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Yundong CAI

Zhiqi SHEN

Chunyan MIAO

Ah-hwee TAN

Singapore Management University, ahtan@smu.edu.sg

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DIRACT: Agent-based Interactive Storytelling

Yundong Cai¹, Zhiqi Shen², Chunyan Miao¹, Ah-Hwee Tan¹

¹School of Computer Engineering, ²School of Electrical & Electronic Engineering
Nanyang Technological University
{ydcai, zqshen, ascymiao, asahtan}@ntu.edu.sg

Abstract

A lot of researches have been done on the interactive storytelling authoring, e.g. by a director agent, or by interactions among a number of character agents. However, it is still difficult to construct the interactive storytelling for novice users, due to a need of various agents development and complex communication among the agents. We propose an agent-based interactive storytelling architecture, namely DIRACT (short for "Direct and Act"). It is composed of numerous atomic DIRACT agents, which are goal oriented and use an unified communication protocol. By removing the difference between the director and character, each DIRACT agent can either direct or act the story in real-time. As a result, it is scalable to story complexity, reusable for inheritance and makes the interactive storytelling authoring much easier.

1 Introduction

Storytelling is used widely in our daily communications, through which people share information and convey messages. As a mixture of conventional storytelling and user interactions, interactive storytelling in the virtual environment enables the audiences to interact with the storyteller or the characters in real-time, so that dynamic and personalized storylines can be achieved, which has become hot area in today's interactive storytelling research.

Currently, there are a lot of research work focusing on interactive story authoring/generation [5, 7], behaviors of virtual characters [2, 3, 4] or a hybrid approach [6] with agent technology. However, the progress to create an interactive storytelling is tedious. For example, different types of agents need to be created, and complex protocols are required for communications among the different types of agents. These barriers prevent novice users to create their interactive storytelling in the virtual environment. Moreover, once the storytelling is constructed, it is hard to re-customize it.

In order to make the agent creation easier and standard-

ized, this paper proposes an agent-based interactive storytelling architecture that combines plot-based story authoring and character-based behavior modeling, namely DIRACT. DIRACT is short for "Direct and Act", which represents two main functions in the storytelling: story structure and story presence. DIRACT is a multi-agent system (MAS) that is composed of a number of goal-oriented DIRACT agents. Each DIRACT agent can perform the roles of either director or character. Fuzzy Cognitive Goal Net (FCGN) is used to model the goal of the DIRACT agent, in which the temporal causal relationships of the scenes and behaviors as well as the cognition of the context and user interactions are clearly defined as goals of DIRACT agents. Through the hybrid system, the audiences are able to create interactive storytelling easily and experience storytelling through various levels of interactions.

2 Related Works

There are two main approaches of interactive storytelling, which are plot-based interactive storytelling and character-based interactive storytelling. Plot-based interactive storytelling uses a director agent/drama manager to make the real-time authoring [5, 7]; on the other hand, character-based interactive storytelling uses character agents to make an interactive storytelling through their interactions [2, 3, 4]. In order to bridge the gap of the two approaches to achieve both story authoring coherence and character believability, hybrid approaches are proposed to have both direct agent and character agents etc [6]. However, it is hard to develop interactive storytelling with the hybrid approach due to various types of agents with complex communication protocols, especially for novice developers.

3 DIRACT

DIRACT is short for "Direct and Act". DIRACT is an agent-based interactive storytelling architecture, such that

the storytelling is composed as a multi-agent system. Each agent is called as DIRACT agent. It exhibits a flexible “plug and play” storytelling architecture which is composed of a number of atomic DIRACT agents. It is a hybrid of character-based interactive storytelling and plot-based interactive storytelling.

3.1 DIRACT Agent

Agents are goal-oriented, autonomous objects, which act in specific context. The goal of a storyteller is to convey a story to audiences with certain interactions from the audiences. Interactive storytelling in the virtual environment involves agents with multiple roles, i.e. scriptwriter, director and virtual characters.

In DIRACT, there is no differences among a scriptwriter agent, a director agent or a character agent. Each agent is a DIRACT agent, which performs the role according to the goals assigned in the storytelling. Therefore, the role of a DIRACT agent can be changed in real-time.

