December 2000

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P-Commerce: New Merchant Server System in Electronic Commerce

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Abstract
With the advent and proliferation of the Internet, Electronic Commerce (EC) on the Internet has become one of the most rapidly growing areas and has been the subject of much research lately. EC encompasses various profit-oriented activities such as purchase of goods and services over the network, banking, and business-to-business trade.
In this paper, we propose a new EC merchant server system, called P (Personalized)-Commerce, for EC market. Also, we present design procedure of the database and the server process with our solution and describe several methods to improve the efficiency of the proposed solution. The proposed solution is designed to meet a cheap, simple, extensible, and interoperable requirement. Our solution supports one-to-one marketing concept by using matching technology. We expect that EC market be enlarged easily through our solution.

Keyword: Electronic Commerce, Merchant Server, Internet, One-to-one Marketing, Matching Technology

1. Introduction

Recently, Electronic Commerce (EC) has been issued and developed in terms of high level business environment, as the Internet has become widely used by people (Ainscough and Luckett, 1996; Bichler, Segev, and Zhao, 1998; Kalakota and Whinston, 1997). EC is commercial transactions using computers in virtual environment through computer networks. The computer system deals with various ranges of things such as products, services and information on EC. In EC, the system gathers useful information about things to buy or sell and proposes efficient way of contract, while users should make the right decisions. The system tries to give reliability to user instead of reducing user's action (Yannis, 1998). For that purpose, the system must have the characteristics of intelligence. Many researchers have studied about the intelligent software in AI. They have tried to apply agent technologies to EC applications (Jennings, Norman, and Faratin, 1998; Lee and Lee, 1995; Milani and Marcugini, 1998; Moukas, Guttman, and Maes, 1998).

The purpose of this paper is to help the electronic commerce companies develop new electronic commerce solution, which combines the servers with the business management tools, to set up the commercial site with a minimum investment of capital by using the P-Commerce proposed in this paper. Investment capital is the gross expense for operation and setting up hardware and software. This solution includes the basic functions such as the commission processing and the approval. Also, it is able to work together with the matching agents which have the matching function based on the profiles, the purchasing lists and the various events (birthday, anniversary, etc) about the customers to make the small and medium distribution or manufacturing enterprises realize their business goals effectively. The business management tools can manage the content and the matching functions (Hwang, 1999). The system architecture proposed in this paper has several advantages over as one-to-one
system of BroadVision (BroadVision, 1997), an existing representative Merchant Server. First, it manages dynamically linked-libraries to expand the functions of the engine, and it can expand the functions easily by adding another CORBA server processes to the engine for operating this solution with the existing databases or for accessing the solution with the heterogeneous DBMS concurrently. Second, the interaction manager orders the predefined execution phases through calling the virtual member functions, and the matching object developers overwrite on the coding-alterable member functions to add new functions. Third, it proposes two methods to implement the business adapter to unite with the older systems or other systems. Fourth, it is composed of two parts, the system schema and the content schema to expand the databases easily. Fifth, it adopts the CORBA communication technology using the proxy object, and caches the templates, the rule and the system information, and distribute the load through the transaction controller at run-time, to improve the system's performance. Finally, it uses the object-oriented design method for the independence of the DBMS from the programming interface of the application.

We introduce about the realm of the solution of this paper. First, the survey about the electronic commerce solution markets - the analysis about the electronic commerce market and the development of the electronic commerce solutions to design a worthwhile commercial electronic commerce solution. Second, the acquirement of the important component technologies - the study of the important technologies for the high-level electronic commerce solution, and the acquirement of the applicable technologies. Third, the implementation of the worthwhile solution - the design of the solution which has the competitive functions, the stability and the extensibility. The solution is composed of the database and the software package, which combine the server part, the client part and the utility part. Fourth, the study about the matching methods, and modeling – the modeling the matching methods which are the important parts to the solution. To do this, we analyze the existing researches and the current technologies, and find the applicable new technologies. Fifth, the implementation of the matching models and integration into the solution - we represent the matching method as the software algorithm, and then implement this representation, and integrate at the solution.

