Agarwal, N.K. & Lawrence, H. (2014). Office location map of individuals in the library and other college campus buildings. The Journal of Web Librarianship, 8(3), 305-323.

Office Location Map of Individuals in the Library and other College Campus Buildings: A Proof-of-Concept Wayfinding System

Abstract.

A Web site is often the first stop for a person trying to determine how to get to a person based in a library or a college campus building. The Web site, and the in-built online directory, may provide the building name and office number for a library staff or a faculty member, but these can be out-of-date and don't provide the complete information the person needs to find the office location. This paper demonstrates an online wayfinding system that could show patrons, faculty, staff and students not only the location of a library or another campus building, but also an individual office location on a building floor plan. A proof-of-concept was developed using HTML and CSS. The simplicity of the concept and implementation ensures that most libraries and college campuses can implement this wayfinding system using basic Web design skills, while greatly helping first time visitors to specific offices. The system addresses the issue of frequent office moves and staff changes, and provides a richer cognitive map as compared to online directories and campus maps, which feature limited data and interactivity. This paper concludes with a discussion of the benefits of interactive Web-based wayfinding tools including being more welcoming and scalable in large buildings and organizations.

Keywords: Web directory, wayfinding, environmental graphic design, information system, indoor map, proof-of-concept, academic library, college campus

INTRODUCTION

A library or a college Web site is often the first place a visitor seeking building information, office location and other way-finding tasks visits. Web directories for library staff in a library building, or faculty and staff in a university or college often provide information such as a picture, a brief biography, an e-mail address, a Web site address and office location. The office location is often just an acronym indicating the building, the floor and the room number. For example, the Beatley Library at Simmons College, Boston has library staff in rooms such as L121A, L233B, L110, L228. Here, L stands for the Library building and the first letter indicates the floor number. Beyond this, a visitor is unable to determine where a person sits, especially in a large building with many staff members seated on the same floor. Students and visitors trying to locate the office of a particular staff member for the first time – whether in the library or another campus building – often have difficulty translating this office number to a mental visual map of where the individual's office might be located. Also, with changes in campus structures and office moves and new hires, locating a specific office can be more than a one-time difficulty. Problems are compounded in difficult to navigate buildings, during building renovations and over time as the original structure of the building is lost.

Lauren Mandel (2013) writes that a user entering a library facility is confronted by at least two information problems: "the information problem he [or she] hopes to address using library resources and the spatial information problem of trying to locate those resources that will help him solve his information problem." (p.264). Along with locating library resources, users also grapple with the initial step of trying to locate specific library staff or people they're looking for, whether in a library building or in any other campus building. Mandel writes that while libraries focus on helping users address their information problems, they don't pay much attention to the spatial information that users need. Thus, "users who may already experience library anxiety may have another level of frustration as they attempt to wayfind through the...library [or another building on a college campus] to solve their information needs." (p.264).

Environmental Graphic Design (EGD) is a relatively new design discipline that sits at the intersection of graphic design and architecture. Wayfinding was defined by Romedi Passini (1981) as a person's "ability to reach spatial destinations in novel as well as in familiar settings" (p.17). Mandel (2013) defines wayfinding as a spatial information process that allows people to orient and navigate in the built environment. While wayfinding focuses on user behavior, EGD focuses on the system design. EGD is concerned with the development of a systematic, visually cohesive graphic communication system for a given site within the built environment, and is increasingly recognized as a contributor to well-being, safety and security in unfamiliar and high-stress environments (Calori 2007). While an academic library or a college campus aims to be a safe space for learners and information seekers, the unfamiliarity of a location can be stressful for a first time visitor. "When people navigate the built environment and struggle to orient themselves, find the appropriate path, or become lost, they suffer frustration, stress, and aggravation, and can blame themselves, and feel stupid, anxious, and angry" (Arthur & Passini-1992, as cited by Mandel- 2013 p.265). Similarly, Maurine Moore and William Piland (1994) found that the design and navigation of the physical environment of a college campus impacts older learners in significant ways. While studies on library Web sites focus on usability (see e.g. Ellington 2008; Jones, Pritting, and Morgan 2014), they rarely focus on improving the usability of physical spaces.

This project arose from the notion that college students can experience difficulty when seeking an office location, whether it is of a library staff member, professor, dean, or a college staff member. It focuses on the how physical spaces – whether in the library or any other campus building – can be made more usable and easily navigable – by incorporating a simple wayfinding or EGD system in a library or campus Web site. Thus, the system provides a digital aid for physical navigation of a floor in a building, and enables using spatial navigation on indoor maps. The progress made in developing such a proof-of-concept wayfinding or EGD system is reported here. This paper proceeds by exploring a theoretical framework for EGD, outlines a proof-of-concept design project that addresses the problem of room wayfinding in libraries, and examines the outcomes and possible next steps of this project.

