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A Zoomable Shopping Browser Using a Graphic-Treemap

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Abstract

Effective and efficient navigation and representation of the entire structure of the product catalogue is one of the important factors for on-line market. This paper proposes an application using Treemaps visualization to enhance the functionality of online product category. We aim to develop high-quality catalog interfaces in terms of readability, understandability and comprehension by integrating graphics into Treemaps. We applied two types of Treemaps: 1) Slice-and-Dice Treemap, 2) Squarified Treemap, into the on-line catalogue to address the “small window” problem allowing buyers to overview and navigate large product categories dynamically. We also use a history bar that locates on the top of each category and sub-category to provide a 2.5-dimensional view of contextual information.

Keywords--- graph visualization, treemaps, zoomable user interface, product catalogue, shopping-cart technology.

1. Introduction

One of the major elements of online e-commerce is the online product catalogue. It provides sellers with a content management system that stores, indexes, aggregates, normalizes, and distributes product information. It also provides potential buyers with an interactive interface that offers a multimedia representation of the product information as well as classification and navigation services.

An important precondition to the success of e-commerce systems is the construction of appropriate customer interfaces, from which an online product catalogue can be displayed. There are many extensive research works have been done on both components of the online product catalog: 1) the content management and 2) the catalog interface. For content management, a number of products have been developed and used at commercial website such as *CardoNet*, *Interwoven*,

OnDisplay, *Poet Software*, *Vignette*, and others (see [1] for more detail). For catalog interface, various methods, that can support product search and navigation, have been developed, such those at [2, 3, 9]. Also, the impact of different shopping metaphors on the effectiveness of online stores in terms of click-through and conversion rates was analyzed in [4, 8].

While these product catalogs can effectively assist the seller/buyer in managing, searching and accessing product information through the WWW, they usually do not provide a graphic user interface that gives a buyer a sense of information “space” when he/she is exploring the large product hierarchy. Instead they only mostly provide the buyer a series of textual lists placed in separate pages. Each list in a page shows only one level of the product hierarchy (see Figure 1). The buyer has to click through many pages to browse down/up the product hierarchy in finding appropriate products he/she need. Thus, the entire structure of the product hierarchy is split into many small pieces that could be very difficult for the buyer to perceive the overall structure of the product hierarchy by reading these textual lists. In fact, the effectiveness of this navigation mechanism in terms of click-through and human cognitive process was lower.

In this paper, we propose a method that uses Treemaps visualization to enhance the presentation of online product catalogs and address the above problems. We aim to develop high-quality catalog interfaces in terms of aesthetical niceness, readability, understandability and comprehension by integrating graphics (product pictures) into Treemaps.

We applied two types of Treemaps: 1) Slice-and-Dice Treemaps [5], 2) Squarified Treemaps [6], into our on-line catalogue system to address the “small window” problem allowing buyers to navigate large product categories dynamically. The user can interactively explore the huge product hierarchy online by clicking-through the multiple levels of the Treemaps to zoom down to a particular subset of the product category.

We also introduce an e-commerce framework of Visual Online Shops that use Treemaps visualization as an interface allowing buyers to navigate through the

large product hierarchies with a sense of information space. The Graphic-Treemap uses an enclosure hierarchical visual representation method to address the *product navigation problem* which allows buyers to view the overall context and visually browse through the large product catalog within a limited display region.

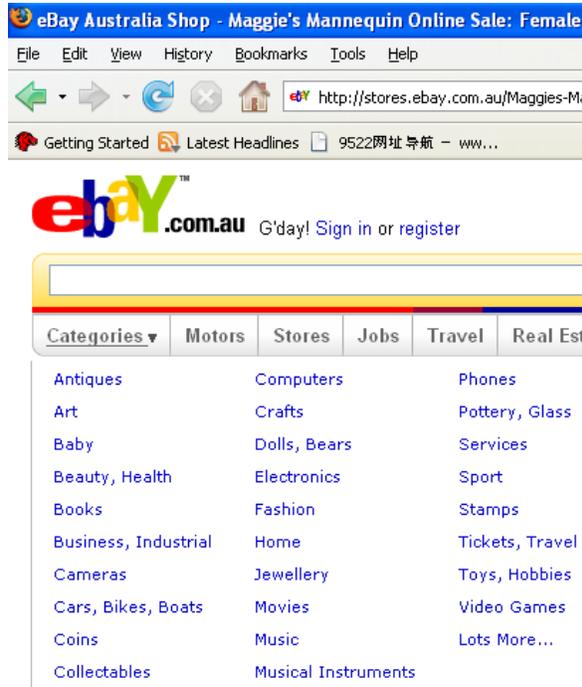


Figure 1: eBay Australia Online Auction Shop – A typical example of using traditional online product catalog for online e-business that provides buyers with a series of textual lists placed in separate pages for navigation. Each list in a page shows only one level of the product hierarchy.

