

Radial Visualization for Geo-spatial Categorical Data

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ABSTRACT

Determining the location of a new public facility is one of the most critical and challenging tasks for local governments. To analyze the area of influence of a potential facility with respect to the distribution of existing facilities, the capacity of those existing facilities, and the demographic characteristics of the area of influence is of central significance in this planning process. We present an interactive radial visualization that allows planners to analyze the area of influence of the potential facility. The proposed visualization provides an intuitive way to identify the presence or absence of public facilities of different categories as well as it complements the traditional geographic view used by urban planners.

Index Terms: H.m [Informations Interfaces and Presentation]; Miscellaneous—; J.5 [Computer Applications]: Arts and Humanities—Architecture

1 INTRODUCTION AND RELATED WORK

Facilities planning aims at establishing the conditions that guide the development of an urban area in terms of the services that should be provided to inhabitants to guarantee their quality of life. For this reason, identifying possible imbalances in the provision of services to the community is advantageous to plan the location of new facilities. One of the approaches used by urban planners to identify such imbalances is the circular service area [3]. This approach considers a circular region (which represents the area of influence of the potential facility) with the potential facility located at the center and the radius defined by a specific criterion (e.g. travel distance or time). Commonly, urban planners use GIS tools to facilitate the analysis of this area. However, they still have to analyze all the existing facilities, the type of service they provide, and their distance to the potential facility one by one. This prolongs the time of assessing a potential location considerably and hinders the task of finding imbalances in the provision of specific services.

An alternative to overcome the current issues when analyzing facilities using geographical visualizations is to provide users with interactive visualization tools that apply coordinated views to see the data from a different perspective [1]. In this project, we consider particularly radial visualizations as complement to the traditional geographical view since they are a natural mapping from the circular service area in the geographic space to the abstract visualization space.

The survey of radial methods for information visualization presented by Draper et al. [5] describes the star plot pattern as a suitable way to depict multivariate systems in a compact form. A par-

ticular sort of star plot is known as radar plot [10]. In this plot, each variable is mapped to an axis and afterwards the plotted points are connected with a line forming a polygon. Even if this plot allows for the comparison of different polygon areas generated by different data values, it does not consider the plot of multiple points over a single axis. Hence, this approach is not applicable for the data. Moreover, examples of radial visualizations applicable to geo-spatial analysis are mainly related to the visualization of time series as can be seen in the visualizations presented in [8] [7] [2] [6].

With the purpose to ease the identification of imbalances and the comparison of the conditions of different potential facility locations, we propose a radial visualization that resembles the circular service area on the geographical view. We explain how the relevant attributes of existing facilities can be represented in our radial visualization by using different visual attributes, and finally we present our conclusions and possible approaches to improve the understanding of facilities distribution.

2 SOLUTION OVERVIEW

Taking into account the task we want to support, the main drawbacks of the visualizations presented in the previous section are the following:

- Most of the techniques use the space filling approach which hinders the meaning of the distance dimension needed;
- the application of radial visualizations in the geo-spatial analysis field is focused on the visualization of time series;
- there is not a natural mapping from the specific domain view to the abstract view.

The proposed visualization displays the 6 most critical categories of facilities (education, social welfare, culture, sports and recreation, health, and food supply facilities) along radial axes. The center of the circle represents the location of the potential facility. Each of the surrounding facilities is represented with a rectangular glyph which is positioned over its corresponding category axis, and the distance to the center represents the relative distance between the potential location and the existing facility. The width of the rectangular glyph represents the capacity of the facility. The criteria used to represent facilities in the proposed visualization is as follows:

Facility categories: We use color coding to differentiate among different types of facility. Color coding is an appropriate technique to depict categorical data. According to Ware [9], nominal information coding can be achieved by using distinctive colors among the objects to code.

Facilities representation: We use rectangular glyphs [4] to represent the capacity of the facilities. This particular attribute of the facilities is not directly related to the size of the parcel where they are located and it is not represented in the geographical view since it is focused on the coarse geometry of the facilities.

3 CASE STUDY: LABORATORIO BOGOTÁ

A study to assess the current situation of public facilities in the city of Bogotá (Colombia) was realized by a group of experts at the Universidad de los Andes under the agreement 300-2009 between Universidad de los Andes and SDP — Secretaría Distrital