LITERATURE REVIEW

Studies in academic libraries have ranged from looking at the patron, the user, the user needs and user experience, to looking at the library as a space and a place (see Matthews 2007; Beck & Manuel 2007; Hernon, Dugan and Matthews 2013).

There have been very few studies on the user behavior of wayfinding and navigating within a library or college campus space, as well as on the design of spaces and systems to aid in this process. We will review the studies in this area, starting with a conceptual framework on wayfinding.

Theoretical framework

Passini's framework conceptualizes wayfinding in terms of spatial problem solving and identifies three distinct but not necessarily chronological phases: 1) the processing of environmental information from present and past experiences, 2) the making of decisions and the development of plans on the basis of this information with respect to a specific task and 3) the execution of plans and the transformation of decisions into behavioral actions (1981). Passini observed two distinct styles of wayfinding - linear and spatial. The linear wayfinding style relies on the signage system – a linearly organized wayfinding support system i.e., "one that progresses from one location to another." For example, in an airport terminal, a passenger often does not understand the layout of the entire airport, but relies on signage to reach one's designated gate or baggage area. The spatial wayfinding style, on the other hand, "relies on the wayfinder's spatial [or overall] understanding of the setting, which is influenced by his [or her] familiarity with the setting, architectural legibility of the setting and wayfinding cues and tools that are available in the setting, such as maps and floor plans." (Passini 1981, as cited by Mandel 2013, p.266). The solution proposed in this study provides support to the spatial wayfinding style of the first-time visitor to a library or a college campus building.

Thus, there are three primary streams of studies relating to this framework – 1) user behavior for navigation – wayfinding; 2) the usability or architectural legibility of library as a space (which includes studies on signage and linear wayfinding aids), and 3) the design and usability of library Web sites and systems. Studies on spatial wayfinding support systems or environmental graphic design in the context on library or college campus Web site and system design have been largely non-existent.

User behavior for navigation – wayfinding

Studies on wayfinding have focused on the behaviors people use in finding locations in the environment (Conners 1983). Wayfinding studies have looked at the challenges faced by specific populations such as older adult learners (Moore and Piland 1994), freshmen (Abu-Ghazzeh 1996) or public library users (Mandel 2013).

Moore and Piland (1994) examined how the physical environment of the college campus impacts older adult learners and how college administrators can improve upon the ways in which they plan classroom locations. They found that younger learners adapt more easily to environmental variables than older adult learners. To mitigate the effects of these variables the administration must make efforts to consider the needs and preferences of older adult learners (Moore and Piland 1994).

Tawfiq Abu-Ghazzeh (1996) stressed the “legibility of a setting” as a significant factor that should be considered when designing buildings. When a building has low legibility, users have difficulty wayfinding, which leads to increased frustration and anger. Abu-Ghazzeh’s study examined how freshman students at King Saud University went through the process of wayfinding to determine the legibility of the buildings on campus. He found that to increase architectural legibility, information about the environment must be supplied to those who are navigating it. Improving the visibility of a space (visual access) and using simpler architectural layouts also helps facilitate wayfinding.

Guided by Passini (1981)’s conceptual framework of wayfinding, Mandel (2013) carried out a multi-method case study to investigate the wayfinding behavior of library users within the entry area of a public library facility. Her methods included a document review of the library’s wayfinding information system, unobtrusive observation and interviews of users. Her findings delved into the cognitive processes employed by library users in wayfinding. She found the wayfinding behavior of users to be generally inconsistent over time.

In addition, researchers have explored differences in wayfinding based on gender (Devlin and Bernstein 1995; Lawton 2010), as well as the effectiveness of wayfinding directions in a complex indoor environment (Padgitt and Hund 2012).

Usability or architectural legibility of library as a space

In order to be more user friendly, library designers often adopt a number of approaches including looking for ways to better organize furniture or spaces, and, when budget allows, focusing on architecture and design in the building or renovation of libraries (Lushington 2002). When it comes to helping users in navigating across the library as a space, the primary focus has been on designing more effective signage. Ellen Bosman and Carol Rusinek (1997) show that installing effective signs and/or incorporating a floor plan can increase users' satisfaction. However, Passini (1981) writes that while signage provide means of linear wayfinding (getting them from point A to point B, and then to point C), signs do not address the spatial needs of users – the need to have an overall sense of the space and facilities.

Spatial wayfinding support / environmental graphic design systems. There has been limited work in the area of spatial wayfinding support and environmental graphic design systems that could be incorporated into library or college Web sites. The work so far in this area has focused on navigation support for automated robots or in developing indoor maps.

