Virtual Institutions Prototype

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ABSTRACT

Virtual Institutions are Virtual Worlds with normative regulation of participants' interactions. This paradigm is based on normative multiagent systems and is technologically supported by Electronic Institutions. In this paper we outline the prototype that illustrates the application of Electronic Institutions to the domain of Virtual Worlds. We show how both human and agent controlled avatars can participate in Virtual Institutions and how the Electronic Institutions technology is used to govern their interactions.

Categories and Subject Descriptors

I.2 [**ARTIFICIAL INTELLIGENCE**]: Distributed Artificial Intelligence—*Multiagent systems*

General Terms

Human Factors

Keywords

Electronic Institutions, 3D Virtual Worlds

1. INTRODUCTION

Existing research evidence suggests that 3D Virtual Worlds are becoming an important part of our lives. More than 97% of American teenagers play video games, many of which can be considered being Virtual Worlds [4]. Studies in South Korea have recently shown that users prefer Virtual Worlds to television [6]. Gartner predicts that 80% of the Internet users will be actively participating in non-gaming Virtual Worlds by the end of 2011 [3].

One of the drawbacks of current Virtual Worlds is that they are rather anarchical environments with no clear mechanisms for establishing social order. Similar to other kinds of software the rules of behavior of virtual worlds' inhabitants are usually expressed in the terms of services of a particular Virtual World. The adherence to those rules is normally controlled through issuing warnings to the rule violators or even banning them if the violation reoccurs.

The participants of Virtual Worlds can interact with each other directly with the Virtual World software being the interaction facilitator. In many of such environments people are often involved into commercial activities and exchange physical money for virtual goods or services. For such interactions having a terms of service approach to dispute resolutions proves to be quite inefficient [5]. When it comes to legal disputes within Virtual Worlds it is often discovered that contract law cannot regulate participants' interactions with each other in such environments [5].

Similar to the physical world Virtual Worlds' participants desire security and justice, but publishers often reply that this is too hard to incorporate it into their products [5].

One of the mechanisms used in human societies to control interactions of self-interested participants is employment of trusted third parties, which establish the *rules* of the interactions and administer the strict *control* in regards to their *enforcement*. In the literature, such trusted parties are called institutions [2] and are defined as follows. *Institutions* are structures and mechanisms of social order and cooperation governing the behavior of two or more individuals [2].

In the Multiagent Systems community the use of institutions is the classical approach to dealing with complex interactions in open systems. On of the most prominent technologies, namely Electronic Institutions [2], is supplied with the set of tools for formal specification of the institutional rules, formal verification of those and a system that controls the enforcement of these rules.

Although, Electronic Institutions (as well as other MAS oriented methodologies known to us) do not consider Virtual Worlds as the area of application they can be used for interaction regulation in Virtual Worlds. In this paper we present the Virtual Institutions prototype that, on the one hand, visualizes Electronic Institutions using the Virtual Worlds metaphor. On the other hand, Virtual Institutions prototype illustrates how the Electronic Institutions technology can be used for governing the interactions of humans and agents participating in 3D Virtual Worlds.

2. VIRTUAL INSTITUTIONS

The concept of Virtual Institutions originates from various different areas of Computer Science. In order to illustrate these areas Figure 1 outlines the taxonomy of concepts related to Virtual Institutions and positions Virtual Institutions within these fields.

Technologically, Virtual Institutions is a combination of Electronic Institutions and 3D Virtual Worlds. The Virtual World acts as an interface visualizing normative multiagent systems to human participants. To some extend, this interface "opens" Multiagent Systems for direct human access.

The current metaphor of Virtual Institutions suggests to represent a Virtual Institution as a building. Each building

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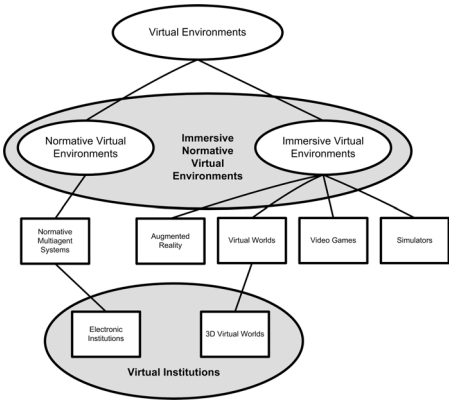

Figure 1: Concept Taxonomy of Virtual Institutions

is associated with a particular Electronic Institution specification that governs the behavior of participants entering this building. The building is separated into rooms, some of which are connected with each other. These rooms correspond to scenes and transitions in the institutional specification. The connections between the scenes and transitions are visualized as doors between the rooms. Only participants with certain roles can enter particular rooms, meaning that only for them the doors will be opened. Inside each room corresponding to a scene in the institutional specifications the participants have to act according to the scene protocol of the corresponding specification.

Figure 2: Virtual Institutions Metaphor

Figure 2 outlines Virtual Institutions metaphor through one of the scenes present in the developed prototype.

3. THE PROTOTYPE

In order to map Electronic Institutions to Virtual Worlds we have to establish a *causal connection* between the two. A system is said to be "causally connected" to its representation if whenever a change is made in the representation, the system itself changes to maintain a consistent state with the changed representation, and whenever the system evolves, its representation is modified to maintain a consistent relationship [1]. The causal connection has to materialize in two directions. *First*, actions made by the agent in the institution have an immediate impact on the 3D representation. *Second*, actions performed by the avatar in the Virtual World are understood as made by the agent in AMELI (system controlling the execution of Electronic Institutions). This has as a consequence that those actions that the agent is not allowed to perform in the current execution state cannot be permitted over the 3D environment. Those actions that are permitted in the current state and are actually performed by the human, must have the same impact on the Electronic Institution infrastructure supporting the execution as if they were performed by the agent.

The architecture establishing the causal connection consists of three conceptual layers outlined in Figure 3.

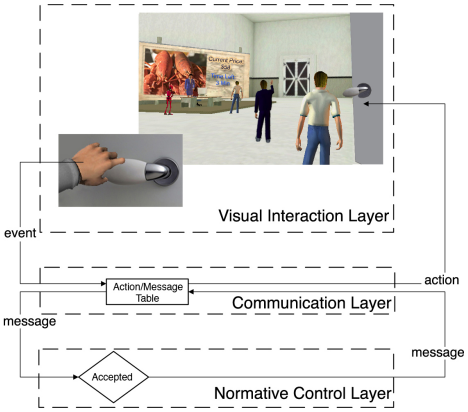

Figure 3: System Architecture

The *Normative Control Layer* uses the functionality of AMELI provided with Electronic Institutions. It is the infrastructure that mediates participant interactions and enforces institutional norms.

The *Communication Layer* performs the task of *causally* connecting the Normative Control Layer with the user interface. All events performed by a user in the Virtual World are passed to the Causal Connection Server. Such an event might be a request for the action of opening a door or typing the price the user is willing to pay for an auctioned good. Before executing an action the Causal Connection Server captures these events and sends them (in terms of messages) in turn to AMELI for "validation". More precisely, AMELI checks whether a particular message goes in line with the electronic institution rules or not. If a positive validation response is given by AMELI, the requested action gets the permit to be performed in the Virtual World.

The *Visual Interaction Layer* is responsible for the visualization of 3D Virtual Worlds and reflecting the approved actions onto them.

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