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At Your Service: Using Butlers as a Model to Overcome the Mobile Attention Deficit

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Abstract
Advances in mobile phones and cellular network capabilities have enabled many opportunities for information access on the move. These capabilities provide instant access for the mobile user, but have exacerbated the problem of interaction in a mobile context. Mobile users are often engaged in another task that makes it difficult for them to filter and interact with their mobile device at the same time. Mobile multitasking creates an attention deficit for the user. This paper proposes using butlers as a model to overcome this problem by offloading the burden of interaction from the user to the device. We describe how a suite of butlers can opportunistically and proactively offer information to the user in the moment, allowing mobile users to stay focused on their task at hand.

Keywords
Mobile agents, attention, butlers

ACM Classification Keywords
H.5.2 [Information interfaces and presentation]: User Interfaces –*User-centered design.*

Introduction

Expectations about information access are rapidly changing due to responsive web browsers, faster network connections, and access to a wide range of services. These changes have empowered users to get the information they want just in time. Unlike desktop machines, mobile phones are able to offer similar powerful services (e.g., online maps) that are paired with mobile contextual information (e.g., location) to add additional value to the service. For example, a phone could offer nearby recommendations for serendipitous discovery of information, such as a previously unvisited but interesting restaurant in the local vicinity [3].

Although access to services and information while on the move is helpful, it may strain the mobile user's attention. Limitations in screen size, input modes, and network latencies increase the difficulty of interaction and demand more focused and extended attention to minimize interaction mistakes. Mobile users are often trying to gather information on the move, but are engaged in multiple tasks at the same time [9]. For example, a person may be driving and trying to get directions from his phone to his next destination. Sharing attention between one's device and the physical world is difficult [7] and creates an attention deficit.

Designing mobile applications to ease the mobile information gathering process requires careful thought and simplicity of design. Applications cannot be overly intrusive or demand a person's undivided attention. The information a person wants to gather must be ready at hand, or easily available without extensive interaction.

In essence, mobile interaction designers must move the burden of information gathering away from the user, to the device. One common way to create this shift is to use mobile contextual information. For example, instead of searching for "McDonald's San Francisco," location-based search eliminates the need to type in a location in the search string. This type of contextual information increases interaction efficiency and reduces the duration of distraction from the surrounding environment. Our approach goes further by proactively performing tasks and presenting information to the user based on their context, further reducing the attention required to get to desired information on a mobile device.

We introduce a system modeled around the concept of butlers, a metaphor derived from the job of their human counterparts. Butlers can anticipate needs based on their knowledge of the people they are serving. In a similar fashion, our mobile phone butlers are designed to fade into the background of attention and collect information across applications on the user's behalf. These butlers can be highly specialized and handle very specific tasks, or be more general to handle a wide variety of tasks. Previous research has shown that specialization has benefits over generalization; butlers that claim specialization will be better liked and appear to be more competent [8]. For example, a navigation butler can prepare the appropriate directions for a user so that they are ready when he departs on his trip. Instead of the user carrying the burden of sifting through information trapped in application silos, butlers can proactively anticipate needs using contextual information in the moment to deliver information just in time to a mobile

user, reducing the amount of interaction required to gather information.

In this paper, we discuss several of the technical challenges to implementing such a system, as well as the necessary design requirements needed by mobile users. The following sections ground the current work in research literature for the personal, unobtrusive butler idea along with our vision for creating a suite of butlers. We also describe our proof-of-concept implementation of a personal navigation butler on the Nokia N810 internet tablet.

Related Work

In a study of administrative assistants, Erickson et. al. found that executives appreciate background facilitation by their assistants. A perfect assistant is one that an executive can trust and also coordinates details without effort on the part of the executive [4]. Our inspiration for butlers is grounded in this type of human assistance and the computer agent community, where an autonomous program gathers and suggests information to a user. The vision work of Apple's Knowledge Navigator similarly posed the computer agent's role as being one like a personal butler [2]. Indeed, some of the original motivations for ubiquitous computing aimed at making computation invisible-in-use, not unlike the invisibility of an ideal butler, though the vision of invisibility of ubiquitous computing was explicitly contrasted against interface agents [10]. Making these computational systems reliable, useful, and yet unobtrusive is a major challenge put forth to the user interface design community.

