Effective Visualization Tool for Job Searching

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Abstract

In this paper, we introduce a web-based visualization tool that provides a new visuospatial and interactive platform for job searching. The tool supports not only the traditional text-based search queries, but also visual search queries based on interaction with geographic space. The job search tool allows users to explore spatial and multivariate information via a web interface that is based on widely-used information APIs. The effectiveness of the new visualization tool is evaluated by comparing it with other traditional job search tools.

Keywords– Information visualization, geovisualization, job search, web tool.

1 Introduction

When people search for a job, they are actually searching for a place to live. In other words, job searchers not only care about the job itself, but also consider a wide range of the other factors. One could be concerned with the number of similar jobs within that area (which could mean greater opportunities for professional development), or one could wonder about quality of life indices for that area, such as the crime rate or cost of living index. As a parent, one may care about if there are good schools within the area.

Yet searching for a place to work is a complicated and multidimensional information task. People need to synthesize a wide variety of relevant variables in order to make a good decision about where to live.

For a job search task, visualization represents a natural, yet under-explored external tool. A visualization of the search space can aid the job search process by providing a natural and intuitive geographic frame of reference. The visual medium also reduces cognitive load by making information and patterns more easy to identify for the searcher [9]. While there are different job search tools available, traditional job search tools do not support information-rich visuospatial job searching.

In this paper, we introduce a new web-based visuospatial job search tool. Stepping beyond the use of traditional text-based selection criteria, the tool enables users to perform a visual search through geographic space. The tool presents an interactive, visual interface that reveals many layers of quality of life indices, gives users the ability to compare regions, and lets users search by a freely defined geographic area. We also compare the functionalities of the new tool to traditional job search tools. The comparison shows that the new tool provides many significant and valuable features for the potential job searcher.

The paper is organized as follows. In Section 2, the related work in information visualization and job search tools are discussed. Section 3 introduces the new visualization tool. In Section 4, the new job search visualization tool is compared to other popularly used job search tools. Section 5 concludes this paper.

2 Related Work

In this section, we show some of the related information visualization methods and discuss other popularly-used tools for a typical job search.

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– Manuscript submitted to The 2013 Int'l Conf. on Modeling, Simulation and Visualization Methods (MSV'13)

Figure 1: A tag-based geovisualization from [19]. Each tag corresponds to a service directory query - red indicates queries that occurred more often than expected and blue indicates queries that occurred less often than expected. (Aerial imagery copyright 2007 NASA, Europa Technologies and TerraMetrics Inc.)

Figure 2: A list of job search results displayed on a map by JobMaps [6].

2.1 Information Visualization

Information Visualization aims to represent data in such a way that facilitates analysis and the generation of new insights using the visual sense as a filter [4]. Research in information visualization has produced both domain-specific and generic tools that present data with maximum transparency, while dealing with common implementation challenges such as performance, interaction, and extensibility.

One example of a information visualization tool was given by Bischof [2], who introduced *Spiegel*. Spiegel is a scientific information visualization runtime architecture that enables the creation of extensible and interactive visualization components. Spiegel serves as a kind of generic visualization operating system, linking together visualization components with a simple interface. Although Spiegel has been primarily applied to the modeling and visualization of astronomical processes, the tool is generic in that it allows for the creation of visualizations for any domain. However, while generic visualizations are often useful, there are also instances (e.g., [12, 18]) where domain-specific visualizations can better represent specific types of information.

Geovisualization, a subfield of information visualization, is an active research area drawing on advances in exploratory data analysis, with roots in the cartographic tradition [12]. Related work in geovisualization has produced tools that aid both researchers and laypeople in understanding, analyzing, synthesizing, and presenting complex geographical data [17, 11, 7].

There are many geovisualization toolkits grouped under the Geographical Information Systems (GIS) umbrella. Some common examples include ArcGIS [1], OpenJump [14], and LandSerf [8]. These toolkits tend to support generic visualizations of geographical data, but provide limited support for analysis of geo-annotated data outside their native formats, their integrations with external data sources notwithstanding. A study which leverages GIS technology for geomodeling and geovisualization has also been presented [3].

An integrated geovisualization tool in the health field is given by Robinson et al. [15], who present $ESTAT$– a geospatial toolkit for epidemiological research. ESTAT is capable of presenting scatter plots, bivariate maps, time series plots, and parallel coordinate plots for geo-referenced data. Each data analysis tool is fully interactive, allowing users to explore and manipulate data in real time.