2. Related work and motivation

The original use of the Treemap visual layout was developed by Johnson and Shneiderman [5] as a way to more easily get a feel for the hierarchical structure of file systems.

The traditional approach to displaying tree structure is to use *node-edge* diagrams. A set of visible graphical edges are drawn in the diagram to link nodes from the parents to their children, such as [3]. The nodes present the data while these edges are used to present hierarchical relationships among data items. This works very well for small trees. However, when the same approach is used for large trees with more than hundreds of nodes, the display quickly becomes cluttered with nodes and lines. There are two obvious solutions to this problem; zoom out on the nodes so all of them can fit on the display, or let the user pan around a full size tree. Neither of these is very satisfactory because of the loss of overall hierarchical structure and navigational landmarks in the visualization.

Unlike the traditional layout approach, Treemaps techniques [5-7] represent hierarchical structures using

an enclosure manner, similarly to *Venn diagram*. It starts with a rectangular space and subdivides it recursively. The initial rectangle represents the root node of the tree. That space is divided into a number of horizontally aligned sub-rectangles, each representing a child of the root node. Typical Treemaps, on each recursive call, the direction of subdivision is rotated: horizontal, then vertical, then horizontal.

This way of representing a tree gives two main benefits. The first is that the main connectivity relationship of the tree, ancestry, is shown with unambiguous graphical relationships. Children of a node are enclosed within that node and parents of a node contain that node. The other benefit is that there is no wasted space in the diagram. The entire original rectangle has been filled with smaller rectangles. Treemaps provide an overall view of the entire hierarchy. This technique optimizes the use of all available space. As a result, it makes the navigation of large hierarchies much easier especially when quantitative variable is concerned.

3. Online Shopping Framework

The proposed online shopping framework is made up of several components and interconnections among them that can be described in Figure 2; details are below:

- **Interactive Treemap Visualization:**

An interactive Treemaps technique that automatically displays the overall or a subset of product category. It integrates the graphics (product pictures) into the Treemap display that allows buyers to have a brief overview of what products for each category. From this, he/she can interactively navigate the large product hierarchy by drilling down or moving up. It addresses the “small window” problem because the space are utilised.

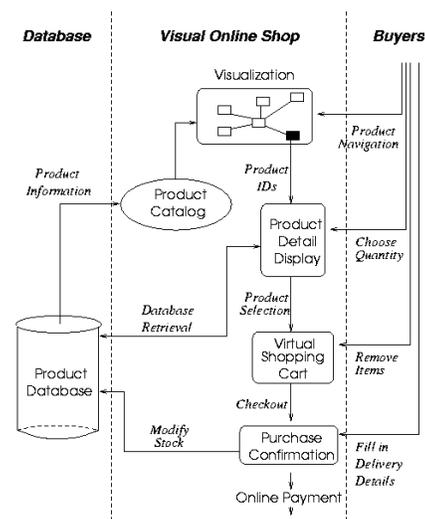


Figure 2: The framework of Online Shopping.