Indoor maps. Not enough research has yet been done on the development of floor plan applications for human consumption and use – one that would apply to the spatial wayfinding style, as per Passini (1981). Google has recently made available its mapping technology for use in public indoor buildings. By uploading a floor plan of the building, Google's mapping application programming interface (API) uses the content to map and plot optimal navigation paths ("Google Maps Floor Plans Content Guidelines - Maps for Mobile Help" 2014). Private institutions and those who wish to maintain control over their content would want to explore other options as Google's system does not allow for the customization of floor plans and the user cedes control over the floor plan to Google upon uploading. Coupled with their already wellestablished outdoor navigation application, Google provides promising options for a complete route guidance system.

The ability to seamlessly navigate from outdoors to indoors is a major focus for researchers studying indoor mapping. Before smartphones rose to prominence, Pierre-Yves Gilliéron and Bertrand Merminod (2003) explored the concept of a personal navigation system that would provide route guidance as the user transitioned from a road map to the indoor environment. Madoka Nakajima (2011) proposed an indoor map database for all registered public buildings in Japan that would allow for the development of a path planning system connecting indoor maps with their more developed outdoor counterparts.

Thus, while libraries and college campuses (as well as past research in these settings) focus on making their facilities and signage user friendly, the navigation support to the user is often linear – from point A to point B. College and library Web sites don't do a very good job of helping a first-time visitor with spatial orientation or with determining the physical locations of the individuals they are seeking to visit.

Wayfinding in other contexts within the library

A simple and dynamic wayfinding system has a multitude of uses and does not need to be restricted to office or room locations. By providing a cognitive map to the searcher beforehand, the library or the college deploying such a map gives the searcher the capacity to perform an informed search, in which the searcher already has an idea of the location of the item and a general concept of the environment (Wiener 2009). Even though this study is about wayfinding as it applies to individual offices, libraries can apply this idea in other contexts such as for locating books within the library based on call numbers. The Boston College Library has recently implemented such a solution to visually identify online the location of a book within the stacks of the library. E.g. if we browse to http://www.bc.edu/libraries/ and search for the topic 'wayfinding' (or any other keyword), a series of search results are listed, which include the links to possible titles relating to the search term. A specific title record has a call number and the phrase 'find it in Library.' Clicking this link leads to a drop-down menu with further details about the book title and a 'locate' link. Clicking on that link leads to a Web page with an automatically generated image showing a map with the stacks in the library and the exact location where the particular book title can be found. See Figure 1 below.

[Place Figure 1 here]

The Library Systems Integration Analyst at Boston College Library Systems, and the developer of the "Locate!" button in the Boston College Library catalog described his rationale, thought process and approach to building the system in the following manner: *"I developed this system at Boston College in 2009. While I'd had significant programming experience in a number of languages (most recently Visual Basic), this was the first large-scale Java system that I'd tackled. It also required quite a bit of JavaScript, as well as learning about SMS text messaging. I had heard about fledgling systems that could locate library books by displaying a map of the appropriate floor, and indicating the approximate location of an item graphically. I began thinking about the methodology that we could use to create such a project, and once the basic outline was complete, I began to design and build it. The technology was not ground-breaking, but the preparation was extremely time-consuming. I had to create floor maps of the library, and record the beginning and ending call number range for every shelf of books. The graphical midpoint of every shelf was stored in a table, along with the call number range associated with that point. The searched-for call number was parsed, located in the table, and, when found, the appropriate map was displayed, along with an arrow pointing to the shelf. Creating efficient* *methods for parsing, sorting and searching LC* [Library of Congress] *call number ranges was key to the smooth functioning of the system. A number of ancillary systems were written to develop the map graphics, enter and record shelf coordinates and send SMS text messages, etc. It's not particularly elegant, but it's a very popular tool that our students find extremely useful – especially for people like me, who can't make heads or tails of the usual library floor maps."* (Glenn Manino, e-mail message to authors, April 21, 2014).

While the idea is similar, in this study we are focusing on locating offices of individuals (or rather, mapping office locations to individuals), as opposed to a particular book in the stacks.

DEVELOPMENT NEED

Mandel (2013) posits that wayfinding information systems must contain the information necessary, such as architectural cues, linearly arranged signage, and floor plans, for the target audience to make and execute decisions along a route. These systems also need to contain the information necessary for users to generate cognitive representations of the building that then facilitate wayfinding.

The authors decided to build a simple, proof-of-concept system mapped to two floors of a campus building at Simmons College. The project started with the need to make navigation to and visual mapping of individual office locations easier. In the first phase, the development need was for a way to integrate simple Web development technologies to create an interactive map of the Simmons College campus, focusing on two floors of a campus building where the Graduate School of Library and Information Science is housed.

The project design involved laying out individual or specific locations in the two floors, and providing visual information or images of the individuals currently assigned to those locations. If a room assignment changed in the future, the information or image at that specific location would be replaced by that of the new occupant of that location. Thus the need was to map to specific locations in those two floors, as opposed to specific individuals and where there were seated within the larger campus, though this could be an eventual goal of such a project.