$CrimeViz$ by Roth et al. [16] is a geospatial tool for analyzing and exploring crime data. In addition to visualizing spatial relationships in complex criminal incident data via the Google Maps API, the tool allows users to manipulate data dimensions through a data panel, and explore temporal relationships through a temporal panel.

Wood et al. [19] have developed a geovisualization mashup prototype based on de-facto standard technologies. It is capable of interactively mapping datasets with spatial, attribute, and temporal dimensions. The tool has been applied to the analysis of data from a mobile directory service. An example visualization from their paper is shown in Figure 1. The figure visualizes the subject of queries made to a mobile phone directory service by location.

2.2 Job Search Tools

There are various job search tools on web, including Indeed [5], Linkedin [10], and Monster [13]. Generally,

these tools require users to input a location of interest and the other job-related information. The tools then return a list of results corresponding to the input criteria. Advanced search options also allow users to enter more specific details, such as the career level, posting date, salary range, or years of experience required.

There also exists an online tool combining traditional job search function with spatial visualization, $JobMaps$ [6]. JobMaps follows the traditional search paradigm, requiring users to enter a location and job keywords, but also displays results visually on a map alongside the job listing (see Figure 2).

Although these tools perform a useful function, they are based on the premise that when searching for a job, one looks only for a company to work for. Yet intuition suggests a more likely premise: job searchers look for places to live, with a low cost of living, low crime rates, good schools, and hospitals, etc. The new job search visualization tool attempts to increase the breadth and depth of information available job searchers, and thereby overcome some of the weaknesses of traditional job search tools.

3 New Visualization Tool

Next, the new web-based job search visualization tool is presented. We first describe the technical description of the tool, followed by a behavioral description.

3.1 Technical Description

Figure 3 gives a technical overview of the new job search tool. The tool uses the standard client-server architecture to retrieve city and job information from the database via a PHP script running on the web server. The PHP server mediates client side requests for job, zip code, and quality-of-life indicator information from a MySQL database, while the client side makes direct requests to the Google Maps, Google Place, and Google Visualization APIs to manage the map display, manage user interaction with the map, display company positions, tables, and charts, and get local institution information.

To retrieve the job search data, we use two Python modules. The first module uses regular expressions to parse HTML from traditional job-search websites for key identifiers such as company name, experience, and job function. The second module downloads and parses zip code data from a zip information database. Both module store the resulting information in a server-side database. Further processing is done on the server by another Python module, which aggregates jobs in each city, saving city information in a separate table.

After the user selects a location, the client queries the database for job information corresponding to that location. Only the top twenty results are initially displayed to improve performance. When the user clicks on a job item in the displayed table, an event is triggered which passes the job place information to Google Place API, which returns the exact location of the company. The job description is also passed into Google Search API, which returns the search result of the job position and list on the left panel.

The tool also supports a one-hour-driving visualization from a specified company location. The visualization shows the approximated one-hour-driving range as a green-shaded area via a recursive call to the Google Maps API. The area is defined as the convex hull of seven 70-mile-away locations on the Google Map.

Another feature of the tool is the display of zip code and quality of life indicator information. For these displays, the client queries the databases on the server and displays markers on the map with varying intensities according to indicator rank. Searching for institutions (e.g., high schools, hospitals) is also supported by implementing a keyword search through the Google Place API.

The tool also allows users to compare multiple areas. The comparison component is primarily implemented using Javascript / jQuery and the Google Maps API. When a user clicks on the map, the client calls the Google Maps API to draw an adjustable circle which defines an area of interest. Then, the information queries are limited to the area through a client-side filter for the defined area. For the data comparison visualization, the tool utilizes the Google Visualization API.

3.2 Behavioral description

In the next section, the behavioral description of the tool is discussed.

When users first use the job search tool, two panels are displayed. One panel shows the controls for user queries and selections. Another panel shows the map of the search space with search results displayed on top of the map. One example is shown in Figure 4 (a) (with a zoomed-in map). On the map, red circles represent cities with job openings, and circle size indicates the total number of jobs within that city. Users can either select a city or select an area to search all the jobs within that city or area. In the control panel, users can also choose a job area, job type, and experience level to make their search more precise.