- Product Database:**
 A relational database used to store product information, including all data fields and attributes associated with a particular product that are available for sale in the online shop.
- Product Catalog:**
 A content management system that assembles, indexes, aggregates and normalizes product information from the product databases, and quickly distributes the product information.
- Product Detail Display:**
 A web page generated on the server side by a scripting language (we use Adobe Flex Builder in our implementation) It retrieves the appropriate product entry from the database table in corresponding to the mouse-click on a particular rectangle in the Treemaps visualization. It then displays selected attributes of one or more products in the right side of the page.
 The Browser supports drag-and-drop to let users directly add products to the shopping cart.
 Each selected product displays an associated picture and users can easily add the items into shopping cart by using the left side mouse to drag the product picture over the shopping cart picture and drop it in. This procedure is repeated if the user wants to add more items of the same product into shopping cart.
- Virtual Shopping Cart:**
 This shopping cart is responsible for controlling the buyer selection of products and the checkout operation. It shows how many products are already chosen and the total value of the chosen products in the cart so far.
- Purchase Confirmation**
 The component displays a purchase form asking buyers to fill in their delivery details (including name, address, suburb, state, country and email address). All these fields must be completed for the order to go ahead. The user completes the transaction by clicking on a button labeled "Purchase". The details of the order are sent via email to the email address given on the form. It then retrieves the product database, re-calculate the product stock and modify the in-stock field of those relevant product entries.
- Online Payments**
 In this project, online payment is not a research focus. Therefore, we are not going to discuss it in further detail. There are many existing online payment systems are available, and the implementation for each one is different. In this framework, we use a *dummy* function that can be replaced with an interface to a chosen online payment system.



Figure 3: Screen snapshot of an Online Grocery Shop with an interactive Graphic-Treemap Browser, displaying 16 sub-categories and over 200 items.

4. Zoomable Shopping Browser

The Graphic-Treemap allows the user to view multiple categories and subcategories of items in a zoomable environment. It then uses a simple but yet effective navigation mechanism semantic zooming + historical-bar to move around the space of product category.

Graphic-Treemap was built using Adobe Flex, an open source framework for building rich Internet applications that get delivered via the Flash Player or to desktops via Adobe AIR. The data items and structures are defined by XML.

To start using Graphic-Treemap, the user opens a URL of Online Grocery Shop, and the Treemap will lay out the top level overall hierarchy of the product category and display it in a space-filling manner as shown in Figure 3, using either a Squarified Treemap or Slice-and-Dice Treemap.

By using the enclosure layout of hierarchical structure, the pictures of product are displayed in a flattened manner. The advantage for this is that users looking at pictures are primarily interested in sub-category of products, such as meat or sea food.

As the user moves the mouse, the image of item the mouse is over is highlighted. Then when the user double-clicks, the corresponding item details will be brought up and an enlarged picture of the product will be displayed in the right side of the virtual menu, see Figure 4.

The bottom right hand frame displays a Virtual Shopping Cart, showing the user how many products are already chosen and the total value of their selections so far. Each product occupies one row. Different orders for the same product are amalgamated on the one row.

A user can interactively add the current displayed product into the shopping cart by simply dragging down the enlarged picture of product, from the virtual menu, over the shopping cart and dropping it, see Figure 5.

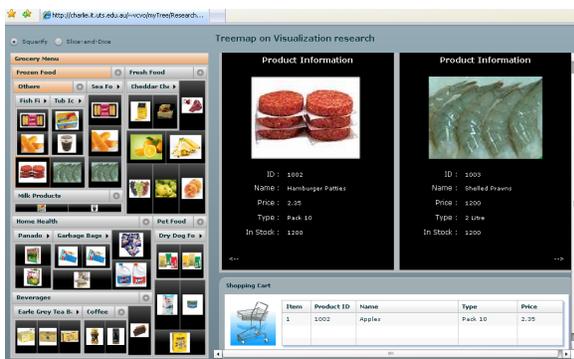


Figure 4: Screen snapshot of a display when the user double-clicks on the item “Hamburger Patties” the details of the item and an enlarged picture of the product are displayed in a virtual menu displayed in the right side of the screen.

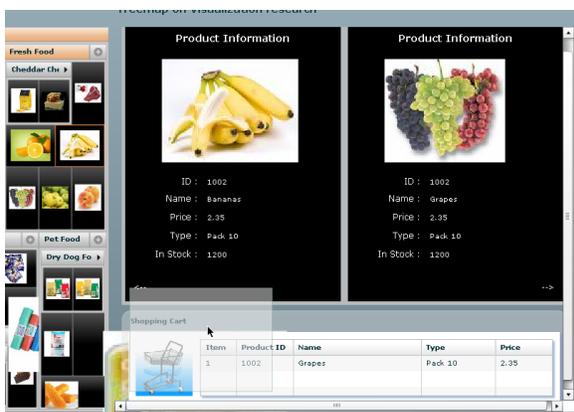


Figure 5: Screen snapshot of a display when the user dragging down the enlarged picture of “Grapes”, from the virtual menu, over the shopping cart. We can see that the corresponding row is added into the shopping cart.