Most Internet or Intranet sites can use the proposed solution including the matching agent to service the content to the customers or the customer groups distinctively. For example, the shopping malls which recommend the personalized products, the Knowledge Management System which supplies the required information to the knowledge customers quickly, the Internet Banking System which provides optimal matching of the depositor or the investor, and the customer management systems can use our proposed solution (Buchner, 1998, Jennings, Norman, and Faratin, 1998). Figure 1 shows the application areas of the system proposed in this paper.

2. Solution of the Middle and Small Scale EC

2.1 Requirements of EC Solution

More middle and small companies should run their business to make the whole electronic commerce market actively. It helps that giving a boost of competition in the electronic commerce, supplying the creative and the abundant contents, and making more information-oriented middle and small-scale companies. The electronic commerce solution ought to have some qualities for this. First, it must be able to run in the minimum cost hardware and software. Second, it needs to do not only display catalogs, but also implement business
policies. Third, it has to support the ‘wizard’ interface to set up and maintain the sites easily. Fourth, it ought to support easy extension of the functions as the market and the office environment change.

2.2 Development Trend of EC Solution

The development trend of EC solution is as follows. First, it is the personalized-service oriented (Hoffman and Novak, 1996). The personalized service matches the customers with the products or the information based on the rule through profiles of the customers and purchase history. Therefore, the companies can manage their customers who are interested in the companies’ goods or bought them differently, and they can realize the various business policies to improve the relationship with the particular customers. The one-to-one System of the BroadVision (BroadVision, 1997) is the representative one in the personalized service.

Second, it inclines to make the composite information-oriented enterprise. The electronic commerce solutions have been becoming a part of Information Age by linking up with the existing databases or the systems (the customers, the accounts and the stock). We need new technology to add the inter-operability and the extensibility to the solution. The DCOM (Distributed Component Object Model) of the Microsoft and the CORBA (Common Object Request Broker Architecture) (Orfali, Harkey, and Edwards, 1997) of the OMG (Object Management Group, http://www.omg.org) are proposed as a basic technology standards to support this tendency.

Third, it requires the lower setting up cost at the beginning. We need just ten thousands dollar when start the electronic commerce with the IBM. IMB provides the Net.Commerce START server, teaches how to manage the customers, and helps to design the general sites. The Site Server Commerce Edition of Microsoft and the intershop server (http://www.intershop.com) provide the package with database inexpensively. The companies providing merchant server solutions have been doing like this to preempt a lot of market share.

Fourth, it has been becoming the intelligent agents. Generally, the universities have studied about the intelligent agents that are applicable to the electronic commerce (Milani and Marcugini, 1998). Recently, the GroupLens (Konstan, Miller, Maltz, Herlocker, Gordon, and Riedl, 1997; Schafer, Konstan, and Riedl, 1999) and the LikeMinds (LikeMinds) have studied about the automated recommendation based on the collaborative filtering.

Fifth, it tends to integrate the malls. However, the existing malls seem to integrate only in the parts without the inexpensive standard solution.

2.3 The Competitive Solution in Market

There are three important points to acquire the competitive solutions. First, we have to implement our business policies using a matching function. Second, we have to manage the policies related to the matching technology effectively. Third, it must be open software architecture to link the existing systems or other systems easily.

3. Web-based Solutions and Matching Functions

3.1 Matching Function
The personalize-oriented services are the dynamic individualized services on the electronic commerce sites. It changes the contents of site according to the customer dynamically. The systems that just connect the customers with the companies have shown lots of problems as the Internet grows. First of all, the customers can not find the goods or the information that they want easily, and the companies can not know who are their customers easily. The one-to-one marketing matches the customers with the pertinent goods or the information that is based on their profiles (tastes, purchase histories, etc). Therefore, the companies can have the business relations with the customers who are interested in their goods or purchased their goods, and they are able to realize their effective business policies to improve the relations.

The matching technology is important to the one-to-one marketing. The matching technology connects the various customers with the massive service contents by the databases or the customers’ reactions or the matching agent algorithm. It has the active meaning and the passive meaning in the Internet. In the passive meaning, it cuts down on the absolute expenses by reaching the target contents quickly. A good example is the personalized option (My Yahoo) of the Yahoo<Figure 2>.

