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INTERSHOP: A DISTRIBUTED ARCHITECTURE FOR ELECTRONIC SHOPPING

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Abstract

Electronic shopping systems offer new horizons in vendor marketing, customer convenience and overall market efficiencies. Information networks can gather thousands of vendors and millions of customers into an information rich marketplace that serves both their perspectives. Unfortunately, existing electronic shopping systems offer low product differentiation and comparability, little information structuring, and almost no navigation aids to evaluate multiple shopping opportunities. These systems are proprietary and lack interoperability and cross navigation. This limits market efficiency and results in negative experiences for both vendors and customers. We propose a functional architecture for a new generation of electronic shopping infrastructures to dramatically improve vendor representation and customer navigation. This design provides the ability to shop and compare among multiple heterogeneous product structures and offers the basis for electronic shopping across distributed vendor databases.

1. THE PROMISE OF ELECTRONIC SHOPPING AND THE REQUIREMENT FOR AN OPEN DISTRIBUTED ARCHITECTURE

The proliferation of the Internet and various on-line information services has resulted in the introduction of many new electronic shopping systems and services. In theory, electronic shopping should provide enhanced functionality and an expanded marketplace for both sellers and shoppers. In practice, however, the electronic shopping experience seems to fall short of the promise. While the newest systems offer hypermedia navigation and multimedia product data in virtual reality storefronts, sellers still find it difficult to distinguish their products and shoppers find it even harder to navigate. The market is dominated by closed proprietary systems with little data structuring and limited cross-vendor or cross-market navigation. In this paper we propose an electronic shopping system architecture that may provide improved navigation over an open, distributed electronic marketplace.

Electronic shopping combines elements of the Yellow Pages and the Sears catalog into on-line Hypermarts that can connect thousands of businesses to millions of consumers using interactive multimedia product advertising. Compared to traditional shopping, electronic shopping should provide a larger search space coupled with lower transaction costs (Lee and Widmeyer

1986). In addition, electronic shopping can provide special market functionality, such as message narrow-casting and shopping agents. This use of information systems could have profound effects on the nature of markets. The use of this technology can impact both the vendors' interest in product differentiation and the consumers' interest in product comparability (Bakos 1991; Malone, Yates and Benjamin 1987). This relationship between the needs of the vendor and consumer can be viewed as a dialectic, that is, the contradiction or balance between two forces that determines their interaction. Ideally, electronic shopping networks can provide the possibility of a win/win situation for vendors and consumers. With multi-media and high information content, vendors should be able to create visible and distinct product offerings. With support for navigating large amounts of information, the consumer should be able to compare hundreds of products and find just the one they want. Electronic shopping should be able to support a vendor/consumer dialectic with both high product differentiation and high comparability.

Regrettably, the history of electronic shopping is one of limited interfaces and navigation, where the promise of improved market functionality goes unfulfilled. Early examples of electronic shopping include European videotext and teletext systems (Cats-Barial and Jalousie 1994; Long and Buckley 1984; Yoon 1984), followed by the American on-line networks such as Compu-Serve's "Electronic Mall" and the Prodigy service. The early electronic shopping experience is characterized by limited user

engagement and menu navigation of text (Buckley and Long 1990; Long and Buckley 1984; Karlsson and Kaulio 1993). Customers are limited by the inability to display more than one advertisement at a time, and by the inability to compare products and their attributes (Rorvig 1982, 1983). These systems utilize baroque architectures where customers bounce up and down in navigational confusion through very simplistic yet complicated menu structures. Vendors cannot differentiate themselves from each other and consumers find it almost impossible to compare products. Recently there has been an explosion in electronic shopping over the Internet based on World Wide Web viewers such as Mosaic and Netscape. The Internet Shopping Network and others can provide multimedia advertising, with sound, graphics and motion video, and transaction support. While these systems provide richer product descriptions, it would seem they continue and exacerbate the restricted dialectic. There is little support for information structuring or product comparison within the systems and almost no support for cross navigating the chaos between different systems. In general, existing electronic shopping systems are characterized by limited or proprietary data structures with little support for cross navigation or product comparison.

The basic problem is how to increase flexibility of vendors to create unique product spaces, while at the same time increasing shoppers' ability to compare these dissimilar product information structures and descriptions. The goal of our design is to support the basic needs of product differentiation and comparison electronic shopping systems and thereby improve the vendor/customer dialectic. To accomplish this we propose a definition of a functional architecture that enables the navigation of multiple heterogeneous shopping databases by providing increased product information, improved vendor semantic representation, advanced consumer navigation and specific product comparison functionality. This architecture provides the basis for an open system specification that will allow the navigation of a distributed network of independent electronic shopping systems.

