

A Directory Service for Multi-literate Users

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ABSTRACT

User directory services, such as a database service cataloging people in a company or community, are important components today to many online applications. Furthermore, the design of computer applications and interfaces that are appropriate to currently marginalized communities, such as those in rural and poor areas of the developing world, has become an increasingly important research area. We have developed and tested a novel user directory service made specifically for rural communities and for users with low written and computer literacy. Our system supports a new interface design that allows users to perform directory searches for people across a number of dimensions without requiring written literacy nor keyboarding skills. This user directory service was tested in a rural community of the Dominican Republic. Initial results suggest that the general user interface and iconography was effective in supporting users with a range of written literacy and computer skills. However, results show that the Boolean query mechanism, as implemented, is difficult to master.

Keywords

Directory services, multi-literate interfaces, information technologies for development, LDAP, VoIP

INTRODUCTION

The adoption of information and communication technology (ICT) and use of online applications are seen as important ways for many currently marginalized communities, such as in rural areas of the developing world, to improve their social and economic standing.

While some technologies pioneered in the North can be ported to these communities, they need to be reconsidered and reimplemented to be suitable to local conditions. An important area of research is the design and implementation of computer applications to meet the needs of these communities. For instance, an appropriate user interface can allow a wide range of users, including those with low

written and computer literacy, to access these applications.

Rural communities in developing countries face many constraints to good communication including poor infrastructure. Medical information for preventive healthcare, education for the entire community, and agricultural advice are examples of important communication services that can directly improve the well-being of the community. Strong communications also boosts commerce and increases efficiency of business transactions, for example, permitting orders to be communicated more quickly. A user directory service can complement a basic communications service by helping to organize the information sources these communities link to.

This paper presents a novel user directory service made specifically for rural communities and for users with low written and computer literacy. The directory service proposed supports a new interface design that allows users to perform directory searches across a number of dimensions without requiring written literacy nor keyboarding skills. Sophisticated Boolean queries, including AND and OR operators, are supported.

RELATED WORK

Our research builds on related work ICT for development, directory services and user interface design.

Community Communication and Display

We are particularly interested in the application of ICT to rural and developing areas. Little work has been done in the area of software development for rural. One example is Community Knowledge Sharing (CKS), an asynchronous messaging system designed for use in the developing world [5]. CKS provides one of the first examples of a purpose-built messaging system for the developing world.

Directory Services

Most directory services are text-based, where users type in keywords or browse through a hierarchical text menu structured by categories. Examples include Yahoo!, various phone book directories, and yellow pages directories. For all of these the primary filter is constructed by entering one or more text keywords which are logically-combined with Boolean operators.

Finding Information

Graphical depictions of Venn diagrams have been proposed as a way to improve Boolean query specification. Several studies have found such interfaces to be more effective than their command-language-based syntax [1][2][3]. To augment query specification, Fishkin and Stone have suggested a visualization extension where a “magic lenses” is used to focus attention on details of a returned query result. This technique was shown to be well suited to a geographical search. [4].

Displaying Information

Young compares displaying information in a list and in a hierarchical tree. Together they can be combined in a hierarchical navigation system with multiple levels of views revealed upon selection. [6] Fishkin shows a two-level view used on a 2D map-based display where a scrollable map helps the user pick items of interest which can be zoomed in for a detailed view [4].

SYSTEM DESIGN AND PRINCIPLES

The user interface design of the directory service was guided by two principles: support for non-textual operation and ability to browse by multiple dimensions. Following on these principles we distilled the search process into three component activities and architected the system to handle each of these phases:

Addressing: A user forms a mental picture of what to search for. It can be as well-defined as knowing the specific name of the person, or as broad as knowing someone with a particular skill or interest.

Representation: The mental picture is transformed into an input for the search interface. Representation is akin to constructing a filter that selects particular records from the database.

Searching: A user browses the results returned from the query a satisfactory hit is located. Searching can also cycle back to addressing and representation to further fine-tune the search.

SYSTEM DESCRIPTION

Architecture of Directory Service

The user directory service architecture consists of several elements (figure 1). This system is similar to a conventional text-based directory service and uses the industry-standard Lightweight Directory Access Protocol (LDAP) system [7], for linking clients to the database server. Much of the complexity of querying and retrieving database records is abstracted from the user by the client interface.

User Interface Design

The main screen (figure 2) of the user directory service is a single window filled with user interface elements ready for an initial query. These elements are arranged from top-to-bottom to match the three-step search process as described above in the design principles.

