

Using Handhelds as Controls for Everyday Appliances

Questions

Can we create better interfaces for everyday appliances on a handheld **computer?**

- What types of problems do appliance interfaces have? What are the sources of these problems?
- Can these problems be corrected by using a handheld computer as a remote control for an appliance?

The Study

We created paper prototype mock-up interfaces for two everyday appliances for comparison with the manufacturer's interface:

- AIWA Shelf Stereo
- AT&T Telephone/Answering Machine

We compared the interfaces using a betweensubjects test. For each subject, the test was divided into two parts:

- A set of tasks on the actual stereo or phone
- A set of tasks on the handheld interfaces for the appliance they did not use in the first part

The following data points were recorded:

- Missteps
- Help requests
- Time to complete all tasks

Subjects were told to attempt all tasks before requesting help.

Participants

Thirteen students, five female and eight male, from the Carnegie Mellon School of Computer Science volunteered to participate in the study. Seven owned Palm devices and only one had no Palm experience. Four subjects happened to own a stereo of the same brand used in the study.











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AIWA Shelf Stereo



What was difficult with the manufacturer's interface?

- To set the alarm clock requires the user to do several steps in sequence, each within four seconds of the last. The flashing of the display is the only indicator of this restriction.
- The remote control has more than 35 buttons, some of which can be pressed multiple times to access different features.

How was the handheld interface improved?

- The interface is factored into screens for each of the different output sources with separate dialog boxes for features that are always available.
- More appropriate names are used for some features.

What was difficult with the handheld interface?

• The standard Palm menus are used to access the audio settings and the alarm clock features. These features were difficult to discover because the menus are not visible until the *menubar* button is pressed.

AT&T Telephone

What was difficult with the manufacturer's interface?

- The telephone gives ambiguous feedback. Often single or double beeps are the only indicator that the user has done something, but it is not clear whether the beeps are positive or negative.
- Buttons are overloaded with two functions, the second of which is accessed by holding the button down for two



- seconds. The second function is not labeled on the unit and can be very difficult for users to discover.
- The telephone and answering machines electronics are completely separate. Thus the numeric keypad cannot be used to set answering machine parameters.

How was the handheld interface improved?

- The internal state of the telephone is explicitly displayed. For example, speed dial numbers are shown.
- The internal electrical separation is hidden by separating the controls for the telephone and answering machine on two different panels.

What was difficult with the handheld interface?

Reverse video selection boxes are used. For boxes with two choices, it may be unclear which is selected.











The Results

The results of the study indicate the following: • Subjects made 5 times more missteps using the manufacturer's interfaces. (p < 0.001)• Subjects required help to finish their tasks 4 times more when using the manufacturer's

- interfaces. (p < 0.001)
- Subjects took about 2 times as long to finish tasks using the manufacturer's interfaces. (informal measurement)



Prototype Handheld Interface

Missteps and Help Requests were compared using an unpaired t-test.

Future Work

Our next goal is to create an interface generator that builds high-quality user interfaces that are comparable to the paper prototypes we have tested. Unlike previous model-based interface work, we will create our specification language based on observations from our hand-designed interfaces. This will ensure that the information we need to build a high-quality user interface will be embedded in our specification language.

We are also working on a similar user study that uses Microsoft PocketPC handhelds instead of paper prototypes. We hope to validate the results of our paper prototype study and learn a little about the implementation of these interfaces.

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