Lab 1 – ResearchLink Product Description

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CS411

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1 Introduction

Research drives advancements in all technologies used in today’s society, especially in the science, technology, engineering and mathematics (STEM) world. Graduate programs focus on research and analysis of topics related to specific areas of study. Undergraduates need to be aware of the benefits of research and how it will prepare them for the type of work they will be doing as they pursue a graduate degree. The participation in research may be the deciding factor that drives whether a student moves forward with a practical career in computer science (CS) or as a computer researcher. With a lack of STEM students progressing into graduate programs, there is a need to increase undergraduate participation in research opportunities.

In 2014, out of the 1,552 applicants accepted to graduate programs available at ODU, only 796 of those applicants chose to enroll (ODU Factbook). 17.46% of those graduate program enrollments consisted of CS students. With the percentage of computer researcher jobs being only 1% of the STEM Computing jobs (CS Presentation 2015), there is a great need to encourage undergraduates to transition to a graduate program.

Undergraduates are often unaware of the importance and availability of research opportunities, which will better prepare them for graduate school and the research that will be required to be successful in the program and in their future career field. Not only will the participation in undergraduate research encourage them to move forward with transition into a graduate program, they will find that their experience in the program will be more beneficial as they will have already gained crucial experience in research and analysis. With this better understanding of subjects in their field, they will be more appealing to future employers. An
increase of involvement in research will also help drive publicity of the university and ultimately drive an increase in student admissions, to include those undergraduates moving on to seek admission into the graduate programs available at ODU. Research involvement will provide additional opportunities for the university to maintain future research related educational experiences that the faculty is able to provide to students.

It was found that the manner in which research opportunities are advertised to the ODU community is not efficient, as opportunities are pushed deeper into the past of faculty and student mailboxes, only to be forgotten and never be reviewed again. Outdated advertising methods, such as using a bulletin board or placing opportunity information on office doors, often leave distance learning students out of the loop. These disconnects illustrated in Figure 1 of how information is being shared prevents students from being aware that there are opportunities available. This can lead to a lack of participation in undergraduate research (Russell et al. 2007). These opportunities can aid in their development and help improve the ranking of the school by conducting research that is meaningful and beneficial to all those involved.

Figure 1. Current process for distributing research opportunities

An additional aspect of the current problem is the lack of an environment in which to highlight departmental and student success in research; this type of publicity may aid in the
increased interest of prospective students. Old Dominion University (ODU) expressed the need for a tool to help improve ranking and enrollments for the University. External agencies will always need resources to help fill available spots for the internships, scholarships, and skill camps that they offer in order to help recruit and retain talent within their organizations.

A way to bring awareness to the availability and successes of research opportunities at the university would be to introduce a consolidated environment in which students and faculty may access to track current undergraduate research opportunities. This environment would also facilitate the sharing of successful research being conducted at ODU. These successes will also be visible by the public, therefore showcasing the innovations occurring within the university and promoting additional enrollments and participation in research.

ResearchLink will provide the environment in which faculty will be able to share research opportunities with students, thereby removing the middleman in the process. Students will have the ability to track opportunities they are interested in, receiving notifications on upcoming deadlines to ensure they do not miss the opportunity to participate. External agencies will have a system where they are able to advertise opportunities for research and internships to the appropriate student body. Faculty will have the opportunity to share departmental and student successes with both the public and the university community, thereby improving enrollments in both undergraduate and graduate programs.

2 ResearchLink Product Description

ResearchLink will provide a convenient system in which registered users will be able to access all undergraduate research opportunities that are available, thereby enhancing opportunity awareness. The system will greet the users, and the public, with a live-stream news feed of departmental and student successes on the launch page of the product. Users have the capability
to identify their interests within their student profile, thereby receiving research opportunities targeted for the type of research they are interested in. Automated notifications for opportunity deadlines prevent undergraduates from missing application dates for opportunities they desire to participate in.

By creating one repository in which all research opportunities and successes may be advertised and tracked, ResearchLink will aid in the dissemination of information to all interested parties and ensure faculty remains on track with recurring opportunities that are available to the university community. Faculty will also be able to spotlight innovative research and successful students through the news feed, which achieves the objective of increasing university departmental public presence.

2.1 Key Product Features and Capabilities

ResearchLink will be accessible through both a web and mobile device compatible interface. Login credentials will be tied in with the Shibboleth system, therefore students and faculty will use the same credentials as they use to access the rest of the services provided by the CS department at ODU. The information a user is able to access is controlled by the type of account that they have. Users without an account will only have access to the public news feed that resides on the ResearchLink landing page.

The three user roles that exist in the ResearchLink environment consist of student, faculty and administrator roles. Student accounts will be used only for undergraduate students. Faculty accounts will be for all faculty that regularly offers research opportunities to undergraduate students. Administrator accounts will be used for designated staff that will be in charge of moderating the data and activity within ResearchLink.
Students will have the capability to create and update their student profile, with the
option to add interests, completed courses, and their GPA. Interests and completed courses may
be selected from a repository by using keywords. Adding this information will increase profile
visibility in faculty searches. Students will also have the ability to annotate the research
opportunities they have participated in on their profile, thereby showcasing their experience with
research work. They will have access to utilize filtered search options to view available research
opportunities.