The basic representational aspect of electronic shopping system design is that of product organizations or structures. A traditional centralized methodology might approach the design in a top-down fashion, imposing a specific product organization. This philosophy can be seen in many existing systems. Lee and Widmeyer have proposed a semantic hierarchy of products coupled with preference elicitation guided navigation. This approach has two pragmatic limitations. Firstly, it was predicated on a single generic product hierarchy. Shopping centers and malls are composed of multiple vendors, each of which offers their own organizational semantic of departments and products. These individual store representations are important ways in which stores differentiate their offerings. Similarly, electronic shopping environments should support multiple heterogeneous organizational representations (i.e., several vendors), and at the same time

must support customer navigation and shopping in this complex environment. Secondly, the Lee and Widmeyer approach assumes that consumers have well-formulated preferences and understand them. It is often, however, the act of shopping itself by which one formulates an understanding of the relevant attributes of a product and what one's preferences are (Bloch, Ridgway and Sherrell 1989). A mechanism is needed which allows for the manipulation, comparison and even discovery of product or service information contained in different independent data structures.

There is a considerable body of work in the areas of heterogeneous databases, multidatabases, and federated databases, regarding both representation and navigation. Much of this work concentrates on the utilization of universal relations, canonical indexes and schema normalization, among other methodologies (Ram 1991; Ozsu and Valduriez 1991; Kim et al. 1991). While these research areas provide considerable insight, there are some peculiarities about the application domain of electronic shopping that lead us to consider additional approaches.

First, in a shopping system, each leaf node (product offering) of a different (or same) vendor, while perhaps offering the same product, constitutes a different object or record, not different aspects of the same object. The same model VCR offered in two different locations constitutes two separate offerings/data objects, each within its own distinct product hierarchy. This need to emphasize separate object identity contrasts with many heterogeneous database applications that emphasize universal relations or canonical indices to normalize different node instances of objects across member databases.

A second important distinction between these approaches and our design is the accessibility of the structures of specific databases. In using a universal relation approach, heterogeneous database system interfaces may purposefully mask the different underlying semantics of member databases to provide the user with a single uniform representation. In electronic shopping, however, it is the differences in these underlying semantics that are most important for representing vendors' product hierarchies, organizational semantics and marketing thrust.

Our design goal is to support differentiation between product descriptions and individual store hierarchies, while providing mechanisms for locating similar products. Our approach can be characterized as a bottom-up design. We focus on attribute standardization and improved navigation support based on those attributes. We leave vendors free to design their own individual data structures and we concentrate on providing support for lightly coupling these structures for cross-navigation.

We have selected an object oriented approach based on frames. The design emphasizes a highly individualized object identity and semantic freedom for each contributing vendor. A system of optional standard and custom attributes is utilized by each vendor.

We have incorporated a mechanism (generic hierarchy search) for finding objects based on the identification of specific examples of product types. Having located these examples, the user can acquire similar products and the links to respective vendor structures by using the "virtual department." Once the items are included in the virtual department, the user can explore the parent department structures of each item. The system allows product differentiation through complete vendor flexibility in product organization and data structures, while it uses low level standardization of vendor optional attributes to support comparability. Consumers can quickly find objects that seem to fit their needs; they can then find all the related objects in the various vendors' schemas and perhaps discover items that they did not even know of.

In existing systems, vendors are either limited to predefined product categories or provided no structural support at all. At the same time, shoppers receive little support either for navigating and locating products or for comparing products once found. It does not have to be this way. We suggest that differentiation and comparability, and the goals of vendor marketing and consumer shopping, are not necessarily in opposition. There can be a win/win in the dialectic. The following section describes the specific design features of our architecture for electronic shopping infrastructures which we call InterShop. This architecture is built on a set-hierarchy knowledge representation coupled with hypermedia navigation that we believe addresses the limitations in the existing vendor/customer dialectic of electronic shopping. We propose that this architecture provides the fundamentals that may be used to support electronic markets based on the cross navigation of a distributed network of multiple independent shopping databases. In addition to the basic architecture, we describe a prototype implementation and finally we draw some conclusions and suggest future extensions of this research.

2. AN ELECTRONIC SHOPPING ARCHITECTURE

The architectural approach of InterShop is to improve the differentiation and comparability dialectic by focusing on knowledge representation and user navigation. The design utilizes a knowledge representation scheme that presents vendors with a flexible structure for organizing products. The structure incorporates open object definitions and the specification of optional standardized attributes. Along with vendor flexibility, this approach makes possible the easy navigation and useful comparison of normally non-comparable data.

The key element of this knowledge representation is the structural organization of products. In "manual shopping" environments (e.g., stores and catalogs) vendors are free to create their own specialized product/department organizations. In a similar fashion, each vendor in InterShop is free to create a unique structure for organizing products. The paradigm adopted is a

departmental hierarchy with each department containing either other departments or individual products. The emphasis is on a user (vendor) driven structure, as opposed to relying on a database/system administrator having centralized control over structural design.

