Modified Playback of Avatar Clip Sequences Based on Student Attention in Educational VR

Adil Khokhar*   Andrew Yoshimura   Christoph W. Borst

University of Louisiana at Lafayette

Figure 1: Left: The teacher agent points at a deck crane and a student looks (indicated here by a yellow gaze trail that is not seen by the student). If the student does not look, the teacher can pause until the student looks. Right: The student receives a text message and the teacher pauses due to student distraction.

ABSTRACT

We demonstrate a system that sequences teacher avatar clips considering student eye tracking. We are investigating subjective suitability of avatar responses to student misunderstandings or inattention. Three different avatar behaviors are demonstrated to allow a teacher pedagogical agent to behave more appropriately to student attention or distraction. An in-game mobile device provides an experiment control mechanism for 2 levels of distractions.

Index Terms: Human-centered computing—Visualization

1 INTRODUCTION

Pedagogical agents provide an educational benefit [4] over a fixed presentation sequence by being more interesting, and they could respond to misunderstandings or shifts in attention by using animated clips to be more responsive. Eye gaze is a useful indicator of attention and eye tracking [1] can provide mechanisms for a system to monitor and respond to shifts in focus.

We previously described an architecture for a pedagogical agent, that uses animated clips, to allow it to consider inattention [3]. The agent detects inattention by calculating a score from contextual metadata and combined sensing data. As a simple example, the teacher explains a deck crane and points at it, pausing until the student looks. In this example the score is calculated from the gaze angle between the student's eye gaze direction and the direction from the student to the deck crane.

We present 3 different avatar behaviors, called responses, that sequence avatar animation clips to allow a teacher pedagogical agent to behave more appropriately to student attention and distraction monitored by eye tracking.

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*e-mail: axk9375@louisiana.edu

We discuss a preliminary experiment approach for investigating subjective suitability of agent responses and for understanding eye response to distractions, for future consideration in our pedagogical agent architecture.

2 PRELIMINARY DETAILS

In our VR environment, students are tasked with learning about equipment on a virtual oil rig while they may receive rig notices on their virtual mobile device. The teacher provides an educational presentation by sequencing the playback of teacher avatar clips that point out and explain equipment on our VR oil rig. The teacher behaves differently depending on student attention or distraction.

2.1 Teacher Responses

Teacher responses control the sequencing of teacher avatar animation clips that point out and explain objects in a virtual oil rig for training. Responses handle sequencing content based on critical periods (Section 2.4), with clip metadata describing what the student must do to progress the sequence and when it is appropriate for the teacher to respond. For example, in Figure 1 the student's eye gaze history, indicated by a trail not visible to them, shows the student looking at the deck crane in order for a paused teacher to continue their explanation of a deck crane. We demonstrate 3 different teacher avatar behaviors:

Normal: The teacher continues behaving normally. This is our baseline response. For example, the teacher points at the iron roughneck, the student looks at the iron roughneck, and the teacher continues to explain what the iron roughneck does.

Pause: The teacher pauses. For example, when the teacher asks the student to answer questions on their mobile device, the teacher's pause response subsumes all other behaviors until the student has completed all required tasks and answered all quiz questions.

Replay: Teacher pauses for a second, then rewinds. For example, the teacher explains the drill string and points at it. The teacher will replay the topic if the student is not looking. Replay can be configured to skip so that in the example the teacher will skip to the next sentence when the student looks.

2.2 Virtual Mobile Device

The student holds a virtual mobile device in our software for general use, such as interactions, and as a mechanism for the system to present distractions in a controlled manner. As shown in figure 2, our phone supports 4 different features for general use and distractions:

Find: A text message that highlights an object and requires the student to point and click at the highlighted object with their wand.

Rate: An interface for students to rate the teacher's behavior.

Messages: A text message that communicates oil rig conditions.

Quiz: A sequence of text messages that ask questions and require the student to select the correct answer.

2.3 Distractions

Our virtual mobile device presents distractions by showing them as text messages with accompanying vibration and sound effect. We have 2 different levels of distraction:

Low: A text message that communicates oil rig conditions.

