What are a Location's "File" and "Edit" Menus?

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Soon we will trade stocks in the park and receive faxes on the beach. While this is all very nice, the real promise of mobile devices lies not in enabling you to drag your desk wherever you go. We go to various places – offices, bowling alleys, airports, Laundromats, restaurants, etc - to do the things that make sense there. Our research is guided by the core idea that mobile devices ought to be about making the things we do at these places easier, rather than trying to be all things to all people. Therefore we are developing mobile device interfaces that enable location-specific tasks. In particular, we are exploring how general mobile devices can be used in a situated context to provide access to the services and resources of a particular location. Broadly speaking, we view the mobile device as a "personal remote control to the world".

Most places tend to have whatever equipment they need to support the activities that occur there. Bowling alleys have ball return machines, doctor's offices have medical equipment, etc. What can a person's general mobile device add that isn't already handled by the location's task-specific equipment? Since people are going to have these increasingly powerful devices anyway, regardless of their value at any one location, it makes sense to see how we can use them to make the things we do at a given location easier. Consider that cars aren't strictly *necessary* to get money from a bank or eat a hamburger at a restaurant. However the fact that most people have cars has led, in many cases, to changes in the way we pursue tasks to take advantage of our cars, as evidenced by drive-through facilities at banks, fast food restaurants, and drug stores among many others.

We are designing applications and services for mobile devices in support of location-specific tasks by exploiting three primary capabilities. First, we see the device as a *persistent, rich channel to an individual.* That is, the device serves as a way to deliver services to the individual. Secondly, mobile devices serve as *user context detectors.* Mobile devices not only contain information about the owner such as personal information, schedule, task-specific data, but also, in the long run, sensors capable of detecting aspects of the user's environment. See Schmidt, et. al, [1999] for an example real-time architecture that derives contextual cues from sensor data. Such sensors might detect features including position, sound, video, temperature, and location contents, among others. These "bottom-up" contextual cues combined with the "top-down" constraints offered by the location's task and the user's input can be used to determine the information to be presented to users and the modality through which it should be presented. Lastly, we see the mobile device serving as a *remote control to the environment.* As mobile devices become as intimate as our wallets, their interfaces will become second nature, and, importantly, feel more familiar than most others. Consequently, we believe that these devices may begin to serve as effective "remote control" interfaces to other devices in the environment. See, Beigl's work on point and click interfaces for control devices in the environment [1999] as an example of work in this direction. While we are also interested in facilitating the use of devices in the environment, we are structuring the interface primarily around the location and its task, rather than on specific devices in the location.

Interfaces for Physical Locations

Designing mobile applications to support location-specific tasks requires an interface that reflects the natural structure of tasks typically performed in various locations. While location-specific tasks will have some functionality that does not generalize, there are, nevertheless, aspects of tasks that do apply across domains that can be used as a starting point to design and structure interfaces. This is much like the "file" and "edit" menus we find on most general computer software applications. While the particular functions a user can invoke necessarily vary from application to application, there are certain general functions that make sense in virtually all applications. Such functions include many of the key features in the File and Edit menus, such as "new", "open", "close", "save", "print", "cut", "paste", "delete", etc. We want to define the analog of these "file" and

"edit" menus for locations. That is, we seek to provide a common, intuitive interface to task functions likely to be found across many locations.

What are these common task functions? Consider what tends to happen when we go to places like offices, restaurants, ballparks, bowling alleys, airports, theaters, hotels, train stations, etc. Common steps often include the need to *find the place, park, register, say what we want, buy admission, contact the "host", find any people with whom we will be collaborating on the task at hand, check the readiness of the specific site where we will pursue our task, find that site, find and check the status of any tools we will need, identify who can help us, find a place to buy coffee, do work, and go to the bathroom while waiting for the task to begin, perform the task, cleanup, and get to the next task.*

Naturally we don't intend for mobile devices to actually implement all of these functions any more than, for example, we would expect an orchestra conductor to play all instruments. Instead we want to use the mobile device in the roles described earlier – as a *remote control* to invoke many of these environmental functions and services, as a rich *channel to the user* for delivering information about these services, and as a set of *context sensors* capable of detecting task relevant information necessary to support these services. The device will collaborate with the physical location by doing things as simple as providing a room name or phone number, to functioning as a remote control for a net appliance.

