

# Insights into Collections of Spatialized Historical Photographs

## The Urban History 4D Project

Jonas BRUSCHKE, Julius-Maximilians-Universität Würzburg, Germany

Cindy KRÖBER, Technische Universität Dresden, Germany

Heike MESSEMER, Julius-Maximilians-Universität Würzburg, Germany

**Keywords:** *Image Repositories — Information Visualization — 4D Browser*

**CHNT Reference:** J. Bruschke, C. Kröber, H. Messemer. 2020. Insights into Collections of Spatialized Historical Photographs. W. Börner and CHNT Organization Committee. Proceedings of the 25th International Conference on Cultural Heritage and New Technologies.

## Introduction

The Urban History 4D project<sup>1</sup> investigates and develops approaches to repositories of images of the city of Dresden. Images and plans provide information on the appearance and architecture of the city as well as their development over time.<sup>2</sup> Access to the information repositories relevant for both the general public and scientific research is usually challenging (Lazarinis, 2011). The main aim of the project is to improve the accessibility of the data through visualizing, spatializing, merging, structuring, and annotating historical photographs in a virtual 3D model. A further ambition is to investigate and develop methods and functionalities that support the analysis and processing of historical photos. On the one hand, the photographs serve as a database for creating 3D models. On the other, they will be included in quantitative analysis addressing research questions from art and architectural history.

Most digital image repositories present their content and photographs in tiles that users can browse. Browsing image galleries has been a common way to access the content and search for certain images for a long time (Besser, 1990). However, a different approach uses geographic positions to display and contextualize information (Fabrikant and Buttenfield, 1997). This method has potential to uncover and visualize certain phenomena linked to the initial acquisition of images. The spatial search approach gets complemented by several visualization methods that allow deeper insights into the spatial information of the images.

## The 4D Browser Approach

The 4D Browser<sup>3</sup> (Fig. 1) of the Urban History 4D project is used to link digital images and their actual location making it possible to present resources directly, providing valuable support for historical research. Users of virtual archives can benefit extensively from effective functions and tools to search based not only on content and theme, but also on location.

---

<sup>1</sup> [www.urbanhistory4d.org](http://www.urbanhistory4d.org)

<sup>2</sup> This abstract is mostly based on the following joint publication of the Urban History 4D project: Dewitz et al., 2019.

<sup>3</sup> <http://4dbrowser.urbanhistory4d.org>



Fig. 1. 4D Browser with spatialized photographs, map underlay and timeline.

Currently the 4D Browser of the project provides an accessible collection of 3,600 historical images which come from the Deutsche Fotothek<sup>4</sup>. These images were handpicked and included in the 4D Browser to demonstrate functionalities and serve as data for usability testing. The photographs within the 4D Browser are spatialized in a virtual 3D city model combined with a map underlay. The spatializing also called geo-referencing of photographs refers to the reconstruction of the geographic position of the camera during acquisition. Currently, the photographs are geo-referenced manually. A (semi-)automatic solution is intended, but unfortunately, several existing approaches cannot be easily adapted for historical images (Maiwald et al., 2017). The addition of a timeline within the 4D Browser makes it possible to show how the cityscape, architecture and acquisition behavior changed over time. The timeline supports the selection of (1) a time span for photographs, (2) a point in time for the 3D model, and (3) maps corresponding to a certain date. In combination with the spatialized presentation of historical photographs, this offers an innovative tool to research the perception of the city in temporal and spatial terms and their connection.

## Quantitative Visualizations for Research

Especially for art and architectural historians, the 4D Browser application offers new research functionalities and helps to answer specific questions regarding perspectives. From which location and direction has a certain historical object frequently been photographed? Did the photographers' acquisition habits change over time? An analysis of photo acquisition of a large area provides information on the preferences connected to buildings and the depiction of cityscape, life and culture. This may lead to further discussion on the importance of specific buildings during certain times. How did photography influence the way a city was perceived? What effect did a client have on the photographers' portfolio and the documentation of a city over time?

As a first visualization approach, heat maps have been utilized. The heat map is a two-dimensional data visualization that uses colors and their perceived temperature. It helps to quickly and intuitively detect phenomena within large amounts of data. In our case, a heat map is created that visualizes the most popular posi-

<sup>4</sup> [www.deutschefotothek.de](http://www.deutschefotothek.de)

tions of photographers (Fig. 2a), based on the filtering of desired images for analysis and the distribution of the photos. Another option for a heat map visualization is to project the existing photographs onto the corresponding buildings to indicate which building parts have been documented (Fig. 2b).

Additionally, the direction or angle of photographs carries a variety of information that could help to answer following questions: Which objects were most popular based on their appearance in photographs? Are there preferred angles for certain buildings? Are acquisition angles connected to surroundings? Hence, the 4D Browser introduces additional visualization methods that emphasize the directions in which the cameras were pointing. First, vector field-based visualizations from flow dynamics including animated particles (Fig. 3a) showing the average acquisition area for a certain area were adopted. Second, two cluster-based visualization methods that show the distribution of different acquisition angles of images contributing to a cluster were developed (Fig. 3b).

