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Cover Letter

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Mobile Media and Digital Wayfinding: Strategies for Implementation

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Introduction

Given our inherent mobility, wayfinding can be described as one of the earliest human activities. In a simple environment, the human mind is capable of generating a cognitive map or “the internal spatial representation of environmental information that people have in their mind” (Golledge, 1999). Within a complex environment, an internal cognitive map alone may not allow the user to have a successful wayfinding experience and may lead to the formulation of representational inaccuracies (Raubal and Egenhofer, 1998).

Traditional wayfinding solutions rely heavily on the physical features of already built environments to provide navigational cues and a signage system to help users find their way. Given the increasing demand for flexibility in a diverse society, traditional fixed wayfinding approaches no longer satisfy today’s users. The need for developing a customized wayfinding system has become urgent.

Mobile media and interactive design offer an opportunity to improve the wayfinding experience in such a way that traditional, fixed wayfinding systems cannot. In this paper, the authors examine how mobile media can be introduced into a wayfinding system to create a ubiquitous wayfinding experience and the guidelines for creating a customized, interactive digital wayfinding system. Ubiquitous wayfinding systems free people from spatial and temporal constraints; for instance, they do not have to visit a certain location to find wayfinding information. Customized wayfinding systems provide services that are based on diverse user needs. With a dynamic nature, the adaptability and flexibility of digital wayfinding can satisfy these demands simultaneously. Therefore, digital wayfinding can be seen to play a key role for future wayfinding.

Background

Wayfinding Wayfinding as a field of study did not develop until the early 20th century. The term “way-finding” was coined in 1960 by city planner Kevin Lynch in his influential book *The Image of the City* and later became “wayfinding” in the mid-1970s. Lynch’s major contribution to architectural design and urban planning is that he recognized the importance of an environmental image for wayfinding tasks. To define elements of a city, Lynch identified the following terms: paths, edges, districts, nodes, and landmarks. These terms continue to be widely used today in all aspects of environmental design and research.

Another important book, *Wayfinding: People, Signs, and Architecture* (Arthur and Passini, 1992) was published in order to make an “impact on the design profession” the importance of wayfinding concepts. In this book, the authors continued to describe wayfinding as spatial problem solving and further specified it as “a term introduced to describe the process of reaching a destination, whether in a familiar or unfamiliar environment” (Arthur and Passini, 1992).

Architects, urban planners, landscape architects, environmental graphic designers as well as behavioral and cognitive psychologists have been involved in the multidisciplinary study of wayfinding. Good designers have been able to solve wayfinding problems comprehensively always beginning with a thorough analysis of the environment: entrances and exits, circulation paths, districts, nodes (decision points), vertical circulation (stairs, elevators), and landmarks. In some cases, these architectural attributes are emphasized for wayfinding purposes. Signage systems are then implemented which provide users with site orientation, directional routing, building identification, and regulatory instructions.

Since Lynch first introduced the term *way-finding* nearly a half-century ago, this concept has now become a commonly applied design strategy in developing static signage systems. Despite this milestone, limitations remain even in the most successful solutions.

Limitations of static wayfinding solutions The proliferation of the internet has enabled users to receive information on demand and on nearly any subject imaginable. Due to the proliferation and growing popularity of online mapping sites such as *Mapquest* (<http://www.mapquest.com/>) and *Google Maps* (<http://maps.google.com/>) or the 3D interface *Google Earth* (<http://earth.google.com/>), people can get detailed visual and textual information on how to drive from location A to location B before their actual visit.

In the physical environment however, it may be more difficult to find maps within a site or to access such displays within a particular building complex. With fixed signage systems, users must stay on routes that have been designed by wayfinding designers. Without consideration for how certain people move through space in search of a particular room or service, traditional signage elements offer little aid to a specific user navigating a complex structure. Is it possible that users can have access to information at anytime based on their own, personal search criteria?