In the initial requirements for creating a proof-of-concept, the method included:

1) Creation of a database containing staff/faculty office locations.
2) Gathering maps/floor plans of campus building(s).
3) Identification of technologies best suited for the purposes of the project, including Relational Database Management Systems (RDBMS), Extensible Markup Language (XML) and other Web-development technologies.
4) Creation of a mapping scheme and a Web-based front-end for user access.

The possible use of the proof-of-concept project was for incorporation on the campus Web site. Alternatively, it could be proposed as a possible solution to the people who developed and maintained the Web site. The deliverable was to be a working Web-based interactive map and database.

In order to provide the most up-to-date and practical information to users, the following goals were kept in mind during the design phase:

1) The technology used to create the maps should be supported by all major browsers.

2) There must be a method of providing the mapping system with the most up-to-date location information (i.e., mapping office locations to individuals currently based in those offices).

3) The system must be easily modifiable by a user not involved in the development of the wayfinding system, and who possesses minimal technical skills, such as the ability to code using basic Hyper-text Markup Language (HTML) and Cascading Style Sheets (CSS).

DESIGN AND DEVELOPMENT

A variety of technologies were studied to accomplish the goals for the system. The most basic concept of the mapping scheme includes an image of each floor in a building with a dynamic pop-up box that displays the office information. Scrolling over an office will reveal a picture and some information about that room's occupant, including name, room number, phone number, and e-mail address. See Figure 2 below. Clicking on the highlighted room will bring the visitor to the homepage of that individual if they have one listed.

[Place Figure 2 here]

Figure 3 shows the change in display as the user moves the mouse from one room to another in an online map showing a particular floor in the library building. Details of the individual(s) in each room appear in the pop-up window where the mouse is currently pointed.

[Place Figure 3 here]

Working with images

In order to most accurately portray the layout of the offices, paper blueprints of each floor of the building were obtained. These were then scanned. As the blueprints were large, multiple scans were taken, and then the image was rejoined in an image editor. The scans were imported as portable network graphic (PNG) images. PNG was selected to provide a higher quality image, so users with a high resolution settings or a large monitor would not notice a decrease in quality. The image is centered within the background of the Web page for greater visual appeal. These images would show students and visitors the office locations of faculty and staff on a floor plan that could then be displayed on a Web page.

Building the online office maps

For the proof-of-concept, an HTML page was created for two floors in a campus building. The idea for this project was to map the offices of all individuals on these two floors.

A combination of HTML and CSS were used in building the Web pages. HTML is considered the standard for markup language in Web pages and was heavily relied upon in the mapping system. Using a series of tags that every browser can understand, HTML allows users to mark up content as they see fit. CSS is used in conjunction with a markup language to organize and manipulate the content within a Web page. While HTML is concerned with the content itself, CSS is concerned with the layout and styling, and allows the user to customize the way the HTML content appears on the page. JavaScript is a scripting language that aids in the creation of dynamic Web sites and user interfaces. Original iterations of the system included JavaScript pop-ups that were later removed due to the possibility that the end user could have disabled scripting or pop-ups in the browser due to security concerns. Thus, the authors decided to keep the technologies used as simple as possible, keeping varying user needs and preferences in mind.

The HTML file for each floor contains the information displayed for each office. By using the unordered list tag <ul>, and defining each office under its own list item <li>, all information relating to an office can be stored in simple HTML. If the page were to be displayed without a style sheet, it would simply display all office information in a bulleted, plain text list. Below is some sample code demonstrating the use of the list tags. In addition, as show in this code, each room on the map was assigned an ‘ID’ for purposes of identifying the room location. An ID selector in CSS is used to specify the style for a single, unique element.

```
<ul id=“thirdFloor”>
        <li id="RoomP313E"><a class="thumbnail"
        href="http://www.simmons.edu/gslis/faculty/fulltime/agarwal.php"><span><img
        src="nareshagarwal.jpg"><br />Naresh Agarwal<br> P-313E <br>
        agarwal@simmons.edu</span></a></li>
        ……
        <li id="RoomP312"><a class="thumbnail"
        href="http://www.institution.edu/staffpage.html"><span><img
        src="staff_picture.jpg"><br />Name of staff member<br> P-312 <br>
        firstname.lastname@institution.edu</span></a></li>
        ……
</ul>
```

In order to achieve the effect of a dynamic, interactive map, each office on the image was measured in length and width by pixels. A pixel is a specific point on an image, and is usually addressed by locating its coordinates on the image. By knowing the size of the office space on the image, it is possible to use CSS to overlay an image on top of each individual office, specified to the proper dimensions.

