MITSUBISHI ELECTRIC RESEARCH LABORATORIES
http://www.merl.com

Collaborative Help for Networked Home Products

Rich, C.; Sidner, C.; Lesh, N.; Garland, A.; Booth, S.

TR2004-083 January 2005

Abstract

Ordinary people already have great difficulty using the advanced features of digitally operated household devices, and the problem is getting worse as more customization and programming features are continually being added. This usability problem cannot be solved using only the tiny displays and limited control buttons typically found on home appliances. In this paper, we demonstrate how, using home networking to share a larger and more powerful display, we can provide home products with a new type of collaborative interface in which the product actively helps the user, especially with complex features that are only occasionally used.

IEEE International Confereance on Consumer Electronics, ICCE 2005

Collaborative Help for Networked Home Products

Charles Rich, Candace Sidner, Neal Lesh, Andy Garland, Shane Booth
Mitsubishi Electric Research Laboratories
www.merl.com

Abstract

Ordinary people already have great difficulty using the advanced features of digitally-operated household devices, and the problem is getting worse as more customization and programming features are continually being added. This usability problem cannot be solved using only the tiny displays and limited control buttons typically found on home appliances. In this paper, we demonstrate how, using home networking to share a larger and more powerful display, we can provide home products with a new type of collaborative interface in which the product actively helps the user, especially with complex features that are only occasionally used.

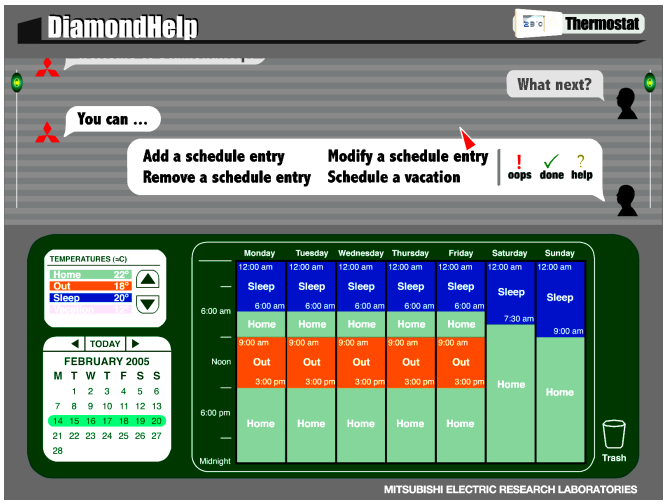
Introduction

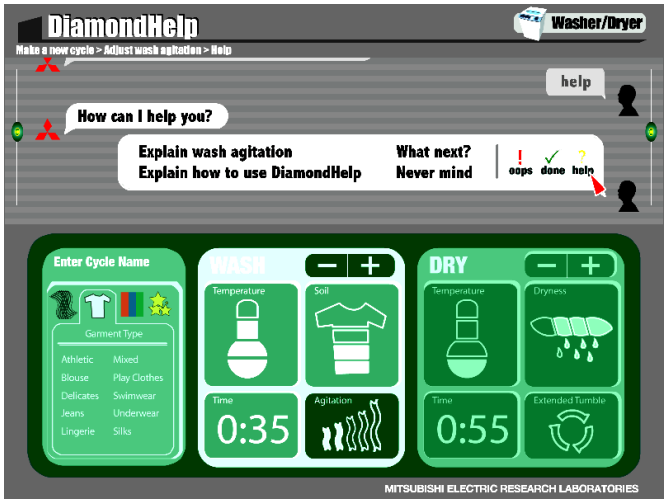
> ... technology remains far too hard for most folks to use and most people can only utilize a tiny fraction of the power at their disposal. Yet companies continue to concentrate on adding features to overstuffed products rather than making the products more usable. [1]

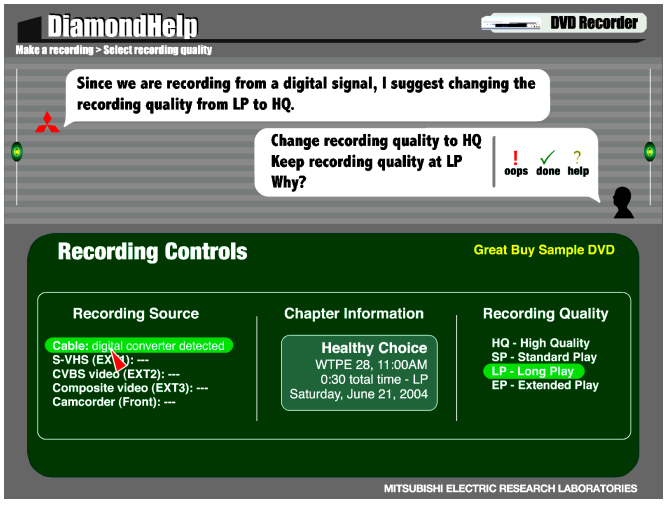
Our diagnosis of the underlying cause of this usability crisis is that the complexity made possible by the proliferation of digital processors in home products has exhausted the capacity of conventional user interface design. We have therefore embarked on a research effort to develop a new paradigm for home product interfaces based on the concept of *collaboration*. The screen shots to the right show three prototypes we have developed to illustrate this new type of interface for a programmable thermostat, a combination washer-dryer and a DVD recorder.