Product descriptions are stored in a set hierarchy employing an IsIn relation. In practice this IsIn relation is similar in function to ISA and AKO relations, in that it infers inclusion. The logical difference is that there is no attribute criterial basis for the IsIn operator. Department stores are seldom structured on completely consistent product attribute semantics. Their organization is instead a combination of opportunistic associations that may incorporate various product associations at different logical levels. This organizational freedom has utility for the marketing of a store and its products (Hallsworth 1991; Mittelstaedt and Stassen 1990). Products are often grouped to promote certain purchasing behavior (e.g., clocks with lamps) as opposed to grouping by shared attributes. To denote this difference we specifically employ the IsIn link to indicate the form of department/sub-department/product inclusion found in actual department stores.

The store department hierarchies and individual advertisements in InterShop are composed of two types of objects, Department and Product, each of which can contain both Standard Attributes and Custom Attributes. The main entrance to the shopping system is the root node, Products are leaf nodes, and intermediate objects are Departments. Minimal inheritance is employed to support generalized store/departmental features or policies (e.g., payment terms, shipping). Each object may contain multi-media data (text, pictures, sound, etc.) which can be used to provide intricate descriptions of products. In this way, the vendor is freed to describe products in information structures as rich as found in any other advertising media. However, the addition of multimedia information affects the issue of comparability by making the underlying data structures significantly more complicated.

InterShop supports data comparability and design flexibility by combining standardized and non-standardized attributes within the department/product hierarchy. The use of mandatory standard product descriptions would severely limit the differentiation available to vendors. Instead we address data complexity through an object oriented application of combined standardized and non-standardized attributes. Attribute comparison is supported via a generalized class structure of standardized attributes available for use by the vendors. Common attributes (price, weight, etc.) can be represented and maintained as similar (and comparable) data types. The use of the standardized attributes is not mandatory, but where they are used they add to product comparability without requiring a rigid structure.

Vendors are also free to attach unique attribute types to specific instances of products. For custom attributes, the vendor specifies the display methods for these objects and the particular semantics

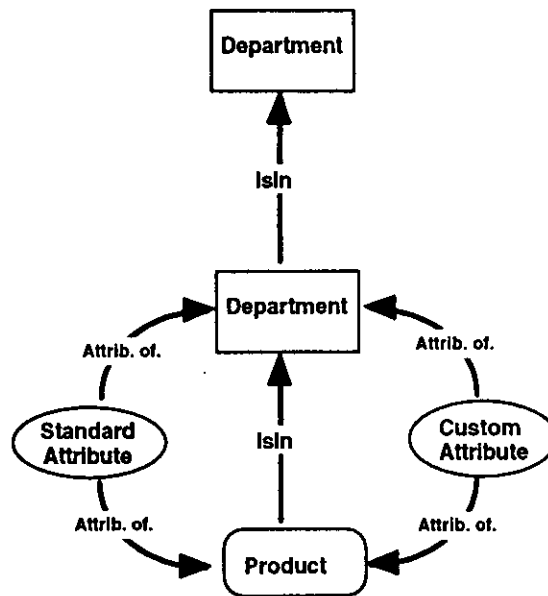


Figure 1. Data Elements and Relations

of each data type. Comparability and efficiency of these custom attributes could be further increased by network support for a class structure of generic display methods (e.g., viewers) that can be applied to custom attributes where appropriate. In each case, the vendor specifies the semantic value of attributes and how their product attributes respond to queries from the customers.

The use of optional standardized attributes is combined with the department/product hierarchy to provide a flexible structure where vendors have organizational and descriptive freedom for their product offerings. Through this strategy, vendors are allowed almost complete freedom to use multimedia information in product descriptions, while at the same time consumers are provided significant product comparability without their having to be aware of the data type specifications of each attribute. The individual data elements and their links (relationships) are diagrammed in Figure 1.

This department/product hierarchy is of course just one possible structural model for electronic shopping systems. Furthermore, the information presentation, or user interface, does not necessarily need to be coupled to the underlying knowledge representation. However, in InterShop we have chosen to closely link information representation and presentation. The set hierarchic architecture utilized supports most of the structural characteristics of "real-world" shopping environments such as physical stores and catalog shopping. In addition, the object/relation structure used for the product/department information is amenable to a hypermedia interaction model. In our design shoppers utilize a

hypermedia node/arc navigation model that is based on the underlying structural data provided by vendors.