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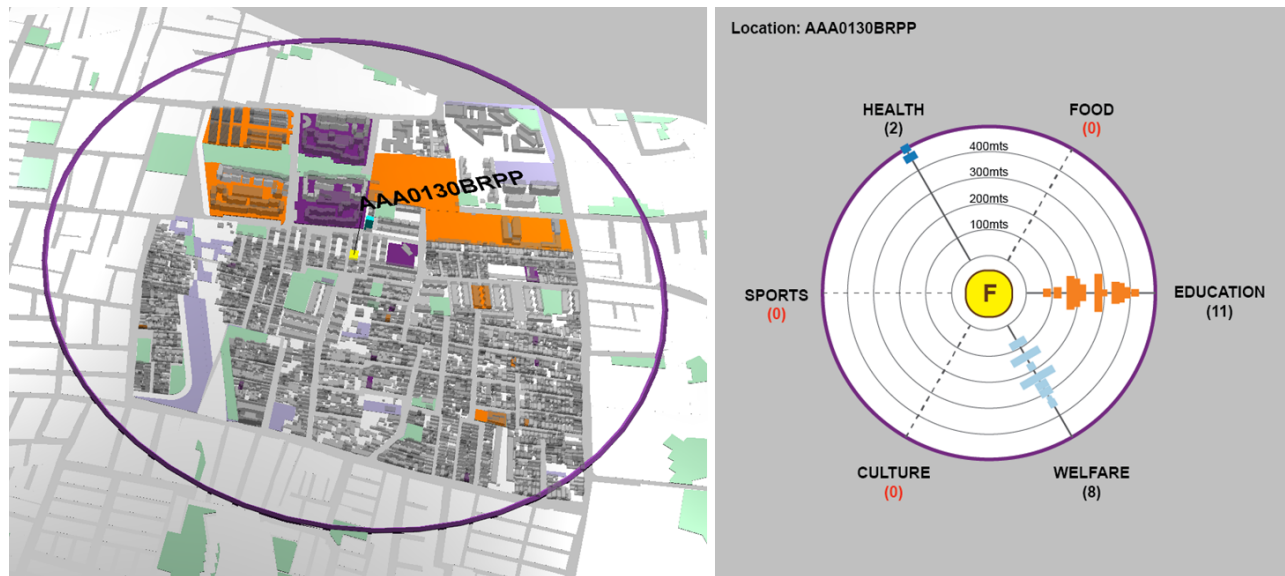


Figure 1: Analysis of a potential facility location with a circle service area of radius 500 mts.

de Planeación (District Department of Planning). In this project a set of empty parcels was selected and the circular service area was evaluated for each of these parcels.

A tool integrating the geographical and abstract views was developed to test the use of the proposed technique. The tool also allows users to interactively configure the size of the circular service area. For the test case we applied a 500 meters radius which means that all facilities located within the circular service area reachable at walking distance (10 minutes-walk). Figure 1 shows the geographical and radial view obtained for the analysis of one parcel. While the geographical view shows the exact position of the surrounding facilities in the circular service area, the radial visualization evidences the absence of cultural, sports and food supply facilities in the area. This is a direct hint for the urban planners focus on the development effort in these three categories of facilities.

4 CONCLUSIONS AND FUTURE WORK

This poster presents a radial visualization technique in addition to a geographical view to support the assessment of potential locations for new facilities. Despite radial visualizations such as the star plot is not novel, the use of this technique helps experts to rapidly get information about the distribution of public facilities. The experts that participated in the Laboratorio Bogotá project reported a considerable reduction in the amount of time they spent to assess a potential location for a new facility by using this visualization. They have also reported that the radial technique implemented to support this task is suitable for communication purposes.

Future work includes the application of different distance functions to determine the position of the facilities in the radial visualization. These functions can provide valuable information with respect to different accessibility metrics that consider the demographic characteristics in the analysis area, the elevation of the terrain, and access to transport facilities among others. The exploration of radial-based methods to compare multiple potential locations for new facilities as well as the exploration of visualization alternatives that help to reduce the occlusion generated when two or more facilities from the same category are too close, is also part of the future work.

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REFERENCES

- [1] M. Q. W. Baldonado, A. Woodfruss, and A. Kuchinsky. Guidelines for Using Multiple Views in Information Visualization. In *AVI '00 Proceedings of the Working Conference on Advanced Visual Interfaces*, pages 110–119, 2000.
- [2] K. Bale, P. Chapman, N. Barraclough, J. Purdy, N. Aydin, and P. Dark. Kaleidomaps: A New Technique for the Visualization of Multivariate Time-series Data. *Information Visualization*, 6(2):155–167, 2007.
- [3] D. Bigman and U. Deichmann. Spatial Indicators of Access and Fairness for the Location of Public Facilities. In D. Bigman and H. Fofack, editors, *Geographical Targeting for Poverty Alleviation*, chapter 6, pages 181–206. The World Bank, Washington D.C., 2000.
- [4] R. Borgo, J. Kehler, D. H. S. Chung, E. Maguire, R. S. Laramée, H. Hauser, M. Ward, and M. Chen. Glyph-based Visualization: Foundations, Design Guidelines, Techniques and Applications. *Eurographics State of the Art Reports*, 2013.
- [5] G. M. Draper, Y. Livnat, and R. F. Riesenfeld. A Survey of Radial Methods for Information Visualization. In *IEEE Transactions on Visualization and Computer Graphics*, volume 15, pages 759–776, 2009.
- [6] Y. Drocourt, R. Borgo, K. Scharrer, T. Murray, S. I. Bevan, and M. Chen. Temporal Visualization of Boundary-based Geoinformation Using Radial Projection. *Computer Graphics Forum*, 30(3):981–990, 2011.
- [7] D. Keim, J. Schneidewind, and M. Sips. CircleView: A New Approach for Visualizing Time-related Multidimensional Data Sets. *Proceedings of the Working Conference on Advanced Visual Interfaces (AVI)*, pages 179–182, 2004.
- [8] C. Tominski, J. Abello, and H. Schumann. Axes-based Visualizations with Radial Layouts. In *Proceedings of the 2004 ACM symposium on Applied computing*, page 1247. ACM, 2004.
- [9] C. Ware. *Information Visualization: Perception for Design*. The Morgan Kaufmann Series in Interactive Technologies. Morgan Kaufmann, 2004.
- [10] L. Wilkinson. *The Grammar of Graphics*. Second edition, 2005.