Within existing static wayfinding systems, there is no way for users to access information in a

personalized manner. One of the most recognized problems relative to this need is language difference. In international public spaces such as airports or sporting venues, a multi-language signage system is an immense challenge for wayfinding designers. International symbols have been developed and put to use for years to eliminate use of multiple languages on signs, but symbols alone cannot communicate adequately all the time. Symbols, no matter how effective as a visual code, have their own limitations. Horn (1999) indicates that fewer than half of the respondents could clearly understand what 86 of 108 international symbols meant in a study. Only three symbols were understood by more than two-thirds of the sample (Jacobson, 1999). And, when multi-language information is provided, the amount of information inevitably crowds the display and slows down the process of information searching even with well-organized information design.

Visual directives from signs are of little use to people with visual impairment who rely on other types of sensory input such as aural or tactile devices. Braille messages, for example, are available only on the nameplate of some destinations, and minimally by law only on permanent room designation signs. As the pattern owner of *Raynes Rail*, a Braille and Audio Handrail System questioned: “How could we honestly label doors with Braille without providing a directional link from the entrance of the building to the designated door?” (McKee, 2003). With the special needs of a diverse group of users, is it possible that wayfinding information can be more easily adapted personal needs?

An additional limitation with static wayfinding is the inconvenience, time consumption, and extra costs involved in updating a fixed signage system. Before maintenance was recognized as a crucial part of wayfinding design, outdated information was a big problem: “Wayfinding systems must respond with speed and sensitivity to changes, or else they become more than outdated: they become liabilities” (ID, 1989). With better management and foresight, information can be updated whenever there are necessary changes in building information or as a response to changes in the organizational structure of the facility. The cost of physically changing a sign is found in both manpower and material; re-design of parts of a signage system may lead to inconsistency in overall, uniform signage if the original material can no longer be specified or the manufacturing contractor changes.

Digital Media & Wayfinding Digital media and interactive design now offer opportunities to improve the wayfinding experience in a way that traditional, static wayfinding systems cannot. For example, airports and other multi-modal locations often use electronic signage to create a dynamic relationship between a constantly changing schedule of events and a very diverse group of information seekers. Information on electronic signage can be quickly and easily updated to reflect changes and offer immediate directives to those relying on this important information.

In a sense, a digital wayfinding system is no longer a static part of the environment. It is flexible and dynamic in nature, at times responding to both the user and the changing environment. Because active technology for wayfinding systems depends on human input, the environment may be able to communicate on a more personal level with the user through alternative auditory and visual cues.

Ubiquitous computing has long been an issue of discussion amongst theorists and futurists. However, the world of intelligent objects and reactive spaces is becoming a reality as the fields of computer science, architecture, visual communication, and industrial design collaborate to better serve specific human needs.

GPS-Enabled Tours The Global Positioning System (GPS) was designed and is controlled by the United States Department of Defense. Although its primary application is for military research and documentation, the system is now used by countless civilians as well. Low cost GPS receivers are often used together with a PDA, laptop, and vehicular devices for navigation purposes.

For example, since 2004 prospective students at Arizona State University are provided a set of headphones and a handheld computer for a GPS-enabled, self-guided tour (Carlson, 2004). The handheld computer will ask the student about his or her interests on campus and adjust the content of the tour accordingly. At the same time, a paper map is also provided for users. When a user arrives at a hot spot on campus, the location is supported by an audio narrative, music, and a sample of sounds from campus life. While the handheld computers are providing a service for the campus tour, there are concerns for privacy of the location of its users. Additionally, the GPS system is only able to provide locational information for those navigating exterior zones of the campus, and does not track interiors.

Information Kiosk The i-Site Information System installed on Johns Hopkins University's Homewood Campus creates an interactive digital wayfinding and communication system. Sixteen i-Site kiosks were installed on the 128-acre campus to help visitors, students, and parents find their way around the campus. The kiosk includes a static map, LCD monitor with five buttons, a hidden microphone, and speaker for audio content. Usability tests of the prototype were conducted by environmental psychologist Dr. Peter Hecht to determine what information should be included and where the kiosks should be located (Greer, 2003). In addition to the two-dimensional map, users can touch the screen for information or push the *Help Desk* button to activate a hands-free telephone which dials out to live assistance via campus security. Even if power is disrupted, users can always refer to the two-dimensional map to find their way. As one of the jurors who awarded the SEG Design Award to the project stated: "The kiosk demonstrates the power of interactive digital communications media to tailor wayfinding to the individual needs of a diverse range of users" (Greer, 2003).