The InterShop architecture, and the prototype implementation, provides for two methods each for both shopper navigation and product comparison. Navigation is provided via browsing and search, and comparison is provided via viewing individual product descriptions and building comparison tables of product information. Browsing navigation primarily occurs top-down, with the user entering the system/mall at the top level view or mall entrance, and navigating the complete department/product hierarchy. While this form of navigation does have its disadvantages, "just browsing" is a very widely practiced shopping activity and it is a requirement that is accommodated in our InterShop design.

At the top level view is an icon for each store in the Electronic Mall. Below that are sub-windows for each department and sub-department of each store. At the lowest level a department contains icons for each product. Selecting these product icons opens up the individual product advertisement with both its standard and custom attributes. Multiple store hierarchies can be navigated and displayed at the same time. This design intuitively parallels traditional physical store layout and product catalog design, and also supports the use of multiple views of the same vendor data. Figure 2 shows a composite conceptual representation of the browsing functionality inherent in the data model and developed in the prototype implementation. Note that the names of stores used here, and the data used in the prototype and its screen dumps, comes from actual retailers and their

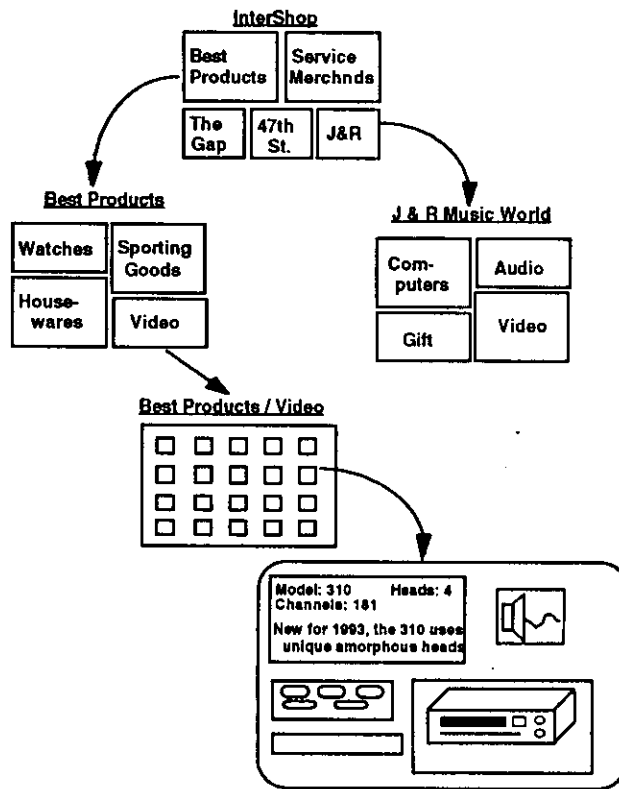


Figure 2. Hierarchical Browsing Navigation

catalogs (i.e., “Best Products” indicates a retail vendor and not a collection of products considered to be “best” by the system or user).

These basic elements of the architecture can be implemented under a wide range of database or language environments, even spanning different implementations. The important aspect is to combine a hierarchical inclusion function and the use of optional but comparable attributes. While the design is relatively simple, the basic architectural elements support the utilization of other functional support for shopping, including a “Virtual Department.” The following section describes an implementation of the architecture and the support for navigation and shopping activities.

3. IMPLEMENTATION

To validate both the proposed design methodology and our beliefs about the vendor/customer dialectic, we have implemented the architecture in a prototype that allows us to explore and evaluate various system design alternatives. This system provides the described functionality in the architectural design and demonstrates that functionality across a sample database. It was built as extensions to the graphical shell tool, CASE/EDI, developed by Lee (Lee and Widmeyer 1986). While some features were not

implemented in the prototype, all the desired functionality was achieved with both browsing and search navigation, and individual advertisement and table comparisons implemented. Figure 3 shows a screen display from the prototype depicting hierarchical browsing. At the top center of the screen is the entrance to the Retail Electronics area of the Mall. Cascading to the lower left and right of this window are department windows for two stores (Best Products and Service Merchandise). The actual departments containing data on VCRs are located at the bottom left and right of the screen. At the bottom center of the screen is a Virtual Department window containing icons for a total of five items selected from the two stores. Note that the product categorization for the two stores is different in structure and naming (e.g., Best Products has three levels and Service Merchandise has four levels).

