December 1999

A Conceptual Model of an Intelligent Catalogue Search System (ICSS)

Chanan Glezer
Ben-Gurion University of the Negev

Surya Yadav
Texas Tech University

A Conceptual Model of an Intelligent Catalogue Search System (ICSS)

Chanan Glezer, Ben-Gurion University of the Negev (chanan@inter.net.il)
Surya B. Yadav, Texas Tech University (odsby@ttacs.ttu.edu)

Abstract

Electronic catalogues are a major tool for developing Electronic Commerce (EC) applications. From a customer's perspective, however, the variety and heterogeneity of electronic catalogues create a major problem in integrating information from various sources. There have been several attempts to overcome this problem using architectures and protocols that enable interoperabilty of electronic catalogues. The extant architectures and protocols emphasize semantic integration of different catalogues as a mean for achieving interoperability. In this paper we expand the previous work on this topic by proposing a comprehensive agent-based conceptual model of an Intelligent Catalogue Search System (ICSS). The ICSS incorporates knowledge in order to analyze, enhance, filter and synthesize a raw query and replies provided by various electronic catalogues or intercatalogue search systems. The benefit of the proposed architecture is an increase in the capability of a customer to locate and compare relevant products from various sources.

Introduction

Electronic catalogues are a major tool for developing electronic commerce applications. They extend the reach of paper-based and CD-ROM catalogues while keeping the cost of handling and distribution low (Ware et al. 1997). Electronic catalogs possess four important characteristics: interactivity, dynamic updating, hypertextuality, and global presence (Segev et al. 1995).

Electronic catalogues resemble paper-based and CD-ROM catalogues in that they can only provide search capabilities for products of one merchant at a time. Even in cases when there are overlaying indexes, they can only lead the customer to suggested merchants. The indexes can not enable integration and comparison of complementary or competing products from several catalogues based on product attributes. By developing interoperable catalogues that integrate the content of several merchant catalogues it is possible to achieve market transparency as customers can make a more informed purchasing decision and merchants can extend their market reach (Ware et al. 1997).

One of the most important factors hampering a wide adoption of interoperable catalogues is a difficulty in creating a widely accepted standard for intercatalogue communication. There have been several attempts to create a standard for interoperable catalogues (e.g., MEPC [Lincke and Schmid, 1997]). Most of the proposed architectures and protocols are based on the idea of semantic integration done by a mediating broker that reconciles semantic differences among vocabularies of catalogues. This idea of semantic integration is very important in addressing the issue of interoperability. However, an equally important issue is to support customer oriented activities such as query analysis and enhancement as well as query-response filtering and synthesis which can help a customer better in locating the best product offering.

In order to provide better support for customer oriented activities, this research proposes a conceptual model of an Intelligent (knowledge-based) Catalogue Search System (ICSS). The ICSS is capable of assisting a customer in locating products in a heterogeneous environment of networked catalogues. Our model is based on the notion of software-agents (Genesereth and Ketchpel, 1994). The model describes the process of handling a query, the knowledge needed to support this process intelligently and the interaction between the ICSS and its external environment, namely the customer, merchant catalogues and other intercatalogue (mediating) search systems. In the following section we present the conceptual model of the ICSS by describing the process of handling a query and the knowledge used by the system.

Conceptual Model of an ICSS

The ICSS is composed of a federation of functional software-agents that interact with a customer. The ICSS provides a set of functions that enable a customer to locate relevant product offerings and also a capability for one-stop-shopping. Each functional agent has an attached Knowledge Base Management System (KBMS) agent that maintains necessary knowledge for activities performed by the functional agent. A conceptual model of the ICSS is depicted in Figure 1.