High: A text message that requires interaction with an object in order for the student to proceed in the sequence.

Distractions are timed to occur during critical periods, such as when the teacher points at an object they're explaining, in order to investigate student distractions at critical moments that effect teacher response. The timing is handled through annotations (Section 2.4). Distractions are also an experiment approach for investigating tracked eye behaviors during distractions.

2.4 Timeline Annotations

Our prerecorded clips are organized with metadata, called annotations, that specify timing of responses, critical periods, requirements to progress the sequence, and distractions. This provides adjustable mechanisms to control how prerecorded content is sequenced by teacher responses, playback, seeking, rewinding, and stopping of teacher clips [3]. Critical periods specify what a student needs to do in order for the teacher to continue default behavior and progress the sequence. For example, the teacher explains what a derrick is and points at it. The clip's critical period specifies the interval of time where the teacher points at the derrick and the student must look.

2.5 Preliminary Demonstration Details

Students are presented with educational content in which a prerecorded teacher points out and explains equipment that is used in our virtual oil rig. The educational presentation will have 6 areas on the oil rig that consist of the teacher going over 3 topics each, with the total number of areas corresponding to the total combinations of teacher responses and distraction levels. A topic is a short explanation of specific oil rig equipment that includes the teacher pointing at the equipment. Each area presents a response-distraction condition in a random order for a total of 6 response-distraction conditions. In order to progress a sequence, students will need to gaze at correct regions when the teacher points out equipment and interact with specified objects when the high distraction condition occurs. We will be gathering feedback and subjective ratings on teacher responses in addition to eye tracker data and the percentage of quiz questions answered correctly. We will compare the percentage of time the student spends looking at the teacher or a pointed object, compared to other objects such as the virtual mobile device.

3 CONCLUSION

We present 3 teacher avatar behaviors and 2 distraction levels that are being used in a study of the subjective suitability and desirable timing of different responses such as pause and replay, effects of distractions on eye tracker data, and the benefits of eye tracking. We will gather eye tracking data, analyze the data for insights into users' attention, and determine the feasibility of various eye tracking sensors in their role in attention and how eyes behave in different attentional states. This data will be used to integrate a pedagogical
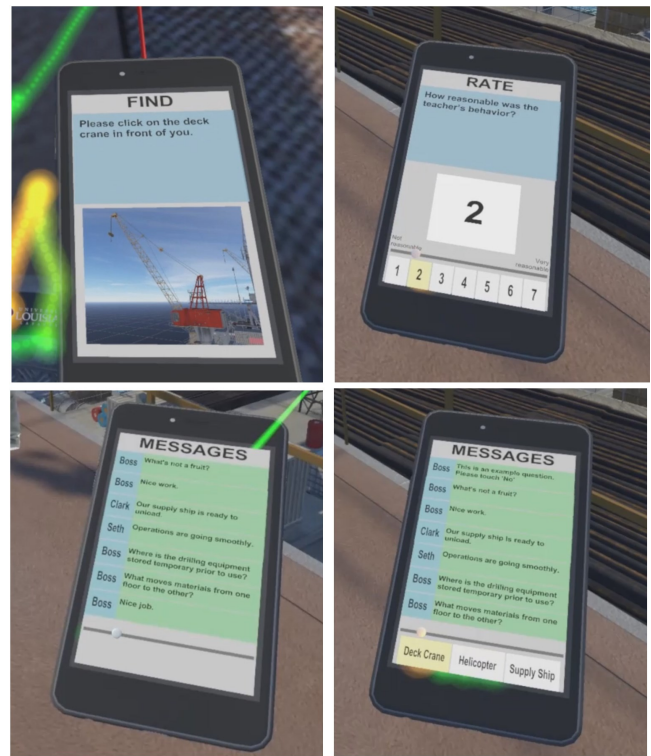

Figure 2: Different features of the virtual mobile device from left to right: Find, Rate, Messages, and Quiz

agent capable of guiding attention with more interesting behaviors, such as pausing and restoring attention with a combination of visual cues [2], in order to promote student attention.

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