Another factor which exacerbates the current crisis is the extreme lack of interface consistency between products, especially for seldom-used features. Our new interface design provides a consistent "look and feel" across products, as illustrated at the right, while also respecting necessary differences between appliances (and as we will explain further below).

The relevance of home networking to this work arises out of the fact that the interface design described here requires some minimum display size (e.g., 640x480 pixels) and input capabilities (e.g., a touch screen), which may not be economically feasible to provide on every home appliance. A solution to this problem is for some appliances to share a single "base station," to which they are connected via a home network.







Human-Machine Collaboration

Our approach is based on computational research on human collaboration [2], from which we take the following two key principles:

- *Mixed Initiative:* The system can provide detailed step-by-step instructions and demonstrations when appropriate, but also allows the user to do things by himself when he wants to.

- *Task Context:* The system knows the user's goal at every point, either because the user explicitly stated it or via automatic goal recognition.

These principles are concretely realized in the interface design as follows.

We achieve mixed initiative through a unique combination of the conversational and direct manipulation interface paradigms. The top half of each screen is like a chat window between the user and the system. System utterances appear in the bubbles anchored on the left. At each step, the user chooses what he wants to say from the choices shown in the lowermost bubble anchored on the right. After the user makes a choice, the other options disappear and all the bubbles scroll up. The appearance and operation of this part of the interface is the same for each product.

The bottom half of the screen is a direct-manipulation interface to the product's state, which is different for each product. For example, for the programmable thermostat, the bottom half of the screen shows the family's schedule for the week. The entries in this schedule determine the thermostat's temperature settings throughout the day.

Just as in a human-human collaboration, the user is free at any moment either to continue the conversation in the upper half of the screen, or to directly modify the product state in the lower half of the screen (e.g., with the mouse or touch screen).

At a deeper level, underlying the operation of the interface is an explicit *task model*, which is provided as a "plugin" for each appliance. The task model defines users' typical goals and the procedures for achieving them, as well as related explanatory material. The system tracks the user's progress with respect to this model and automatically generates both system utterances and the choices for user utterances based on on where they are in the current task. For example, the four toplevel goals in programming a thermostat are shown in the topmost screen shot. The task model representation and computation is provided by Java tool we have developed called COLLAGEN [3].

Finally, notice that the current user bubble always contains three fixed choices, indicated by icons labeled "oops," "done," and "help." The user can use these to ask for context-specific guidance and support at any time.

Home Networking

Some home appliances, such as a DVD recorder, are already normally connected to a display (TV) adequate to support our collaborative interface design. Other devices will need to use networking to share access to an adequate interactive display, which could be either a dedicated unit, or a home PC, wireless tablet, etc. The particular hardware and software out of which the home network is constructed (power line, wireless, infrared, TCP/IP, etc.) are not particularly relevant to this work.

Networking also highlights another important element of our design methodology, namely the separation of simple and complex functions. The basic, commonly used functions (such channel/volume up/down on a TV), which often predate the feature explosion, should remain available directly on the appliance. Access to the more advanced and often less used functions, such as setup, scheduling, programming, etc., can migrate to the shared base station. This methodology could lead to a reduction in the manufacturing cost of appliances.

Finally, there is the difficult issue of standards. For collaborative help to be of the greatest benefit to consumers, some sort of standard must evolve which makes it possible for products from different manufacturers to operate with the same shared base station. Perhaps this can be part of one of the (unfortunately) many currently competing home networking standards and consortia.

Conclusion

In summary, the contributions of our work are:

- the demonstration of a new paradigm for home product interfaces, which addresses the problem of complex and seldom used features

- a model for how this interface can be deployed via home networking

We are also exploring a number of variations and extensions to the interface paradigm presented here. For example, the conversational part of the interface lends itself very naturally to the use of speech technology. It would be very easy to add a text-to-speech capability for system utterances. The entire conversational interaction could be spoken by providing a speech recognition engine for user utterances. Furthemore, because the user bubble always offers a specific set of choices, the speech recognition could be quite accurate.

References

[1] S. H. Wildstrom. "Technology & You: Lessons from a Dizzying Decade in Tech." *BusinessWeek*, June 14, 2004.

[2] B. J. Grosz, C. L. Sidner. Plans for Discourse. In P. R. Cohen, J. L. Morgan, M. E. Pollack, eds, *Intentions and Communication*, pp 417–444. MIT Press, Cambridge, MA, 1990.

[3] C. Rich, C. Sidner, N. Lesh. COLLAGEN: Applying Collaborative Discourse Theory to Human-Computer Interaction. *AI Magazine*, 22(4):15–25, 2001.