The process of handling a query is composed of two main tasks. In the front-end, the ICSS accepts a raw query, analyses and enhances it before passing it in the form of keywords to external merchant catalogues and intercatalogue information services such as Mysimon and MEPC. In the back-end, each intercatalogue information service contacts registered catalogues of merchants it believes are relevant to the query and integrates their replies using a semantic reconciliation mechanism. The back-end and front-end processes are autonomous. They share information through simple interfaces such as query

keywords and tables with product specifications. Following is a detailed description of a query cycle.

The query is initially submitted by a customer to the Intelligent Customer Interface Agent (ICIA) which is in charge of the dialogue with the customer. The ICIA examines the query and attempts to understand which products the customer is interested in. The ICIA then decides whether the query relates to a single product and can be passed directly to the Query Enhancing Agent (QEA) or whether it is a more complex query that first needs to be divided into a set of more simple queries by the Analysis and Synthesis Agent (ASA).

The QEA supplements the original query by adding information from several sources: customer-profile indicators, internal product specification database, external databases and search engines. The customer-profile indicators are maintained by a Customer-Profile Agent (CPA) and hold knowledge about interests, preferences and constraints of a customer in different domains, and his or her typical purchases ("shopping-bags"). The product specification database is maintained by a Product Specification Agent (PSA). This database holds an hierarchical collection of knowledge elements about categories and subcategories of products, manufacturers, attributes and values of specific product models, as well as rules specifying relationships with alternative, complementary, and competing products. The external databases and search engines are usually commercial information services that are accessed by an External Information Services Agent (EISA).

The enhanced query is then passed to the Intercatalogue Search Agent (ICSA) before being broadcast to intercatalogue information services such as Mysimon and MEPC. These services are responsible for semantically integrating product offerings from different catalogues of merchants. It is possible that a product offered by a merchant in a catalogue will be retrieved more than once.

Replies provided by the intercatalogue information services are then passed to the Filtering Agent (FA). The FA is responsible for filtering the information retrieved by removing duplicate offerings and by using the customer-profile indicators maintained by the CPA. The filtered information is then passed to the Analysis and Synthesis Agent (ASA) which invokes online analytical processing (OLAP) tools such as data cubes and other multidimensional visualization software in order to synthesize, compare and evaluate the offers from the merchants using objective criteria. The raw results as well as a summarized report based on the analysis performed by the ASA is finally passed to the ICIA which presents it to the customer and receives feedback.

Conclusions

The ICSS is an adaptive system. As an example, the knowledge in the product specification database is updated constantly based on information retrieved by the EISA and ICSA. The system also updates the customer-profile based on customer feedback following the final response of the system. The ability of ICSS to adapt its knowledge based on ongoing performance evaluation and customer feedback is expected to provide added value to the customer by improving the relevance and accuracy of the information retrieved.

References

1. Genesereth, M.R., Ketchpel, S.P. "Software Agents," *Communications of the ACM*, (37:7), 1994, pp. 58-53.

2. Lincke, D.M., Schmid, B. "Architecture and Business Potential of Mediating Electronic Product Catalogs," In *Proceedings of the Association for Information Systems 1997 Americas Conference* (AIS '97), Indianapolis, August 1997.

3. Segev, A., Wan, D., Beam, C. "Designing Electronic Product Catalogs for Business Value," Results of the CommerceNet Pilot. The Fisher Center for Information Technology & Management, Haas School of Business, University of California, Berkeley, CA, 1995, URL: http://www.haas.berkeley.edu/˜citm/wp-1005.ps