4.1. Integrating Pictures into Treemaps

To increase the readability, understandability and comprehension of visual representation, we integrated graphics into the Treemaps to replace the traditional approach: textual labeling.

We associated one image for each product and tried to use the most typical picture for the different types of the same product that reduce the duplication of the use of images.

“A Good Picture is Worth Tens Thousand Words”. The use of images to represent the physical figure of products is a straight forward way to identify things. It does not require any pre-knowledge of human language. Thus the interfaces designed using image identification are appropriate to be used in any country without the obstacle of difference in cultural and language backgrounds.

4.2. History Bars for Navigation

Our Shopping Browser design builds upon the treemap layout and the navigational scheme. Based on these techniques, we contribute customized techniques for visually navigating and interacting with the product category.

In this application, we propose a novel approach, 2.5D treemaps, to tree visualization. The 2.5D treemaps aim at highlighting the child-parent relations of the hierarchy without losing the overall contextual information. This enables the user to visualize large data set within constrained space. The intuition is to make the depth of the tree an additional dimension.

We display a History Bar on the top of each particular category or sub-category that takes advantage of a “2.5-Dimensional” representation for displaying contextual information, see Figure 6.



Figure 6: Screen snapshot of a display when “Tub Ice Cream” is selected. We can see that three levels of the History Bar clearly illustrate the hierarchical structure of the category: *GroceryMenu -> FrozenFood -> Others -> TubIceCream*.

The user can click on the right-side circle of a History Bar to move down or up one level of the hierarchical structure, see Figures 7 and 8. In addition, the user can click on a sequence of history bars to zoom in all the way into that a particular product image, or to zoom out all the way from the product to the top level of the category.

Graphic-Treemap supports mouse drag-and-drop to let users directly explore product images by interactively turn over pages of the virtual menu, see Figure 9.

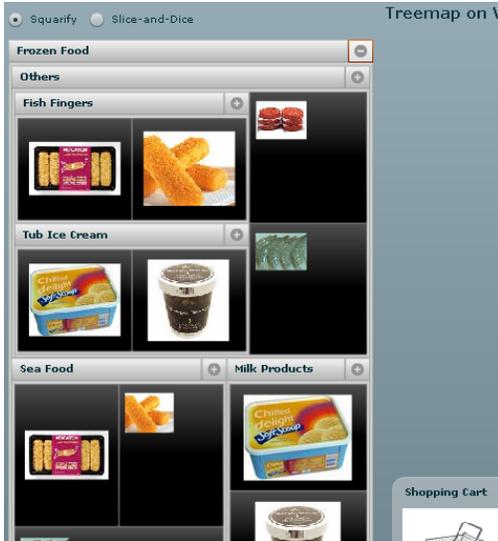


Figure 7: Screen snapshot of a display when the right-side circle of “Frozen Food” is clicked. A semantic zoom in is occurred that the detail of sub-category “Frozen Food” is enlarged and fully displayed.



Figure 8: When clicking again on the right-side circle of “Frozen Food”, a semantic zoom out is occurred that the context is returning back to the top level hierarchy.

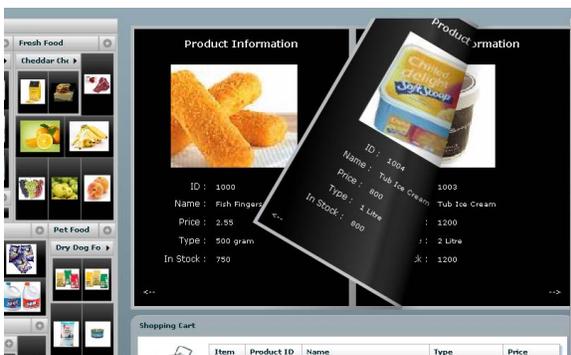


Figure 9: A display of turning over the pages of virtual menu through the mouse drag-and-drop interactions.

Conclusions and Future Work

We have presented our online product catalogue visualization and browser using Treemap techniques. The product catalogue is visualized within a small display area, and can be used for assistant of product browsing. This visual component enables users to view the entire catalogue as well as quickly browse a particular product item. The combination of Treemap layout algorithms with image view provides users with a visual aid for the aesthetical view of entire catalogue with fast and effective product navigation. Although this project is still at its early stage, we believe that this technique is very valuable for quick navigation, and also for improving the understanding of users to the online product categories in e-commerce.

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