While browsing is useful, shoppers often have at least a partial idea of what they are looking for and would prefer to specifically search for those items meeting some specified criteria. InterShop’s standardized attributes make object comparison easier but they do not directly address locating or searching for objects. One mechanism to locate specific items would be to use a string search, but that is too dependent on the specific naming and matching of individual items. Another mechanism is a comprehensive product hierarchy, but as discussed we have not

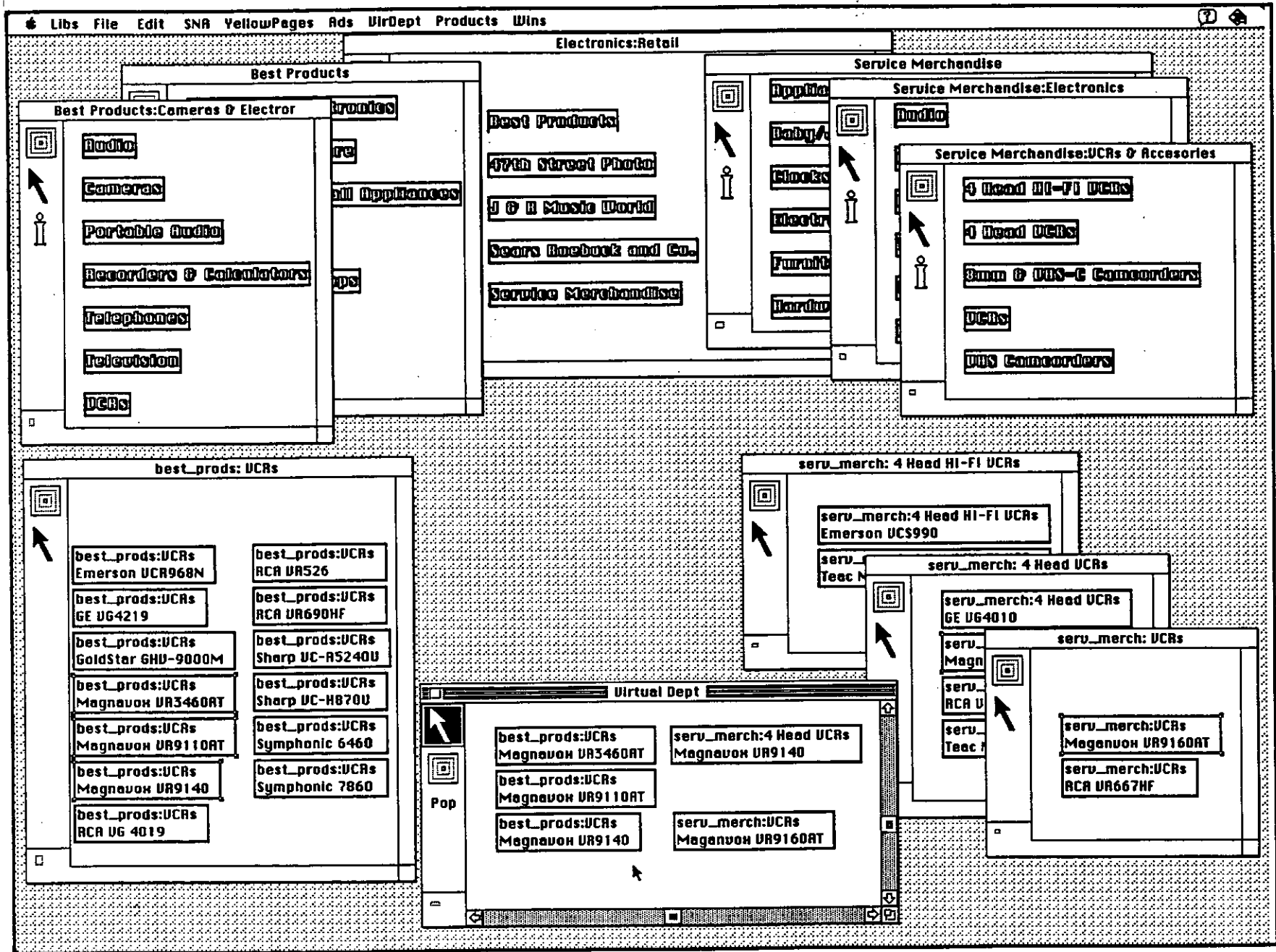


Figure 3. InterShop — Browsing

Electronics

Selection Criteria?

- cable_comp_chan
- has_hq
- has_index_search
- has_osp
- has_ucrp
- mfr
- model
- nu_of_heads
- price
- size
- timer
- type_remote
- upc
- weight_lbs

Ok Cancel

mfr

Emerson	RCA
GE	Sony
Panasonic	LHI
Magnavox	Teac
Symphonic	

timer

- 4 event, 1 month
- 4 event, 1 year
- 4 event, 28 day
- 8 event, 1 month
- 8 event, 1 year