4. Ware, J., Gebaur, J., Hartman, A., Roldan, M. *The Search for Digital Excellence*, McGraw-Hill, 1997.

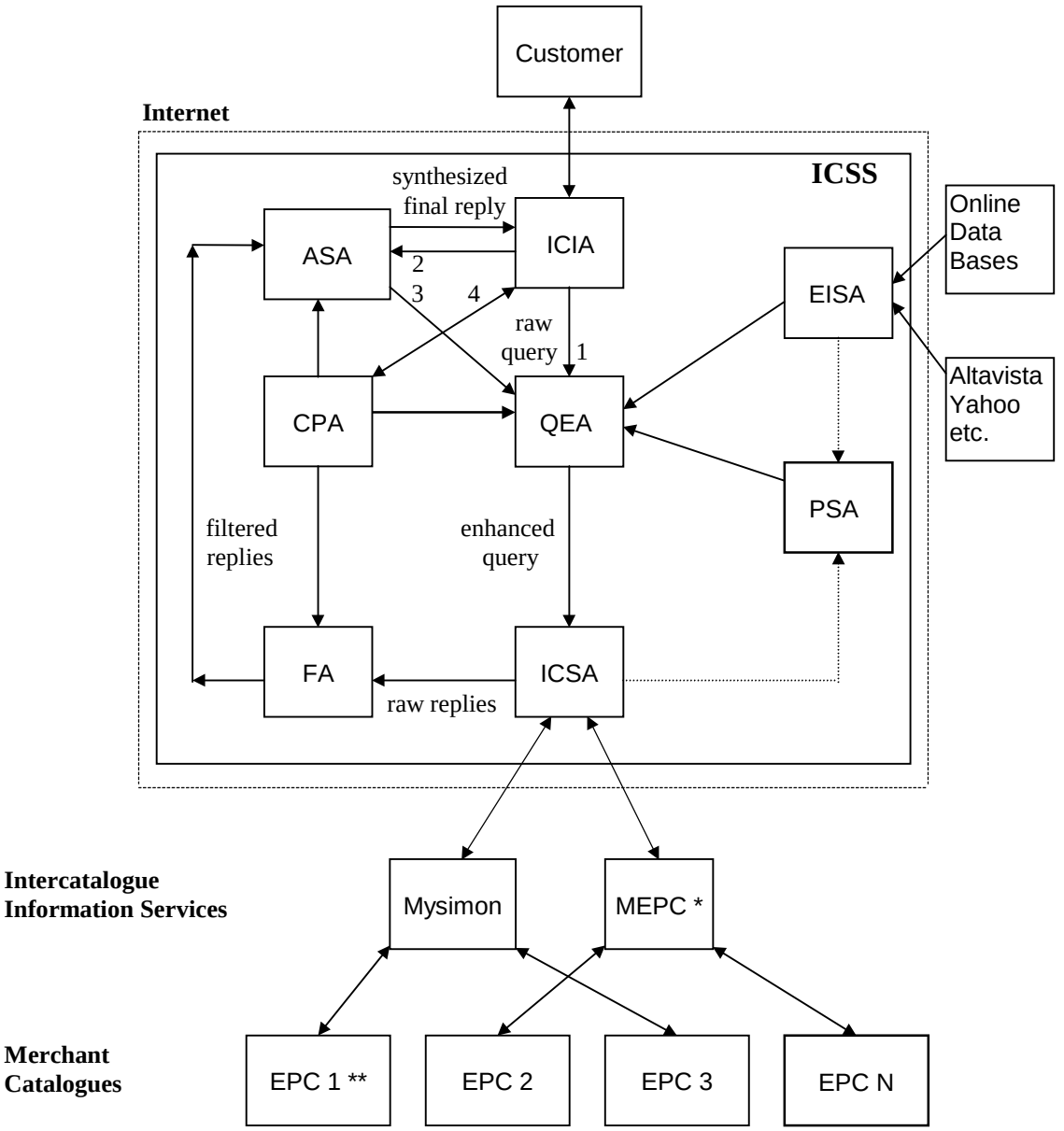

Fig. 1: Conceptual Model of ICSS

→ path used for processing a query

⇢ path used for updating of product specification database

1: simple query is passed directly to QEA.

2-3: complex query is first divided and then submitted part by part to the QEA

4: maintaining a customer profile

* Mediating Electronic Product Catalogue (Lincke and Schmid, 1997)

** Electronic Product Catalogue (Lincke and Schmid, 1997)