行政院國家科學委員會補助專題研究計畫成果報告

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計畫類別：☑個別型計畫　　□整合型計畫

計畫編號：NSC 89-2213-E-009-019

執行期間：88 年 8 月 1 日至 89 年 7 月 31 日

計畫主持人：劉敦仁

共同主持人：

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執行單位：國立交通大學資訊管理研究所

中　華　民　國　　89 年　　10 月　　30 日

整合個人化商品建議發展以 XML 為基礎的電子目錄系統之研究
Research on XML-based Electronic Catalog Systems Incorporated with Personalized Merchandise Suggestions

主持人：　劉敦仁　交通大學 資訊管理研究所
計劃參與人員：林裕展、黃雅文、蔡聰洲 交大資管所

一、摘要

　　以電子目錄在網路上提供商品搜尋服務是電子中介者的重要功能之一，然而急劇增加的資訊卻使得客戶難以搜尋到所需要的商品資訊。本研究提出一建構個人化電子目錄的整合式架構，此架構結合了以 XML 為基礎的資料描述模式、使用者模式、以及軟體代理程式。資料描述模式採用多層次架構以便利資源搜尋與格式轉換，並可以彈性地描述各種不同的屬性定義。而使用者模式則使用三層式的使用者喜好設定檔來描述使用者對資源、類別、以及產品的購買偏好。本研究採用代理程式技術，結合資料描述模式與使用者模式來開發個人化電子目錄系統。藉由個人化的服務，本研究所提出之電子目錄系統能夠更有效地提供整合式的商品搜尋功能。

關鍵詞：電子目錄；使用者喜好設定；XML；中介者；代理程式；Metadata

Abstract

Supporting electronic catalogs (e-catalogs) to provide product-search services on the Internet is emerging as an important function of electronic brokers. However, the explosive growth of information is creating difficulties for customers to search for goods information they desire. In this work, an integrated framework is proposed to develop personalized e-catalogs. The proposed framework integrates XML-based metadata models, user models and agents. The proposed metadata model has a multi-level architecture that can facilitate resource-discovery and format translation, and can flexibly model the definitions of diverse attributes. The proposed user model uses three-level user profiles to model a user's shopping interests to resources, categories and goods. This work integrates the agent technology with the proposed metadata models and user models to develop a personalized e-catalog system. With the support of personalized services, the novel e-catalog system allows an integrated product search to be performed effectively.

Keywords：E-catalog, User Profile, XML, E-Broker, Agent, Metadata

二、緣由與目的

Electronic brokers (e-brokers) provide various important brokerage services, such as merchandise filtering, suggestions, search, negotiation and electronic catalogs. The primary function of an electronic catalog (e-catalog) system is to support Internet-based product searches. However, the explosive growth of information is creating difficulties for customers in searching for goods information they require. The characteristics of goods may vary in distinct product categories. Resources (virtual stores) may also employ different methods and data formats to query and store goods information. Relevant issues include the integration of heterogeneous goods information as well as interoperation among the search system and diverse resources.

Metadata [10,11] describes the characteristics of data that has been collected for a specific purpose. It can be used to facilitate the search service and integrate heterogene-

ous information. The extensible markup language (XML) [9,13] is designed to facilitate the interchange of structured documents over the Internet. Software agent technology [4,5] is well suited to search and integrate data from heterogeneous environments. Agents communicate through agent communication language (ACL)[3].

Keller et al. have proposed smart catalogs and virtual catalogs to support cross-catalog searches [6]. Lincke et al.[7] also presents an architecture for mediating electronic product catalogs. Recently, Web-based e-catalog systems in B2B procurement have also been proposed [1].

The filtering of goods information can be realized by incorporating user profiles into search systems. Most studies have focused on text-based document filtering. Barra et al. [2] have proposed a vector of configurations indicating customer preference to buy product items from specific categories. However, their model is inadequate to model user needs.

The objective of this research is the following. (1) Develop an XML-based metadata model. (2) Design a personalized merchandise information filtering and suggestion system on the basis of user shopping profile. (3) Apply agent technology to develop a personalized e-catalog system enabling users to conduct structured query and personalized product search and browsing on the Internet.

三、研究方法及成果

The research results of this work have been published in conference [8]. The main research results are summarized as follows.
(1) In this work, an integrated framework is proposed to develop personalized e-catalogs. The proposed framework integrates XML-based metadata models, user models and agents. The proposed metadata model is a multi-level architecture to describe separate levels of goods-related information. In the multi-level metadata model, XML is employed as the meta-language to describe domain-level metadata, resource-level metadata, category-level metadata, and goods-level metadata. The metadata model can facilitate resource-discovery and format translation, and can flexibly model the definitions of diverse attributes to describe goods in various product categories and data resources.
(2) User models are designed to support personalized filtering within e-catalogs. The proposed user model uses three-level user profiles to model shopping interests to a certain level of goods information, including preferred resources, categories and goods. The user profile records the user's preference (weight) to the characteristics (described by attribute and value) of goods information. To provide personalized filtering, via referencing user profiles, a match process is designed to rank users' preferred product items in the search of the metadata model.
(3) On the basis of the proposed metadata model and user model, this work integrates the agent technology to develop a personalized e-catalog system. The proposed metadata is used as the basis of the ontology (vocabulary). The proposed e-catalog system employs agents to achieve search results that satisfy the needs of customers. Based on user profiles, the novel system provides structured query by the attributes of selected product category as well as supports personalized product search and browsing for each user. The multi-level design flexibly models goods-related information and users' shopping interests

The major works of this research are summarized in the following.