If users choose an area on the map, a table of job list-

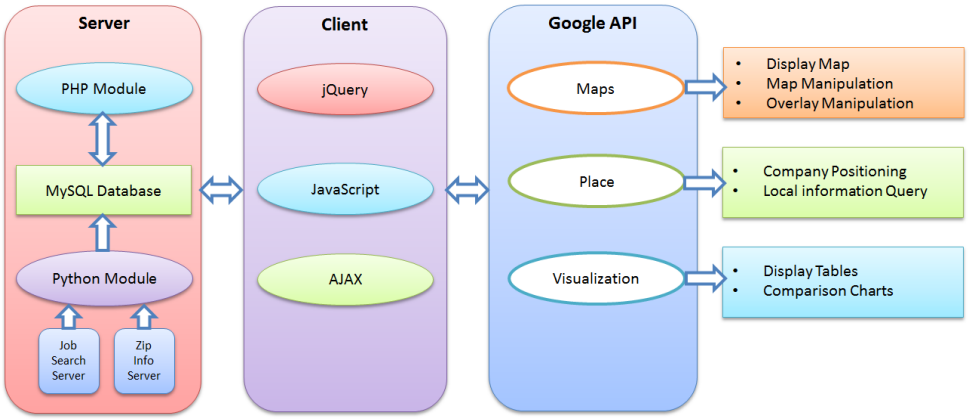


Figure 3: A technical overview of the visualization tool.

ings is displayed. At the bottom of the control panel, the user can click on interesting job positions to get more information, as shown in Figure 4 (b).

On the map, company location is indicated by a marker. When the user clicks on the marker, an option panel with three choices is displayed. The first choice allows the user to draw a circle with the company as its center, and adds the area to the comparison list, (which will be discussed later). The second choice allows the user investigate the one hour driving range from the company for quality of life indicators and other relevant information. Using the selected area as a reference, the user can inspect house prices, crime rates, the cost of living index, high schools or even restaurants. When the user investigates an area for related information, data aggregated by zip code are presented. Each zip code has a green marker located at its center, and the intensity of the marker indicates the rank of the zip code's index among all zip codes in the U.S. Users can also search for colleges, high schools, or other institutions within the selected area. The institutions' locations are marked on the map, while their names are listed in a table form. When the user clicks on an institution in the table, the corresponding marker on map bumps to highlight the institution's location. An example is shown in Figure 4 (c). In the figure, a company in Columbus, Ohio, is marked, and the one hour driving range is shown as a green shaded region, while nearby high schools are also marked with blue squares.

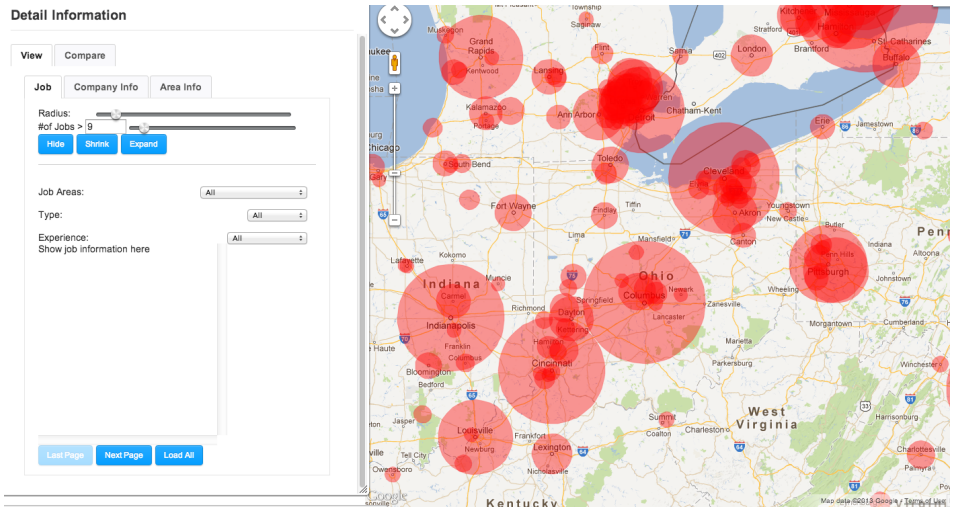
The comparison of multiple areas is also supported by the tool. To compare areas, users draw circles over the relevant areas, then select quality of life indicators (e.g., median income, cost of living index) to compare. The tool then displays three charts comparing the areas with respect to the information selected as well as the total job numbers. The first two charts are simple bar charts showing the comparison of job numbers and the selected information. The last chart is a bubble chart, which plots the comparison between the selected information on an X-Y scatter plot with the circle size indicating the number of jobs (see Figure 5 (a) and (b)).