OAD Systems Developed by the Guide Dogs for the Blind Association in the UK, Orientation Assistant Device (OAD) systems provide aid to users training with guide dogs the ability to link with information provided about a space through a portable hand held unit. The system relies on radio beacons placed at strategic positions along a route which communicate information about the environment to the mobile device, usually in the form of simple directives and instructions. When the user encounters a beacon, it sends a signal to the device that then indicates its presence with an audible cue that directs the user through the space. This system has received wide accolades because it allows the trainer to focus on working with the dog and not the complexities of navigating their environment (Hind, *et al.*, 2000). The OAD systems trainers can record successful wayfinding

throughout a building, thus enabling a later user the ability to choose from a series of specific journeys based on their needs and preferences.

PhoneGuide *PhoneGuide* is a museum guidance approach that uses camera-equipped mobile phones and on-device object recognition. The research project conducted by Föckler, Zeidler, Brombach, Bruns, and Bimber (2005) offers guidance to visitors within a museum by allowing them to take a picture of any exhibition in the museum with their cell phone. When the image is recognized by the device, presentation and information about the exhibition are displayed on the phone (Figure 1). Laboratory experiments and field surveys show that photographed museum exhibits can be recognized with a probability of over 90% (Föckler *et al.*, 2005).

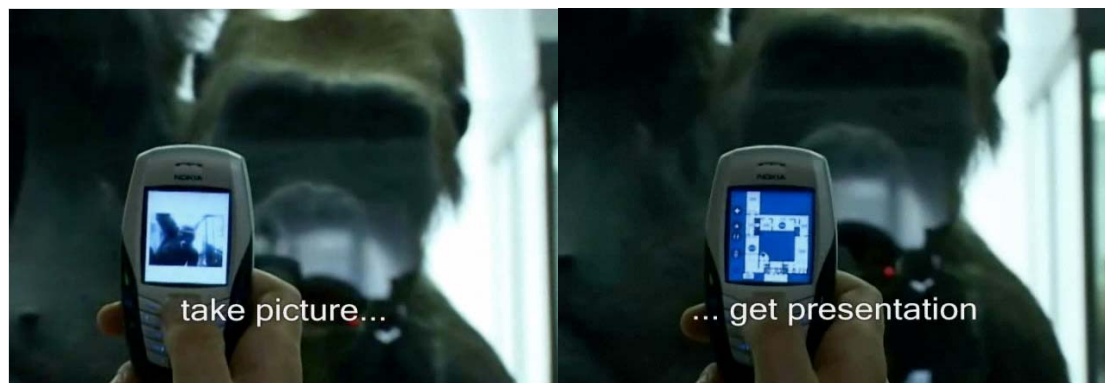


Figure 1: Screen shots from simulation video of the application of PhoneGuide.

Miniature, context-aware devices such as the *PhoneGuide* and a similar device developed by Swedish researchers at the Viktoria Institute's Future Applications Lab are being imbedded into furniture, textiles, and other objects. These devices are programmed to rely on communication from the users through a common user interface such as a cell phone or PDA. The format for this graphical user interface is of notable interest, as the potential for the development of context-aware mobile media are able to communicate information about the built environment. It has the potential to revolutionize the way in which we navigate in the built environment and indicates a new approach for wayfinding designers.

Strategies for Digital Wayfinding

Online mapping sites such as *MapQuest* and *Google Maps* have found an increasing audience through the expanding availability of internet service, and have already been widely used for wayfinding purposes. Interactive kiosks and electronic presentations are becoming more widely used in wayfinding systems. However, because they are fixtures within the environment, they cannot facilitate a ubiquitous wayfinding experience. By introducing mobile media, such as cell phones and PDAs into the wayfinding system, people can find their way with much greater ease.

In this section, the authors explore the components and principles of digital wayfinding and identify strategies for implementation. For wayfinding within a building, existing signage is an immediate and available means to test the *PhoneGuide* technology developed by Föckler, *et al.*

Powered by the *PhoneGuide* technology, users can take a picture of a sign and receive related multimedia presentations such as texts, maps, images, videos, and audio on their own phone. Alternatives for the input include the ability for a user to input (via voice or keypad) information from the identification signs to receive multimedia content.