Though the butler idea is similar to proactive displays [6] in that they both proactively offer potentially useful, contextually-generated information, the butler model is unique in its heavy focus upon supporting the individual in a personal and explicitly unobstrusive manner.

Some of the earlier work in building systems to work as butlers comes from Web browsing agents such as Ask Jeeves[1] and Ms. Dewey[2]. These search engines were portrayed as web butlers who would parse natural language questions and return web search results. The attraction of these services was that a web search engine was personified and created to offer an intuitive natural interface for web users' queries.

The information retrieval community has been exploring web agents for many years. Letizia is an example of an early web agent that suggested relevant web pages based on a user's task [5]. Suggestions are often made based on keywords, user browsing history, and other heuristics. In contrast to answering explicit search queries or finding relevant information in the cloud, our vision of a personal butler is to simplify the common tasks that a mobile user performs by using his own context and personal data to anticipate information needs. Instead of using multiple applications to find the address to an upcoming appointment, and then switching applications to get directions, a personal butler could gather that information for the user ahead of time and present it in a glanceable view.

A Suite of Unobtrusive Butlers

We hypothesize that the key requirement to help ease the burden of mobile information gathering is to reduce the interaction required by the user. Our butler agents are designed to gather information that would have taken extensive interaction to obtain. The butlers

[1] Ask Jeeves. http://www.askjeeves.com

[2] Ms. Dewey. http://www.msdewey.com/

expedite simple tasks (e.g., finding directions) that are often cumbersome on a mobile device. The gathered information is packaged together and passively displayed onscreen in order to create a glanceable view. We imagine that a user would have a suite of butlers that he could activate, each one specialized for gathering a specific type of information. The butlers would gather information in the background incorporating the user's personal data (e.g., email, calendar, web history) and contextual information.

Figure 1. Homescreen on the N810 with the navigation butler on the right-hand side of the screen. The four events listed are gathered from the user's personal calendars. Clicking on them brings up a map to the event that was automatically extracted by the butler.

The information a butler provides is always available, but can be ignored by the user if he would rather obtain the information through other means. We describe one butler implementation below and our vision for improving the mobile experience by addressing the limited attention problem.

Navigation Butler

For our first butler prototype, we chose to focus on designing and implementing a navigation butler based on the high importance of finding directions as reported in a recent mobile information need study [9]. The entire space of finding directions is quite broad. Some information desires involve "the nearest place to buy stamps" or "the closest Safeway on the way home." These are more complex types of needs that we would like to support in future versions of our navigation butler. In our current implementation, the navigation butler uses calendar data to automatically offer a list of possible destinations that a user may want to travel to.

Current solutions implemented on mobile phones such as the iPhone[3] or Android[4] have mechanisms for recognizing addresses and integrating directions from other applications with the native map application. For example, Joe could look in his email inbox to find the address for the party later tonight and click the address to immediately open his preferred map application. However, that intermediate step of opening his email to find the address can be extremely taxing on one's attention in a mobile context [7]. Our navigation butler addresses this problem by automatically fetching

[3] http://www.apple.com/iphone/

[4] http://www.google.com/mobile/android/

potentially needed directions before the user looks for them.

The system is implemented in Qt using Python with the PyQt bindings. We use Qt because of its cross-compilation capabilities that would enable us to deploy our system to a variety of mobile devices.

Gathering Addresses

Our current implementation gathers addresses from Google Calendar and Facebook Events. Each of these data sources would require the user to open a separate application (web browser or native application) in order to find the address and directions to their destination. Instead, the navigation butler monitors theses two data sources and looks for upcoming events that the user is planning to attend. If the event has a location listed, the butler uses the location to create a list of directions and map to the destination. Since most event locations are listed in human readable form, the butler geocodes these locations into a latitude-longitude coordinate to present direction information later.