Virtual Dept

serv_merch:4 Head UCRs GE U64010	sears:4-Head UCRs RCA UR505
best_prods:UCRs Magnavox UR9140	serv_merch:4 Head UCRs RCA UR506
serv_merch:4 Head UCRs Magnavox UR9140	sears:4-Head UCRs RCA UR535

cable_comp_chan

- 155
- 181

has_osp

- yes

mono 4head

best_prods:UCRs RCA U6 4019	best_prods:UCRs Emerson UCA968N	sears:4-Head UCRs RCA UR535	serv_merch:4 Head UCRs Teac MU-525
best_prods:UCRs Symphonic 7860	sears:4-Head UCRs Panasonic PV-4125	sears:4-Head UCRs Sony SLU373	serv_merch:4 Head UCRs Magnavox UR9140
best_prods:UCRs RCA UR526	sears:4-Head UCRs RCA UR505	serv_merch:4 Head UCRs GE U64010	
best_prods:UCRs Magnavox UR9140	sears:4-Head UCRs LHI LH447	serv_merch:4 Head UCRs RCA UR506	

Figure 4. InterShop — Search

chosen this because of its maintenance requirements and its limitations to flexibility. In InterShop the desire is to support consumer navigation of dynamic vendor defined structures by providing a mechanism that locates specific product examples in the vendor structures. In the proposed architectural model a lightweight generic hierarchy for individual product categories is offered the user. As implemented, this hierarchy is used only to find some examples of the desired product and does not need to be comprehensive. This design offers high flexibility and low maintenance requirements while being extensible over large distributed networks. In the prototype this hierarchy is based on the system designers' understanding of general product classifications, but in the long term the automatic generation of this product hierarchy represents an interesting additional research issue.

After selecting a product category, the user is then offered a menu that lists all standard attributes that apply to the selected products. This provides a mechanism for informing the shopper about which features are to be considered in purchasing this product. Then, for each attribute selected, the shopper is offered a sub-menu detailing the set of values that exist for that attribute. In this way the user needs to have very little information about product characteristics to be able to engage in a search. This multi-menu approach provides the user with menu based prompting for search criteria based on the actual contents of the underlying database. In this way the user avoids the naming problem and does not have to be a priori knowledgeable about the range of attributes or features available for a product type.

Figure 4 shows a screen dump from the prototype which includes the Generic Product Hierarchy for VCRs (left side of screen), the selected subcategory of "mono 4-head" (bottom left window), the selection criteria menu (center top), and the attribute value sub-menus (manufacturer, timer, cable compatibility, and on-screen-programming — right side of screen). The result of this search is displayed in the Virtual Department sub-window (center of screen).

Thus in the architecture and prototype we have provided for both general browsing and the ability to search for individual products and product types. To provide for product comparison the architecture supports two mechanisms. One, by simultaneously viewing multiple individual product descriptions and two, by building a set of objects for viewing in a comparison tool (in our example a spreadsheet). For side-by-side comparison the design specifies that multiple individual product specifications should be viewable on the screen at the same time. Figure 5 shows a screen dump from the prototype with departments from three stores (Sears, Service Merchandise and Best Products), a Virtual Department containing six selected products, and at the bottom of the screen, advertisements displayed for two individual products. (Note that the actual product graphics are 24 bit color. The graphic quality of the screen dumps in this document is

reduced.) The highlighted text in the product description window at the bottom left indicates an embedded hypertext link.

To provide for more formalized comparisons spanning large numbers of alternatives, the architecture offers a mechanism for selecting objects and attributes to compare based on the relative availability of attribute information among the selected items. This supports comparing the selected product items in any external tool which accepts formatted data streams. To do this the user selects the items to compare and is then offered a menu that controls what attributes are used in the comparison. These attributes are divided into four categories: (1) standard attributes for which all objects under consideration have the same value, (2) standard attributes that all of the objects have, but for which there are different values, (3) standard attributes that not all objects have, and (4) custom attributes. In this way the user may select products through a combination of specific attributes which can be exported to various external routines, including the preference elicitation mechanism employed by Lee and Widmeyer.

The multi-menu system is useful for selecting objects but there also needs to be a mechanism to navigate into vendors' departmental structures. To support advanced aspects of both user navigation and product comparability we utilize the concept of a Virtual Department. This consists of a customer specific department or sub-window into which product icons may be collected. Objects are placed in the Virtual Department either manually, where the shopper simply copies the product icon to the Virtual Department window, or by using the Multi-Menus and specific attribute criteria to select products from the Generic Product Hierarchy for automatic inclusion in the Virtual Department. This provides a compact visual representation of a shopper's selection-set of products that provides both conceptual and functional advantages. The products selected are those that meet the shopper's specific criteria, and other items are ignored. Using the Virtual Department, further discovery of product alternatives is supported via local navigation. From each item in the Virtual Department the shopper can jump to that item's parent department in its respective store hierarchy. From there the shopper can examine other related products, or begin to traverse the store department hierarchy from the bottom-up. This functionality provides for a form of product discovery (based on proximity in the vendor's product schema) from a bottom-up navigation perspective as opposed to more exhaustive top-down traversal. Beyond this, the Virtual Department serves as a foundation for comparison, both viewing the objects represented there, and generating comparison structures (tables) of the selected products.

