ServerDroid: A MultiMedia Service Robot

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Introduction

ServerDroid -- to be entered in the "Hors d'oeuvres, anyone?" event of the AAAI-97 Robot Competition -- is the embodiment of a concept wherein the robot is both a conveyor of product (e.g., hors d'oeuvres) as well as information (e.g., movie trailers). The product is carried on the robot platform, but the information is presented, *simultaneously*, in a multimedia format on the robot's "face". The "face" makes use of the multimedia form to convey information about the robot as well. In one platform then, there is a sensate, reactive robot with a personality whose sole goal is to make the information in its "head" available to humans.

Figure 1. The ServerDroid System

In this abstract I describe the robot platform and the software processing running on the robot, and discuss the interleaving of sensing and action to convey the multimedia information. I close with a short summary of the kinds of applications in which this technology should be useful.

The ServerDroid

ServerDroid consists of a robot base and a multimedia head which is a laptop computer. The design of ServerDroid is aimed at making a robot that is low-cost when manufactured at production quantities. The base has a single item cost of about $2500, and the laptop is about $4400, yielding a $6900 single quantity robot.

The robot's base is a Pioneer I mobile robot (ActivMedia 1996a) from RWI, Inc (see Figure 1). It's battery contains power to support about one and a half hours of ServerDroid activity. It is equipped with seven ultrasonic sonars which face front and to the sides and are used for obstacle detection during navigation. They are also used to orient the video head in the multimedia display. Additionally, a front-facing Eltec 442-25 pyroelectric sensor is used to differentiate people from inanimate objects.

Velcroed to the base is a foam-core hollow body, the sole purpose of which is to raise the head to a useful height (it's also handy to conceal the RS232 wire).

The multimedia head is a 7 pound, 133 MHZ Macintosh Powerbook 1400, whose 11.3 inch display has been integrated with a touchscreen from Troll Touch, Inc. The PB 1400 is connected to the Pioneer via an RS232 link.

In the competition, a lightweight tray sits astride the keyboard of the Powerbook to carry hors d'oeuvres.

The Software

The Pioneer runs the PSOS operating system (ActivMedia 1996b). The PSOS communications server accepts command packets to drive the robot's motors and provides packets of sensor and robot configuration information to clients.

On the PB 1400, I use Macromedia's Director (Macromedia 1996) as the multimedia presentation software. Director uses a scripting language and a stage and score metaphor to execute multimedia movies. Figure 2 depicts the Director view on the head display. The video face of the ServerDroid personality in the center continuously turns to face in the direction of the sonar with the closest range reading. Flashing icons at the bottom of the display depict the real-time sensor activity. The video head is surrounded by "hot" pictures of movie trailers.

When a visitor touches any of these pictures, the appropriate movie trailer plays in the center of the screen.

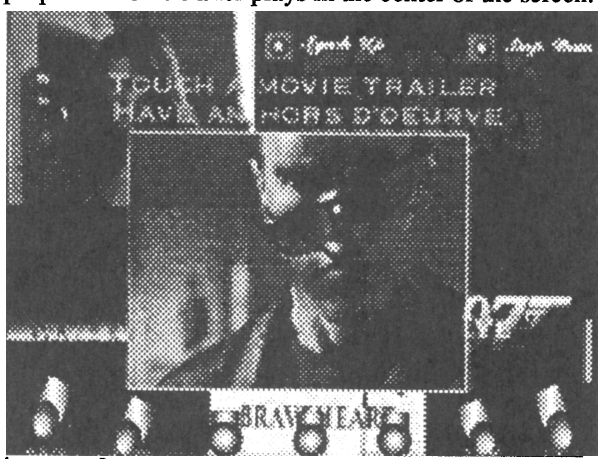

Figure 2. ServerDroid's Multimedia Head

Director interleaves two execution threads: the main thread of playing the score and a thread which runs whenever the CPU is idle. One can also augment Director's built-in capabilities by writing scripts in Director's Lingo programming language. Using these capabilities and drawing upon the layered software approach being used in the AI robotics community (e.g., Bonasso et al 1997), I developed software to control the robot and its multimedia interface as follows. The skills loop, running at about 3 Hz, executes skills which read the sensors and update flags concerning the proximity of objects and people, update the sensor display, turn the video head, and turn the physical robot to orient on the nearest of any object within a predefined range. There is also a skill which backs up the robot whenever the nearest object is within a pre-defined danger-close distance.

Running at about 1 Hz, a high level score script controls the task level of the robot by running behaviors triggered by the various flags set by the skills level. These behaviors include establishing communications with the base, determining if there are humans present and stopping if there are, moving to another location if there is no human activity after a predetermined length of time, and running videos. These videos are either movie trailers when selected by the user, or clips of the ServerDroid personality which prompt the user to take action or inform the user of events, such as when the robot is getting ready to move to another location.

When ServerDroid starts up, the head establishes communications with the base and activates the sensors. If there is no one around, it will call to humans promising not to kill anyone, or stating that there isn't much time left before it moves. After about a minute, it will move (while playing appropriate traveling music) in a direction indicated by one of its far-ranging sonars, and will continue until it detects proximate objects. If the objects don't register with the pyro sensor, it will continue on, otherwise it will stop, orient on the nearest (assumed) humans and prompt them to have an hors d'oeuvre or to play a movie trailer. If no activity is perceived after prompting the humans once or twice, ServerDroid will move on.

Applications

Our group believes that immediate application areas for reactive robots are those which provide a great deal of entertainment with a modicum of service: museum tourbots, mall guidebots, roving ticketbots for attractions or ad(vertisement)bots for merchandise sales. And of course, food serving robots. The attraction for these is their animation in both movement and personality. Interleaving reactive responses to environmental changes with information being presented in a multimedia fashion by a robotic personality provides just such an attraction. Our ServerDroid prototype consists entirely of off-the-shelf components, and indicates that such an info-tainment capability can be produced at low cost, making it ultimately more affordable.

References

ActivMedia, Inc. 1996a. Pioneer I Operation Manual, ActivMedia, Inc., Peterborough, NH.

ActivMedia, Inc. 1996b. Pioneer I Software Manual, ActivMedia, Inc., Peterborough, NH.

Bonasso, R. P., Firby, R. J., Gat, E., Miller, D. and Slack, M. 1997. Experiences With an Architecture for Intelligent, Reactive Agents, *JETAI*, 9(2).

Macromedia, Inc. 1996. Using Director, Version 5, Macromedia and Apple Computer, San Francisco, CA.