Each DIRACT agent acts as either a director or a character, depending on the story scenario or user requirements. For example, if the scenario is very simple, the DIRACT agent can perform itself; otherwise, it can dispatch to other DIRACT agents to perform together. The properties of DIRACT agent are:

- Atomic: Each agent is atomic which is easy to plug in and out in real-time by the storyteller. It make the storytelling process more customized.
- Inheritance: The goal of an agent can be inherited from another agent, which simplifies the goal creating with reusability.
- Automate: Each agent is a goal-oriented object to manipulate the story scene, i.e. selecting a scene or performing an act.
- Robust: If an agent doesn’t perform well, it can be re-spawned by the storytelling system.
- Adaptive: The agent is able to adapt to the context changes as well as user interactions.

3.2 DIRACT Architecture

The structure of the multi-agent system is depicted in Figure 1, which involves the following elements:

DIRACT agents (DA) Each DIRACT agent can perform different roles in real time. The director agent or character agents by other researchers are unified as DIRACT agents, which simplifies the communication and makes the interactive storytelling authoring process easier.

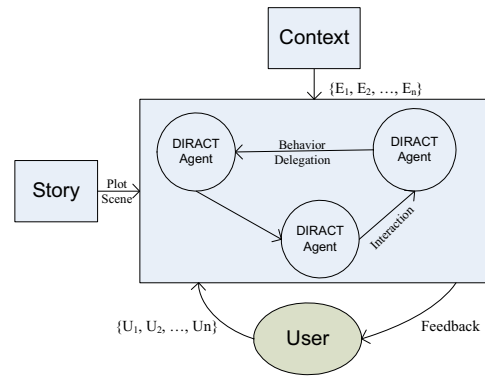


Figure 1. Multi-agent Interactive Storytelling System of DIRACT

Story It represents the initial story. It includes the story scenes to be implemented in the interactive storytelling.

User An user is the person who engages in the virtual storytelling through interactions.

Context Story context represents the circumstances that a story occurs, e.g. virtual environment, user preference and system resources.

3.3 Interactive Storytelling Process

The process of interactive storytelling is the process of pursuing goals for the DIRACT agents, an sample of which is shown in Figure 2. It includes four steps: story authoring, story executing, scene dispatching and character performing.

Story Authoring In this phase, the non-linear story plot is constructed as the hierarchical goal net.

Story Executing/Selection The goal net is loaded into a DIRACT agent. The DIRACT agent pursues its goal in the temporal order based on context variables and user interactions.

Scene Dispatching If one scene contains two or more characters, the root DIRACT agent dispatches its goals to character DIRACT agents.

Character Performing Each character DIRACT agent performs its goal and presents the story to the user.

3.4 Fuzzy Cognitive Goal Net for Goal Modeling

Each DIRACT agent is goal oriented, i.e., it pursuits its goals after it is created. In the interactive storytelling, one

DIRACT agent’s goal is performing an act or distributing a complex act to other agents. In our research, the goal of the DIRACT agent is modeled with Fuzzy Cognitive Goal Net. The model is made up of two parts: goal planning tool based on Goal net and the context reasoning mechanism using Evolutionary Fuzzy Cognitive Maps (EFCMs). Goal net is used by the DIRACT agent to select an act or performs an act. Evolutionary Fuzzy Cognitive Maps empower the DIRACT agents to create dynamic path by reasoning the user interactions and environment contexts, and strengthen character’s task selection in realtime.

In DIRACT interactive storytelling, a scene of story/drama is regarded as a goal to be executed by the director agent. The goals are loaded to the DIRACT agent according to the temporal relationships of the scenes. For a complex scene in the presentation path, the goal can be decomposed to more specific sub goals. Depending on the user interactions and context, different consequent goals may be reached after a certain goal, i.e, different scenes are achieved in different situations. Evolutionary Fuzzy Cognitive Maps are used for the decision making or goal selection by analyzing the relationships among related concepts. Through the goal dispatching, one DIRACT agent arranges the behaviors for the DIRACT agents to act in story scenes dynamically. The details of Fuzzy Cognitive Goal Net can be found in [1].

4 Results and Discussions

4.1 Case Study

In order to prove our proposed design, we applied it into our interactive storytelling, “Chronicles of Singapura”. The story scene is that, “in front of a school, the teacher asks the students to explore the inside of the banana tree, to study the plant transportation system”.

