Addressing Information Overload in Urban Augmented Reality Applications

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ABSTRACT
How can we design effective urban visualizations in augmented reality when there are large numbers of points-of-interest (POIs) to display? We present three issues we have encountered as we tackle this problem in our own research: inadequate support for browsing, limited visual real estate, and minimal use of abstraction.

Author Keywords
Augmented reality, information overload, urban visualization.

ACM Classification Keywords
H.2.8 [Database Applications]: Spatial databases and GIS; H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems—Artificial, augmented and virtual realities; H.5.2 [Information Interfaces and Presentation]: User Interfaces

INTRODUCTION
Over the last few years, the amount of georeferenced information accessible to consumers has increased significantly [8]. This can be attributed in large part to the mass adoption of “smart” mobile devices, which have popularized the use of location-aware applications such as Facebook, Yelp, Foursquare, Instagram, and Flickr. Some of these applications (e.g., Yelp) use augmented reality (AR) to visualize georeferenced information, such as “points of interest” (POIs). As AR becomes more pervasive across mobile and other platforms, we believe that location-aware AR applications will be the standard way to explore spatial information in the real world.

In fact, there are already a number of commercial applications devoted specifically to browsing geospatial information in-situ through AR (e.g., Junaio, Wikitude, and Layar). These “AR Browsers”, however, have not been widely adopted because of technical limitations causing poor registration, a paucity of relevant content, and a lack of information structure to help the user navigate the visualization [6]. Regardless of these limitations, it is our belief that current AR visualization techniques are not adequate for presenting large numbers of POIs in a way that reduces the likelihood of information overload. Further, tasks that use large numbers of POIs will be commonplace in urban areas.

In this position statement, we share some of the issues we have encountered in visualizing data in our urban AR testbed. As part of this work, we are experimenting with hundreds of POIs we have collected from a set of data sources including Yelp, Bing Search, Foursquare, CityMaps, and NYC 311 OpenData for the Flatiron district in Manhattan.

ISSUES
Inadequate support for browsing
Browsing is “the process of exposing oneself to a resource space by scanning its contents” [3]. Browsing thus goes beyond simply presenting information to the user. It is a complex task whose mechanics are not well understood by most users [3]. In the spirit of Shneiderman’s visual information-seeking mantra, Bates [1] and Chang and Rice [3] recommend that browsers need to support four stages of information exploration: 1) Glimpsing the information in the environment; 2) Selection and sampling of this information; 3) Examining selected information in more detail; 4) Deciding whether to keep or discard the selection. When interacting with a large number of POIs, it is crucial to be able to browse through them.

Limited visual real estate
Deciding on a visualization technique is not enough. AR presents both the real and the virtual world, which limits the effective area available for rendering the virtual world.

One way to address this would be by calculating the smallest number of pixels needed to effectively render a single POI to be able to identify it and interact with it. This is determined in part by the visualization and interaction techniques used, the display resolution and size, the location of the user’s eyes relative to the display, and the user’s visual acuity. How we filter POIs is also crucial.

Minimal use of abstraction
Passini [9] argues that, in the real world, anchoring signs and maintaining them in a consistent spatial organization assists users in creating their own cognitive maps, which greatly facilitates navigating and understanding the real world.

Numerous AR browsers, from the Columbia Touring machine [5] to the majority surveyed by Schall et al. [10], fix their visualizations to positions in the real world. While this...
is suitable for viewing geospatial information whose projected POIs do not overlap as seen from the user’s viewpoint, this is rarely the case when viewing information at a distance, as POIs can cluster and occlude one another. View management techniques [2] are useful here, as they can ensure that POIs do not occlude one another. However, if users rely on the visualizations as a means of orienting themselves, view management techniques that change the position of a projected POI in the view plane may prevent users from forming consistent cognitive maps.

One way to address this would be to render POI visualizations spatially wherever the POIs are situated, as long as they are neither obstructed by other visualizations nor occluded by the real world. Otherwise, POI visualizations would be abstracted, each representing a collection of POIs rather than a single one. This abstraction would be in both content and placement. POIs are abstracted in content by utilizing a visualization that encompasses the collection of POIs. While the abstraction of POIs in content is similar to level-of-detail interfaces [4] and to the filtering techniques of Julier et al. [7], each icon in these previous works instead represents at most one POI. POIs are abstracted in placement when, once they have been abstracted by content, they are allowed to move over an area in the environment with which they are associated [2]. Figure 1, which is generated using our testbed, shows the Flatiron district with POIs abstracted in both content and placement, and represented as pictograms.

While the Nokia City Lens browser (http://conversations.nokia.com/2012/09/10/nokia-city-lens-comes-out-of-beta/) provides a degree of abstraction through the clustering of POI visualizations, we believe that it should also be possible to abstract a group of POIs using a single visualization. If this is done recursively, each level of abstraction removes a level of specificity both spatially and contextually. Yet, this poses a number of problems: How should the levels of abstraction determined? (For example, in depicting restaurants, we could partition based on many factors such as: cost, cuisine, rating, or reservation availability.) How should the decision to abstract POIs depend upon task domain, user preference and real-world limitations?

CONCLUSIONS
To summarize, there are numerous concerns that need to be addressed, as we seek to represent large numbers of POIs in AR. To create effective AR experiences using real-world data, further research is necessary to determine which techniques and methodologies are most effective.

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REFERENCES