4 Comparison of Job Search Tools

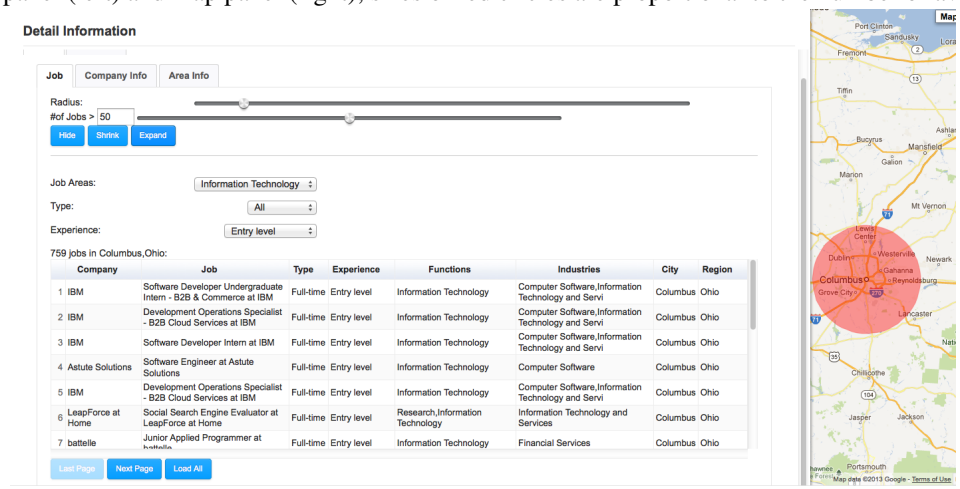
In this subsection, we compare our new visualization tool with other widely-used job search tools.

The fundamental difference between existing job search tools and the new tool is that the former provide a text interface and a table of listings, with relevant information such as company location and distance, but without a visual interface presenting the data in an intuitive spatial layout. The one exception is JobMaps [6], which presents job results visually on a Google API-enabled map. Yet JobMaps displays individual results, and not aggregate data, and does not allow user interaction–users cannot search by a freely defined geographical area. The new tool not only visualizes the geographic locations of job opportunities, but also offers an easily accessible, aggregate view of overall job distributions. While both traditional job search tools and the new tool offer users a listing of job opportunities, the new visualization tool presents results geographically and gives an immediate overall picture of where certain job type is aggregated.

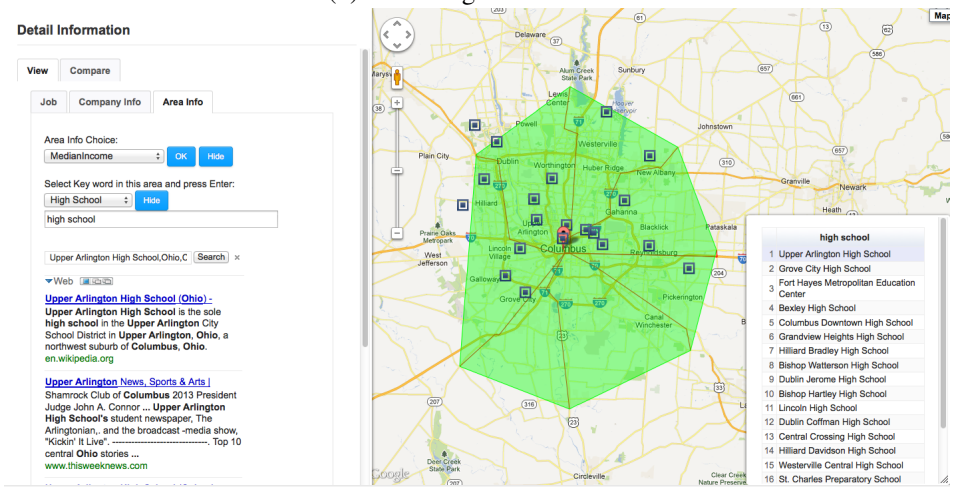
The new visualization tool also offers users information often considered beyond the scope of traditional job search tools. As noted in Section 2, traditional job search tools have relatively narrow view of the job search– finding a job is, simply, finding a company to work for. On the other hand, the new job search vi-



(a) Control panel (left) and map panel (right); sizes of red circles are proportional to the number of available jobs.

