Narrative

Librarians and staff from the University Library at the University of Illinois at Urbana-Champaign, propose a two-year project to work collaboratively with students in the design of new library access tools. The focus of the new library applications to be created is on the use of library data that is not traditionally used by students. In leveraging both student conceptualizations of information access as well as un-tapped data sources, compelling new forms of library engagement may result.

The outcomes of this project will close several critical gaps between observed student and researcher needs for location-based and context-dependent library research, collections, and services, and what is currently available. The program will focus on collaboration methods for developing mobile applications that provide enhanced tools for engagement in the library collection; the physical browsing of the library collection can be re-engineered based on advances in mobile technology and now functional prototypes for location-based service.

New methods and applications for accessing library and campus information on demand that are flexible, open, and portable will be developed by a team of library researchers, programmers, and students. A student design team will be formed to give students a lead role in the conceptualization and building of these applications, and an opportunity to develop the skills needed for cutting edge careers in technology start-ups and other development ventures.

Goals

1. Increase student collaborations and input into library software design;
2. Improve the abilities of libraries of all types to provide services for location-specific information needs;
3. Broaden access to library collections;
4. Create connections between changing student computing uses and library resources and services

This program targets the design, development, and delivery of interlocking mobile applications and interfaces based on previously untapped library data. This two-year project will produce a generalizable "collaboration game-plan," the resulting extensible applications, training modules, and program design guidelines that can be utilized by other libraries and cultural institutions of any size, type, or patron group. The work designed here takes as its departure point the idea that next generation access tools that are useful for students are those which students have had a part in shaping through formative evaluative feedback and co-creating in the initial design phases.

Building on already established collaborations with students in the Department of Electrical and Computer Engineering, The Department of Computer Science, and the Graduate School of Library and Information Science, a student design team will be formed to compete for prizes based on the development of mobile applications that meet the program's criteria.

This project will provide a training ground for students interested in usability testing and technology development for projects to support curricular and larger career needs. It will also create a model that can be

replicated for identifying student technical ability throughout the campus that can be tapped to identify what they value in library services and then to use library data to create location enhances services the re-invigorate the onsite library experience.

Although the computing approach is important to the work of this grant, it is not the sole focus of this work. The immediate benefit for librarians will be to further understand student information needs and how to meet those needs with mobile technologies. The University Library has already developed a number of application programming interfaces (APIs) and mobile-device applications (Apps) based on those APIs. Through this proposal we seek to build on our prior work (Hahn, 2011; Hahn et al. 2011) and develop a framework for location-based library software and an organizational model that other institutions can apply to meet their needs. Part of the proposal's purpose is to further extend already existing partnerships with campus departments involved in mobile computing research. In taking a focused approach to building on these partnerships, the library will be creating a model for collaborative mobile service design.

Needs Assessment

Mobile computing technologies offer the potential to integrate the best of digital and physical information resources while supporting access to both. Mobile technologies offer an exciting possibility for invigorating the on-site library experience by integrating library circulation data into the browsing experience of the student. With this circulation data available as an easy (and fun) to use library App – the student will navigate the stacks and be made aware of popular resources in the collection. Libraries have not traditionally incorporated this kind of use data into any kind of mobile service. Further data associations with other resources can be made based on the student's position in the stacks – related digital resources of the library can be delivered to the student's mobile device based on position in the library stacks and also by student interest, such as course enrollment or declared major.

In Summer 2010, researchers in the Undergraduate Library worked with PhD. students in engineering to make a mobile wayfinding App that directs students to the location of books on the shelves in the Undergraduate Library. This was a need expressed during previous basic wayfinding research studies at the library. The prototype application, "Library Helper," is now available from the Android market (http://www.library.illinois.edu/ugl/about/Experimental_Android_Apps/Android.html).

As of early 2011 *Library Helper* is in the functional prototype stage, yet this work is immediately useful to students since it provides a collections map of the lower level of the undergraduate library via the student's phone. The App will approximate the user's location in the undergraduate library, and redisplay the map accordingly. While observing test usage of this map all students who used this App were able to find the location of the range of shelf the test item was located on.

The following additional needs were identified as a result of the usability study done on the "Library Helper":

- Finding rooms in the library, finding the location of other department libraries, the location of the multiple service desks in the library, exits, and resources beyond books.