The elements to measure and apply the right-sized square to each room are contained within the CSS for each floor. For example, the line of code in the CSS file for a particular floor below indicates the starting position for the room with ID p313e (P-313E) on the map. The blue square that highlights the room will place its top-left corner 98 pixels left from the edge and 22 pixels from the top.

```
#p313e {left: 98px; top: 22px;}
```

The line below in the CSS file tells the highlighting square how much area to cover for ID 'p313e'.

```
#p313e a {width: 71px; height: 85px;}
```

When a user hovers a mouse on top of an office space on the Web display, a box appears on top of the office location, highlighting the office (see Figures 2 and 3).

Additional styles for this box can be applied in the form of opacity, which is a CSS element (e.g., see the code snippet below). In order to ensure conformity across most browsers, the tag must define the opacity level in several different tags. The piece of CSS code below provides the opacity for the image. Opacity ranges from 0-100%, 100 indicating a 100% opaque image, and numbers closer to 0 indicating a transparent background image.

```
#p313e  a: hover {
   background: url(../images/first.png) -0px -0px no-repeat;
   opacity: .95;
```

-ms-filter:"progid:DXImageTransform.Microsoft.Alpha

(Opacity=95)";

filter: alpha(opacity=95);

-moz-opacity: 0.95;

-khtml-opacity: 0.95;

}

In order to define each office and allow for individual pop-up boxes, apart from an ID in the CSS document, each office is defined in the class *thumbnail,* which provides the pop-up box in which the text is displayed. See "Dynamic Drive CSS Library- CSS Popup Image Viewer" (2014), for an example of such an implementation. The class thumbnail is applied to all office locations within the floor, which results in a uniform style affecting all pop-up windows. By assigning each office its own unique ID, every office can have its own size dimensions, so there is no overlap resulting from shading. The browser is also able to understand which information to retrieve and import into the pop-up.

LIMITATIONS AND FUTURE WORK

What we've presented is a working proof-of-concept of a wayfinding system spanning offices in two floors of a campus building. A truly dynamic system would combine such a feature with the library building map, as well as the campus map and would allow users to zoom in directly to the floor or room for which they are looking. Also, apart from displaying the entire floor plan, snippets of a person's location within a large floor plan could be integrated within individual Web pages for library staff or other staff and faculty members across campus. For every office location included in the Web profile of a staff member, it would include a "locate" button for that office and show it in context (much like the system developed by Boston College described above, but more dynamic and showing the occupants of neighboring offices as well).

Rather than hard-coding office locations to occupants in HTML, a more fluid system would pull that data from a different source such as the library directory or the campus directory. In acquiring data for each office location, several options are available in order to create a more dynamic system:

- Text retrieval. *grep* (globally search a regular expression and print) is a Unix command-line utility for searching plain-text data sets for lines matching a regular expression and printing all matching lines. For example, given a text file fox.txt with the following contents:

The quick brown fox

does not like the cat

but jumps over the lazy dog

grep cat fox.txt

will return the line that includes 'cat':

does not like the cat

In order to keep contact information up-to-date, a text retrieval program or command such as *grep* could be used to pull information from the Web profiles containing information on faculty and staff. For example, *grep*ing for the word 'Office' or 'Room' in the Web profile of a library staff member would give information on the office location associated with a given staff member. This option did not fit this proof-of-concept because 1) we were mapping office locations in two floors of a single building (and the associated staff and faculty members), as opposed to searching for the office associated with a given staff member (though this would be desirable in an actual implementation); and 2) the Web directories in many institutions are not always current (with a delay in the information reaching the Web designer and in incorporating the change, especially in places with frequent staff turnover or office changes), which would make the map out-of-date or irrelevant.

- Spreadsheet and XML: For the scope of this proof-of-concept, an Excel spreadsheet (see "Reading and Writing Spreadsheets with PHP | Zend Developer Zone" 2014) or XML file that contained the data was not considered as a management tool. If the wayfinding system were to be expanded across the entire campus, storing the data within the HTML file could become clumsy and would cause issues when loading the map. For a small-sized library or organization, a spreadsheet or a file with comma-separated values (CSV) would be a convenient way to manage the data. XML allows the user to create tags, and is interoperable across different platforms and systems, so an XML file such as the one shown below (for a single staff member) would be useful in retrieving user data.

```
<staff>
    <firstname>Naresh</firstname>
    <lastname>Agarwal</lastname>
    <officelocation>P-313E</officelocation>
    <phone use="work">+1 617 xxxxxxx</phone>
    <email use="work">agarwal@simmons.edu</email>
    <website> http://www.simmons.edu/gslis/faculty/fulltime/agarwal.php</website>
</staff>
```

- Text file: Reading details of occupants for respective offices from a text file would be a simple solution to the problem of maintaining and acquiring the mapping of current occupants of office locations in a given building or floor. A college or library staff working on maintaining employee details could easily update such a file. However, this might only work for a small organization.
- Database: If the mapping concept was integrated with the college Web site, and was able to fill data directly from a college-level directory, a scripting language like PHP would be more useful in designing a dynamic page that would be updated automatically every time a change was made to the directory. Enabling the map within the Web space of an organization would require a server-side query language, such as Structured Query Language (SQL). This would call for additional training of library or college staff, which may not always be possible. While not always the simplest solution, implementation or reading from a database (mapping staff to offices, or vice versa) should be an important consideration in the design of the wayfinding system, as such a system would be more scalable, automated and easier to maintain in the long run.