Yahoo services the personalized Yahoo pages to the Yahoo members after they register their personal preferences. The personal preferences are different from the profiles that are the data for the business policies. The profiles must include not only the customers’ tastes, but also the several items to guess at their qualities. The personal preferences may be an unreliable data, because the preferences are on the customers’ own tastes. This matching is effective to the Yahoo site, which serves the information services and the news services, but it just brings the familiarities by the navigation assist effect. In the active meaning, it connects the site managers with the customers, and helps to improve the relations. We need the same level as the active matching technology to realize the one-to-one marketing effectively in the electronic commerce. Therefore, we ought to analyze the matching technology in the active meaning, and define the implementation model to apply to our solutions.

3.2 Site Management based on Rule

It is easy to know that the one-to-one marketing policies are composed of the particular matching or the matching groups. The solutions must have an interface to operate the matching policies as well as a matching function to implement the active one-to-one marketing. If the site managers can not define, operate and run matching easily, they might miss a good chance for matching policy. In case of the policies connected with many matching rules, if we can not follow them on the system easily, we have to spend a lot of time on evaluating the policies. Therefore, the solutions must have the interface to help the business policy managers. The rule-based site management meets the requirements for the successful implementation of the web policies. The one-to-one system of the BroadVision is the content operating system to build up the personalized sites. Its special quality is that it is easy to apply the business rules to the sites. However, it does not provide the rule-based policy tracking function on the system. Therefore, it seems to need the high-level data collecting technology based on the rule-based site management to follow the site policies.

4. Design of the Proposed System

4.1 Architecture of the Proposed System
<Figure 3> shows the architecture proposed in this paper. The interaction manager, the transaction controller and the server processes of the engine are the CORBA-based object servers.

4.1.1 Transaction Controller

The transaction controller operates the server processes of the interaction manager, the engine and the business adapter daemon. For example, the interaction manager registers its host information and the object reference information to the transaction controller at the loading time. The transaction controller rejects or permits this. If it permits, the interaction manager receives the object reference information of the engine server and the engine object that it can access from the transaction controller, and then this interaction manager run. It is the same with other server processes. The transaction controller operates the communication among the servers and the objects. The objects and the servers must register and ask for the permission whenever they try to communicate. This is a means to the stability of the transactions.

The transaction controllers issue the session IDs to the browser users after the transaction controllers identify them. This session IDs are the keys to identify identity and continuity of transactions.

Generally, the session means the continuous connection between the servers and the clients in the network communication. Strictly speaking, the session is built on the session layer (fifth layer) among the seven layers of the OSI communication by the communication protocols (Free Online Dictionary Of Computing). Some protocols do not build the sessions, or just keep the sessions for a minute. The HTTP keeps the sessions just for a minute. We generally build the virtual sessions on these protocols. In the HTTP case, we do this by issuing the cookies or the IDs of the applications.

The solutions manage the transactions in the same session by issuing the session IDs. The transaction controllers store the available session IDs, and the session states with their session keys. It grasps the unregistered sessions or the erred sessions or the sessions need long time.

It can measure the loads of the specific server processes or the whole solution because it oversees and controls the communication environment and the session state of the solutions. If there is a lot of load at one server, it runs new server processes with the object service of the ORB (Object Request Broker) or require to wait the server processes.

4.1.2 Interaction Manager

The interaction manager sends the dynamic web pages to the browsers, and transmits the customers’ requirements and the observations about the customers to the engines.<Figure 4>.

The operating procedure of the interaction manager is as follows. The interaction manager finds the templates to be processed based on the information that comes from the web. This means that it finds the path of the templates on the file systems. It ascertains whether the templates are cached. If the template is not cached, it reads this template’s source from the file systems, and compiles, and then caches on the memory. The formative information of the
IWO (Interactive Web Object) and the working elements with IS tags are written in the template. The following is an example.

<ISObject IS_ContentAccessor access_type="collection" .... >

The IS tag starts with ‘<IS’. The object type is the following-letter sequence without a blank. It is the ‘Object’ in this example. It is to be classified into four items, the Object, the BlockObject, the Method and the Loop. The Method type does not have the reserved words. For example, ‘<IS print ...>’ shows a Method, which is ‘print’. The Object name is the next word separated by a blank and can not include a blank. You must avoid the duplicated name. The pair of the object attribute names and the values is changeable with the special objects. We can record the pair from the zero pair to the tens pairs.