- A recommendation service for items related to major, or items in the library related to the courses students are currently enrolled. Students also asked if, based on items the student has checked out, could such a service show her the location of other items in the library that are of interest to her?

This grant will build on this experimental work, since we now have an idea of student use preferences for location-based service – but seek to also continue to co-create and design mobile context-dependent applications based upon ongoing evaluation. This demonstration grant could provide a significant leap forward in the design for location-based services for libraries of all type.

Two applied research studies on information search using the iPod and iPod touch by Undergraduate Students at the University of Illinois (Hahn 2009, Hahn 2010) show that students show a preference to search for information about persons or concepts, more so than other subject types. This may help inform our additional design for Apps that draw on quick facts and also biographic resources. Students also characterize the nature of their information search for mobile as recreational searching. There is a definite opportunity for engaging a population of the undergraduate student who may not traditionally make use of library resources due to this "fun-factor," of mobile access tools.

This grant targets the undergraduate population at the University of Illinois. A Pew Research Study (Lenhart et al, 2010) found that 75% of teens and 93% of adults aged18-29 (similar to the target group at universities) now have a cell phone. Another study done by the Pew Research Center (Horrigan, 2009) indicated that 60% of those in the age group of 18-29 age group used mobile devices for "on the go" information. In addition to using their mobile devices as a phone and for text messaging, they also use them for checking for info, maps or directions, email, and social networking (Smith, Salaway, & Caruso, 2009). The Horizon Report (Johnson, Smith & Stone, 2010) found that "The portability of mobile devices and their ability to connect to the Internet almost anywhere makes them ideal as a store of reference materials and learning experiences, as well as general-use tools for fieldwork, where they can be used to record observations via voice, text, or multimedia, and access reference sources in real time." Clearly libraries need to move forward in the direction of creating library applications that can be accessed from mobile devices if they want to continue to provide ways for patrons to interact with library resources.

Lippencott (2010) observed that libraries need to offer content and services suitable for mobile devices if they want to maintain a significant presence to users. She also urged the library community to "create compelling information services and to make digital content available in a way that our user community will find not only acceptable, but tailored to their needs (pp. 212)."

Beyond the Mobile Web

Many libraries have been able to optimize their library site for mobile devices (see the M-libraries page for Libraries offering mobile interfaces or applications: http://www.libsuccess.org/index.php?title=M-Libraries#Mobile_interface%20s_%20.28and.2For_OPACS.29) and some have turned to commercial firms (such as Boopsie, Blackboard Mobile, or LibraryThingAnywhere) to develop mobile Apps for their library, such as mobile access to collections, new books, maps of the library, events, classes. However, libraries have not generally taken advantage of using their existing library data paired with the full functionality of what mobile devices could mean for library services.

The design for location-based mobile library service has not seen robust development. While mobile application development in libraries is seeing increased experimentation, this work remains overwhelmingly in the bibliographic sphere: the catalog search, hours of building operation, and other librarian-developed tools. There is some experimentation in services by location, as implemented in the WolfWalk app developed by NCSU (http://www.lib.ncsu.edu/wolfwalk/), which delivers the digital content of their university's archives and special collections based on a user's location on campus.

This work is valuable to libraries for the collaborative approach it takes to forming partnerships and lessons learned by working with students as co-creators in library access tools. The collaborative student-library partnership at Cornell University, in repurposing library data for an iPhone app, shows initial promise of such an approach in this technological domain (Connolly, Cosgrave, Krkoska, 2011). The proposed demonstration project will help librarians understand how students conceptualize information searching with mobile technology, as well as how the library can fit into the range of tools students make use of in completing research and academic tasks. While we are using mobile computing technology to create new previously unavailable library services, this isn't solely a computing-based demonstration; rather, librarians in the Undergraduate Library will articulate a "game-plan" for the collaborative approaches to co-creating new access tools.

This method for studying student usage of Apps will be of interest to libraries nationwide. Collaborative approaches to designing library tools have not documented the process for using formative evaluative techniques or in showing how these methods can result in library services that are used and useful. Our work will develop ways of understanding the use of applications and combining the use data to inform new versions of the Apps and library resources.