There were a few other limitations of the proof-of-concept:

First, the floor plan is a scan of a paper blueprint, so the base image of the map is static, i.e., the map or image itself does not change. The only portions that change are the images or information of office occupants as the user moves his or her mouse from one square or area (depicting an office room) in the map to the other.

A more dynamic map would render the floor plan each time the page is loaded, possibly through a scalar vector graphic (SVG). SVG, developed by the World Wide Web Consortium, is an XML-based format that allows for dynamic rendering of images, and supports interactivity and animation. Because the file is stored in a text document under XML rules, it can be easily edited by users and languages alike as a static or animated image, greatly improving the flexibility of the content. Thus, SVG would allow for a simpler map to be rendered, omitting some of the extra architectural elements on the scanned image such as doors, electrical closets, or furniture.

Second, while the pages developed for the proof-of-concept worked across different browsers and devices such as tablets, there were minor differences in the display of specific CSS elements across browsers. For example, when you hover over an office location on the online map and an image with the details of the occupant pops up, you still see a portion of the map through the popped-up image. This transparency or opacity (a CSS property) was a major hurdle, especially in Google Chrome or Internet Explorer where, depending on the version of these browsers, the transparency did not always work as desired. Any system developed for deployment must be tested across browsers such as Microsoft Internet Explorer, Apple Safari, Google Chrome and Mozilla Firefox. In addition, a responsive Web design must be used so that the page is visible and loads correctly on devices such as smartphones and tablets. A mapping scheme that could be readily accessed via these devices would be a useful tool, especially with mobile devices emerging as desktop and laptop computer replacements.

Third, the authors had limited floor plans for working on this proof-of-concept. The plans were limited to two floors of a single building on campus. An expansion in this project would require acquiring floor maps of the entire library building, as well as campus-wide blueprints. Various levels of permissions and security concerns (with displaying indoor maps of a building publicly) might have to be addressed in this process.

Fourth, the length of e-mail addresses (or other data associated with an individual) can affect the size of the pop-up window. Many users have aliases that might be advisable to use instead of a lengthy e-mail address. A mechanism should be devised to truncate or limit the text that is displayed in the pop-up window. This becomes even more paramount if a user is trying to view the wayfinding system using a smartphone where the viewing area is relatively small.

Finally, planning for future modifications to the system should take note of several considerations based on evolving technological standards. The latest iteration of HTML, HTML5, is slowly emerging as a Web standard, to be supported by all major browsers. HTML5 has begun to replace some of the most popular Web languages, such as Adobe Flash, JavaScript, and Silverlight as the Web's most efficient and supported language. HTML5 is still a work-in-progress and is in its early stages ("HTML5" 2014), but is being supported by most of the major browsers. However, it is generally not supported by older Web browsers, and devices with touch screens may find difficulties with certain functionalities. Librarians building a wayfinding system should carefully consider how their end users will be accessing the interface when deciding on which HTML and CSS elements to incorporate.

One of the major changes released in HTML5 is the ability for browsers to support more advanced images. We discussed SVG earlier. *Canvas*, an HTML5 element, allows for similar rendering of 2D graphics, and would be suited for the rendering of more basic images. A floor plan would suit the *canvas* element well as it is only needed to make mostly vertical or horizontal lines (representing office locations in a floor map) appear on the screen. A Web page incorporating JavaScript can easily access the HTML5 *canvas* element to display dynamic and interactive images. By using an image that can be rendered on-the-fly such as SVG or *canvas*, more options become available for manipulation and creating dynamic elements than are traditionally available in a PNG image format.

CONCLUSION

As Web technologies continue to make their way into our everyday lives, it is useful to examine the technologies that are available for problem solving. Often, a tool that has been so heavily relied upon in the past has room to evolve and improve, simply by taking advantage of new advancements in technology. In the case of this project, the online directory gives users the information they need, but it lacks context. A visual representation of the directory would provide a cognitive map for users before they attempted to find the office, allowing them to enter the library or another building and know exactly where to go, eliminating confusion and improving efficiency. While Google Maps and similar initiatives are helping people to easily locate a building within a particular street, this tool would be the next stage in providing even more specific visual and spatial context. Wide-scale implementation and adoption of such a tool would be useful for library patrons, students, outside visitors, as well as faculty and staff in a university when they visit their colleagues in their offices. It would aid in making the library, as well as the university as a whole more welcoming. Of course, a scenario of visitors navigating through a maze of office locations is not exclusive to the academic library or academia. Many organizations, especially those with a large number of offices, could benefit from an online office map on their Web sites.