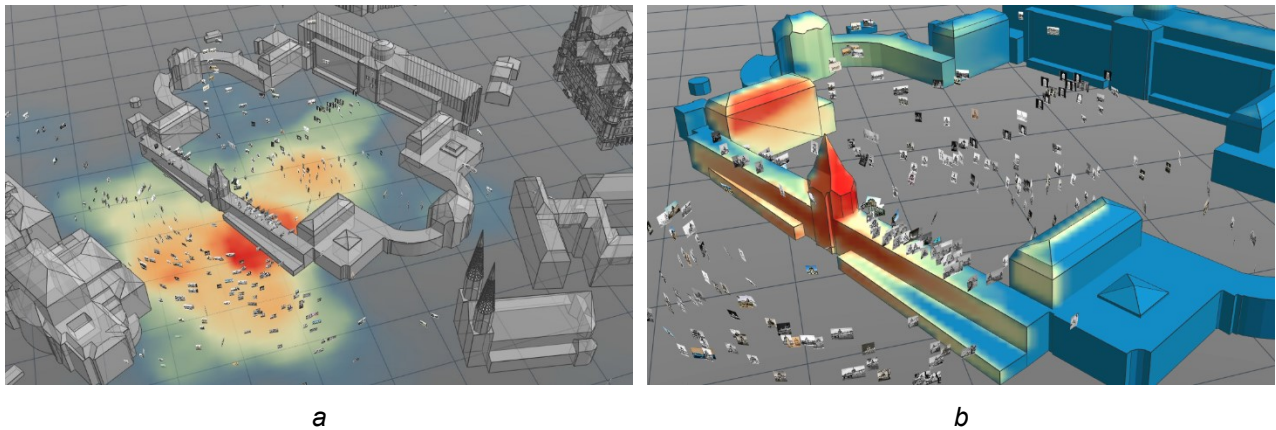


Fig. 2. Heat map visualizations showing a) accumulation of photos and b) which building parts were photographed more often.

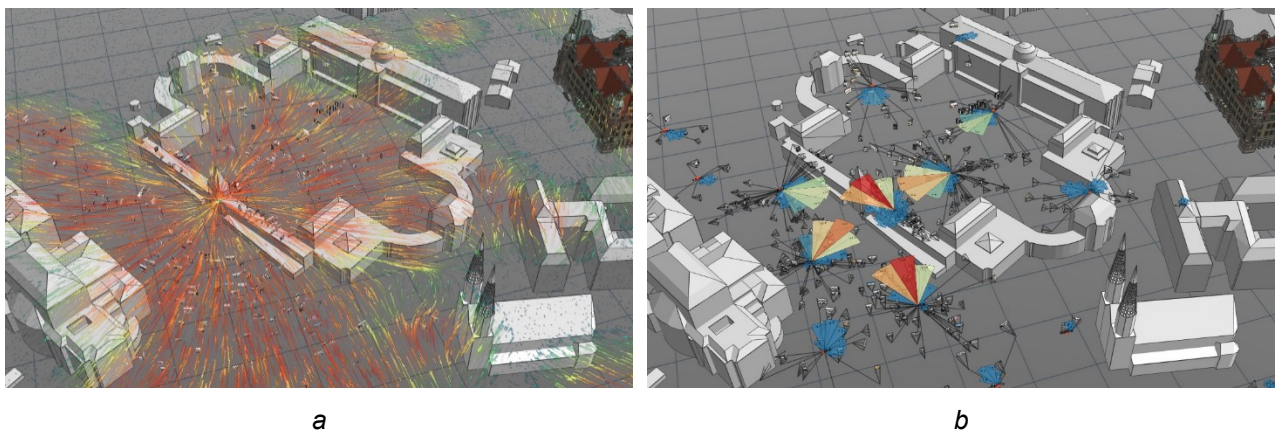


Fig. 3. Visualizing popular angles using a) vector field-based flow animation and b) cluster-based approach with radial fans.

## Conclusion

A conventional metadata search paired with a spatial search approach in a 4D Browser context can enhance the finding of single images as well as the understanding of large collections of images in relation to their built environment. Additional quantitative visualizations can serve as a valuable tool to investigate the correlation between the documentation and the perception of a city and help to answer specific research questions of historians. Though this is a prototype application, aspects concerning the usability and the user experience are still to be evaluated and improved.

## Acknowledgements

The research upon which this paper is based is part of the junior research group Urban History 4D's activities which has received funding from the German Federal Ministry of Education and Research under grant agreement No 01UG1630.

## References

- Besser, H. (1990). 'Visual access to visual images: the UC Berkeley Image Database Project', *Library trends*, 38(4), pp. 787-798.
- Dewitz, L., Kröber, C., Messemer, H., Maiwald, F., Münster, S., Bruschke, J. and Niebling, F. (2019). 'Historical Photos and Visualizations: Potential for Research', *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci.*, XLII-2W15, pp. 405-412. DOI: <https://doi.org/10.5194/isprs-archives-XLII-2-W15-405-2019>
- Fabrikant, S.I. and Buttenfield, B.P. (1997). Envisioning user access to a large data archive. *Proceedings of GIS/LIS*.
- Lazarinis, F. (2011). 'Exploring the effectiveness of information searching tools on Greek museum websites', *Museum Management and Curatorship*, 26, pp. 391-408. DOI: 10.1080/09647775.2011.603935
- Maiwald, F., Vietze, T., Schneider, D., Henze, F., Münster, S. and Niebling, F. (2017). 'Photogrammetric analysis of historical image repositories for virtual reconstruction in the field of digital humanities', *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci.*, XLII-2/W3, pp. 447-452. DOI: 10.5194/isprs-archives-XLII-2-W3-447-2017