Target Audiences

1. *Students on campus who will benefit from the Apps to be developed that help them to navigate through library resources, while offering new ways of seeing the interconnections of collections and use;*
2. *The students who will both help test and inform the design of location based Apps;*
3. *Libraries nationwide who will benefit from the collaborative methods produced as a result of this work, as well as the deliverables that provide guidance of how to create interfaces and applications based on existing library data*

National Impact and Intended Results

A model for student-led software development programs

While ad hoc student programmers have been used in many library contexts for software development, there is little to no investigation on methods for creating a formal, ongoing environment in which students make regular, higher-level contributions towards systematic development of library resources. This grant will produce a national model for creating a sustainable student-led software development program. The bottom-up design approach will yield insights into how students approach library research, what kinds of library resources they value, and what combinations of library-generated data resonate most strongly with their

research and academic pursuits. The student-led design approach will generate tools for self-paced learning and research, and build pedagogical connections to students as independent learners. The documented collaborations resulting from the grant work will have a lasting, widespread impact on how libraries can organize to engage their users as partners in designing next generation research discovery tools.

Innovative mobile library applications
Mobile device-based software development is still in its infancy, and there is much to be learned about how traditional library services and tools function best in this environment. Previous research at the University of Illinois has shown that students have many and varied expectations for how their mobile devices can connect them to library and campus resources. Getting turn-by-turn directions to specific library materials based on a known call number, locating similar materials to an item in hand, and connecting to related class and campus resources are a few of the known student needs with which mobile application development can assist. Defining the relationship between a student's location and their information needs will help libraries understand how to market and expand the reach of their collections and services beyond the four walls of their physical buildings. The software tools developed through this grant can provide inspiration to other libraries for new methods to connect their users with their research resources, helping libraries keep pace with changing national trends towards mobile device use. The coding framework for the software will also be designed with portability in mind, so that other libraries with sufficient programming expertise can readily adapt them for application to their own local settings. The APIs designed will also be designed for interoperability, and build around common types of library data used in other large-scale digital initiatives.

Transferrable user research on student preferences for mobile software applications
As the functionality of mobile devices continues to expand, libraries will need to know which of their multiple features correlate most strongly with increased and enhanced student use of library collections and resources. Usability studies conducted as part of the software testing phase will document how these applications solve real world problems that current library discovery tools do not adequately address. This user research will help libraries both construct instructional materials relevant to observed user behavior, as well as evaluate which features of next generation search and discovery tools are most important to students when making staff allocation, development, and purchasing decisions.

Project Deliverables
- Documentation on best practices for collaborative student-led software development programs that can be replicated in a variety of library and information technology settings;
- APIs for providing common types of library data to students to use in software development;
- Student-developed software applications for mobile devices utilizing the above data;
- User research/usability studies on these software applications;
- Production and assessment of significant new knowledge and tools on the location-based needs of researchers and best practices for meeting those needs

Project Design

Year 1

1.1 Collaborative design meetings with students

Already existing partnerships with departments will be leveraged to gather input and desired functionalities on the next generation of location based mobile access tools.

- The programmer will work with library staff and students to create APIs. The first student design team will be selected (through a competition) and trained and mentored through the development from APIs to APPs. Examples of starter, location-based projects that can be developed the first year are based on what students have requested:
  a. wayfinding software code for retrieving recommendation tags (items that people tag as favorites) from the library catalog; APIs for the library catalog (Voyager) reports server for location-based services that indicate nearby popular resources; popular reserve items; popular call numbers of the week; creating a Wordlens App[1] (uses OCR to recognize text and redirect – so holding a book up to see the call number, then relaying info about it, or holding your cell phone up to a catalog page with the call number on it and connecting to the real time positioning and recommendation information) Jim Hahn (a co-PI) has worked on.
  b. Easy Search: most popular queries for the day; week; month; if possible to develop the most popular queries by people enrolled in a specific class
  d. "Course packages" of information for students based on user feedback from multiple past use studies: mobile usability, web usability, service focus groups.
  e. Other resources i.e. what is available in the library that is on the New York Times best sellers list. We will explore the possibility of integrated these XML strings into already existing mobile Apps, such as the Layar API (http://layar.pbworks.com/w/page/7783228/FrontPage). More about Layar here: http://www.layar.com/
- Gather ideas from students of other things they believe should be designed given the data (whether it's call number information, materials, various library tools, information).