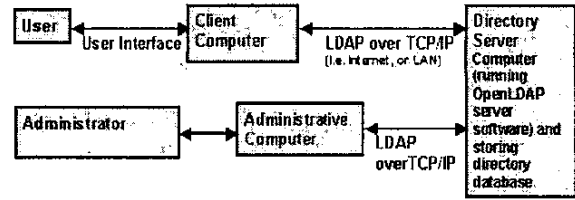


Figure 1. System architecture

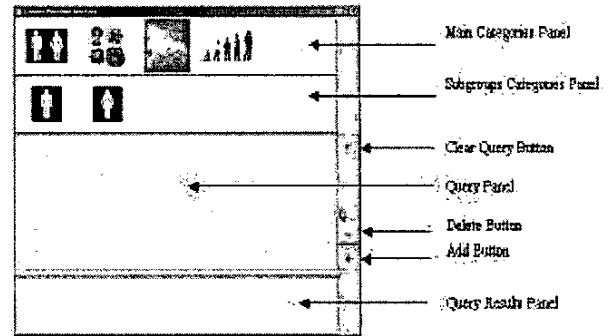


Figure 2. Main screen

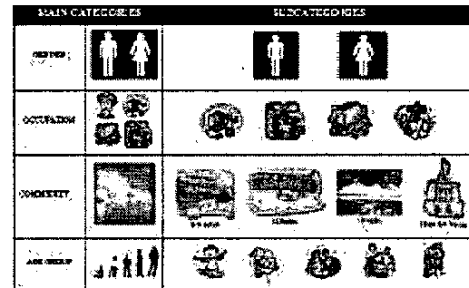


Figure 3. Examples of categories and subcategories icons

The main categories and subgroups are each displayed as horizontal scroll-lists. Below this is a brightly-colored query panel where the user visually forms the query. At the bottom, the query results panel shows the results of the query formed on the query panel. Auxiliary buttons to help manage the query are on the right, though all operations can be achieved solely by mouse operations within the top-to-bottom elements. No keyboard usage is required for any of the actions.

Addressing

A user query starts by formulating search intents into:

- 1) People already known: their name, face, or physical characteristics.
- 2) People by categories: their occupation, business or professional skill.

The main and subgroup categories list pictorial icons representing likely search dimensions (figure 3). An audio prompt also describes the category as the user moves the mouse over each icon.

Representation

To construct a query, the user picks a main category and selects a subgroup category. This is done via a click on the main category icon, then double-clicking on the subgroup category icon or by dragging-and-dropping the subgroup category icon from the scroll-list to the query panel or; by clicking on the Add button, after having clicked on the subgroup category icon. All these actions result in the subcategory icon appearing on the query panel. To construct a query involving a combination of subgroup categories, for example, "A AND B", or "A OR B", the user can continue to insert more subgroup category icons onto the query panel. Removing the icons from the query panel is done by dragging-and-dropping the icon from the query panel to any position outside the query panel, or by clicking on the delete button, which removes the last-placed icon.

Once the desired subgroup category icons are on the query panel, they can be combined into a query filter. Inspired by the Venn diagrams approach, we investigated two methods of combining the subcategories into a query filter: 1) a simple version where all icons on the query panel, regardless of position on the query panel, will be "AND"ed together; and 2) a complex version where overlapping icons will be "AND"ed together, and non-overlapping icons will be "OR"ed together.

Figure 4 shows a sample Query Panel view that presents a query does not depend on the type of filter: "Female educators living in Bohechio". Figure 5 shows another sample Query Panel view. This query depends on the type of filter: a) simple version filter: "Female educators living in Bohechio", b) complex version filter: "All females, plus all people living in Bohechio, plus all educators".

Searching

The visual representation of the query in the query panel constructs a list of matching results which is displayed in the query results panel. These results are displayed as faces, to help users find people whom they already recognize. The panel is interactive; as the user adjusts the icons on the query panel, the list of matched records is updated immediately. Users wanting to find more about the skill sets of the person can move the mouse pointer over any face. A window pops-up (figure 6) showing a detailed record of the person pointed to by the mouse. This window contains text data, but users who are non-literate can click the speaker icon to hear an audio description. The call button lets the user proceed with a telephone call to that user. Clicking on the close button or any other element removes the pop-up window.

Implementation

The directory service client was fully coded in java and implemented on PC's running Microsoft Windows. It provided the GUI and translated the visual query into LDAP commands which were sent to the directory server, that ran OpenLDAP, an open-source LDAP server package.