Components of Wayfinding Information

A comprehensive wayfinding system provides not only information that people need when they are in the environment, but also information that they need before and after the visit.

- **Pre-visit information** Pre-visit information is useful for people have a general understanding of the environment before they visit the site. There are two different needs for pre-visit information: general information and information for planning the trip.

General information:

General information is especially useful when the user is not familiar with the site. Overview of the site, general introduction, and background information will be appropriate for this purpose. User surveys can be conducted to determine what information is relevant to the users of the site. A well-designed overall information design can help to create a cognitive map for wayfinding purpose and establish a sense of familiarity by visual and/or audio representations: texts, graphics, maps, photos, audios, videos, 3d models, etc. The emphasis is not to provide specific wayfinding information, but to establish identity of the site.

Planning the trip:

When people decide to go to the site, specific information such as parking lots, bus stations, entrances, accessible entrances (and elevators) will be needed for planning the trip. It is important not to overwhelm people with too much detailed information at this stage since it may be difficult for users to remember. *Map Quest*, *Google Maps/Google Earth* are tools for searching for driving directions. What they cannot offer is more specific information, for example, where the parking lot is located or which entrances are accessible. A well-designed web site will provide essential information based on user needs and allow them to customize the information.

- **On-site information** On-site information should be very specific to help people find their way around. It can incorporate visual information, as well as sound and tactile surfaces for diverse user needs.

Approaching the site:

For a public institute, on-site wayfinding starts by guiding users from the street to its entrances, or street to parking lot and parking lot to entrance. Effective wayfinding for this stage provides directional signs to guide users from the street to the entrance or the appropriate parking lot, and a clear identification sign to confirm the arrival. A meaningful identification sig will also contribute to establishing the identity of the site.

Reaching the destination:

Another critical component in the analysis of on-site information is the process from the entrance to the destination(s). With the mobile phone or PDA in hand, users can type in or speak out information on the identification sign, or simply take a picture of the sign using the digital camera on the phone. Information of users current location will then display on the phone. With further input from a destination, a customized direction will then be created for the user. Compared to traditional static wayfinding solutions, digital wayfinding with customized directives help users to find their way with greater ease. They don't have to search for the desired directions among other irrelevant information and may select a guided tour if they desire.

Finding one's way out:

Wayfinding is not complete when users reach their destination. It is also important to help them find their way out, which is especially true in emergency conditions such as a fire evacuation. With inputs such as where they are and where they want to go provided by users, a customized directive will then be presented on the phone to guide users out. Unlike other wayfinding information, information for finding one's way out should not rely mainly on digital media. A highly effective and efficient wayfinding system should be provided within the physical space of the facility. Failure to find an exit during an emergency condition can endanger the health and safety of all users.

Guidelines for Digital Wayfinding

Wayfinding design is not just about signage placement and indicating directions. More importantly it is about creating a pleasant and memorable experience for users. Guidelines and strategies are available to aid designers of physical wayfinding systems, but little has been written relative to guidelines for digital wayfinding. The focus of study for future wayfinding will shift from solving problems of navigation in a physical world to solving problems of navigation in a virtual world. Because new problems emerge when considering mobile devices and interactive media, without proper design considerations, users will not only have to find their way in the physical environment but at the same time find themselves struggling with the digital media. Therefore, it is important to develop guidelines to ensure that new technologies are used to facilitate wayfinding, rather than creating a new barrier.

Guidelines for digital wayfinding are divided into two sections: usability and user satisfaction.

Usability

- **Consistency** Effective presentation of information relies on clear and organized information delivery. It must instantly reveal the information's hierarchy and its' descending order of priorities. When digital media is introduced into the wayfinding system, it is important to maintain consistency in information presentation: naming system, typeface, size, color, graphics, as well as auditory information and animations. Information presented on the digital media should be consistent with those in the physical environment. Consistency in information presentation (visual, audio or kinetic)

helps develop an easily recognized pattern for users to follow so that they always know where to search for information they need.