The interaction manager calls another interaction manager with the object type and the object name, and then sends the attribute names and the attribute values to the interaction manager. This interaction manager works own jobs with these.

4.1.3 Engine

The engine has the five functions. First, it manages the content schema such as the goods, the articles (news) and the coupons. It divides the schema into the each stores, and manages the each of them. This make the various stores can service at one site. Second, it registers, deletes, modifies and breaks the services of the contents. Third, it interprets the matching rules, and selects the matching contents. Fourth, it applies the observations of the session come from the interaction managers to matching, or saves them at the databases for the regular reporting. Fifth, it processes the order, the approval and the transportation.

4.2 Definition of Matching Model

4.2.1 Formative Model of Matching-based Personalized Session

<Figure 5> shows the formative model of the matching-based personalized session. The session means the transaction group, which are created while the customer stays in the site. Each time the customer visits the site, it is created. We describe that how the matching-based personalized service starts, how this works, and how this ends.

The session starts with a visit of a customer or after the authentication. It creates the basic session data after identify the customer (name and class). The basic session data are able to acquire by authentication of a customer and be applied for matching. For example, the profiles of the customers (address, average income, name, gender and age), the histories of the customers (total purchase, purchase pattern and visit count) and the marketing policies are the representative one of basic session data.

The profiles may not true, because the customers check their profiles by themselves. Even though this is true, the profiles are important at the initial accessing. The customer histories are trustworthy because these are automatically created by solution. The business managers using the profiles and customer history insert the marketing policies. The marketing policies are the third basic data.
Once the session has been created, the customer receives the services provided in the site. The site service is based on the basic data and the customer’s response. This means that the service may change when the response is not same, even though the basic data are equal. After one session has ended, the information about this session is reflected to the basic data. The profiles usually are not changed without the customers’ replacing. We add new purchase history and response to the customer history. Also, the business managers observe one or more sessions, analyze the business performances and update the business policies. Basic session data are being improved in this feedback. <Figure 6> shows the application of the matching model.

4.2.2 Matching and Rule

The rule is the specification that represents the conditions and the matching objects to manage the matching. The following is an example of rule function.

Function Rule (Operator, Operand) returns True or False
   ( IF Operator (Operand) = TRUE
       THEN
       RETURN True
       ELSE
       RETURN False
     END IF
   )

The rule function returns ‘True’ or ‘False’ according to the operator and the operand. Let’s analyze a natural language sentence as an example. “The gender of the user is male.”

This sentence is a rule. ‘The gender of the user’ is the operand, and ‘is male’ is the operator. The operand is the data for matching. This may be the profile or the response such as the purchase history or clicking a banner advertisement. The operator is the conditional expression for estimating the operand. It returns a ‘True’ or a ‘False’. This rule function is too simple to manage the sites since the business policies require the combinative and discriminative rule function. Therefore, we need the rule set, the tool to combine the various rules, for the complex policy.

Function RuleSet (Rule-Check-Option, Rule-List, Target) returns Target or Null
{ Rule_Count, // The total number of the rules included in the rule list cnt, // The counter FOR cnt ← 0 TO Rule_Count
{ Rule, // each rules CheckResults, // The result of the each rules; a True or a False Rule ← GET-NEXT-RULE (Rule-List)
CheckResults ← CheckResults + Check-Rule (Rule)
}
IF STOP-CHECKING (CheckResults, Rule-Check-Option)=TRUE
THEN
IF GET-RULESET-RESULT (CheckResult, Rule-Check-Option) =TRUE
THEN
   RETURN Target
ELSE
   RETURN Null
END IF
ELSE
   cnt ← cnt + 1
   CONTINUE
END IF
}
RETURN Null
}

The Rule-List is a rule package. The Rule-Check-Option is the option to check Rule-List. This option has the criterions for the Rule; how to evaluate the rules and distinguish the True and the False. An example of the evaluation options is ‘if one or more rules meet the qualification, stop checking.’ In the distinction option, it is ‘it is the True when every rule is satisfied.’ The Target is the object content that will be the matching object when it’s the True. Target is the object content to be matched when the rule set is True. There are many ways to make the Targets. First, it is the list form such as ‘a leather jumper’, ‘Guess jeans’, etc. Second, it is the categorical form; it shows all of the products belong to the home electronic appliances. Finally, it’s the agent form; what is most popular accessory to teenage girls for last three months?. The definitions of the rule and the rule set are most important on the implementation of matching interface.

