STUDY ON RE-USE SUPPORT SYSTEM FOR ELECTRONICALLY DELIVERED DATA

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ABSTRACT

Electronic delivery of documents produced in the process of public works ordered by public organizations such as Ministry of Land, Infrastructures and Transport has been done in the past several years. Although great amount of electronic data has been accumulated through this sort of activity, the data have not been reused smoothly yet because of the lack of support systems.

In this study, the authors designed a prototype system to enhance usability of electronically delivered databases and a search system for electronically delivered data. This system contains a set of templates for searching desirable data as well as the template development support system for engineers to easily make a set of templates. The proposed system is accomplished based on the framework of multi-agent system to integrate various existing databases.

KEY WORDS

electronic delivery, multi-agent, template, knowledge acquisition

INTRODUCTION

In Japan, reduction of public investment must be going to last presumably for coming decades. Japanese government must maintain the stock of the enormous infrastructures with the restricted budget. The effective use of the information produced in the various processes is indispensable to do the maintenance of the infrastructure efficiently (Akaui 2004). Therefore, the Ministry of Land Infrastructure and Transport (Here after called MLIT) introduced electronic delivery in all the public construction works from the fiscal year of 2005. Electronic delivery policy requires contractors to deliver all the documents and data produced in public construction works by the electronic data. Electronically delivered data storage and control system is employed to store, manage, browse, and search electronically delivered data.

In this study, an agent-based electronically delivered data management system is proposed to manage information stored independently in databases managed by some local

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branch of the ministry. Also, a template management system is proposed to acquire knowledge on how to use the system to search required data.

CALS/ EC AND ELECTRONIC DELIVERY SYSTEM

MLIT settled and repeatedly revised various standards related to the electronic delivery since August, 1999. Contractors are required to submit the information or data produced in each work processes to MLIT by a set of CD-ROMs based on those standards. Those electronic data is structuralized by using XML, and they are styled with XSLT. The preparation process of the electronic documents produced in construction processes is shown in the Figure 1. Construction consultants and contractors make delivery data through some processes and owners are expected to use the information effectively.

SEARCH SYSTEM FOR ELECTRONICALLY DELIVERED DATA BASED ON MULTI-AGENT TECHNOLOGY

DEVELOPMENT ENVIRONMENT

It is desirable to adopt the development environment dependent on platforms. It is effective for the cost reduction to use free software of the open source. And, it is also desirable to accomplish a system easily constructed and managed even if special knowledge on Information Technology is not relatively rich. The development environment is shown in Table 1. TX1, which is the XML data base system of Toshiba Corp., is used as a database for the experiment. TX1 is the database that can be used to register XML data. By using that database system, high-speed search of large data can be established.
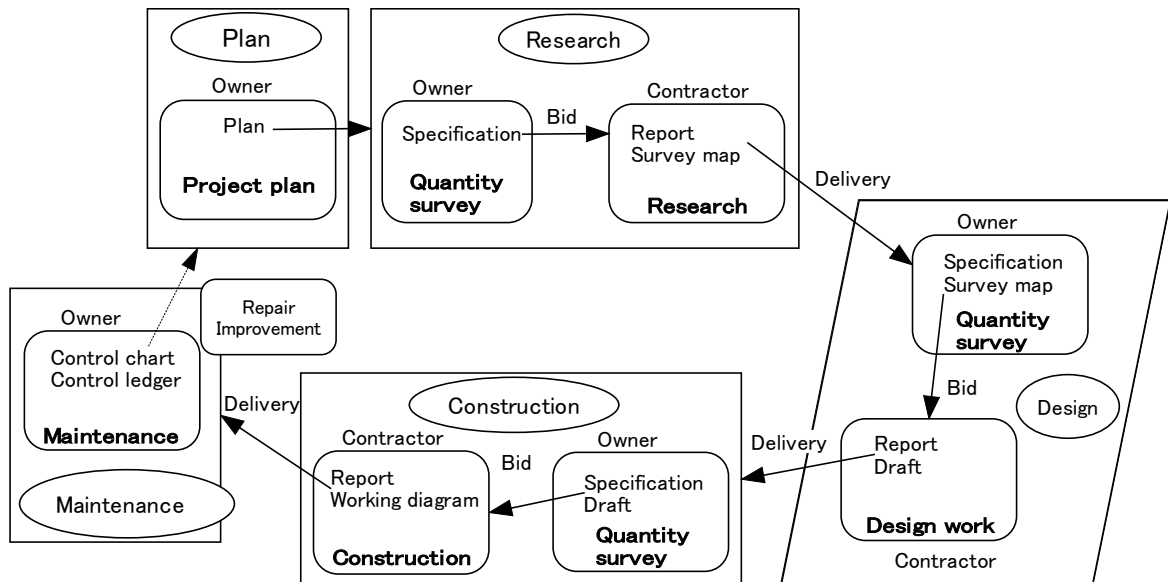

