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Supporting Unplanned Activities Through Cross-Device Interaction

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ABSTRACT
People interact with numerous personal devices on a daily basis. Sharing content among these devices is often done depending on the device capabilities and context of use; following turn-by-turn directions is more appropriate when mobile. Although several solutions exist to share content among one's devices, these solutions rely on the user planning ahead for the data he may need on another device. In this paper, we describe a system that addresses the unplanned activities, by automatically extracting addresses and points of interest that users view in their web browser and making those readily available through an in-car interface.

Categories and Subject Descriptors
H.5.m [Information Interfaces and Presentation (e.g., HCI)]: Miscellaneous

General Terms
Human Factors

Keywords
Cross-device, mobile, vehicle

1. INTRODUCTION
People often interact with multiple devices depending on their current task and device capabilities. Dearman et. al. found that users interact with as many as 5 personal devices and often have activities that span across many of them [1]. Each device affords a different usage pattern based on its capabilities and context of use. Typing and browsing for points of interest is easier to do on a desktop/laptop than on a mobile device or in the car. Following those directions and turn-by-turn routing is more useful though when mobile.

Since devices have different capabilities and use, people often transfer information between devices. While reading an article on a phone, a user may send the URL to his desktop to continue reading the article. A variety of techniques are employed to transfer and access information across different devices, such as email, print outs, calendar entries, or post-it notes [1]. There are also a variety of electronic tools that help users transfer information from personal computers to mobile devices [2]. Both physical and digital methods of information sharing require users to plan ahead for the information they may need later on. However, there are many times when plans change, or a user needs to reaccess information previously seen on another device. These predicaments tend to occur when a user is mobile and in a limited attention situation. Although many cloud-based applications and recent cross-device infrastructures [6] allow users to search for the content they need, users will often defer searching for the information because of their situation [7].

These unplanned moments present an opportunity to assist users in the by automatically providing information they may need at their fingertips. Several studies on mobile web access have found that mining and sharing web history across one's device can provide rich information about content a user may want to access later [3][4]. We extend these ideas further by specifically exploring how to support cross-device activities with a vehicle through sharing web content. Our system mines a user's web history for addresses and points of interest, then makes this data available for quick access to the user while mobile. This allows the user to take advantage of the natural capabilities of each device, namely browsing points of interest on a desktop and following directions within a vehicle. The following sections describe a usage scenario, followed by a description of our system and visual interface.

2. SCENARIO
Mike has been browsing the web all morning trying to find a place for dinner tonight. After looking through 10 different business listings, he decides on going to *San Pedros* to get Mexican food with his friends. After a long day of work, Mike gets into his car and sees that directions are available to the restaurant because they were automatically transferred from his desktop machine. He touches the icon to start getting turn-by-turn directions (Figure 1a). Mike arrives at *San Pedros* only to find out that they are closed on Mondays. Luckily, the other 9 business listings he viewed on his desktop are available at the touch of a button. He touches another icon in his car that represents *Hawg's Seafood Bar* and gets turn-by-turn directions to the next destination where he enjoys dinner with his friends (Figure 1b).

3. CROSS-DEVICE INTERACTION
3.1 System Design
Our system is designed as a client-server model. The server is implemented as a Django backend that stores webpage metadata and provides filtering of that data to client devices. Client devices

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Figure 1. (a) Home screen that shows thumbnail images taken from Yelp pages that a user viewed **(b)** Clicking on a thumbnail image brings up a map with the point of interest indicated. The user can get directions to the place from the map.

can both upload and view web page content from the server. On the desktop, we currently have a Chrome browser plugin that uploads webpage metadata whenever a user visits a page. This includes the webpage URL and timestamp of visit. The webpage contents are not stored, since a user may visit pages behind logins such as banking websites. The server filters the web pages and provides the content to client devices through a webpage or native application (e.g., in-car application).

We support users' unplanned activities by automatically filtering relevant content from their web history. Currently, the system identifies point of interest pages that a user browsed through Yelp [8], a website commonly used to discover restaurants and businesses. Whenever users browse a Yelp page, the server gathers the metadata about the corresponding point of interest (i.e., address, phone number). The point of interest data is automatically provided to client devices so that a user can easily access previously seen data in unplanned circumstances.

3.2 Vehicle Interface

The in-car interface is designed to be simple and enable quick access to previously seen point of interest data. We created a native car application on a N900 mobile phone that interfaces with the vehicle through Nokia Terminal Mode [5]. Figure 1a shows the home screen that would display inside the head unit when the user opens the application. The images are aligned in a grid view and represent the business listing images from their respective Yelp pages. We chose to use these thumbnails to provide the user with familiarity and easy identification of each business. The thumbnails default to being ordered chronologically, but can also be ordered by time or location. The metadata for this information can be found through the businesses Yelp page.

When the user clicks one of the thumbnail images, a map is shown centered on the business name (Figure 1b). The user can then choose to view the address information, get directions, or make a phone call to the business. This quick easy access method allows the user to view previously browsed data without having to re-find the information.

4. CONCLUSION AND FUTURE WORK

We have described a system to assist users in unplanned activities that may occur while mobile in the car. We rely on previous activities that the user performed on other devices to provide easy access to point of interest and address information on other devices. Although users have the capabilities to search for new points of interest in the car, the time it takes to perform these searches may be a barrier to the user. Car interfaces could greatly benefit from using information from previously seen activity streams. In the future we would like to explore the appropriate interface to display cross-device information and conduct a user evaluation of the types of information that would be beneficial for the user in a vehicle. Our system currently shares information in one direction from the PC to car, but we would also like to explore sharing information from car to desktop.

5. REFERENCES

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