We design a very simple “School Scene” as the goal net shown in Figure 3. The scene involves a teacher and a number of students. At the start of storytelling, one DIRACT agent is created to execute the goal “School Scene”. Each complex scene (i.e. a composite goal) can be separated into goals of different characters. For example, the goal “Scene Initialization” is a composite goal that can be separated into atomic goals in hierarchy. We can either use one DIRACT agent to perform the whole storytelling, or involve more DIRACT agents to act together.

We create the DIRACT agents for both the teacher and the students. Through the goal dispatching algorithm, the goal nets for the teacher and students are illustrated in Figure 4 and Figure 5 respectively.

We run the DIRACT agents inside the Torque Game Engine virtual environment. Some screenshots are taken in Figure 6 and Figure 7, corresponding to the goal pursuing of the teacher and students. For the trial run in the Catholic

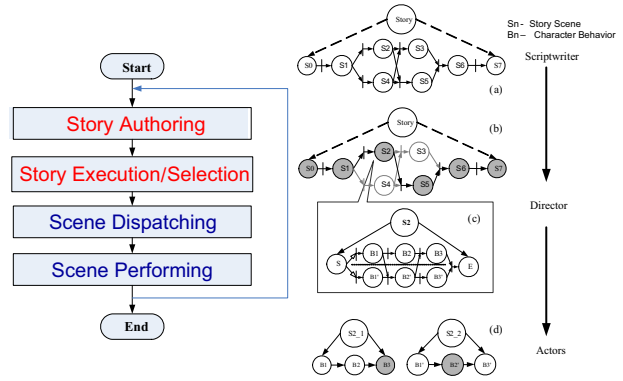


Figure 2. Interactive Storytelling Process (a) The DIRACT agent designs story plot with various choices; (b) The DIRACT agent selects story scenes dynamically; (c) The story scene S2 involves the interactions between two actors; (d) One DIRACT agent dispatches the scene to two DIRACT agents as their behaviors.

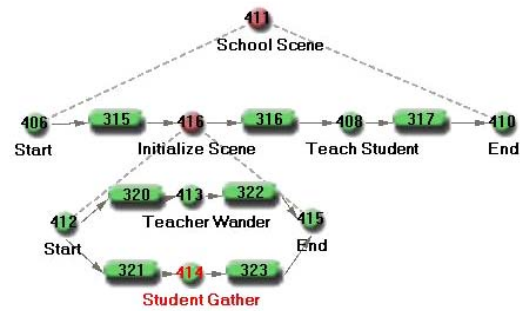


Figure 3. Goal Net for the School Scene

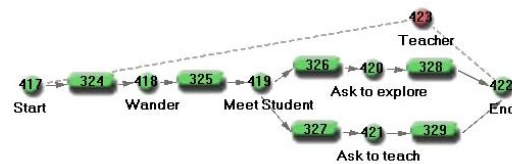


Figure 4. Goal Net for DIRACT agent “Teacher”

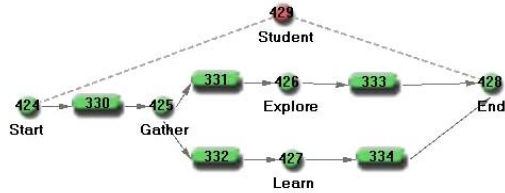


Figure 5. Goal Net for DIRACT agent “Student”



Figure 6. Snapshots for scene initialization (teacher wandering and students gathering) - Goal “Wander” by the “Teacher” in Figure 4

High School, the test results show that the students like the learning experience with the intelligent virtual characters. Moreover, the teachers of science class like to use the system to develop the goals and behaviors of the non-player characters in the storytelling. A more detailed informal test would be conducted in the following months.

5 Conclusions

In this paper, we have proposed a new agent-based interactive storytelling system, DIRACT, which is composed of a number of atomic DIRACT agents. The storytelling can be constructed as a simple toy with different agents for kids or teachers. Compared to the conventional agent approach of interactive storytelling, DIRACT is more modular and easier to expand.

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Figure 7. Snapshots for asking the student to explore the inside of banana tree - Goal “Ask to explore” by the “Teacher” in Figure 4- Goal “Gather” by the “Student” in Figure 5

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