3.1 XML-based metadata model

XML is used herein to define the proposed multi-level metadata framework.

Users with the same interest may form an Internet community. The domain-level metadata has been designed to describe each community (domain). The resource-level metadata describes the sorts of product a virtual store or virtual mall sells. Products that have common attributes are grouped within the same category. Category-level metadata is used to describe searchable attributes of each category and class relationship within

categories. Goods-level metadata provides detailed product information. To facilitate a search, product information formats of diverse virtual stores must be translated to a unified format that is described by the goods-level metadata.

3.2 Personalized e-catalog design

The setting options of the user profile are based upon the metadata architecture. The information stored in user profile includes the basic information of each user, password, and preferred locations, virtual stores, and categories. In addition, we propose a three-level user profile that has a corresponding level to the merchandise metadata, to describe a user's interest to a certain level of merchandise. Under an attribute-based description, the profile describes users' shopping interests in detail. This implies that the profile records every weight of an attribute and its value of a certain item.

To separate the interests of a user into resource, category and goods level, the user model is therefore, a three-level profile. The resource-level user profile describes the user shopping interest to virtual stores when buying items of a certain product category. In addition, the goods-level user profile can filter out certain product items that the user may not be interested in. Category-level user profile is used to achieve a symmetric modeling and provide a more specific filtering to category-level goods information.

The system establishes a Directory Information Tree (DIT), through processing the Resource-level metadata and Category-level metadata. The system constructs a tree structured virtual catalog by consulting the DIT. Once a user profile is established, the system will use the personalized information stored therein as filtering constraints to search the DIT and dynamically construct a personalized virtual catalog.

3.3 Agent-based e-catalog framework

The proposed brokering architecture consists of the user agent, the facilitator, and the resource agent. The facilitator comprises five components, the control agent, broker agent, category model agent, virtual catalog agent and domain agent. The user agent connects the system to the client. The resource agent is responsible for retrieving data from a particular resource. The control agent controls the query flow, gathers the result from resource agents and communicates with other agent communities. In addition, the control agent cooperates with the broker agent for resource discovery and communicates with the category model agent to verify the capabilities of the probable resources. The broker agent checks resource-level metadata and category-level metadata to find possible data resources that may sell goods, which satisfy the request. The category model agent manages the capability of each resource and specific (searchable) attributes of diverse product categories. The domain agent uses a domain table to maintain domain-related information regarding other agent communities. The virtual catalog agent maintains user profiles to construct personalized virtual catalogs. Furthermore, several functions on the agents were enhanced to support the personalized filtering service. Personalized constraints including the resource, category and goods-level user profiles, are used by agents to cooperate in the ranking and filtering of product items.

We used JAVA and Voyager, a JAVA-based agent class by ObjectSpace Inc [13]. to develop the proposed system. We also developed an Applet in a Web browser to communicate with the user agent. The demonstration of the prototype system is described in [8].

四、結果與討論

The proposed XML-based metadata can facilitate resource-discovery and format translation, and flexibly model the definitions of diverse attributes to describe goods in various product categories and data resources. Furthermore, in supporting personalized filtering within e-catalogs, the designed user model, with three-level user profiles, can

model users' shopping interests. With the multi-level design of both a user and merchandise model, the match process can be carried out efficiently to search and rank users' preferred product items.

Moreover, with the integration of XML-based metadata and user models, the designed agents can communicate and cooperate with other agents in resource discovery, format translation, ranking and filtering to achieve search results that satisfy customer needs. The novel system provides structured query via the attributes of selected product category, as well as supports personalized product search and browsing for each user based on their profiles.

五、計畫成果自評

We have accomplished 90% of the work described in the proposal. The research achievements include (1) proposing novel approach: A personalized e-catalog framework is proposed to satisfy diverse customers' preference. XML is used to describe the metadata to facilitate the interoperability between heterogeneous systems. Moreover, an effective merchandise filtering and suggestion technique is developed based on user shopping profile; (2) applying new technology: We used Java and agent technology to develop the system; and (3) deploying a prototype system.

The e-catalog system is a crucial function for e-brokers in Internet shopping. Our work will be a basis for further research on Internet commerce. Our work not only contributes to further research on Internet commerce but also contributes to the application of electronic commerce. In summary, we have proposed novel idea, investigated new technology and developed a prototype system. The work has been published in the conference [8]. We are highly satisfied with the research achievements of the project.

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