Faculty will have the capability to create and update their professional and departmental
profiles within ResearchLink. This will allow them to share research opportunities that they are
currently participating in or have participated in in the past. They will have the capability to
create and manage research opportunities. Faculty accounts will have the authorization to
conduct filtered searches for eligible students based on student interests, completed courses, and
GPA. These filtered searches will aid faculty in identifying qualified students to participate in
their research opportunities.

Faculty will have the ability to push information that is related to specific departmental
interests. If there are specific types of research opportunities that are conducted on a yearly basis,
ResearchLink will use a calendar-based system to remind that faculty member that to send out
information relative to those opportunities. This feature will aid the faculty in keeping track of
important opportunities that benefit the university each year.

Administrators will monitor access and operations within the system. Those with
administrator access will have the capability to create accounts, create and modify opportunities,
and archive old opportunities. User accounts will be tied to the Shibboleth system; therefore, the
ResearchLink Administrator will not be responsible for user access, as those will be managed by the Systems Group.

ResearchLink will push notifications to users, both through email and within the ResearchLink environment, depending on the user’s notification settings. A calendar-based system will control the triggering of notifications. If a student has chosen to incorporate their interests with their profile, they will receive notifications containing the information pushed by the faculty member. The calendar-based system will also control the auto-archival of expired opportunities.

While access to ResearchLink information will differ between registered users and the general public, an up-to-date news feed will be available to the public on the launch page of ResearchLink. This information will consist of the successes of recent research endeavors and students involved in the research at ODU. Faculty will have the capability to add information to the news feed while students will only be able to view those successes that have been shared.

2.2 Major Components (Hardware/Software)

ResearchLink is supported by a SQL database server and a web server. The software components are set up as a LAMP Structure, consisting of Linux, Apache, MySQL, and PHP. ResearchLink will be integrated with the Shibboleth and Banner systems to facilitate user login and authentication.
The ResearchLink user interface is developed using HTML and CSS, with PHP driving interaction with the database. The color scheme is designed to follow the color scheme for ODU. Figures 1 and 2 provide a mock-up of the user interface for the forms for entering student information and creating an opportunity.

![Figure 2. Major functional component diagram](image)

![Figure 3. Student information form user interface](image)
The forms used for entering information into the database are driven by the use of PHP. Form development relies on input from the users to ensure all required fields are available. These changes may be made during initial development or through product maintenance to satisfy customer requirements. Fields in the real-world product may differ than what is presented in Figures 1 and 2 of this document as these requirements change.

![Create Opportunity Form User Interface](image)

Figure 4. Create opportunity form user interface

The algorithms associated with features provided by ResearchLink will not have to be modified even if field requirements on forms change. Users will follow the same steps in order to accomplish the same result. The processes for logging in, creating a research opportunity, and searching for opportunities within ResearchLink will follow the same paths as are depicted in Figures 3-5.
Figure 5. Algorithm for logging into ResearchLink

Figure 6. Algorithm for searching in ResearchLink
3 Identification of Case Study

ResearchLink is being developed for the CS department at ODU. The method in which research opportunities are being disseminated is not effectively reaching the enough undergraduates. Those undergraduates need to be introduced to research opportunities to encourage their admission into graduate school. This will help the chances of more students becoming computer researchers. While the CS department is the initial focus for deployment of this product, ResearchLink could be useful for additional in any department that regularly has research opportunities available for undergraduates. There is potential for other universities and research organizations benefiting from utilizing ResearchLink as well.

4 ResearchLink Product Prototype Description

In order to demonstrate the benefits that ResearchLink will provide for the CS Department, a prototype will be developed to demonstrate the main features and capabilities. Demonstration will provide proof of a resolution to the problem at hand. The prototype will
represent all real-world product capabilities, with the exception of integration with ODU systems (Banner, Shibboleth, and MyODU), as is outlined in Table 1. Risk mitigation will be incorporated in the prototype through provision of user guides.

Table 1

Real-World versus Prototype Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Real-World</th>
<th>Prototype</th>
</tr>
</thead>
<tbody>
<tr>
<td>News Feed</td>
<td>Present on launch page and internal to ResearchLink</td>
<td>Present on launch page and internal to ResearchLink</td>
</tr>
<tr>
<td>Searchable</td>
<td>Opportunities and profiles are searchable</td>
<td>Opportunities and profiles are searchable</td>
</tr>
<tr>
<td>Filterable</td>
<td>Searches are filterable based on user selections</td>
<td>Searches are filterable based on user selections</td>
</tr>
<tr>
<td>Automatic Notifications</td>
<td>Customizable notifications for faculty and students</td>
<td>Customizable notifications for faculty and students</td>
</tr>
<tr>
<td>User Profiles</td>
<td>Customizable profiles for faculty and students</td>
<td>Customizable profiles for faculty and students</td>
</tr>
<tr>
<td>Banner Integration</td>
<td>Banner information used for user authentication during profile creation</td>
<td>Simulated through SQL Database</td>
</tr>
<tr>
<td>Shibboleth Integration</td>
<td>Shibboleth used for login credentials; integrated with MyODU portal</td>
<td>Simulated through SQL Database</td>
</tr>
<tr>
<td>Interface</td>
<td>Hosted on ODU server, in conjunction with system integrations</td>
<td>Hosted on CS Virtual Machine</td>
</tr>
<tr>
<td>User Guides</td>
<td>Tutorials to provide new users with guidance on how to utilize ResearchLink</td>
<td>Tutorials to provide new users with guidance on how to utilize ResearchLink</td>
</tr>
<tr>
<td>Testing Environment</td>
<td>Does not exist</td>
<td>Environment in which to test features controlled by date and time</td>
</tr>
</tbody>
</table>