- **Simplicity** By simplifying the interface, designers can provide information based on user needs and not become overload with too much “raw data”. For example, a building plan that illustrates the entire complex is unnecessary to the relative experience of the individual user. Because their needs would be addressed individually within a digital wayfinding system, extraneous / accessory information is presented to the user on a ‘need to know’ basis.
- **Legibility and Readability** The Americans with Disabilities Act (ADA) introduced comprehensive guidelines for legibility and readability issues for physical wayfinding, yet not much has been developed for digital wayfinding. Legibility and readability issues are especially critical when people are relying on mobile media for wayfinding. With a limited screen size, careful selection of typeface, letterform size, color, and contrast are crucial.
- **Alternatives** While digital wayfinding incorporates new technologies for wayfinding purposes, traditional wayfinding means such as landmarks, maps, and signs should be an integrated part of the system to help people find their way when the technology is not available, which is especially true when users are finding their way out in emergency.
- **Landmarks** The landmark as a readily-identifiable feature of a site is important for wayfinding. It is much easier for users to remember a landmark in the environment and find their way based on its location. When digital media is applied, physical landmarks should be integrated into the system to help people navigate.

User Satisfaction

- **Feedback** The major difference between a static wayfinding system and a digital wayfinding system is that a digital wayfinding system allows for dynamic interaction between users and the information. Feedback may be indicated as changes in color, size, movement, sound, etc. in the interface. A tangible and immediate feedback to users’ action is crucial for user satisfaction.
- **Customization** While traditional wayfinding approach doesn’t allow people to customize the content and presentation of the information, digital wayfinding enables people to find information that is based on personal needs and presents it in a way that is best suited for the users. A customized information presentation can help people to focus on their task and not distract them with irrelevant information. Guiding users through a building involves understanding who will be using the facility and designing for variations in age, education, language, physical mobility, etc. Providing alternatives for information retrieval will make the process easier and instill within a user a sense of control over their environment. For example, a user can choose to see information in

different sizes and color, still image presentation versus animations or videos, and aural versus visual information. Customization empowers people and therefore, leads to greater user satisfaction.

- **Other senses** Combination of visual information (static or kinetic), sound, and texture for the wayfinding system allows people to access information from various senses. Traditional wayfinding approaches emphasis on static visual information display. When textures are used, they are mainly for Braille messages, which are available only on the nameplate of some destinations, and minimally by law only on permanent room designation signs. For a digital wayfinding system, it is much easier to incorporate sound, movement (vibration of a cell phone, for instance), and texture to help people find their way with more options.
- **Interpersonal communication** As social beings, we tend to rely on interpersonal communication. When people get lost, they tend to ask for help. A digital wayfinding strategy can provide a needed human counterpart to the frustrating experience of being lost in a foreign environment. A trained staff can stay on line to answer wayfinding questions or talk to users directly on the phone.
- **Privacy** People want to know where they are and where they are going, but they don't necessarily want to let others know where they are. It is important to consider privacy within the design of the digital wayfinding system.

Summary and Conclusions

The digital wayfinding system is no longer a static part of the environment. It is becoming an integral partner with static systems. It is flexible and dynamic in nature, at times responding to both the user and the built environment. Compared to traditional static wayfinding, digital wayfinding offers environmental information that is ubiquitous, customized and flexible. With mobile media connected to a wireless network, people can find their way around without spatial and temporal constraints. A properly designed interface enables people to get information based on their diverse personal needs and instills a sense of comfort with the task of navigating a complex environment.

As building functions and designations change, wayfinding systems must be updated. Digital systems can be easily adapted to the needs of users through interface programming at a fraction of the cost of updating physical systems. Additionally, digital systems are easily updated for users with special needs, as technology can more easily accommodate the needs of special user groups.

A hand-held mobile device provides the opportunity for wayfinding designers to examine the spatial components of a building to create a customizable interface that can provide users with choices as to how they want to move through the building. Incorporating mobile media and digital technology within a building's wayfinding strategy allows for ubiquitous, customized wayfinding experiences

and therefore, create a better wayfinding experience for users.

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