1.2 Programming APIs for extending library data sources

Previously unused library data, such as book circulations, popularity of reserve items, popular videos circulations, are generated. Programming is partially informed by student input in step 1.1

1.3 Development of Apps/user testing on Apps

By the end of the first year prototype location-based Apps will be developed that have been informed through student input. User testing is a part of the formative design process. Graduate hourly students will assist with user testing and documenting results of the usability of Apps.

1.4 Students presented with design awards

Since this demonstration will feature a design competition the best projects will receive awards.

1.5 C*onference presentations and documentation*

[1] http://www.wired.com/gadgetlab/2010/12/word-lens-augmented-reality-app-translates-street-signs-instantly/

Initial dissemination of the planning, work and results will be presented at two conferences. Documentation of the process and usability results will be ongoing.

Year 2 – Second round of student-created Apps and usability testing; documenting work and making available software code and findings on location based needs of undergraduate students.

2.1 Development of Apps/user testing on Apps
Second round of student developed Apps competition. User testing is a part of the formative design process. Graduate hourly students will assist with user testing and documenting results of the usability of Apps.

2.2 Best practices documentation is created for student/library collaborative projects.
With graduate hourly help, librarians will document lessons-learned and a general method for forming and co-creating library services.

2.3 APIs for extending previously un-used library data are made openly available to the library community.
The APIs will be developed as openly as possible so that other libraries could make use of the general framework for repurposing library data for location-based library services.

2.4 Mobile application code is made freely available for libraries to re-purpose.
The software code from this project will be made available from the University of Illinois institutional repository – which will provide a long-term access to the digital archive of these digital products.

2.5 Lessons learned documentation/videos in the location-based needs of students are produced.
Librarians, along with graduate hourly will document the desired functionalities and library services for location based needs of students.

2.6 *Stable, production level applications are made freely available on device specific application stores such as the iPhone App store and the Android Market.*

2.7 *Conference presentations*
Dissemination of results of the program at identified conferences.

Project Evaluation Plan
The project coordinators will employ continuous formative evaluation through usability studies, rapid use studies, and prototype studies, to measure the project outcomes against the goals, as detailed below.

Goal 1: Increase student collaborations and input into library software design
The student-led design group, in coordination with the project coordinators and programmer, will collaborate on formulating mobile application concepts, and turning these into functioning prototypes. The success of this collaboration will be measured quantitatively, through detailing the number and kind of software applications generated, as well as qualitatively, through documenting the interactive, project management based procedures that the group develops for recruiting students, vetting software ideas, and generating functioning prototypes.

Goal 2: Improve the abilities of libraries of all types to provide services for location-specific information needs
The software development process will result in expanded methodologies and code for determining a user's physical location in a library and connecting that to related information resources. Progress towards this goal

will be measured through the number and type of software APIs and applications that the development group generates. This software will be released to other libraries for their use and modification after they have been tested, and an additional measure will be surveying libraries to see how many of the applications gain traction at other institutions.

Goal 3: Broaden access to library collections
The applications developed will allow students to make direct connections to specific, known library items (such as locating a physical book in a building based on its call number), and will also create deeper connections to related library collections, including digital collections. These connections will be measured by looking at use statistics for resources, and checking metadata about access methods to see how many and which kind of resources are accessed by mobile devices, as well as by the specific applications.

Goal 4: Create connections between changing student computing uses and library resources and services
Student use of technology is moving increasing towards mobile devices and similar thin clients, which have a reduced physical footprint but connect to deep, rich resources housed in the cloud. User studies will measure student preferences for accessing information through mobile devices, including both what types of information needs they seek to answer with their mobile devices, as well as best practices for interface design and content presentation.

Project Resources: Budget, Personnel, and Management

Budget
The institutional responsibilities for project management and implementation fall to the University of Illinois at Urbana-Champaign. We request funding to demonstrate the process for co-designing location-based mobile library services. This demonstration requires development of APIs for applications to use based on user context in the library. We intend to hire a programmer with grant funds who will then build the data feeds for extending previously unused library data in the on-site library experience. The demonstration of this collaboration "game-plan" will help to inform libraries nationwide of the techniques that work for co-designing useful and used library services that more align with twenty-first century expectations. Time from librarians and staff from the University Library will be used to meet the cost-share requirements.

