The design and implementation of dynamic interactive agents in virtual basketball

Divesh Kanu Lala

Today's virtual environments are inhabited with a large range of embodied virtual characters, some designed to try and accurately portray a real human. These characters have varying functionalities and interfaces but the majority can be categorized as either video game agents or interactive embodied conversational agents. This work proposes an extension of these which combines elements of the two. This is termed a dynamic interactive agent. The dynamic interactive agent navigates around a virtual environment with the user much like a video game agent, usually to complete a shared task. It also uses human-based modalities as an interface for communication, much like an embodied conversational agent. This work describes the design and evaluation of these agents in the context of a virtual basketball game.

Implementation of the environment is achieved by using an immersive display system, a Kinect sensor for tracking the body movement of the user and a foot pressure sensor so the user can navigate around the court. This hardware allows walking motions and basketball gestures to be identified without the need for any external peripherals such as a keyboard or mouse. The agents are designed based on Herbert Clark's joint activity theory, in which signal identification and recognition are the primary basis for communication. The communication modality is body movements.

To test this theory in the virtual world, virtual basketball games with human team mates were played to discover joint activity theory phenomena such as explicit signals and common ground. A macro-behavior analysis of this experiment found patterns of signal types and meanings. A micro-behavior analysis produced a conceptualized joint activity theory model for passing interactions. Basketball agents were designed based on this model and other concepts of joint activity theory.

Two experiments were conducted in which participants played basketball with an agent team mate. The first experiment was to test whether participants preferred the joint activity theory agent which was not competent at basketball or a competent basketball agent with little communication skill. Participants were able to recognize the differences between the agents and rated the joint activity theory agent as more likeable and could better recognize its intention. The perceived intelligence of both agents were the same, indicating that communication skill nor competence alone do not necessarily account for intelligence. The second experiment involved the agent having to learn a strategy from the user by increasing its common ground. This common ground was built up from observing and imitating user

actions in the basketball game. The results from this did not produce any significant findings, although they suggested patterns which could be explored further in future research. More importantly, questions relating to the nature of common ground arose from the results and approaches to these questions were discussed.

The major point to take away from this work is that dynamic interactive agents can be seen as an extension of other agent types and should be addressed by researchers. As technology becomes more sophisticated it is expected that these types of agents will become more prevalent. The results in this work show that joint activity theory concepts can be used as a basis for their creation especially because they can accommodate their specific interaction requirements.