Once implemented, this wayfinding system could progress to further projects such as not only showing a library staff member, faculty or staff in a university in a building floor map, but also whether the person is currently in the office (e.g., an ‘is IN’ or ‘available’ button showing if the person is in and ready to receive visitors). This would require signing in, or perhaps the use of motion-detection mechanisms, which would come with their own share of logistical and privacy concerns. The other option would be to compare the office hours provided by individual faculty or staff members with the current system time and indicating with a green ‘light’ or button if a particular individual is likely to be in his or her office based on a match of the office hours and the current day and time.

Thus a simple system such as this one could go a long way in addressing the spatial wayfinding needs of library or campus visitors. With the implementation of such a system, “when people navigate the built environment”, they will no longer “struggle to orient themselves, find the appropriate path, or become lost”, or “suffer frustration, stress, and aggravation”, or “blame themselves”, or “feel stupid, anxious, and angry” (Arthur & Passini 1992; Mandel 2013 p.265). Therefore, along with meeting the information needs of information seekers, libraries and college campuses would be able to also meet the spatial needs of users navigating their facilities. With successful wayfinding for physical spaces occupied by individual staff members, libraries could also extend the concept to highlight the precise locations of books within the stacks, thereby providing the user with an idea of where the book is located before ever visiting the library.

ACKNOWLEDGMENTS

The proof-of-concept was developed as part of an independent study in Spring 2012 at the Graduate School of Library and Information Science, Simmons College. The authors would like to thank Dr. Gerald Benoit for sharing his ideas and examples, which were useful during the implementation phase of this proof-of-concept.

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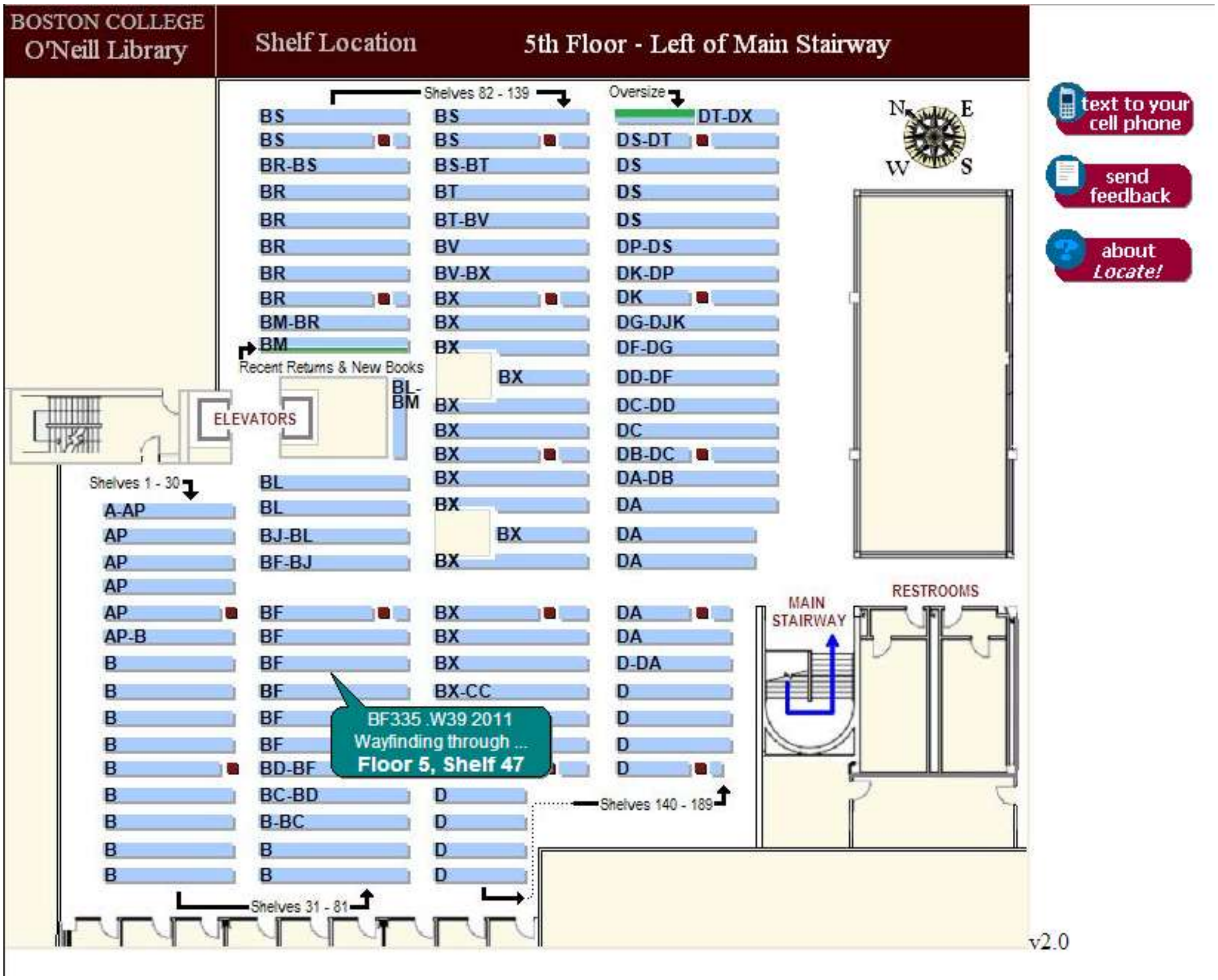