Personnel and Management
Lori Mestre is an Associate Professor and Head of the Undergraduate Library at the University of Illinois. In addition to her M.A.L.S. degree, she has a doctorate specializing in multicultural education (language, culture, and curriculum). Research and publication interests pertain to multicultural librarianship, including developing learning objects and online tools that best reflect and incorporate the diverse learning and cognitive styles of patrons. Lori will be the overall project administrator, making certain that institutional collaborations are running smoothly, will oversee the project budget, deadlines, reports, and administration of the student innovation design process and awards.

Jim Hahn is Assistant Professor and Orientation Services Librarian of the Undergraduate Library, University of Illinois at Urbana-Champaign. Jim is an award-winning researcher on mobile computing for information access and is experienced in the development of prototype iPhone and Android Apps for library services. He

led four user studies of search by mobile devices covering iPods, iPod touch, the iPad, and an Android device, the Nexus One. Jim is the author of the only book available to librarians on the topic of iPhone application development specifically geared to librarians, available from Chandos books in February 2011. Jim will work with student design teams to develop the location-based mobile applications. He will help also in the user studies of the applications and work with programmer to specify requirements for the needed data feeds.

David Ward is an Associate Professor at the University of Illinois, where he has been the Reference Services Librarian in the Undergraduate Library for the past 10 years. His research interests include assessment and training for reference, with a focus on best practices for delivering online reference services. David will be involved in working with the programmer to ensure the data feeds are available for App development, as well as assisting with usability studies and following up with project management processes and procedures to ensure that project work is completed in a timely fashion.

Michael Norman is an Associate Professor at the University of Illinois and is the Head of Content Access Management at University of Illinois at Urbana-Champaign. Michael will assist the grant programmer with understanding SQL queries from the Voyager server. While much of the data we want to use for this project is available in the Voyager Integrated Library system, Michael has the knowledge to help the programmer build the APIs necessary to make available this data through an extensible format.

Beth Sandore is associate university librarian for information technology planning and policy, associate dean of libraries, and professor at the University of Illinois Library at Urbana-Champaign. She leads technology programs that focus on developing discovery services, and long-term data curation and management programs for the research and cultural heritage communities. She has contributed substantively to the development of programs to trained and mentored LIS graduate students through research supported by the Institute of Museum and Library Services (IMLS), the National Science Foundation, the Library of Congress, and private foundations. Beth will provide guidance and advice on the project and how it relates to Library Information Technology issues.

Communication Plan

Reaching libraries with the project deliverables:
Conference presentations and articles will result from this work. Librarians and students will present the lessons learned in collaborative services development. The actual performance of location-based applications will be presented as well, with student use data and formative evaluation methods. Researchers from the library will make presentations and prepare documentation on how to re-use the demonstration APIs for location-based service in libraries. The training materials and documentation will be available from our Library website.

Reaching students with project deliverables:
The mobile applications that are developed will be freely available on device specific Application Stores. Marketing videos that are created will be made available on the Library's YouTube channel and from the Library's web page. The Undergraduate Library will promote user studies with blog posts and twitter posts, as well as an announcement to students from the Library's Facebook page.

Reaching students to test prototype Apps
In order to reach a diverse range of student preferences for location based apps – we will also recruit user feedback from the cultural houses on the campus of the University of Illinois. The diverse student testers will include student participants from the African American Cultural Center, the Asian American Cultural Center, La Casa Cultural Latina, and the Native American House. The proposed demonstration work sufficiently aligns with the service focus of the Undergraduate Library, which is committed to the ongoing study of the user experience.

Sustainability
To continue benefitting libraries and students beyond the grant period, the University Library will maintain a website for student innovation awards that result from this project. Training documentation will also be available from the website. The University Library will also keep copies of the software code available in the institutional repository so that other libraries can have stable and persistent long-term access to the software code. The University of Illinois Library IT department will support the ongoing student innovation contests with annual funding which will support these activities after the grant period. The library will continue to research and develop methods for working with students in the design of library service – possibly extending this work to other domains of service development.

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