Pixel-Oriented Treemap for Display Ecologies

Haeyong Chung, Yong Ju Cho, Jessica Self, Chris North

1. Motivation
The data set for the VAST Challenge 2012 Mini Challenge 1 (MC1) requires a large scale situation awareness analysis to understand the large data set containing the network health and activity status of approximately one million online devices for three days. The online machines in the MC1 dataset can be hierarchically ordered based on business units and facilities. The main visualization challenge was to support very large quantities of hierarchical information.

2. The System Overview
The system consists of two main views designed for different displays.
- The Overview visualization allows multiple users to explore high level patterns through an aggregated view on the large display.
- The Detail view enables to examine the detailed information of each online device through a coordinated pixel map on individual computers. (Fig. 1)

The Overview.
The Overview visualization represents the overall health and status of 888,977 online machines in the entire BoM. Its basic visual representation is based on Treemap in which each big rectangle represents a region (i.e. business units), and the online devices with unique IP addresses are represented by small squares. Each level of the policy status (Fig 3b) and activity flag (Fig 3a) are represented in 5 different colors, and the number of connections are represented by Heatmap containing 100 levels (Fig 3c). This visualization is space-filling to maximize the use of every available pixel on the large display to visualize the entire health and status of devices at a specific time, therefore we could easily scale to a million devices fully utilizing the large display’s high-resolution. For interaction methods, users can also change and select a Treemap for a specific date, time and data type using the mouse.

The Detail View.
The Detail View runs on the individual displays and it enables users to zoom (Fig 2c) and explore specific areas of concern by breaking the big Treemap down into manageable chunks by selecting a date, time and region on the tooltip (Fig 2a). In this view, users can see detailed domain-specific information such as machine class, function, unit, facility, etc (Fig 2b).

3. Examples of Analysis Results

Effect of hurricane. A hurricane caused a blackout at the eastern coast. Several computers of region 25 go offline starting at 10am and continuing until 2:15am. This outage at region 25 clearly showed different patterns of offline computers from other regions.

Suspicous Use of Teller Machines Off-Hours. Teller machines at several regions are being used off-hours. The figure shows abnormal traffic of the teller machines at 2:45am on February 3rd.

Server Farm Comes On Line. The “datacenter-5” server farm comes online at 19:45 on February 2nd attempting to achieve full capacity.

Figure. 1. A multiple display environment for Pixel-Oriented Treemap

Figure. 2. The Detail View of an individual machine from Region 17 at 21:15 on 2/3.

Figure. 3. Three types of The Overview Treemap. Each Treemap contains statuses for 14:00 on Feb. 2. Each rectangle represents a different region in BankWorld, and small pixels (colored squares) within the rectangles present the online machines. The color black represents machines that are currently offline.