Figure 1. Locating the physical location of a book on a map of the stacks in the library

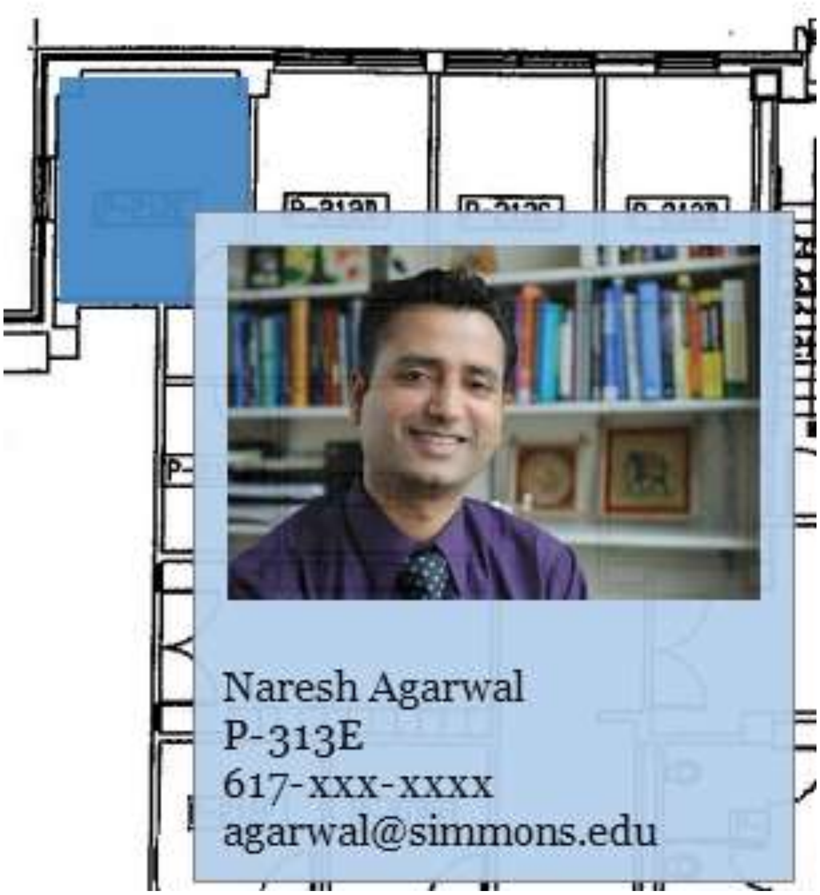

Figure 2. Navigating the rooms on an online floor map to view their occupants

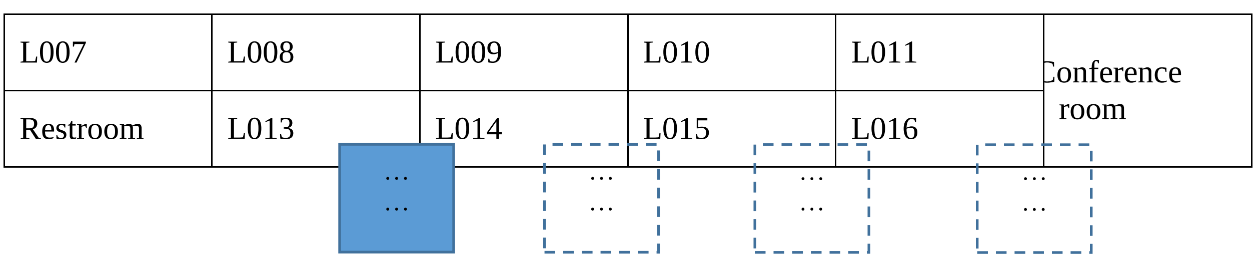

Figure 3. Moving the mouse from one room to the other in an online map