Interactive Performance: Dramatic Improvisation in a Mixed Reality Environment for Learning

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Abstract. A trained interactive performer uses a combination of head-motion capture and a new desktop gesture/posture control system to enact five avatars on a screen, as those avatars interact face-to-face with a participant/trainee. The inter-actor, assisted by a narrator/operator, provides voices for all five on-screen characters and leads the participant through a story-driven improvisational experience. This paper focuses on the processes of scenario development, inter-actor training and production management in the new creative discipline of interactive performance in mixed reality environments.

Keywords: interactive performance, mixed reality, avatar, role-playing, learning, training.

1 Introduction

1.1 Interactive Performance

Interactive Performance (IP) is an emerging discipline in which trained inter-actors work with an untrained spect-actor ('spect') to improvise a story. Beginning the mid-1990's, Jeff Wirth has developed a body of theory and practice and a training methodology for preparing inter-actors [1]. Five areas of skill and knowledge are required for a successful inter-actor: story structure, psychology, improvisation, dramatic performance and technology. During the interval between 2000 and 2010, Wirth trained a group of inter-actors at the University of Central Florida and conducted a series of projects and experiments to apply their skills to tasks related to entertainment, learning and training. Wirth's StoryBox was featured at the 2009 Chicago Improv Festival.

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In interactive performance, there is no traditional script. The inter-actors must be free to respond as the situation develops. However, the team needs to be able to structure the story experience and plan their actions and reactions. To a first-time spect-actor (participant) in an interactive performance, the sequence of events may seem entirely spontaneous. The 'spect' may say or do things which directly and immediately impact the development of the story. However, the trained inter-actors are continuously applying a rich mix of psychological skills, knowledge of story structure and experience in improvisation to shape and support the spect's experience.

1.2 The Latina Empowerment Project

Anne Norris and Charles Hughes (UCF Computer Science and Institute for Simulation & Training) received funding from the National Institutes of Health to develop a game using avatars and real-life scenarios to build skills in Latina middle-schoolers for resisting peer pressure to engage in sexual behavior. They assembled a team and set forth to create a system that uses one or more inter-actors to play the roles of peers, interacting with the targeted teenage participants. The key idea is to create a simulated peer group interaction within a game-like context. The inter-actors control cartoon-like characters on a computer screen. A story-driven dialog with several scenes leads the participant to experience peer pressure, and provide opportunity to practice peer resistance skills.

This paper focuses on the issues concerned with interactive performance in mixed reality environments. The research objectives, methods and results concerning training to resist peer pressure, and the details of the specific scenario will be published elsewhere. We describe the characters within the scenario because they are particularly germane to the process of interactive performance.

2 Story Development and Training

2.1 The Development Process

Jeff Wirth was engaged to develop the content of the game. The overall strategy was as follows:

- Recruit a team of inter-actors to conduct focus groups and field work, and to use these experiences to develop characters and a story through a series of improvisation sessions.
- Use PowerPoint to produce simple visuals for the characters and situations in the story, and video projection to test the story with a few typical Latina teenagers through a *live storyboarding* process.
- Document the results and provide guidance to the programming and art team, so as to construct an avatar-based system for formal experiments.
- Conduct a series of rehearsals using the deliverable version of the game, with three dimensional avatars.
- Test the final version with students in a middle school.

2.2 Field Work

A team of three women with prior inter-actor or theatrical experience were recruited to accomplish this work. In March and April 2010, two focus groups, each involving approximately ten Latina middle school girls, were held. In May 2010, Wirth involved the inter-actors in field work at the middle school. They observed and interacted with girls and boys in the after school program, observing interpersonal non-verbal and verbal behaviors.

The team then met with two high school students who were Latina for ten design sessions of approximately four hours each, during June and July. They used improvisational techniques to develop middle school characters and a story. This process was facilitated by initially providing archetype characters, which the group then named and described.

The game's characters:

Vicki - a friend and companion to the protagonist, also a sixth grader.
Julissa - the coolest girl in the class; physically the most mature; an antagonist and source of temptation
Margarita - younger, less developed. The 'goat' of the group.
Javier - the coolest boy in the seventh grade and source of temptation
Zack - the slightly younger and goofier sidekick to Javier

The protagonist is the participant. She has no on-screen representation. Rather, she is looking at, and being 'seen' by the on-screen characters. (Actually she is being seen by the inter-actor(s) controlling the characters, via a video link.) This mixture of real and virtual presence has been termed mixed reality [2].

