Map Morphing: Visualizing Relationships Between Map Views

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Abstract

In this poster, an interactive visualization technique called *map morphing* is introduced. Map morphing provides a visual translation from one model view to another; by morphing between representations, an immediate, visual illustration of view interrelationships is provided. Map morphing is discussed in relation to existing visualization and interface techniques for viewing maps, and its application potential is explored.

Key words: information visualization, GIS, morphing, interaction design.

1 Introduction

Map morphing is a graphical morph from one map to another of approximately the same area. To see its usefulness, consider relating a physically accurate map and a schematic map of the same area (such as a typical subway map). The Geographic Information System (GIS) *overlay* mechanism, which displays geographic data in a series of layers on the same screen region, is not appropriate because a schematic map discards physical accuracy in favour of targeted information presentation. Presenting the two maps side-by-side can lead to translation difficulties when individuals need to move between them. Reference points on both maps can be effective [1], however providing more than a few points can make it difficult to relate these markings, while too few points makes it difficult to appreciate exactly how the schematic map deviates from the accurate representation.

By switching views via an animated morph, we show how the schematic representation differs from a physically accurate representation at all points, and in all directions. In this way, a clearer understanding of the transformations underlying the schematic map can be achieved. This increased "transformation information", along with the ability to switch representations as required, may facilitate navigation or route planning using a schematic map. In general, associating the relative positions of objects across map views should be straightforward for an individual to accomplish when map morphing is used.

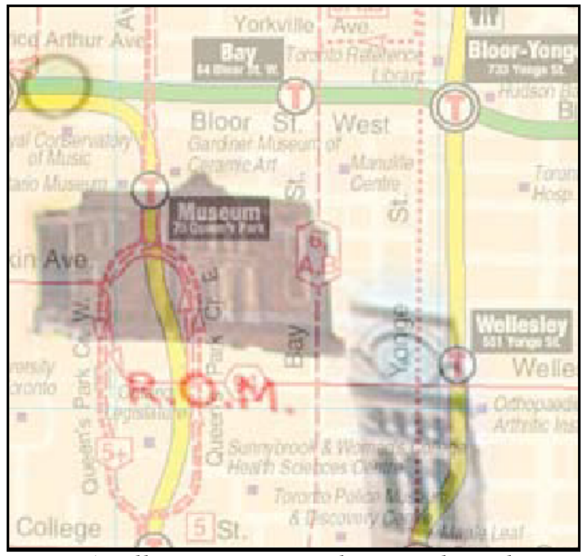

Figure 1. Illustrative example, morphing between schematic and physically accurate maps of downtown Toronto, Canada.

2 Background

Map morphing is an interactive visualization technique. A wealth of research exists concerning interactivity and visualization in general, much of which is applicable to or directly pertains to map views. Much of the research on morphing itself focuses on implementation and its use as a tool for animation however; see [4] for a survey.

Dynamism in map views is an integral part of map interactivity. Werner Kuhn [3] argues that positional data should be perceived as a dynamic *view* of an underlying physical space, rather than as a concrete map. This encourages users to change views as appropriate for a particular task or subtask. Map morphing follows this idea by providing a fluid representation of distinct views and their relation to one another.

Alternative map viewing techniques in the literature include *focus plus context*, and *detail in context*. Both are important to consider in relation to map morphing, and we discuss each in turn. Baudisch et al. [1] evaluated a technique called *focus plus context*, in which a high-resolution (focused) region is provided inside a larger, lower-resolution display. They found the technique advantageous for route finding on maps, over the more traditional techniques of inset reference maps and zooming. This was attributed to increased context around the focused region, and the ability to use a single map view. When it is not possible to provide a single map view, as with topographically divergent representations of the same space, morphing provides additional context and presents all views in the same display region. Morphing, therefore, may provide similar advantages over the use of inset maps.

Carpendale et al. [2] discuss issues of human comprehension when using distorted views such as fisheye views (a *detail in context* approach). They demonstrate a need for appropriate visual cues to ensure that distortion does not affect an individual's internal model of a space. Morphing between physically accurate and schematic maps constitutes just such a visual cue, enabling an individual to use a schematic map without losing an accurate sense of relative positioning.

3 Applications

The map morphing technique is useful both as a complement and an alternative to existing display strategies. Several applications are envisioned in addition to relating schematic and accurate maps.

3.1 Morph and Scale

Traditional zoom techniques involve selecting an area to zoom or centering over the region to zoom. They often do not employ animation to show the zoom, which is arguably less necessary when the zoomed and expanded views maintain the same relative positioning among items on the map. However, one might want a particular schematic relationship at one level of detail, and a quite different one at another level of detail. In such situations, the typical zoom implementation can cause disorientation when changing scales. A *Morph and Scale* interface animates both the zoom and the change in relative positioning between views. By doing so, the relationship between the differently scaled views is made clear.

3.2 Just-in-time Views

When a view is required only intermittently, it makes little sense to provide a constant display of the view. Morphing may provide a fast and intuitive way to switch between or cycle through maps.

3.3 Benefits for Collaboration

Map morphing is well suited to situations where two or more individuals must concentrate on different but related maps. Morphing can facilitate communication by showing the interrelationships between views. Alternately, individuals might share a separate common view, while maintaining their own personal view.

3.4 Screen Space

When a display has low resolution, or small physical size, an inset map may be infeasible. Detail in context and zooming are techniques that address screen space, however they require that the detail be topographically similar to the context or zoomed-out view. Morphing provides a solution when two dissimilar map views are required.

4 Future Work

A scenario-based user study is planned for the near future, and its pilot study is in preparation. Currently in the design phase, plans for the study include the use of a single pair of maps. The maps chosen at present are a schematic map of attractions in downtown Toronto, Canada, and a portion of the transit map covering the same area. Participants will be required to determine relative locations of attractions, distances between attractions, and routes. Performance and satisfaction measures will be recorded, and analysed in comparison with other display techniques such as juxtaposing map views, and selection by thumbnails.

Development of prototype implementations is ongoing. The initial prototype was developed using the GroupLab Collabrary, a toolkit created at the University of Calgary for collaborative multimedia applications. This infrastructure will facilitate planned further study of the technique for collaboration.

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References

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