Virtual Characters in Agent-Augmented Co-Space (Demonstration)

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ABSTRACT

Co-Space refers to interactive virtual environment modelled after the real world in terms of look-and-feel, functionalities and services. We have developed a 3D virtual world named Nanyang Technological University (NTU) Co-Space populated with virtual human characters. In order to create realistic virtual humans, we have designed a brain-inspired agent architecture with the properties of goal-directed autonomy, natural interactivity and human-like personification. The demo will show how the virtual characters may enhance the interactivity and playability of the virtual worlds.

Categories and Subject Descriptors

I.2.0 [**General**]: Cognitive simulation; I.2.11 [**Distributed Artificial Intelligence**]: Intelligent agents

General Terms

Design, Human Factors, Languages,Theory

Keywords

Virtual characters, autonomy, interactivity, personality

1. INTRODUCTION

Virtual worlds has become a popular platform used in a variety of contexts, including education, business, and e-commerce. We are particularly interested in a special class of virtual world, called Co-Space, referring to interactive virtual environment modelled after a real physical space in terms of look-and-feel, functionalities and services.

Besides providing faster and easier access to information and services, the development of Co-Space has offered great opportunities for innovative applications. In particular, intelligent agents can be deployed in Co-Space enhancing its interactivity and playability. We have developed a 3D virtual world called NTU Co-Space, modelled after the Nanyang Technological University (NTU) campus and populated with virtual human characters. This demo shall show how virtual humans, designed based on a brain-inspired agent model, may enhance the interactivity and playability of the virtual world in a natural manner.

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2. NTU CO-SPACE

The NTU Co-Space is implemented using the Unity3D, a 3D game engine that can be deployed into different platforms including Microsoft Windows™, Mac OS™, popular game consoles, and mobile devices. The Co-Space can also be embedded in a web page to be easily accessed using typical web browsers (e.g. IE, Chrome, Safari, Firefox).

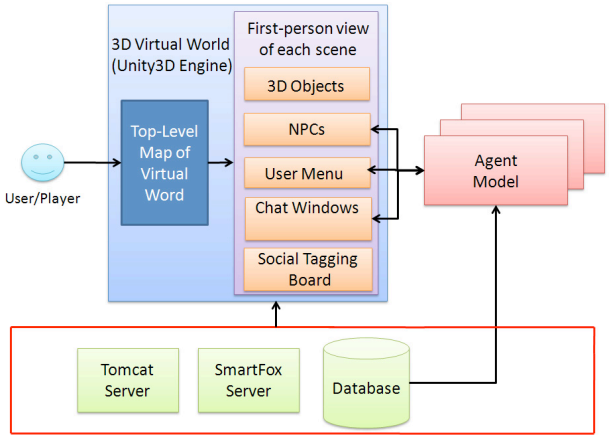

Figure 1: System architecture of NTU Co-Space.

The overall architecture of the NTU Co-Space is depicted in Figure 1. At the back-end, two application servers, Apache Tomcat and SmartFox, support the multi-user environment. A dedicated database is used for the storage and retrieval of environmental and content data.

3. THE AGENT TECHNOLOGY

As shown in Figure 2, the integrated agent architecture consists of a *Perception Module* receiving situational signals from the environment through a set of sensory APIs and an *Action Module* for performing actions through the various actuator APIs. If the sensory signals involve a text input, the *Chat Understanding Module* interprets the text for the player's intention. The outputs of *Situational Assessment* and *Chat Understanding Modules* then serve as part of the working memory content . The *Inference Engine* then identifies the most appropriate action, by tapping a diverse pool of knowledge, in accordance to the desire, intention and personality of the virtual agent. The knowledge learned and used by the Inference Engine include declarative knowledge of self, players, and environment, as well as procedural knowledge of goal-oriented rules, which guide an agent in

fulfilling goals, and social rules, for generating socially appropriate behavior. The decision of the *Inference Engine* again forms part of the *Working Memory*, which throughout maintains the context of the interaction. For actions involving a verbal response, the *Natural Language Generation Module* translates the chosen response into natural text for presentation.

Consistent with the view in the state of the art [1], we outline three key characteristics of realistic characters in virtual worlds, namely autonomy, interactivity, and personification, described as follows.

Autonomy Based on a family of self-organizing neural models known as fusion Adaptive Resonance Theory (ART) [3], the *Inference Engine* of the proposed agent architecture performs a myriad of cognitive functions, including recognition, prediction and learning, in response to a continual stream of input signals received from multiple pattern channels. As a result, an agent makes decisions not only based on the situational factors perceived from the environment but also her mental states characterized by desire, intention and personality. By modelling the internal states of individual agents explicitly, the virtual humans can live a more complete and realistic life in the virtual world.

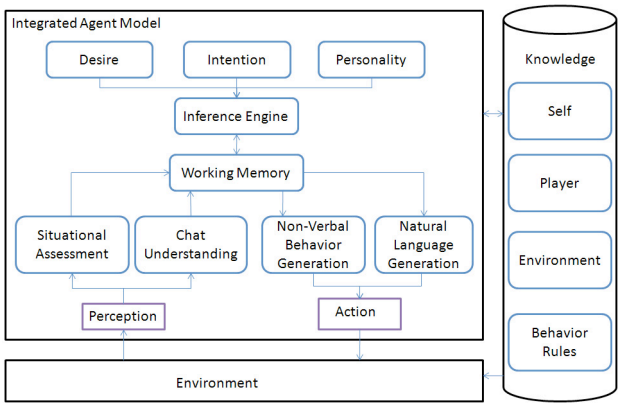

Figure 2: A schematic of the integrated agent model.

Interactivity For interaction between the agents and the players, an intuitive user interface is provided, through which a player may ask typical questions and provide quick responses by button clicks. The player may also enter free-text sentences via the chat box. The dual communication mode provides the players both ease of use and flexibility. While interacting with player, the agent builds an internal model of the player, with his/her profile, interests and preferences. The player model in turns allows the agent to make intelligent conversation on topics relevant to the player.

Personification For improving the believability of virtual humans, our agents adopt the Five Factor Model (FFM) [2], which characterizes personality in five trait dimensions . By giving a weighage to each dimension, a unique personality can be formed by a combination of the traits. Comparing with traditional pattern-matching-based conversational agent, our agents with strong *openness* and *extroversion* personality are much more warm and friendly as they do not stay idle and wait for input queries. Acting pro-actively, they approach the players, offer help, and make conversation.

4. DEMONSTRATION DESCRIPTION

A video clip of the NTU Co-Space can be viewed on You Tube (http://www.youtube.com/watch?v=bYIthOYjrxw). During the live demo, multiple players will be able to log in and experience the NTU Co-Space. As illustrated in Figure 3, a player may choose to roam around the campus on his/her own for self-discovery or play a mini-game, called *Amazing Quest*, which will bring the player to experience the key places of the NTU campus through a fun and interactive journey. Specifically, the player will visit the five key landmarks on campus, with the accompaniment of a virtual character.

Figure 3: A player touring the NTU Co-Space.

5. CONCLUSIONS

With the virtual characters befriending and providing personalized context-aware services, we hope players will find virtual worlds more fun and appealing. To the best of our knowledge, this is perhaps one of the few in-depth works on building complete realistic agents in virtual worlds with autonomous behavior, natural interactivity and personification.

Finally, it is also our objective that the NTU Co-Space may serve as a open platform for agent researchers to deploy and field test their technologies. A set of APIs with documentation have been made available to ease the integration effort. For a wider accessibility of the Co-Space content and services, implementation of mobile clients running on iPhone and iPad are already under way.

6. ACKNOWLEDGEMENT

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