Battlefield Information Integration and Visualization for Command (BIIVC)

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Problem

One of the lessons of recent low-intensity conflicts is that the Army needs a capability to quickly deploy armored units to a trouble spot. What if we could remove the crews from the armored vehicles? DARPA has teamed with the Army to conceive a new capability for the Army called Future Combat Systems (FCS) to do just this. The objective of the FCS Program is to develop robotic combat forces that can be deployed quickly anywhere in the world until heavy forces arrive. Our approach uses a lightly armored Command Vehicle (CV) placed well back in a location of relative safety. We put the commander in a virtual battlespace, in which he has access to all of the sensors and assets of the robotic combat force. In BIIVC, we investigate the HCI problem: "can we build an effective warfighter-centered immersive virtual environment that provides the commander with support for controlling robotic forces while leveraging networked information sources to provide excellent situational awareness in the CV?"

Approach

We gave the commander 4π steradians of field-of-regard by using a head-mounted-display (HMD). We designed a very flexible method for using this field-of-regard given that the commander is secured into a chair in a moving vehicle. We established a "no-mouse, no-keyboard" policy for interaction in the environment, leading to a gesture-, graphics-, and speech-based multimodal interface for navigation and interaction with the robots (Rigure 1). Since several researchers have demonstrated effective behavioral robot control derived from sets of goals and constraints [Payton90, Koenig99], we sought an intuitive way for the commander to establish these goals and constraints in the battlespace. We sought a method or methods for mitigating the cybersickness problem that occurs in many users when navigating through virtual environments.

Progress

We developed a prototype virtual environment (VE) software system that demonstrates multimodal (gesture, graphics, and speech) for configuring individual or groups of robots. In addition, the commander can navigate to any location in the "known" virtual world, and can "see" what the various sensor platforms are seeing.

In a typical multimodal robot configuration interaction, the Commander would use a "point and fire" gesture to identify single robots, select groups of robots, or identify features on the ground, such as the boundaries of target and landing zones. Selected objects can be named: the speech recognizer can recognize names from arbitrary classes of objects (we use fruit) and the radio communication alphabet (e.g., Alpha, Bravo, Charlie…). The interface is object-oriented, so that when the Commander asks to configure an object, the dialogue is directed toward appropriate configurations for that object (Figure 2). So, for example, it will never ask an IUGS whether it wants to fire HEAT or Sabot rounds. We assume that a system external to BIIVC handles conversion of the goals and constraints into programming for the robots.

We developed a novel method for navigation in the environment that combines the best features of a trackball, i.e., capability to pivot about an arbitrary location, with an egocentric navigation mode invoked by a pulling motion.

The operator can also translate large distances by selecting a point on the ground, creating a new trackball location, and "jumping" to it. Since discontinuous jumping tends to cause disorientation, and the image flow from "flying" through virtual space can cause some operators to experience cybersickness, we developed a novel hybrid that mitigates the problem. We use some initial simulated acceleration, to give the operator a feel for the direction of travel, and then complete the jump with a similar deceleration. We use a "snail trail" marker that gradually "dries" with time, to show the path just traveled. The operator can reorient himself by looking back in the direction from which he came.

Demonstration

We will show a video of a prototype virtual environment system with gesture, graphics, and speech interaction for configuring individual or groups of robots. In addition, the commander can navigate to any location in the "known" virtual world, and can "see" what the various sensor platforms are seeing.

Figure 1 – BIIVC needs no mouse or keyboard

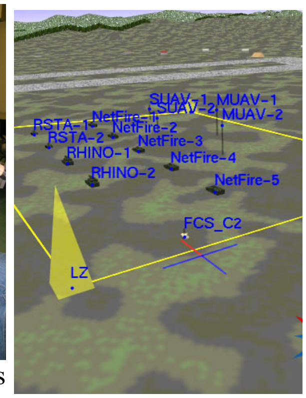

Figure 2 – Screen Shot of FCS Forces Assembled at the Landing Zone

References

[Koenig99] Koenig, S. "Exploring Unknown Environments with Real-Time Search or Reinforcement Learning", Proceedings of the Neural Information Processing Systems Conference, 1999, pp. 1003-1009.

[Payton90] Payton, D.W., J.K. Rosenblatt, D.M. Keirsey, "Plan Guided Reaction", IEEE Transactions on Systems, Man and Cybernetics, Vol. 20, No. 6, November/December 1990, pp 1370-1382.