

Some Strategies for Resource Sensitive HCI - Keith Cheverst

1. Background

This position paper describes some of the issues that arise when considering how to maintain appropriate Human Computer Interaction when various resources can become too scarce to allow 'normal' interaction to continue. In the domain of mobile systems, potential scarce resources include: battery power, processing power, local memory, network availability, network bandwidth, available input (e.g. mobile phone keyboard), available output (e.g. screen acreage) and so on. It is also important to note that certain resources might only become 'scarce' under certain situated context. For example, if the user is stationary, using the screen on a mobile phone to read e-mail may be fine. However, if the situated context is that the user is walking, the small screen may not be an appropriate output device and the use of some other form of modality might be necessary, e.g. using audio.

Most of my experience with this area has been gained through the development and evaluation of two mobile interactive systems. The first system, known as MOST, was built to support synchronous and asynchronous multimedia collaboration between highly mobile field engineers. For this system, the wireless network used was an extremely scarce resource. The fact that the quality of network bandwidth available to a group member could fluctuate rapidly and drastically prompted the identification of a new type of *awareness*, i.e. *mobile-awareness*. In MOST, this type of awareness was used to provide field engineers with relevant information concerning the effect that the constraints imposed by their mobile environment might have on the group's collaboration. The second system, GUIDE, utilizes context in order to provide tailored information to city visitors. In this system, the scarce resources include network connectivity, the availability of positioning information and the relatively low input/output bandwidth afforded by the client end-system (a small tablet PC). In addition to providing mobile awareness, this system also utilizes the user's environmental and personal context in order to enable the system to 'intelligently' reduce the user's demands on scarce resources.

2. The Provision of Mobile Awareness

The scarcity of certain resources is not always obvious to the user, e.g. the availability of network bandwidth or the availability of positioning information. However, the scarcity of these resources can adversely affect the system, e.g. by causing certain functionality to become unavailable or the presentation of out-of-date and inaccurate information. By providing the user with appropriate awareness mechanisms, it is possible enable the user to adapt their behavior in order to cope effectively with the scarce resources. For example, in the GUIDE system, a 'bars of connectivity' metaphor is utilised in order to indicate the state of network connectivity. The user will then hopefully temper their expectations for viewing absolutely 'up-to-date' information, when connectivity is unavailable.

The provision of awareness requires careful design. For example, providing inappropriate awareness can result in information overload and place a further burden on already scarce resources. Furthermore, from an engineering perspective, supporting this kind of awareness requires an underlying platform or middleware that is capable of providing the application with low-level details such as the quality of network connection currently available (rather than masking-out such details).

3. The Use of Context to Reduce the User's Demands on Scarce Resources

One way in which context can be used in this manner involves reducing the task specification required for achieving desired goal(s); thus reducing the need for explicit input. At one level this can simply mean filling in a required blank, such as the user's current location, based on information that is sensed by the system. However, at a higher level, it can also involve attempting to pre-empt the user's current goal. One type of context utilized by GUIDE is that of the visitor's location and the location of attractions within the city. The system reduces the need for input by assuming that the information required by the visitor is strongly influenced by his or her current location. So, for example, a visitor standing outside Lancaster Castle can simply request 'Information about my current location' as opposed to searching the whole information space for 'Information on Lancaster Castle'. The difficulty is of course successfully (and consistently) pre-empting the information goals of the user and not over-determining or over-constraining the user.

Another way in which context can be used involves adapting the output produced by the system in order to (i) reduce the quantity of information to be processed by the user (ii) increase the quality of information presented (iii) make the presentation more appropriate to the current context, e.g. display text in a larger font if the user is moving. The GUIDE system attempts to both prioritize and constrain the information presented to a visitor based on personal and environmental context. So, for example, when a user requests a list of nearby attractions, the list is ordered based on proximity and user interests, while those attractions that are greater than a certain distance away are simply not shown.