Free Your Data!
Cenimation: Visualization for Constrained Displays

Sophie Engle* James Shearer* Michael Ogawa* Steve Haroz* Kwan-Liu Ma*

Department of Computer Science
University of California, Davis

Abstract

Understanding and gaining insight from census data poses an interesting multidimensional geospatial visualization task. This paper discusses a tool which attempts to address that task. Specifically, we allow visualization of static, multidimensional data such as nationality, race, or spoken language through animation.

Keywords: Visualization, Multidimensional Data, Animation, Census Visualization, Geovisualization

1 Introduction

Animation is often utilized to augment visualization software. Smooth animation can help users maintain context when navigating large data sets, or when exploring three dimensional volumes [4, 3]. Furthermore, it is a natural fit for visualizing change in time-varying data sets [1].

We have also found animation useful in enhancinging the visualization of static geospatial data from the 2000 U.S. Census. With animation, we can effectively present data on resolution-constrained displays, avoid misleading geospatial layouts, assist users in building a "mental model" of the data, and provide a visually pleasing experience. We introduce Cenimation – Census Animation.

2 Data

The 1% Public Use Microdata Sample (PUMS) from the 2000 U.S. Census provides diverse data for geographic subdivisions called super-Public Use Microdata Areas, or super-PUMAs. These geographic regions contain a minimum population of 400,000. For each super-PUMA, we extracted the percentage of people belonging to the seven represented racial categories. We also utilized the U.S. Census Bureau's 2000 1% PUMA cartographic boundary files.

3 Animated Approach

Like many data sets, our super-PUMA race samples are ripe with interesting information. They tell us a story of diversity and homogeneity – but not when they are inert; not when imprisoned as simple text.

We chose to free this data using color and animation. Upon startup, we assign each of the seven represented races a color, choose a default glyph shape, and then being the animation loop. During each iteration of the loop, we select a random location within *each* super-PUMA, and "plant" a new glyph which will grow to full size in subsequent iterations. We color the glyph based on a stochastic selection conforming to the super-PUMA's racial breakdown. For example, if 43.4% of the surveyed people in the super-PUMA self-identified as "Native Hawaiian or Other Pacific Islander," then our selection will be colored as such with probability 0.434. This process continues ad-infinitum, during which users can experiment with glyph shape, maximize size, birth rate, growth rate, and other attributes. The resulting animation is an ever-tiling, bubbling visualization wherein the racial consistency of a super-PUMA leaps out at the viewer.

*e-mail: {engle,shearer,ogawa,haroz,ma}@cs.ucdavis.edu

4 Discussion

Our overall goal with Cenimation was to present categorical census data as clearly as possible. Further, we wanted to create a representation that exceeded the informational capacity of a static encoding and was suitable for both high and low resolution displays. We desired an engaging and visually pleasing animation which could serve as an overview of the data, encouraging exploration.

4.1 Constrained Space Visualization

Visualizing census data provides an interesting challenge for low-resolution displays. In general, the smallest and most ethnically diverse super-PUMAs are those surrounding the major population centers. A static representation would be hard pressed to accurately encode seven different ethnic groups for a small super-PUMA when displayed alongside other large PUMAs. For example, using a current-generation iPod display (320 x 240 pixels), minorities in a relatively small super-PUMA might be represented by only one or two pixels, becoming effectively invisible. By utilizing animation, we gain display resolution *through time*. As a minority group's glyph grows to full size, it could possibly fill the entire super-PUMA, but it would not appear as frequently as more prevalent races. This effect yields the desired result: we can clearly see all the races present in a given super-PUMA, with a frequency directly proportional to their prevalence.

4.2 Categorical Data Presentation

The dominant race for a given super-PUMA is immediately obvious. With a few moments of observation, a clear picture of the distribution of minorities also emerges. Because smaller super-PUMAs receive more glyphs per unit time, the cities seem to teem with life, as the flickering correctly conveys a sense of greater population.

Super-PUMAs are relatively coarse geographic subdivisions, and a static encoding of the races could be geospatially misleading. For example, the static image designer must choose a location within the super-PUMA for each category color. Even if he or she randomly distributes pixels for each race throughout the PUMA area, a viewer might mistakenly associate members of that race with that *exact* area, even though this placement was arbitrary.

In Cenimation, glyphs are randomly placed *and* will eventually be obscured as new glyphs appear. Therefore, the chance of similar misconceptions is reduced. Within the confines of a super-PUMA, no single category will always occupy a given space, unless that super-PUMA is 100% homogenous.

Figure 1: Three snapshots of Cenimation. (a) Maryland using circle glyphs. (b) California using square glyphs with random orientation. (c) Maryland using square glyphs. (d) Maryland using random rectangles.

4.3 Mental Model

Animation is used often for exploration of three dimensional volume data. These tools do not provide a single, static display of the data. Instead, the display changes as users rotate or slice through the volume. This dynamic display allows users to create a complete mental representation of the volume over time. Our approach draws on this concept. By animating the static data, we allow users to build a mental model of the data over time.

4.4 Visually Pleasing

We believe that software is more effective when it is visually pleasing, and Cenimation reflects this philosophy. It utilizes smooth animation, balanced default colors, and simple default glyphs. However, as "pleasing" is very subjective, we also have provided customizability. By combining different glyph styles with birth speed variation, maximum size randomization, or glyph rotation, we can produce surprisingly varied images and effects.

4.5 Limitations

As was discussed by Marois and Ivanoff, our visual cognition is limited not only by the rate of information presented, but also by the amount [2]. Therefore, we are limited by the rate of our animation and the number of dimensions represented.

5 Conclusion

We provide a visually pleasing, simple, stochastic method of visualizing static geospatial data. We take advantage of visual short term memory through animation, allowing users to build a mental model of the data and increasing our display resolution through time. This feature allows visualization on space-constrained displays without losing representation of small percentages.

While we presented our results for visualizing race concentration, our approach is extensible to variables beyond race. It may also provide a method of visualizing static data which is not geospatial in nature.

For more information, visit http://vis.cs.ucdavis.edu/cenimation.

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