4.3 Interface for Site Page Implementation

4.3.1 The Solution Tag

In templates, the solutions use the characteristic tags which has not being used in the HTML. This tag is used to describe the matching object names, the matching function names and the arguments. These tags are extended to the HTML, and the templates are changed to the HTML text. These HTML texts are sent to the browser. We proposed three kinds of tags in this paper.

<ISObject …> // The single type object tag

<ISBlockObject … > …
</ISBlockObject> // The block type object tag

<IS print …> // The function tag

The block type object tag can include the single type object tag or other HTML tags. The function tag is used to call the functions that need not create object instances.

4.3.2 Usage of Variable in Template
We can declare the new variables or use the existing variables in the template. There are two variable. The one is the variable of the template, which is available only in the template. The other is the variable of the session, which is available in the session.

```xml
<IS dim name="OID_BUF">
// Declaration of the variable
<IS dim name="OID_FROM_DB">
// Declaration of the variable
<IS set name="OID_BUF" value="1006">
// Allocating the value to the variable
<ISBlockObject IS_List max_items="10">
<ISObject IS_ContentAccessor
access_mode="SELECT" access_type="oid" oid="$(OID_BUF)"
// Defining the attribute value of the template by the allocated value.
<ISLoop>
  <ISObject IS_Field name="OID" type="OUT" set="OID_FROM_DB">
    // Allocating the extracted data to the variable
    <IS print value="The value of the OID_FROM_DB is $(OID_FROM_DB)."
  </ISLoop>
</ISBlockObject>
```

We can use the CURRENT TEMPLATE, the PREVIOUS TEMPLATE, the FETCHED ROWS and the TOTAL_ROW without declaration. The variable that is available while the session is keeping has two variables. The one is the session variable, and the other is the variable of the customer’s profile. The session variable can open only the predefined variable as the form of ‘session.[the name of the session-variable]’. The variable of the customer’s profile means the profile of the current user, and it is used by ‘profile.[the name of the profile column]’. It works like the variable of the session in the system, but it can apply the values whenever, because the values are set at the log-in time. The profile schema of the customer might different in each store, and the name of the profile column is available only when this name exists at the profile schema of the customer in the store.

4.3.3 Writing rule of Conditional Sentence

The conditional sentence is the sentence that has the value of the condition in the template, and its value always is the True or the False. We can cut down the cache memory of the template or make the more dynamic page if we set up the condition.

```xml
<ISBlockObject IS_List max_items="20">
<ISObject IS_ContentAccessor
access_mode="SELECT" content_type="product" max_items="20">
<table border=0>
<tr>
<ISLoop>
<td><font size=2>
<ISObject IS_Field name="OID" type="OUT">
<br>
<img src="<ISObject IS_Field name="PREVIEW_IMAGE_URL"
```
This is the example that the product items be outputted in the table form of three rows. The conditional expression, which is used in the example, is as follows.

```
template.FETCHED_ROWS%3 equal 0 and template.FETCHED_ROWS notequal template.TOTAL_ROWS
```

This expression inserts the boundary tag of the html table when the total number of the fetched rows can divide by three without a remainder and it doesn’t equal to the total number of the rows. The print method output a value to a web page only if the condition is satisfied.

### 4.4 Interface for Content Management of Site

The interface for the content management is characterized by working on the external management tool of the business, not on the web. It can work on the web if we need few functions such as the register, the addition and update of the content. However, the web interface must change the web pages whenever the event of the customer occurs. In addition, it is hard to implement the interface when we have to open many related windows concurrently. The solution proposed in this paper is made to manage the contents in the client program of the Windows98. <Figure 7> shows the prototype of the content-editing interface selected in the solution.

The tool of business management serves the intuitive interface to help to edit the rules for managing the matching functions. < Figure 8> shows the prototype of the rule-editing interface.