2.3 Live Storyboarding

A PowerPoint presentation was constructed, built around simple flat cartoon-like pictures of the five characters listed above. At this stage, three inter-actors were used, although the ultimate plan was to have one inter-actor control all the avatars. The three inter-actors, a group of observers and three Latina teen-agers conducted a pilot testing process. We describe this process as "live storyboarding", because the PowerPoint scenes serve a role similar to that of storyboards in planning a movie. They allow experimentation with the layout of scenery, positioning of the characters in scenes, and their respective entrances, interactions and exits.

2.4 Physical Setup

A conference room at the Institute for Simulation and Training, approximately 20 feet wide and 40 feet long, has an airwall that divides it into two rooms. One of these rooms was set up with a rear projection screen. Between this screen and the far wall was a table and chair, observed by a video camera on a tripod. The airwall was partially closed. On a table sitting in the gap in the airwall was a projector, which illuminated the back of the rear projection screen. The participant (i.e., middle school girl playing the game) sat at the table facing the screen.

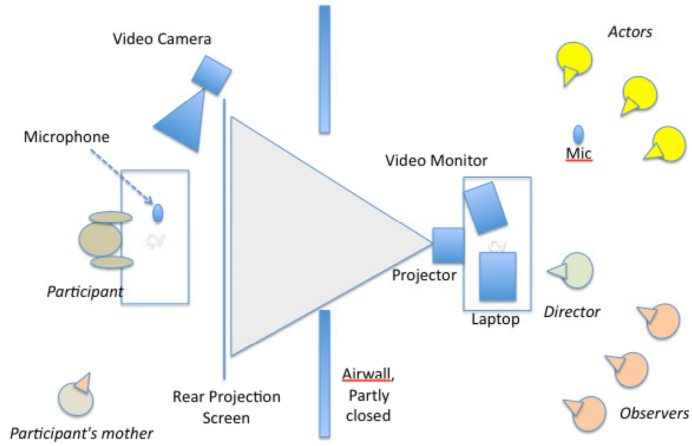

Fig. 1. Setup for the Live Storyboard Tests

In the other room, sitting on a table was a control console which contained a video monitor (displaying an image of the seated participant), and an audio mixer (not shown in diagram). This system was set up so that the show director was sitting at the table, facing through the gap in the airwall, and watching the back side of the rear projection screen. To his right were three actors, gathered around a microphone. They could see the participant's video image and the cartoon characters on the screen of the laptop. They could also see the rear projected imagery, but neither they nor the show director (Wirth) could directly see the participant.

The inter-actors spoke into a shared microphone; the sound was reproduced by speakers in the participant's room, but she could also hear the actors' voices through the open airwall door. Likewise, the participant could hear the actors' voices partially through the airwall. There was no delay or other impediment to the audio 'boost' system, as there is no Skype or other digitization of the audio being done.

2.5 Trial Runs

Two trial runs with participants were staged. The participants and their parents were interviewed, and the team then planned revisions to the storyline based on the experience. As the personalities of the five characters evolved, the inter-actors gained confidence in their ability to portray them. Parts of the scenario that 'worked' were expanded. The entrances and exits of the characters were modified. In one case, an entire scene was excised and replaced by a different scene, to remove an ambiguity about what happened. In the original plan, a 'fade to black' allowed the participant to imagine what took place between one scene and the next. This kind of openness to spect-actor creativity is common in interactive performance, but it did not serve the didactic purposes of the current project. It created too much ambiguity on the part of the inter-actor as to what the spect imagined was happening.

3 Transition from Live Storyboarding to 3d Avatar System

3.1 A Novel Control Mechanism

A novel control mechanism was designed by Dan Mapes for control of the 3d avatars. Derived from the TeachMe system [3] for remote avatar control, the new system differs in several fundamental ways. TeachMe, like the new system, enables a single inter-actor to control five avatars. However, TeachMe is a totally analog system. The inter-actor wears a motion-capture shirt and hat, and controls five seated avatars (one at a time). The hand, torso and head motions of the inter-actor are directly mapped onto the motion of the avatars. A relatively simple system provides plausible movements to the other avatars while the inter-actor has control of a specific avatar.

