A Virtual Interface Agent and its Agency

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In the VIENA Project ("Virtual Environments and Agents") we develop virtual environments for interactive design and exploration (Wachsmuth & Cao 1995). In our recent work we have modeled a synthetic human-like agent, Hamilton, that inhabits a simulated office environment and acts as an embodied virtual interface agent (VIA). On request, Hamilton can change its position and appearance in the following ways.

- **Moving and turning; looking**
  The agent can move in the horizontal plane and turn around its vertical axis. To look around, the agent can turn its head left, right, up, and down within human-like boundaries.

Figure 1: "Hello"

Figure 2: User pointing gesture

- **Pointing and waving**
  Hamilton can issue pointing gestures. In response to the input "hello" or a data-glove waving, the agent turns to the camera and waves back (Figure 1).

- **Changing size and perspective**
  We have provided instructions that cause a shrinking or growing of the agent, and the user can also switch from an external view to an immersed view.

To explore or change the simulated environment, people can instruct Hamilton by way of verbal input and simple hand gestures. Instructions can make use of pointing gestures of the user (by way of data glove; cf. Figure 2) or of Hamilton (Figure 3). Sample instructions for Hamilton are shown below.

1. *Hamilton come here*
2. *hello*
3. *make the left table green*
4. *much darker*
5. *put this* <user pointing gesture> *computer on the floor*
6. *put it back*

7. *Hamilton point to the green table*
8. *put the chair between you and there*
9. *change the view*
10. *Hamilton be smaller ...*

When having the immersed view, the user can move in the virtual room looking "through Hamilton's eyes" (Figure 4) and can shrink or grow to explore the environment from the perspective of a child or a tall person. The VIA also serves as an anchored reference system that allows the use of various kinds of spatial language (Jörding & Wachsmuth 1996).

Hamilton's Agency

Hamilton's functionalities are put into effect by its invisible agency, a multi-agent system. Three listener agents, i.e., a type listener, a speech listener, and a gesture listener, track and analyze multi-modal sensor data from the keyboard, the microphone, and the data glove, respectively. With the help of a parser, a coordinator analyzes and integrates the inputs received from the listeners and generates an internal task description that is posted to appropriate agents of Hamilton's agency.

Figure 3: Pointing (external view)

In mediating an instruction, further software agents in the VIENA system track exact object locations and colorings. For example, by inspecting or modifying (r,g,b)-vectors, a color agent helps to identify an object by means of a color description ("the red chair") or to change the appearance of objects (e.g., blue, lighter). Agents' functionalities account for implicit assumptions of the human when manipulating the environment.

Hamilton's agency is also able to adapt to individual users during run time (Lenzmann & Wachsmuth 1996). In case a visualized solution does not meet the user's expectation, the user can correct the system. By learning from user feedback, agents compete with each other to meet the user's preferences. The system's knowledge of the user is expressed in the activation of certain agents in the entire interface agency, without accumulating explicit user models.

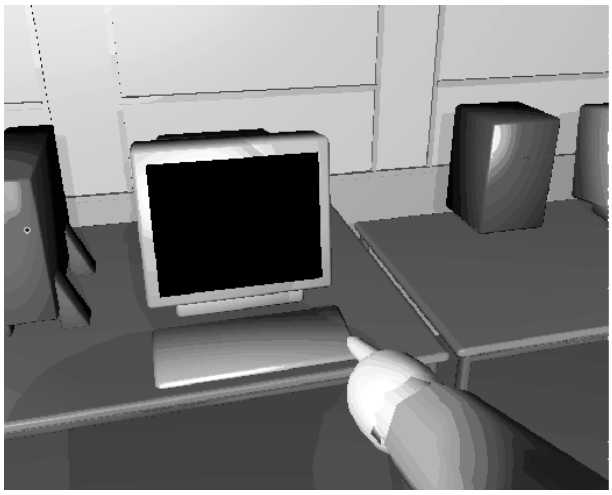

Figure 4: Pointing (immersed view)

Conclusion

We think that virtual interface agents can greatly enhance natural interaction with virtual environments. In the presence of a human-like figure, it is natural to include means of verbal interaction, especially when gestural manipulation is impossible or unnatural ("make all tables green"). On the other hand, gestural interaction is more intuitive to convey spatial information. In our next work, we will change to a setting where a virtual environment is presented on a large-screen display, so the synthetic agent is close to human-size. We expect that a wider range of gestural expression in communicating with the interface agent can be used.

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References

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