

HIHEREI: Human Interaction within Hybrid Environments Regulated through Electronic Institutions

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ABSTRACT

In this paper we present an application build on top of electronic institutions in order to create a remote experimental platform for human and virtual agents. Our software objectives are twofold: (1) provide experiment designers with a tool to design an experiment where human and virtual agents will interact, and, (2) provide experimental subjects with a friendly interface to interact with virtual agents through an electronic institution.

Categories and Subject Descriptors

I.2.11 [Distributed Artificial Intelligence]: Multi-agent Systems

Keywords

Electronic Institutions, Web Interface, Experimental Platform

1. INTRODUCTION

Disciplines like sociology, psychology, anthropology, economy etc... have based part of their research on observing, monitoring and analyzing individual's actions in pre-designed and controlled scenarios. Some of them require some interaction among the participants, for instance, in experiments or games where there is a competition for the same products. Nowadays, a lot of these experiments are designed using computerized models offering the participants nice interfaces to play with. In these kind of experiments humans sometimes are substituted by artificial agents, both to simplify the complexity associated with human experiments with a big number of participants and also to study the reaction of humans in front of these autonomous artificial entities. In these hybrid experiments, humans and autonomous agents are put together in the same environment to interact.

In order to perform these experiments it is necessary a theoretical and technological framework that can support both the execution of the experiments and the gathering of the results for a subsequent analysis. Given the kind of experiments we are interested to be able to design and

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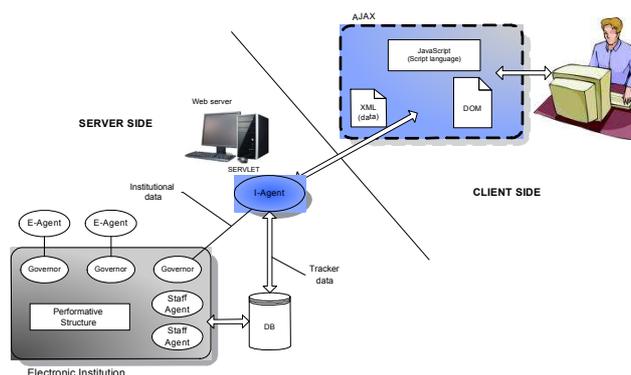


Figure 1: Human - eI interaction

implement, a framework that seems to fit with our needs is that of the electronic institutions [3].

However, the set of tools already provided to specify, develop and run electronic institutions do not allow humans to participate remotely either alone or together with autonomous agents in the electronic institution. Given that, we have extended the current technological framework to incorporate it. This work is the implementation of the design presented in [5].

2. GENERAL ARCHITECTURE

Figure 1 shows the main elements of the presented architecture

- **Electronic Institution (eI):** The environment that specifies the performative structures and the interaction models.
- **Virtual agents (E-Agents):** Agents endowed with autonomous behavior that participate in the e-institution through the *governors* (elements that provide the agent with the interface to interact with the eI and at the same time restrict the possible actions the agent can perform given the current state of the eI).
- **Interface agents (I-Agents):** Agents that represent human users in the electronic institution. They also act as web servers and, like E-Agents, connect to the eI by interacting with the governors. This allows a totally distributed approach.
- **Staff agents:** Institutional agents in charge of different aspects related to the well functioning of the eI.

- **Data base:** Everything relevant that happens in the e-institution is stored in the DB for a subsequent analysis. The DB also stores the human user activity regarding the actions she/he performs in the client side.
- **Client application:** It is the software that provides a friendly interface for the human user.

2.1 Extending EIDE

EIDE [3], the Integrated Development Environment for Electronic Institutions, is a set of tools developed at the IIIA-CSIC aimed at supporting the engineering of multi-agent systems as electronic institutions. As we have mentioned in the introduction, these tools do not provide a general framework for a flexible participation of humans in electronic institutions. The desirable requirements for this extension are the following:

1. Allow remote access of human users to the eI.
2. Provide flexible and standard client applications for this access. Web applications are a good solution since they can run with standard Internet browsers.

The central element in the link between the human user and the e-institution is the servlet, which is activated once the user (client side), using a web browser, establishes the connection with the server side. This piece of software (I-Agent) is seen as a servlet from the point of view of the web server but at the same time as a normal agent from the point of view of the eI.

The I-Agent, acting as a servlet, receives messages in XML format from the client application running locally in the user's computer as a web application. The XML messages can be of two types:

- Tracker messages. This is the information that can be used later to analyze the actions performed by the user in the client side.
- Institutional messages. Information that is associated with the e-institution. These are actions that the user wants to perform and that have an influence the state of the eI.

Simultaneously, the client application receives XML messages from the servlet describing the changes that have been produced in the eI. These changes are shown to the user by the client application.

3. CASE OF STUDY: THE EFFECT OF REPUTATION IN ONLINE MARKETS

The main objective of the European Project "eRep: Social Knowledge for e-Governance" [1] is to provide a theory-driven and empirically guidelines for using and designing reputation technology. Under this framework, an objective of the project is to formulate hypotheses on the grounds of cross-methodological experiments. One of these experiments relies on the dynamics of online auction markets under the effect of reputation information. These experiments require both a human interface, to emulate an auction site, and virtual agents to simulate other humans in the same auction site, with predefined strategies to have an absolute control over the experiment.

In the context of time-constraint virtual auctions, the use of electronic institutions as interaction middleware among agents have been proved to be a good solution. Under these circumstances, the following instantiation of the platform was developed:

1. **Electronic institutions:** Using the eI development environment [3] an appropriate electronic institution was defined and verified. This includes the specification of interaction protocols, illocution schemas and a concrete ontology.
2. **Client application:** Using HIHEREI we developed a web-based application simulating an auction market site. Then, human users can be remotely connected to the eI through a simple web browser. The application shows a list of predefined items, each of them with attached information such like pictures, reputation scores etc. Users have a limited time to bid for the items, meanwhile other *users* (simulated by virtual agents) do the same.
3. **E-Agents:** Virtual agents were defined using JADEx, a *Belief, Desire, Intention* (BDI) reasoning engine for Java. They followed certain predefined bidding strategies.

A detailed description of this case study can be found at [2]

4. FUTURE APPLICATIONS

This platform is also planned to be used under the MacNorms project [4], where experiments with humans and virtual agents will be used to test hypothesis about the emergence of social norms.

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