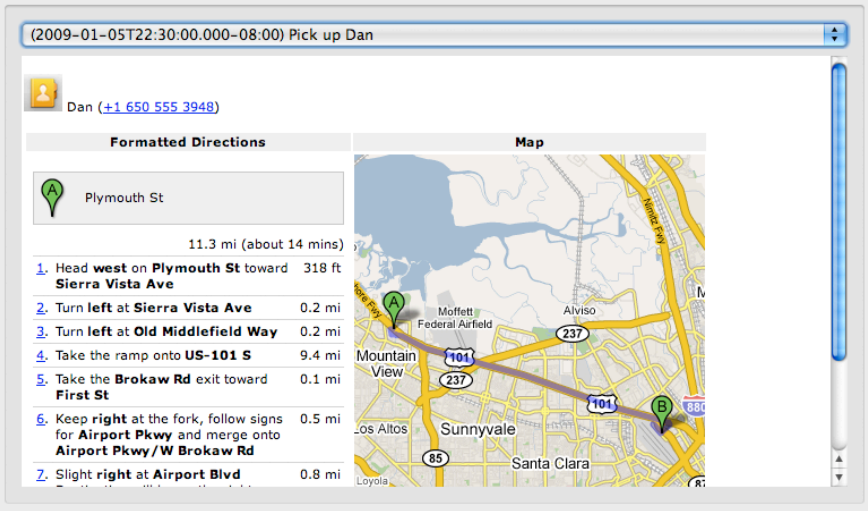

Figure 2. The navigation screen that shows turn-by-turn and map overview directions to the event. The butler also extracts a relevant phone number for the event, in this case Dan who is getting picked up at the airport.

Presenting Direction Information

The direction information is presented as a list of turn-by-turn directions and an overview map of the route. People are often navigating in areas that are vaguely familiar, so having an overview of the route with the option for turn-by-turn details offers a nice glanceable display.

Figure 1 shows the homescreen for a user on the Nokia N810 device. The right side shows the personal navigation butler with a list of upcoming events. This homescreen widget gives the user an at-a-glance look at the information the butler has collected. Tapping on any of the events will bring up a turn-by-turn list and map of directions to the event's corresponding location (Figure 2). The drop down box shows a sorted list of destinations based on the user's calendar so the user does not have to go back to the homescreen to check a different event. Each item in the drop down box shows the date, time and title of the upcoming event. When a user selects an item in the dropdown box, the bottom part of the screen renders a turn-by-turn direction list on the left with a map of directions on the right. The system automatically starts the directions from the user's current location based on the device's GPS unit. The user can click any of the turn-by-turn directions to update the map with the current direction set. The butler also collects information across different applications by showing contact information relevant to

the event (Figure 2, top left). In this scenario, the user can call Dan to let him know that he's running late without switching to the contact application.

This system is designed to be a simple high-level overview of a route that automatically extracts addresses from multiple data sources and produces directions. The features described could be integrated to a phone's native mapping application for a better user experience.

Future versions of the navigation butler will involve integrating additional data sources and refining the mobile interface. We plan to include popular event management data from Evites and parse addresses from emails that the user receives. Our mobile interface may include automatically generated routes, such as those used by LineDrive [1]

Conclusions

The attentional resources of mobile users are continually being strained by the amount of interaction required on a mobile device to obtain the information they need. Mobile users are often involved in primary tasks other than interaction with the mobile device, which makes extended and focused interaction with the mobile device difficult. We have proposed a framework for alleviating this problem modeled after real-world butlers. The key for addressing the limited attention problem is to offload the burden of information gathering and filtering from the user to the device. Our navigation butler is a simple way to achieve this shift by automatically gathering addresses from a user's event databases and generating directions based on the user's current location. As mobile technology continues to develop, the capabilities of mobile devices will improve, but the human attention constraint is one that the research community will need to address.

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