Figure 6 shows the use of the Select Report Attributes Menu within the Virtual Department for comparing large numbers of items. "Identicals" are attributes for which all products under

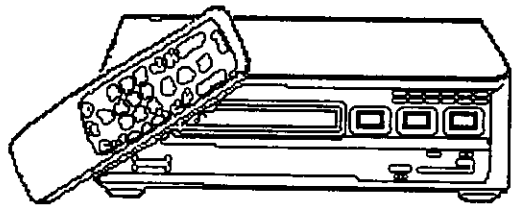
best_prods:UCRs Emerson UCR968N	best_prods:UCRs Magnavox UR9140	best_prods:UCRs Sharp UC-A5240U
best_prods:UCRs GE UG4219	best_prods:UCRs RCA UG 4019	best_prods:UCRs Sharp UC-H870U
best_prods:UCRs GoldStar GHV-9000M	best_prods:UCRs RCA UR526	best_prods:UCRs Symphonic 6460
best_prods:UCRs Magnavox UR3460AT	best_prods:UCRs RCA UR690HF	best_prods:UCRs Symphonic 7860
best_prods:UCRs Magnavox UR9110AT		

sears:4-Head UCRs LHI LH447
sears:4-Head UCRs Panasonic PV-4125
sears:4-Head UCRs RCA UR505
sears:4-Head UCRs RCA UR535
sears:4-Head UCRs Sony SLU373

serv_merch:4 Head UCRs GE U64010
serv_merch:4 Head UCRs Magnavox UR9140
serv_merch:4 Head UCRs RCA UR506
serv_merch:4 Head UCRs Teac MU-525

Virtual Dept

sears:4-Head UCRs RCA UR535	sears:4-Head UCRs RCA UR505	serv_merch:4 Head UCRs GE U64010
best_prods:UCRs Magnavox UR9140	serv_merch:4 Head UCRs RCA UR506	serv_merch:4 Head UCRs Magnavox UR9140

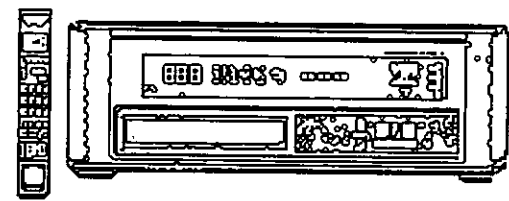


Magnavox 4-Head VHS VCR Model UR9140 with Remote.

With a 181 channel cable-ready tuner and 8 event, 1 year timer.

Features include smart programming, on-screen display menu, auto channel preset, still frame advance & variable slow motion, front audio/video input/outputs, double azimuth design and automatic head cleaner.

11 lbs.
Price - \$ 279.99



Magnavox 4-Head Remote VHS VCR Model UR9140.

4 heads for special effects. Remote on screen programming instructions with Magnavox unified TV/VCR remote.

Features include auto head cleaner, auto power on, play, rewind, center load design and fluorescent display. With a 181 channel cable compatible tuner, and a 8 event, 1 year timer.

14.5x11.8x3.5, 12 lbs.
Your cost - \$ 279.95

Figure 5. InterShop — Viewing Advertisements

File Edit Formula Format Data Options Macro Window

Normal

A1 | tape_std='VHS'

best_prods: UCRs

- best_prods:UCRs
Emerson UCR968N
- best_prods:UCRs
GE U64219
- best_prods:UCRs
GoldStar GHU-9000M
- best_prods:UCRs
Magnavox UR3460AT
- best_prods:UCRs
Magnavox UR9110AT
- best_prods:UCRs
Magnavox UR9140
- best_prods:UCRs
RCA UG 4019
- best_prods:UCRs
RCA UR526
- best_prods:UCRs
RCA UR690HF
- best_prods:UCRs
Sharp UC-AS240U
- best_prods:UCRs
Sharp UC-H870U
- best_prods:UCRs
Symphonic 6460
- best_prods:UCRs
Symphonic 7860

Virtual Dept

- serv_merch:UCRs
Magnavox UR9160AT
- best_prods:UCRs
Magnavox UR3460AT
- best_prods:UCRs
Magnavox UR9110AT
- serv_merch:4 Head UCRs
Magnavox UR9140
- best_prods:UCRs
Magnavox UR9140

serv_merch: 4 Head HI-FI UCRs

- serv_merch:4 Head HI-FI UCRs
Emerson UCS990
- serv_merch:4 Head HI-FI UCRs
Teac MU625

Select Report Attributes

Identicals	Full Comparables	Part Comparables
tape_std='VHS'	upc mfr model price cats weight_lbs type_remote cable_comp_chan	size has_osp

