MAS)
A multi-agent system is a collection of software agents that work in conjunction with each other cooperatively or competitively to achieve some individual or collective task. Multi-agent systems can be used to solve problems which are difficult or impossible for an individual agent or noncooperative system to solve.

REMOTE ELDERLY CARE
Care at home is often preferable to patients and is usually less expensive for care providers than institutional alternatives. New developments in assistive technology are likely to make an important contribution to the remote care of elderly people improving older people’s safety, security and ability to cope at home. Systems introduced in this context are mainly focused on fall detection, meaning that they are capable of recognizing simple hazardous situations, triggering alarms and notifying caregivers or relatives.

Components of a typical care system architecture

Communication
Reporting component

Sensing

Interpretation
Detection component

Components of a typical care system architecture

Communication
Reporting component

Sensing

Interpretation
Detection component

Cognitively-enhanced architecture

Communication
Cognition
Prevention
Interpretation
Reconstruction
Refining
Refining
Refining

Intervention components

A set of agents observe user’s behavior, where each of them collects specific subset of behavior data ranging from posture characteristics to daily activities. These agents automatically build behavior models that are constantly updated and classify the current behavior to recognize changes that might lead to a disease or illness. Since each agent only partially observes the user’s behavior, an integration agent collects their observations and merges them into the final behavior observation.

Figure on the right shows measured behavior of gait characteristics agents. Each measured attribute is presented on one vertical axis, while green interesecting lines are precise measurements of normal/behaviors. New measurement, marked by blue line, represents new measurement.

RESULTS
We have designed two sets of experiments showing the capabilities of the intervention and prevention group of agents. The first experiment was devoted to Fall detection, when we presented complex situations that can be easily misinterpreted by an acceleration-based fall detector. The system successfully recognized all falls and had some problems recognizing sliding from the chair. The second experiment raised only one false alarm, achieving overall accuracy of 93.13%. The second experiment verified how the prevention group of agents adapts to a person and detects disabilities. After two weeks in this experimental setting, the user was walking slow (fourth day), which was successfully recognized by at least one statistics-agent group.

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The interpretation group of agents contracts physical awareness of a person in the environment and detects emergency situations which are caused by a fall or a sudden health problem. These situations are reflected by a person laying or sitting at an inappropriate place (e.g., on the ground) for a prolonged period of time. The group is structured similar as the reconstruction agent group: it consists of expert knowledge agents, prediction agents based on machine-learning algorithms, while the final decision is made by the meta-prediction agent.

The image below group architecture shows realizations of alarm messages triggered by the particular subgroup.