### 5. Performance Analysis

We describe extensibility, the number of concurrent users and response time to compare the P-Commerce proposed in this paper with others. First, extensibility means how much performance improves easily after add new hardware hosts. P-Commerce has an advantage
of structure, because it is distributed architecture based on CORBA. Even if the new servers play same part, they create new processes as many as a load of the system, and the system notice this automatically. Therefore, the proposed P-Commerce provides the better extensibility than other systems. Second, simultaneous stream is important for web application. The proposed P-Commerce supports multithreading and a module that schedules threads, so the number of simultaneous users grows as hardware ability. Finally, the P-Commerce executes Cache Forward policy to reduce response time. It caches as many data as possible at client, and it has a special control interface for synchronization of effective data.

P-Commerce has a characteristic function. In the first stage, it had intended to be a total commerce server, but it turned to matching server including a component structure. Therefore, P-Commerce doesn’t consider the transactions decreasing a performance (e.g. payment, conduct of order and delivery). The performance of P-Commerce falls off little when appending it to old commerce server because it is added only with a limited information for matching customer with contents. The matching function of P-Commerce helps that merchants sell more products and customers search what they want to buy. Further, the matching function is separable, so it is easy of extension.

6. Conclusions

In this paper, we proposed a new merchant server system, called P-Commerce, in electronic commerce. The proposed system consists of the servers and the tools of business management to help that the medium and small companies set up the commercial sites with the minimum investment of capital. We presented design procedure of the database and the server processes with the solution proposed in this paper. Also, we described several methods to improve the efficiency of the proposed solution. The proposed solution might be used for the shopping malls, which recommend personalized products, the Knowledge Management Systems that supply the required information to the knowledge-customers quickly, the Internet Banking Systems, which match the depositors, or investors, and the customer management systems.

We have been researching the technology of the expanded matching agent, which is based on Testbed algorithm, called GroupLens(Konstan, Miller, Maltz, Herlocker, Gordon, and Riedl, 1997, Schafer, Konstan, and Riedl, 1999) to add the matching agent that recommends the personalized products. The GroupLens algorithm finds the resemblance customers among a lot of users, and recommends the special item based on the purchase pattern of these resemblance customers. However, in the real world, the efficiency fall off when there are too many users because it find the pattern by comparing the ratings of each items of the users. Therefore, we are implementing a new algorithm based on the optimized clustering of the user and the item and sampling technology, and we will simulate performance of the proposed system with the real data from EachMovie (http://www.research.digital.com/SRC/eachmovie)

References


<Figure 1> Application areas of matching agent system
<Figure 2> Personalized preferences in the Yahoo site

<Figure 3> The proposed system architecture
Web Browser

HTTP/CGI Server

Interaction Manager

Page Template File

Template Parser

Template Cache

Shared Library

<Figure 4> Functional diagram of Interaction Manager
Session Model

Real-time Usage & Sales Stimulation by Matching
- Continuous Stimulation: Accumulation of Bonus Points
- Managing Classes of Customers
- Intensive Stimulation: Proposition of Contents Matching based on Purchase Histories

Data Gathering
- Content Check: Utilization of Content
- User Check: Patterns of Behavior
- Marketing Policy Check: Tracking of Policy Rules

General Contents Matching
- Promotion of Navigation efficiency: Short Seek Time
- Improvement of Relationship: Keep Familiarity by Paying Attention

<Figure 5> Session matching model

<Figure 6> Application of session matching model

Session Material
- Customer Profile
- Customer History
- Marketing Policy

Feedback

Profile
- Age: 31
- Single
- Interest: Housing, Seobak-Condominium
- 1. Week Ago
- External Point: 250
- Internal Grade: B

Log in
- Check Log in Count
- Check Last Log in Date

Web surfing
- Personal Room Link
- Item in Detail
- 'Push Client Download' Linked

Item Category
- Personal Item Updated
- 'Push Client Download' Linked

Point Update
- Participation Item

Seobak Condominium
- Thank You for Your Visiting
- Answer the Questions, please - Offering Coupon

News: Sale Apartments in the Capital Area
- Info1: Rural House Price is Same with Apartment
- Events for High Class Customers
- A Message from Seobak Condominium... etc.

Policy Report
- Purchase History Analysis Effective
- Improving Relationship and Interactivity
- Tendency: Prefer Cyber Tour than Real Travel

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<Figure 7> Prototype of content-editing interface

<Figure 8> Prototype of rule-editing interface