Ok Select All Show Special Features Cancel

Excel Report File

	A	B	C	D	E
1	tape_std='VHS'				
2	mfr	model	price	cable_comp_chan	has_osp
3	Magnavox	VR9140	279.95	181	yes
4	Magnavox	VR9140	279.99	181	yes
5	Magnavox	VR9110AT	219.99	181	n/e
6	Magnavox	VR3460AT	379.99	155	yes
7	Magnavox	VR9160AT	329.95	181	yes
8					
9					
10					
11					
12					
13					
14					
15					

Excel Report File

```
tape_std='VHS'
mfr model price cable_comp_chan has_osp
Magnavox VR9140 279.95 181 yes
Magnavox VR9140 279.99 181 yes
Magnavox VR9110AT 219.99 181 n/e
Magnavox VR3460AT 379.99 155 yes
Magnavox VR9160AT 329.95 181 yes
```

serv_merch: 4 Head UCRs

- serv_merch:4 Head UCRs
GE UG4010
- serv_merch:4 Head UCRs
Magnavox UR9140
- serv_merch:4 Head UCRs
RCA UR506
- serv_merch:4 Head UCRs
Teac MU-525

serv_merch: UCRs

- serv_merch:UCRs
Magnavox UR9160AT
- serv_merch:UCRs
RCA UR667HF

Ready

Figure 6. InterShop — Comparison Tables

consideration have the same value. "Full Comparables" are attributes that are possessed by all the products under consideration but the individual products have different values. "Partial Comparables" are attributes that are not shared by all products under consideration and "Special Features" includes all non-comparable unique attributes. On each side of the screen are departments from two stores. In the center top is the Virtual Department with items selected from each store. Below the Virtual Department is the Select Report Attributes menu, and below that is the Excel spreadsheet containing the attributes requested for the selected items. At bottom right of the screen is the intermediate data file that InterShop uses to provide information to the external application. Non-standard text oriented attributes would also be exported if the Show Special Features box was checked.

To validate the functional design and the prototype implementation, the shell was used to represent the actual data on departments and sub-departments of five stores with complete product data for video cassette recorders. The representation language of the InterShop prototype was sufficient for representing all the required product data elements and vendor organization structures. The authors performed several sample navigations illustrating the full range of browsing and search navigation and of individual advertisement and table comparisons.

4. CONCLUSION AND FUTURE WORK

The primary research contribution is an improved paradigm for the design of electronic markets. This system approach may substantially improve the information processing capabilities of consumers in electronic shopping systems and could more effectively represent the vendor's message. At the same time, vendors are offered maximal flexibility in product description and organization in conjunction with a design that supports a distributed, decentralized model. While the prototype was implemented on a closed system, the model should be especially appropriate to navigating marketplaces of multiple heterogeneous shopping databases on the Internet.

This solution to electronic shopping system design provides a significant conceptual contribution that may extend beyond the problem domain. This application requires a method for manipulating and comparing dissimilar, or semi-comparable, data structures in a way that allows comparison on similar attributes, but preserves access to unique attributes and data types. While in theory a universal relation across all attributes is possible, this is rejected here as both unwieldy and unamenable to multimedia information and the real-world applications requirements. Instead, an approach is developed that analyzes the available objects and their attributes and builds comparisons on relevant common attributes and represents more unique attributes as additional information. All of this is with the appropriate presentation information for each type of data. This InterShop

design could be applied to other areas where the underlying data is organized in dynamic, decentralized, multiple heterogeneous information spaces.

Based on the architecture and the prototype there are several long term directions for research. In the InterShop prototype a simple generic product hierarchy is used to begin the search dialog between the shopper and the system. In the prototype this hierarchy is instantiated by the authors, based on experience with the product domain. However, in practice it is desirable if this evolving hierarchy can be automatically generated, without the need for extensive hand linking or reclassification by a network administrator. These generic hierarchies can be created by monitoring the underlying product database entered by the vendors. The vendors do not directly create generic categories, but these categories reflect similarities in their distinct individual classification structures. The importance of the generic hierarchy is not comprehensive indexing, but is more finding initial examples of items from which more discriminant attributes can be selected. Some work has been done in this area.

At the same time that the prototype is being further developed, it may be used to empirically examine various forms of product organization and representation and the behavioral aspects of different vendor and consumer system interactions. The prototype functions as a design tool where different types of electronic shopping structures can be created. This provides a platform for evaluating alternate electronic shopping system designs. In this way, InterShop could prove useful in validating the claimed benefits of electronic shopping. Beyond the area of electronic shopping, the design presented here may be useful in other areas where the navigation of multiple heterogeneous information structures is a consideration. We are working on additional formal specification of the architecture and considering several areas for empirical evaluation. On the development side we are incorporating the basic InterShop engine into an http environment.

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