

# DiamondHelp: A Collaborative Task Guidance Framework for Complex Devices

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## Abstract

DiamondHelp is a reusable Java framework for building collaborative task guidance systems for complex devices, such as digitally enabled home appliances. DiamondHelp combines a generic conversational interface, adapted from online chat programs, with an application-specific direct manipulation interface. DiamondHelp provides “a things to say” mechanism for use without spoken language understanding; it also supports extensions to take advantage of speech technology. DiamondHelp’s software architecture factors all application-specific content into two modular plug-ins, one of which includes Collagen and a task model.

DiamondHelp (Rich *et al.* 2005) is an offshoot of the Collagen project (Rich, Sidner, & Lesh 2001), focusing on networked home appliances. We believe DiamondHelp is applicable to building collaborative task-guidance systems for any complex device which can be controlled (or simulated, for training) through a software interface. We are currently investigating military and industrial applications.

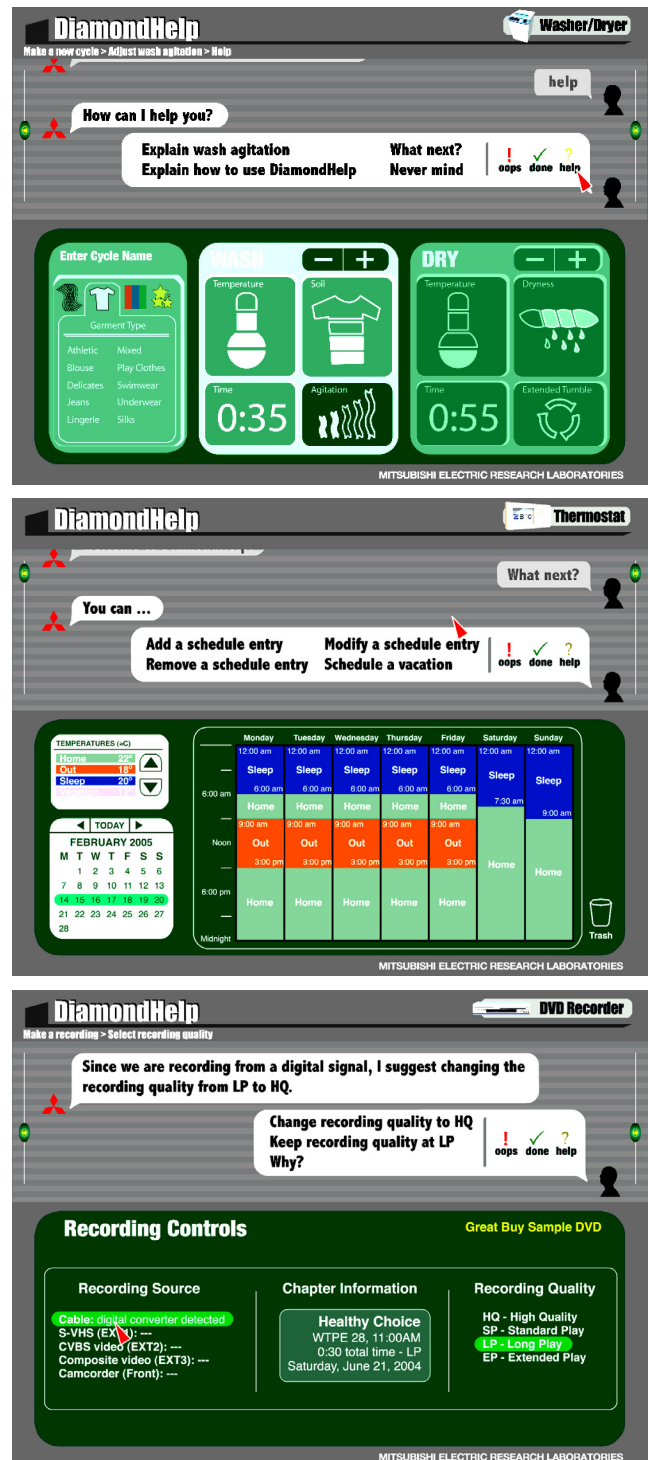
The DiamondHelp framework consists of three components:

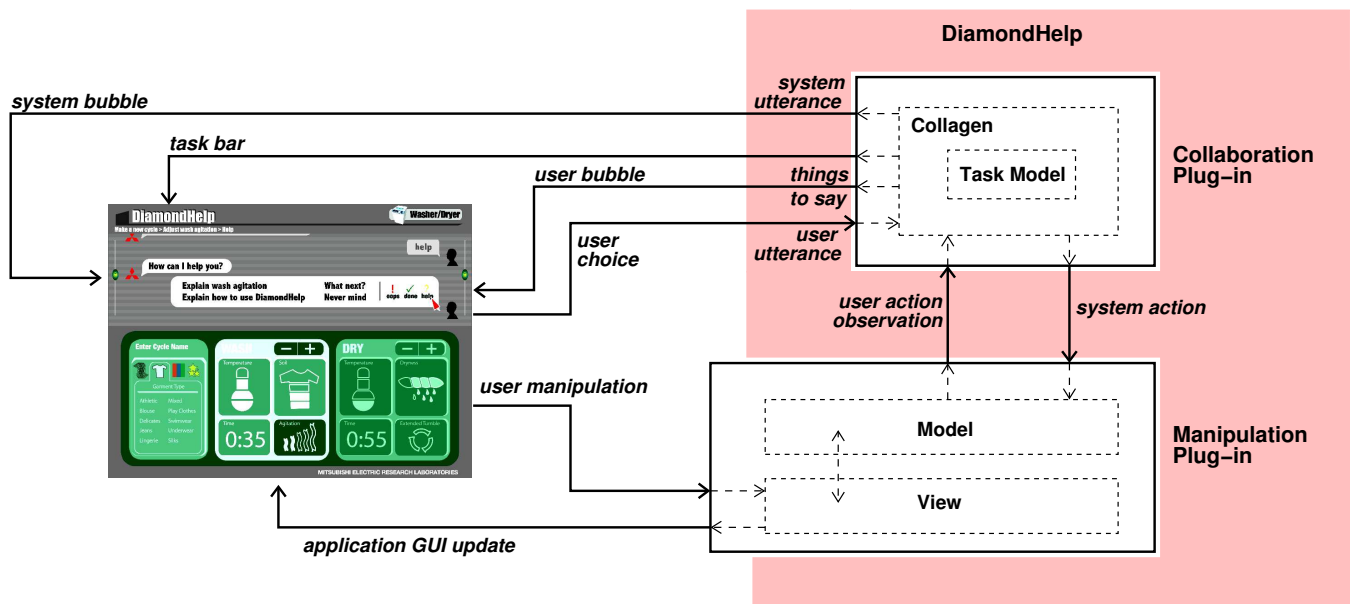
- an *interaction paradigm* based on task-oriented human collaboration,
- a graphical *user interface design* which combines conversational and direct manipulation interfaces,
- and a *software architecture* of reusable Java Beans.

The SharedPlan model of collaborative discourse (Grosz & Sidner 1986) is the foundation of the Collagen project and therefore also of DiamondHelp. In this model, communication and collaboration between two people (or in the case of DiamondHelp, a person and a computer system) is mediated by their mutual understanding of the shared task. Furthermore, the collaborative discourse model spans a very broad range of human-computer interaction, from intelligent tutoring (in which the computer is the expert) to intelligent assistance (in which the user is the expert), all of which are supported by DiamondHelp.

The screen shots at the right illustrate DiamondHelp’s user interface design applied to three different home appliances (from top to bottom): a combination washer-dryer, a programmable thermostat, and a DVD recorder. Notice that DiamondHelp provides a consistent “look and feel” across appliances, while also providing for the necessary differences between appliances.

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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 she 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 upward. The appearance and operation of this part of the interface is the same for each appliance.

The bottom half of the screen is a direct-manipulation interface to the appliance's state, which is different for each appliance. 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 appliance state in the lower half of the screen (e.g., with the mouse or touch screen).

The block diagram above shows DiamondHelp's software architecture, which we have implemented in Java Beans and Swing. All the application-specific code is contained in two "plug-ins," which are closely related to the two halves of the user interface. The rest of the code (shaded region) is generic DiamondHelp framework code.

Notice that the *manipulation plug-in* "sticks out" of the DiamondHelp framework box in the diagram. This is because it is directly responsible for managing the application-specific portion of the DiamondHelp interface. DiamondHelp simply gives this plug-in a Swing container object corresponding to the bottom half of the screen.

The responsibility of the *collaboration plug-in* is to generate the system's responses (actions and utterances) to the user's actions and utterances. Note that the collaboration plug-in is only responsible for providing the *content* of the system and user bubbles and the task bar. All of the graph-

ical aspects of the conversational window are managed by DiamondHelp framework code.

The heart of the collaboration plug-in is an instance of Collagen (the DiamondHelp architecture is, in fact, general enough to support implementations without Collagen). The heart of Collagen is the *task model*. The task model defines users' typical goals and the procedures for achieving them, as well as related explanatory material. Collagen tracks the user's progress with respect to this model and automatically generates both system utterances and the choices for user utterances based on where they are in the current task.

A key output of the collaborative plug-in is the *things to say*, which are displayed in the user bubble. Basically, the things to say are the result of filtering the output of Collagen's existing discourse (agenda) generation algorithm. The first step of filtering is remove everything except expected user utterances. Then, if there are still too many choices, a set of application-independent heuristics are applied based on the type of communicative act (proposal, question, etc.).

For more information about DiamondHelp please visit <http://www.merl.com/projects/diamondhelp>.

## References

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