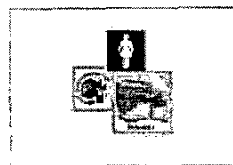


Figure 4. AND operation

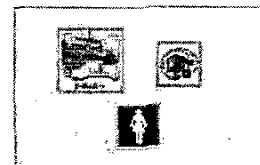


Figure 5. R operation

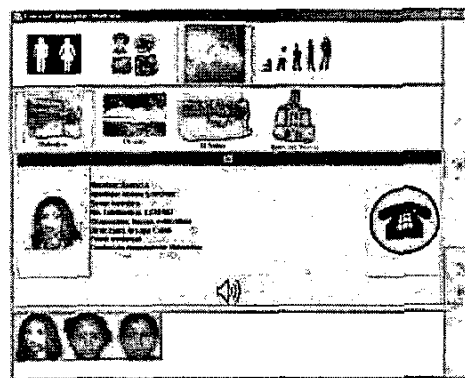


Figure 6. Search results panel

EVALUATION

In 2002 the directory service was evaluated in a user study conducted in Bohechio, a rural agricultural village in the Dominican Republic, where a Little Intelligent Communities (LINCOS) community telecenter exists. The evaluation methodology and instruments were based on recommendations obtained from previous research studies conducted in Bohechio [5][10], and from existing methods of evaluating user interfaces [9]. The user study was part of a larger suite of tests involving the user interface and the audio quality of the Convivo Communicator [10], a voice over IP system for poor quality networks.

RESULTS

In total, twenty-five people participated in the user study. Participants were asked to use the GUI to perform a query to locate all the women who work in the LINCOS telecenter in Bohechio. Test results were obtained from observing participants and from interviewing them after the exercise. To assess the overall user response to system we used Brooke's System Usability Scale.

We found that the user interface was easy-to-use and approachable. The results from the test (table 1) showed that users felt comfortable and confident while using the directory service. Although the usability test results showed that the interface was easy-to-use and approachable, during the study we observed that most of the participants had problems completing the query. Only five participants finished the query successfully and easily. These five people did the exercise fluently and without asking assistance. The rest of the participants asked for assistance, or did not complete the query, or inputted an incorrect query, or did not know what to do.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I would like to use this system frequently	18	9	0	0	0
I thought the system was easy to use	19	5	1	0	0
I would need the support of a technical person to be able to use this system	0	2	1	9	13
I would imagine that most people would learn to use this system	9	12	0	4	0
I felt very confident using the system	12	9	3	1	0
I need to learn a lot of things before I could get going with this system	1	4	1	11	8

Table 1. usability test results

The “Venn diagram” approach to specifying operations turned out to be a difficult concept for most people to grasp at first hand. It appeared difficult to symbolize and represent a complex query of “AND”s and “OR”s using a mix of overlapping and non-overlapping icons. Therefore, most users preferred the simple approach, using only “AND” operators in the query. Some villagers noted that the skill to convey more complex queries visually could be learned over time and it was worth devising better ways to represent the queries. We also found that facial recognition was a quick way to browse results when the user already knew the search target.

of mentions	their uses for the user directory service mentioned by study group
8	As a tool to facilitate contacting and finding relatives and friends
6	As a tool to provide more information about communities
3	As a tool to find jobs
1	As a tool to census
7	Didn't have an opinion

Table 2. their uses for the directory service

Most participants agreed that the directory service GUI should be an essential component of a communications package. They would like to use it in conjunction with a communication application to perform searches for friends and family. Also, they noted how an enhanced directory service could be more than just a search tool, but also a learning tool about other locations or fields (table 2). Users suggested that related information could be delivered as they were browsing locations or skill sets.

CONCLUSION

We have developed a novel non-textual multi-literate directory service and evaluated it in a rural user environment. Our software implementation translated graphical representations into LDAP queries for use with a standard LDAP server. Initial results suggest that the

general user interface and iconography was effective in supporting users with a range of written literacy and computer skills. The primary concept of using faces for browsing worked well, and so did organizing the community around different categories. However, results show that the Boolean query mechanism, as implemented, is difficult to master. Still, there is enthusiasm for a useful directory service that caters to a range of users. Future work improving on the visual representation system is indicated. Finally, we note that a combination of specialized LDAP clients, incorporating customized user interfaces, can be a powerful way to leverage the increasing availability of LDAP-based directories and providing accessibility to the largest set of users.

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