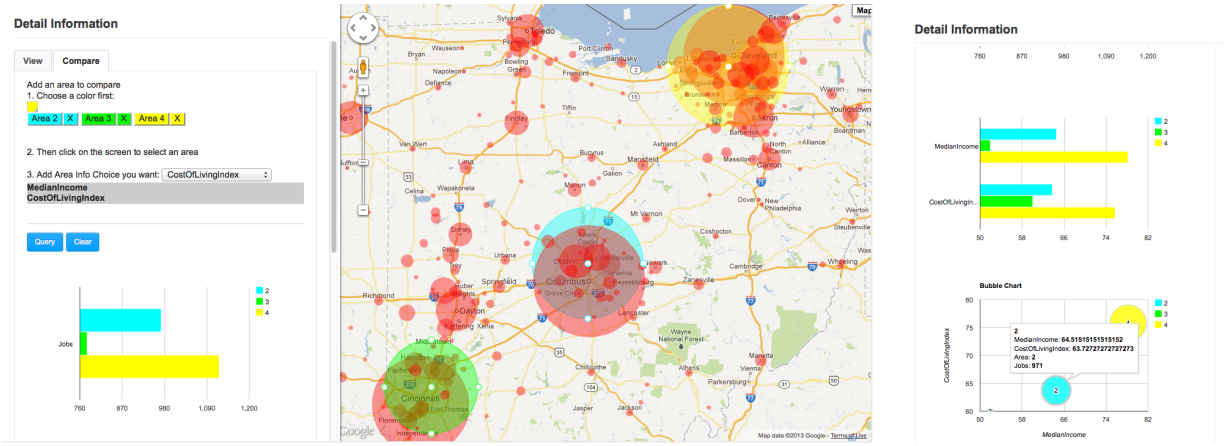


(b) Job listing in table form.



(c) One hour driving range and nearby high schools for a user-selected company.

Figure 4: Functionalities of the new tool.



(a) Three-city comparison: map selection and a comparison chart

(b) Other comparison charts

Figure 5: The area comparison functionality of the tool

sualization tool is motivated by the intuition that job searchers search for places, in addition to companies to work for. Thus, the new tool gives users immediate, visual access to a wealth of area information, so that the user can easily acquire a comprehensive summary knowledge of the potential work place.

In addition to providing area information, the new job search visualization tool also provides users with the ability to analyze information relevant to the job search through area comparisons. This interactive feature, missing from traditional job search tools, extends and deepens the tool's motivating idea that users search for a place to live; the tool provides users a means to inform themselves on the differences between places. The ability to compare greatly aids their decision making– users can highlight two, three, or more areas which they are considering, and compare them using the indices made available by the tool, thereby gaining an appreciation for the relative qualities of each selected area.

Table 1 summarizes the contrasts between the new visualization tool and LinkedIn, Monster, and JobMaps. Like traditional tools, the new visualization tool supports job searching and filtering, but it also supports visualization of company locations, job aggregations, zip/area information and area comparisons, as well as filtering jobs by a freely defined geographic area. However, the job search visualization tool does lack some features widely available among popular search tools (e.g., providing social networking services).

Functionalities	LinkedIn, Monster	Job-Maps	New Tool
Provides job search listings	√	√	√
Allows user to filters listings	√	√	√
Displays aggregate job information	×	×	√
Displays zip/area information	×	×	√
Allows user to view jobs by area	×	×	√
Allows for comparison between areas	×	×	√
Displays company locations	×	√	√
Provides social networking services	√	×	×

Table 1: Functionalities of different job search tools

One feature that is currently missing from the job search visualization tool, but found in many traditional tools, is the ability to create a searchable profile and the ability to connect this profile to other job searcher or employer profiles. Implementing this feature was not considered a high priority, since its absence does not detract from the main contribution of the new visualization tool– features like visual searching, visualization of area information, and area comparisons. The employee profile features, best demonstrated by LinkedIn [10], could also be added in the future.

5 Conclusion and Discussion

In this paper, we have presented a new job search visualization tool that gives users access to a wide spectrum of useful information relevant to the job search. In addition to giving users the ability to search through geographic space using an interactive map, the tool can visually reveal multiple indices relevant to the job search. The tool also lets users compare regions across a range of indices.

Although many job search tools already exist and some have geographical components, these tools either have limited support for location-based searching, or statically present job place information. We are unaware of any other tools that let users interactively search using a visual interface, present multiple quality

of life indicators with job search data, and allow users to compare geographic regions using these indicators.

In the future, other features will be considered to improve the user's search experience. One possible area for improvement is user-customizability; searches could be customized with a profile which allows users to store a history of searches, interesting indices, index comparisons, or a customized search interface. With customization, the job search visualization tool could also support crowd-sourcing the job search; users could give comments on companies or area indices, and grade each index along a spectrum. The tool could then visually present the crowd-sourced information to search queries. Here, we note that a user study to quantitatively evaluate the new tool is being conducted. The result of the user study will also be considered to improve the tool.

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