Towards a new Role of Agent Technology in User Modelling

Andreas Lorenz

Workshop on Adaptivity and User Modelling in Interactive Software Systems
Karlsruhe, Germany
Outline

- Why Agent Technology?
- Current Role of Agent Technology
- A User Modelling Agent
- Benefits
- Challenges Ahead
Motivation

• No standards in User Modelling
  
  o to implement Adaptive Behaviour
  o to employ AI Technologies
  o to employ Machine Learning Algorithms

• Users are self-controlled active entities

“Software agents have their own thread of control, localizing not only code and state but their invocation as well. Such agents can also have individual rules and goals, making them appear like ‘active objects with initiative’. In other words, when and how an agent acts is determined by the agent.”\(^1\)

\(\Rightarrow\) The agent-approach for representing individual users sounds reasonable.

Recent Approaches

- **Adaptive Information Server**: Information Acquisition
  - Learning about the user’s interests

- **Deep Map Agents**: Providing Tour recommendation
  - Communicate to a User Modelling Server (UMS) about the user’s interaction with the system
  - Query the UMS for user characteristics

- **Goodman et al.**: Integrating a human-like intelligent agent into collaborative learning environments
  - The agent analyses the students chatting
  - The tutor joins the chat in order to answer questions, to avoid or repair misunderstandings, and to provide expert help.

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A user-adaptive system

- adapts its behaviour to the individual user
- on the basis of nontrivial inferences from information about the user
Adaptive Information Server

User Model Acquisition

Information about the User

Predictions or Decisions about the User

Production of results

Use of information

Processing Methods

Input

In-/Output

Agent

Agent

Agent


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Deep Map Agents$^2$

User Model Server

User Model Acquisition

User Model Application

Information about the User

Predictions or Decisions about the User

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Query

Agent

Agent

Agent

Agent

User characteristics

A User Modelling Agent

- General Agent-Definition
- General Definition of a User-Agent
- Integration into the general Schema
- Aspects of teamwork
- Examples
An Agent is a triple \{Dat, Act, Sit\}, whereby

- \textbf{Dat} represents the agent’s internal knowledge base,
- \textbf{Act} is the set of possible actions, and
- \textbf{Sit} is a set of situations

Behaviour of an intelligent Agent \( f_A : Sit \times Dat \to Act \)
General Definition of a User-Agent

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\[
\text{Behaviour of an intelligent Agent } f_A : \text{Sit} \times \text{Dat} \rightarrow \text{Act}
\]

A User-Agent is a triple \( \{\text{Dat}, \text{Act}, \text{Sit}\} \), whereby

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Behaviour of an intelligent Agent \(f_A : \text{Sit} \times \text{Dat} \rightarrow \text{Act}\)

User Model \(\Rightarrow\) knowledge about the user, e.g. Identity, Interests, Knowledge, Preferences

User Context \(\Rightarrow\) any information that can be used to characterize the situation of a user, e.g. location, technical and physical environment, time
General Schema of a User-Agent

User-Model Acquisition

Information about the User and Context

User Model

Processing Methods

Actions

Predictions or Decisions about the User

Input

Production of results

Use of information

In-/Output

User-Agent
Team working Agents

User Model Application

Set of User-Agents

For Example: Agents representing
• several users
• several roles of one user
• several stereotypes

User Model Acquisition
Communication between Agents

User Model Application

User-Agents

Agent
Agent
Agent
Agent
Agent
Agent
Agent

User Model Acquisition

Blackboard
Cooperating Agents

User Model Application

Cooperation
Negotiations
Auction
Competition

User-Agents

User Model Acquisition

Blackboard

User Model Acquisition

Negotiations
Auction
Competition

Agent
Agent
Agent
Agent
Agent
Agent
Example of Use: Stereotypes

1. Definition of Stereotypes with fixed Components

- **Stereotype-Agent**
  - User Contexts
  - $f_A$
  - User Model
  - Actions

- **User-Agent**
  - User Contexts
  - $f_A$
  - User Model
  - Actions
Example of Use: Stereotypes

2. Handing over the knowledge about the current user, e.g. the user’s interests
Example of Use: Stereotypes

3. Receiving similarity measures as bedding in an Auction

<table>
<thead>
<tr>
<th>User Contexts</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
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Stereotype-Agent

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User-Agent

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Example of Use: Stereotypes

4. Selection of the most similar one

User Contexts $f_A$ Actions

User Model

Stereotype-Agent

User Contexts $f_A$ Actions

User Model

Stereotype-Agent

User Model

User-Agent
Example of Use: Stereotypes

5. Taking over Situations and Actions

![Diagram showing the interaction between user contexts, user model, and actions in the context of stereotype-agents and user-agents.](image-url)
More Examples of Use

A similar approach can be applied in Recommender Systems

- the agent’s knowledge base consists of the user’s preferences / interests
- the agents compete for the opportunity to recommend to the user

Integration of intelligent agents as Avatars in human computer interaction

- mix of real users and intelligent active system components
- the user can clearly recognize the computer partner
- the behaviour of the component behind is similar to the behaviour of a human teacher
Benefits

• Differences between individuals can be represented more appropriate:
  o Individual behaviour can be modelled by different configurations of the agent systems
  o Implementing several roles, several ways of thinking
• Use of highly specialized agents to represent the user in a certain context
  o Overall system becomes more flexible to react to changed user contexts
• Improved conflict handling
  o Between users
  o Inside users

• Possibilities of changing the configuration at runtime

• For employing the user representation in another domain, the domain-independent agents could be retained unchanged
Challenges ahead

Background development

- Not task-driven, clear definition in multi-agent terminology
- Definition and implementation of the multi-agent environment
- Cooperation and communication background facilities

Connection with domain-dependant external applications

- Interfaces have to be designed and implemented for gaining data from the application
- Interfaces to have influence on the application in order to adapt its behaviour based on the agents’ knowledge
- Between the acquisition of data, and the affect to the domain, the data is semantically enriched in several steps, and the gained information is used to control the system behaviour
Thank you for your attention!

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