Interaction with a Smart Espresso Machine

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Smart Espresso Machine

We took a standard off-the-shelf espresso machine and integrated a microcontroller, an RFID-reader, and a Bluetooth module. We can control the machine from a computer or a cellphone using these extensions. With the RFID-reader, the machine can automatically detect a cup being inserted; it is also possible to distinguish between cups. We have equipped the cups in our group with suitable RFID-tags. Coffee cups are shared, therefore users *associate* cups with them by using their personal, electronic doorkey. This action *personalizes* a cup with a user's preferences. Before cups are put into the dishwasher, they are swiped over a second RFID-reader to remove the user association. By default, cups stay personalized for a predefined time, the corresponding lease is extended every time the cup is used. More details about the project can be found at `http://www.tk.informatik.tu-darmstadt.de/PimpMySaeco`.

Demonstration

The demonstration will show how to interact with the "invisible" computer that is controlling the espresso machine. In particular, we will show the following:

- Making coffee or tea just by putting the cup under the coffee dispenser.
- Associating cups to users and the use of leases. Association is possible either with a GUI application or, more naturally, with the electronic doorkey ("One-Click Association"). After the lease expires, the cup automatically gets deassociated and is free for anybody else to use.
- Manual deassociation of cups by using an RFID-reader.
- Voice feedback. The coffee machine complains about empty water tank and full coffee grounds container. The machine also indicates if a cup is recognized that is not associated with a user.
- Value added services. Putting a cup under the coffee dispenser can trigger additional actions like displaying the favourite web page on a screen. The user can, for example, read a newsticker while waiting for the coffee to be brewed.

Contribution

The main contribution of the demonstration is to show how user acceptance of pervasive computing technologies can significantly be improved by removing the (visible) computer and allowing the users to interact in a way that is natural to the task at hand. We have also gained lot of experience on the importance of user feedback for pervasive applications, main parts of which are summarized below.

The smart coffee maker has been used for several months in our group of 25 people, serving about 400 cups of coffee a month. We constantly get feedback from the users not only about program bugs but more importantly about weaknesses in the interaction with the machine.

In addition, we have made user studies both with questionnaires and observing users. Although our work has concentrated on interaction with the espresso machine, we believe that many of the lessons can be generalized to other pervasive applications.

First, users need feedback and the feedback has to be in *an "expected" modality*. Normally, if you press button of a espresso machine and you do not get coffee then there is something wrong, for example no water left or the container for used coffee grounds is full. Such errors are normally indicated by the machine on its small display. After upgrading the machine, users got very confused by the errors, since they did not think of reading the display anymore, but expected "upgraded" feedback. Therefore, we implemented audio feedback for handling the error cases.

Second, users do not accept a GUI-based application for controlling the espresso machine, even when such an interface is needed only infrequently. This was the reason for the "one-click association" where users can associate cups to themselves and personalize them by clicking on their electronic doorkey. The keys are needed several times per day in normal activities and using the same key for the espresso machine was found to be natural.

In summary, our experience shows that user acceptance of pervasive computing applications can be significantly increased by allowing the users to interact naturally with the application.

Infrastructure Requirements

We need a wastebasket next to the table and a source for drinkable water near the demo location would be nice. For demonstrating the loading of the favorite web page we would need a LAN or WLAN with Internet access, but this is not required for demonstrating the basic interaction.

Author

Gerhard Austaller is research assistant and PhD candidate at the Telecooperation group since spring 2001. His research interests are service oriented architectures and context-aware computing. He researches the benefits of using context in particular in service description, discovery and composition. Before he moved to Germany he studied computer science at Johannes Kepler University in Linz, Austria, where he also worked for short time as assistant and in industry projects.