The new (patent-pending) system could be described as a "five dimensional" control metaphor, representing a blend of discrete and continuous control. The inter-actor moves a pawn-like control device (with a motion capture ball on its head) across a two dimensional map on the desktop to select an avatar and a particular group of gestures or behaviors. These behaviors are custom-animated to support the scenario being enacted. Figure 2 shows the controls used in the first demonstration/tests.

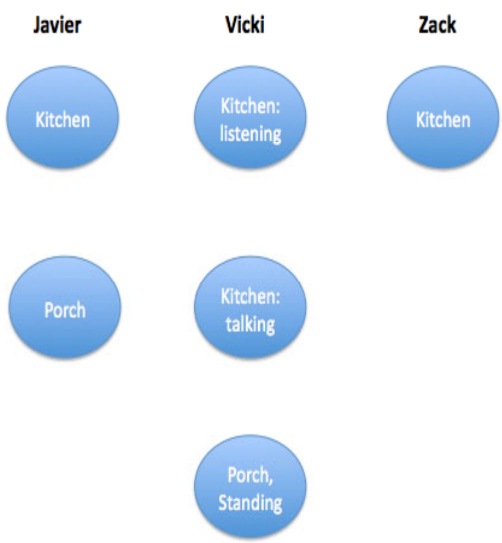

Fig. 2. The control map used in early tests

The inter-actor moves the control away from its neutral position above one of the marks, and the corresponding gesture is smoothly carried out. Associated with each mark, up to nine gestures can be mapped onto the four available directions of motion parallel to the table-top and directly up from the table (each lateral direction can contain up to two gestures). Diagonal motion results in a blend of the corresponding discrete gestures.

For instance, the dot at Javier: Kitchen controlled four gestures. Moving the marker away ("north") caused Javier to lean forward on the kitchen table. Moving to the east (right) generated a "chest bump" - an assertive thrusting outward of Javier's chest. Moving south caused Javier to cross his arms. Further movement southward produced an opening of the arms, in a palms-up gesture. Movement westward caused Javier to rotate toward his right, and to look "flirty"; i. e. downward, with eyes upward.

In each case, the inter-actor's head motions (tracked by means of markers on a baseball cap) are added to those based on the pose control system. Thus a gesture which turns the head to the left, for instance, can still be modified with additional left/right or up/down movement of the inter-actor's head.

3.2 Scenario-Specific Gestures

The limitations of this technique are obvious: only those gestures that have been prepared for a given scenario are available. However, there are several advantages as well. The motion capture suit of TeachMe requires that the inter-actor have a rich repertoire of 'body language', with which to express the personalities of all the characters in the story. The new technique requires good control of timing but relaxes the requirement for specific body movement skills. It also frees up the inter-actors' hands for other purposes, when required.

Two of those purposes are to move the avatar's lips when speaking, and to control facial emotions. An Ergodex keyboard [4] or similar device is used to move the lips, and to select facial expressions.

3.3 Designing the 3d Characters

The team worked with teenage consultants to gather images of prototypes for the characters in the story. The inter-actors posed the various postures and gestures that would be needed, and photographs were provided to the 3d modelers.

The team generated a specific list of emotions that the faces of the characters would need to convey. These included:

confused
interested
excited/flirty
pleased/happy
concerned
disgusted
'whatever'
displeased/hurt

An obvious question would be why no expression of anger was included. This choice was made because, based on the context of the story, there is no expectation that the onscreen characters will need to express anger. The participant may well experience that emotion or others, but the available expressions coupled with appropriate tone of voice and dialog could adequately deliver such emotions.

The acting team produced these facial expressions and then developed consensus as to which expression best reflected what they wanted on the characters. Photographs of these inter-actor-generated emotional faces were then provided to the artists.

3.4 Test Configuration

The next round of in-lab tests were set up as depicted in Figure 3 below.