The Prototype

We are currently developing a prototype for a mobile device intended to demonstrate a common core interface for two different task scenarios: a visitor attending a meeting at an Andersen Consulting office, and a customer visiting a store intending to select and purchase a camera. Briefly, in the meeting scenario we are focusing on an out of town Andersen Consulting employee arriving in one of our offices and dealing with issues including registering, coordinating with colleagues, arranging and finding a temporary office, dealing with meeting services requests, finding and using office equipment (e.g. projectors, VCRs, printers), and arranging transportation to leave. The store scenario involves a customer interested in a digital camera arriving at the store, finding the appropriate part of the store, finding the right salesman, getting directions on how to try and use particular models on display, getting third party customer service advice on camera selections, being presented with alternative vendors, third party financing, and third party insurance options, determining compatibility with other equipment. While the two scenarios are clearly different, they share the need to find locations, use local equipment, invoke supporting services, find people, and get help with local resources.

Our prototypes are being designed for both Palm VII devices as well as for Wireless Application Protocol (WAP) enabled phones. In both of these scenarios the device will interact with a server at the location running a "task host" application that is aware of the task to be performed, the resources of the location, and the user. Our lab is equipped with active badge sensors and various tagging and tracking devices that allow us to detect the presence of people in any office or conference room and monitor the whereabouts of people and objects throughout our workplace. The task host application is being designed to exploit the information from these tools and, in part, will make use of earlier awareness systems built on this infrastructure [McCarthy & Meidel, 1999].

The Interface

The interface for our mobile application is being designed around the stages of generic location-based tasks. Within each stage we are identify and enable the core *objects*, *locations*, and *people*, we work with, and the *actions* we need to perform. At each task stage there is typically a *focus object* (e.g., the presentation we intend to give at a meeting or the person we are going to see / the camera under consideration), and a small number of *supporting objects*, (e.g. overhead projectors, printers, VCRs, executive assistants, AV specialist / other cameras under consideration, accessories, salesmen, customer service reps). These supporting objects play predictable supporting roles (i.e. they provide an alternative or an enabling service).

The actions we want to perform tend to be a function of the focus object and its type. One of our goals in this research is to identify a core set of actions we will want to include as a function of the focus object type. For example, if the focus object is a person we will frequently want to *contact them, invoke their role, send them*

something, pay them, or query them. If the focus object is a location we will want to *go there, see the current status and contents, reserve it, prepare it, release it*. For physical objects we may want to *buy, configure, send, examine, return, invoke, or release* them. For a service or event we may want to *register, reschedule, cancel, upgrade/downgrade, repeat, undo, start, stop,* and *continue*. More generally, we wish to enable easy access to context sensitive *help*, the *most recent task* pursued by the user at this location (so that, for example, a user can request the same arrangements as last time), and any *changes and exceptions* to the routine since the user's last visit to this location. For example, is someone I normally deal with no longer working here? Are there any new facilities or offerings? And what exceptions to the norm are in effect. Is the store or office closing early? Is someone absent? Is a certain dish not on the menu?

Naturally not all "menu options" are shown at once. The selection is made on the basis of the particular task stage and the services available to support a given focus object. Moreover, not all information is intended to be received by the user through the device. Instead, we are making heavy use of displays available in the environment, but controlled through the mobile device. Once again, the intent is not for the mobile device to become the predominant tool to perform all functions everywhere but rather to see how such devices, with the appropriate interfaces, can complement the facilities and services at a location and ease the way we pursue tasks.

Our work in this area follows a series of projects in which we developed prototype applications for mobile devices to support specific remote tasks. The Avalanche project explores new ways in which technologies such as PDAs, wireless communications, GPS, and onboard computers can be used to provide new services centered around the automobile in support of the tasks that drivers typically engage in. Given how central the automobile is to many of our routine activities – commuting, ferrying children about, shopping and vacationing, among others, the automobile is an ideal theme around which to anchor the delivery of a variety of services in support of these tasks. The Shopper's Eye project focused on using mobile technology in support of *physical* shopping [Fano, 1998]. The intent was not to provide a self contained shopping application, but rather to augment the physical shopping experience of a shopper in a mall. Using a PDA equipped with a global positioning system (GPS) receiver we built an application that maintains a profile of the shopper along with a current shopping list, and, based on the current location of the shopper, presents relevant offers from retailers in close physical proximity to the shopper. More recently, another CSTaR project explored how barcode scanner equipped PDAs could be used to perform live price comparisons within a bookstore [Brody & Gottsman, 1999].

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