

# The City of Uruk: Virtual Institutions in Cultural Heritage

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## ABSTRACT

The use of 3D Virtual Worlds in the domain of cultural heritage represents a unique opportunity to accurately recreate historically significant sites as well as to provide a collaborative working environment for historians, archaeologists, designers and programmers. While most existing solutions are purely focused on reconstructing the architectural elements we also find it very important to preserve the interactions of the people that populated the given area. Through the use of the Virtual Institutions technology we demonstrate how a virtual heritage site can be populated by autonomous agents imitating the behavior of ancient people in the Virtual World. Moreover, those agents can manipulate objects in the environment, interact, collaborate and synchronize their actions with other agents or humans. The presented prototype features autonomous agents reenacting the life of two typical fisherman families from the virtual City of Uruk in ancient Mesopotamia, 3000 B.C.

## Categories and Subject Descriptors

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

## General Terms

Human Factors

## Keywords

Cultural Heritage, 3D Virtual Worlds, Virtual Institutions

## 1. INTRODUCTION

Non-gaming Virtual Worlds like Second Life or Active Worlds constantly grow in popularity. Their importance was highlighted by many researchers (i.e. [4], [2]). A report recently released by Gartner predicts that 80% of the Internet users will be actively participating in non-gaming Virtual Worlds by the end of 2011 [4].

One of the most promising application domains for non-gaming Virtual Worlds is the domain of cultural heritage. Using 3D graphics to reconstruct lost sites of high historical significance has become very popular during the last decade. Initially, 3D heritage ap-

plications were only focused on using the results of archaeological excavations and expert knowledge to reconstruct destroyed or damaged buildings (e.g. Roman Colosseum). While such an approach creates a unique possibility to examine the architectural details of the heritage site it still does not help a general observer to understand how this site has been enacted in the past. Therefore, at a later stage, some researchers started to populate such virtual sites with so-called virtual crowds [5]. Such crowds normally consist of a large number of autonomous agents (represented as avatars) dressed appropriately for the selected period of time and appearing as local citizens of the reconstructed area. The state of the art in combining crowd simulation and 3D heritage reconstruction can be observed on the example outlined in [5]. Here, a 3D reconstruction of the ancient City of Pompeii is populated with a large number of avatars that walk around the city avoiding collisions.

Through the use of Virtual Institutions technology [1] we intend to bring virtual heritage to a new level by making it more interactive. Instead of just having virtual crowds walking around the city we suggest populating virtual heritage sites with autonomous agents that reenact the most typical daily activities of the reconstructed society. Creating such agents is quite a challenging task as the degree of interaction is quite high, the agents have to depend on other agents, play different roles, synchronize their activities with other agents and even solve some tasks in a teamwork manner while actively using the objects in the virtual environment. We are convinced that for solving this task it is necessary to formalize the environment and agent interactions in this environment. The Virtual Institutions technique that we employ for such environment formalization is based on the Electronic Institutions methodology [3] widely used in the Multiagent Systems community for structuring the interactions of the agents participating in open systems.

The presented prototype illustrates the potential of using Virtual Institutions in the cultural heritage domain by recreating daily activities of two typical fisherman families “living” in the 3D reconstruction of the ancient city of Uruk developed in the Virtual World of Second Life.

## 2. VIRTUAL INSTITUTIONS

Conceptually, Virtual Institutions are 3D Virtual Worlds with normative regulation of participants’ interactions [1]. Technologically speaking, Virtual Institutions is an amalgamation of two technologies: Electronic Institutions and 3D Virtual Worlds. The 3D Virtual World is used as an interface for visualizing normative multiagent systems to human participants. To some extent, this interface “opens” Multiagent Systems for direct human access.

The Electronic Institution serves the purpose of formalizing the interactions of Virtual World participants (which can be either humans or agents) as well as controlling the validity of interactions.

The Virtual Institutions technology features a number of soft-

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The paper is to appear in HCSNet 2009 Workshop on Interacting with Intelligent Virtual Characters held as part of HCSNet SummerFest 2009 on Friday 4th December 2009.

ware components that allow for specification of institutional rules (norms of behavior), formal verification of rule correctness, deployment of the institution and maintaining the causal connection between the Virtual World and the institution.

### 3. THE CITY OF URUK

Uruk was an ancient city located in present day Iraq (roughly 250 km south of Baghdad). Many historians and archaeologists believe that Uruk was one of the first human built cities on Earth. By around 2900 B.C. Uruk is believed to be one of the largest settlements in the world and one of the key centers of influence of the Sumerian culture.

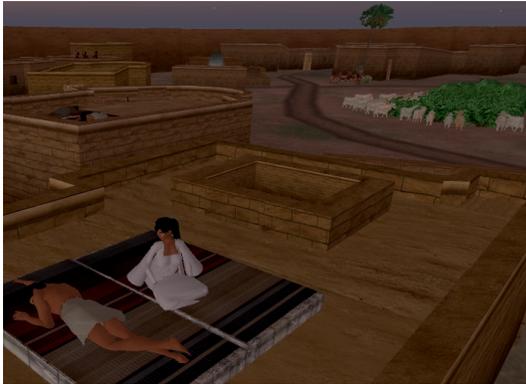


Figure 1: Morning in the City of Uruk

Uruk played a major role in the invention of writing, emergence of urban life and development of many scientific disciplines including mathematics and astronomy.

### 4. THE PROTOTYPE

The prototype aims at showing how Virtual Institutions can be used to enhance the educational process of history students by providing them with a possibility to visually experience the daily life of the ancient citizens of Uruk and gain quick understanding of the advance of technological and cultural development of ancient Sumerians. Ultimately, those students may become part of the virtual society and will have to interact with agents and other humans to solve the assigned tasks.

The 3D reconstruction of the city was produced within the Virtual World of Second Life based on the results of archeological excavations and available written sources. Both modeling of the city and programming of the virtual humans populating it were conducted under the supervision of subject matter experts.

In order to illustrate the habits and behaviours of the people of ancient Uruk, we created four agents that represent members of two fisherman families. Each family consists of the husband and wife. Every agent has a unique historically authentic appearance and is dressed appropriately for the period around 3000 B.C.

The agents literally “live” in the virtual world of Second Life. Their day is approximately 15 minutes long and starts with waking up on the roof of the building (see Figure 1). Although, most of the buildings in Uruk had ventilation holes the temperatures inside (especially during summer) could become quite unpleasant and most of the citizens would prefer sleeping on the roof top in the evening, where it would have been much cooler. The wives would wake up first to collect some water from the well and prepare breakfast for their husbands. The husbands normally start their day by having a morning chat while waiting for the breakfast to be prepared (in the current prototype eating and cooking are not implemented).



Figure 2: Agents Walking Towards the City Gates

After breakfast the fishermen would collect their fishing gear and walk towards the city gates (Figure 2). Outside the gates on the river bank they would find their boat which they will both board and start fishing. One of the agents would be standing in the boat with a spear trying to catch the fish and the other agent would be rowing. Figure 3 illustrates the fishing process.



Figure 3: Agents in the Fishing Boat

After fishing, the men exit the boat, collect the fishing basket and spear and bring them back to their homes. This daily cycle is then continuously repeated with slight variations in agent behavior.

### 5. FUTURE WORK

The current prototype illustrates only a part of the 24 hour life cycle of four agents. In the future we plan to model the complete life cycle for these agents as well as to create more virtual citizens.

### 6. REFERENCES

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