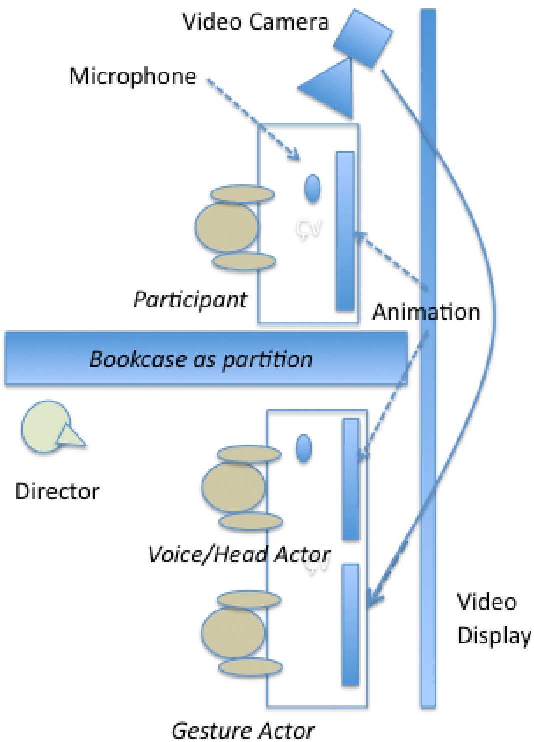

Fig. 3. Setup for Laboratory Tests of 3d System

During early trials, two inter-actors shared control of the avatars. One (wearing the motion capture hat) controlled the head's movement, spoke the lines and selected the facial expressions of the avatar. The second controlled the gestures. The show director, sitting behind the inter-actors, provided narration and changed the scene when appropriate.

During later trials, one inter-actor performed all the tasks previously handled by two. The second inter-actor (now sitting where the director is marked in Figure 3) was in charge of narration, scene changes and also with providing feedback to the participant. The show director remained close by, but took no active role in the scenario while it was running.

3.5 A Feedback System

In the original design of the scenario, it was intended that the participant should be given continuous feedback by an on-screen display of some kind. The first version was a display with two columns whose height represented 'Strength' and 'Coolness', with a horizontal bar across the top. The participant was instructed to try to keep the two parameters in balance.

As pilot experiments continued, it became clear that it was quite difficult for the narrator to reliably assign scores to the participant's actions. Also the scoring was not providing feedback specific to the two peer resistance skills being targeted by game play. The feedback was modified to target two peer resistance skills, resistance and avoidance. Consistent with the conceptual framework guiding game design ('Communication, Competence Model')[5], the points earned for resistance and avoidance can be increased by demonstrating each behavior in a “cool” way.

It will be part of the research component of the project to determine if the narrator will be able to assign scores in a reliable and reproducible manner. In this paper our principal concern is with the cognitive loading and overall task performance of the inter-actor and narrator.

4 Interactive Performance Issues

The inter-actors involved in this project have several years of experience in live interactive performance. They were not daunted by the challenge of playing five characters in rotation. The new control interface took some getting used to, but the inter-actors report that they feel that they have good control over the avatars.

One of the advantages of the five dimensional interface is that, if an inter-actor is unsure what gesture a given control movement will produce, they can make a small movement and observe the beginnings of the gesture, then retract if necessary. To the participant, the movement looks like natural 'fidgeting' behavior of the avatar character.

A more significant challenge is to make sure that the participant encounters all of the experiences planned for in the experimental treatment plan. A paper check-list is currently being used. The narrator is responsible for tracking whether the essential story points come up, and for prompting the inter-actor if necessary before a scene change, to include all the expected experiences.

We are using an inter-actor as the narrator because the narrator is playing an essential role in the dramatic process. For consistency in the evaluation process, this person will play the role of narrator/evaluator throughout the school experiment.

5 Experiments to Be Conducted

At press time, the actual experiments are scheduled to take place in April 2011 in the after-school program held at a public middle school in Orange County, Florida. The inter-actors will be working from the Institute for Simulation and Training at UCF, approximately fifteen miles from the school. The outcomes of the experiments with respect to interactive performance will be presented at the HCII 2011 conference. The outcomes with respect to the training goals of the project will be presented at conferences and published in nursing and interdisciplinary journals that focus on health promotion.

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