Table 2. Real-World versus Prototype Features
4.1 Prototype Architecture (Hardware/Software)

The hardware required to support the prototype consists of one individual component – the CS Virtual Machine (VM). The VM must be loaded with Apache2 Server, MySQL Database, PHP 7.0, Laravel Framework 5.2, and Composer. The VM will be the component that all requests and data are transferred through. The prototype functional components are depicted in Figure 3.

Figure 8. Prototype major functional component diagram

The prototype user interface will follow the real-world architecture by using HTML and CSS, with PHP driving interaction with the database. The color scheme is designed to follow the color scheme for ODU. The forms used for entering information into the database are driven by the use of PHP. Form development relies on input from the users to ensure all required fields are
available. These changes may be made during initial development or through product maintenance to satisfy customer requirements. All algorithms will also follow the real-world architecture.

4.2 Prototype Features and Capabilities

The ResearchLink prototype will contain all features and capabilities other than interfacing with Banner for authentication of the type of user account and Shibboleth to manage the logins that will grant access to the system; Table 1 outlines the differences between the features of the real world product and the prototype. This will not interfere with demonstrating the overall functional goal of providing a convenient and consolidated environment that houses available research opportunities and showcasing successes to help advertise accomplishments that are occurring through ODU research, namely in the CS department.

Banner authentication and Shibboleth login access will be simulated by fabricated data being loaded into the MySQL database tables. Simulated Banner authentication will be accomplished by housing user emails and their affiliation with ODU (whether student or faculty). Shibboleth login access will be accomplished by maintaining a table containing user emails and passwords.

The main features of ResearchLink are easily simulated by the use of multiple devices by different team members, each utilizing a different user account type. This will allow proof of profile creation, notifications, and updates for both faculty and student accounts, thereby proving ResearchLink’s success at providing targeted research opportunities and notifications. The news feed will be available on the launch page and upon login through a faculty or student account, demonstrating that there is both public and internal access to the news feed that broadcasts departmental and student successes. Research opportunity creation will demonstrate the fields
and options available for each opportunity that is to be listed within the system. These fields can be modified within the real-world product in order to suit the needs of the department and university as a whole.

The testing environment will allow for the team to prove the benefit of calendar-based notifications tied to deadline reminders and recurring opportunity reminders for faculty. Archival of expired opportunities will also rely on a calendar-based system. These features will be simulated by modifying the date and time to simulate time passing and stakeholders may see how the system shares notifications and also archives expired opportunities.

The prototype will incorporate helpful tutorials to aid in training users that will utilize the system. Making these guides available will help with risk mitigation for both transitioning users to a new system and ensuring that the system does not end up being underutilized. If users do not understand how a new system works, they are less likely to utilize the system often, if at all.

4.3 Prototype Development Challenges

The only challenge that exists with the prototype is integration with existing ODU systems, such as Banner, MyODU and Shibboleth. These challenges are overcome by the simulation of a database that provides the data necessary for user authentication and login credentials. The prototype will easily demonstrate the capabilities of the product without the integration with these systems. Access to these systems will be crucial in order to provide seamless implementation of the real world product within the university community.
Glossary

Banner: Old Dominion University's Administration System that provides controlled access to financial, student and personnel data. This system is only available to Faculty and Staff.

Laravel Framework: A powerful MVC PHP framework, designed for developers who need a simple and elegant toolkit to create full-featured web applications.

PHP: Server scripting language for making dynamic and interactive Web pages.

HTML: HyperText Markup Language is the standard language for creating web pages and applications.

CSS: Cascading Style Sheets is a style sheet language used for describing the presentation of a document written in a markup language.

MySQL: Open-source relational database management system.

Apache2 Server: Web server software.

NSF: National Science Foundation offers funded research opportunities through Research Experiences for Undergraduates (REU).

NASA: National Aeronautics and Space Administration is an organization that offers Undergraduate Research Fellowships and internships.
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Vieyra, M., Carlson, A., Leaver, E., & Timmerman, B. Undergraduate Research: I Am Not Sure What It Is, But I Don’t Have Time to Do It Anyway. Council on Undergraduate Research Quarterly, (Spring 2013, Volume 33, Number 3)