Figure 1 : Electronic Documents Produced in Construction Processes

Table 1 : Development Environment

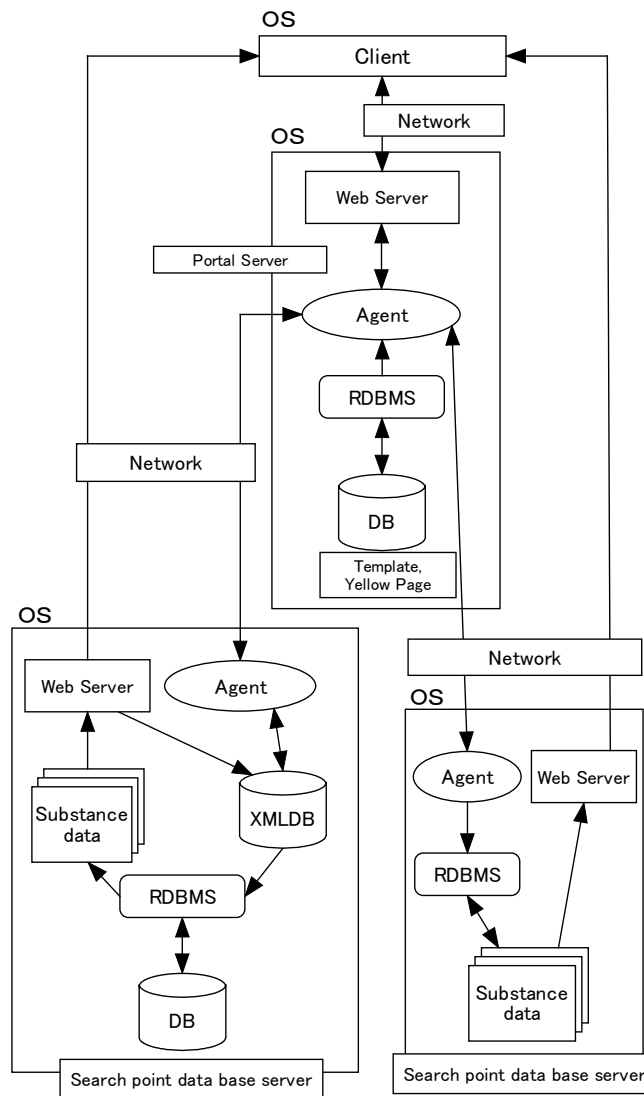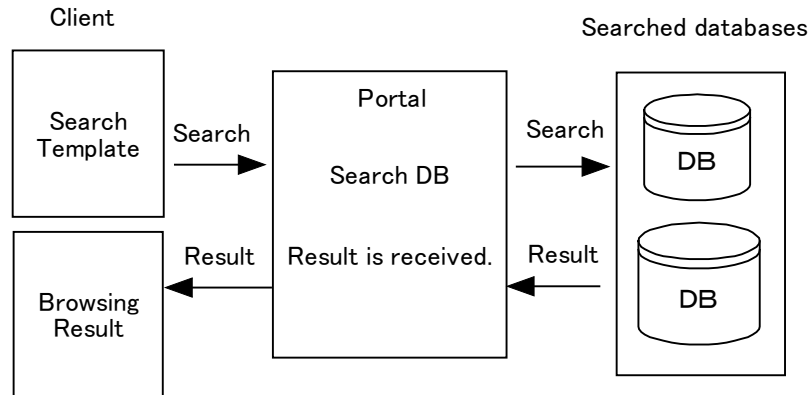| Server(Portal)			Client	
OS	**Linux**		**OS**	**Windows**
Database	MySQL		Web Browser	Firefox
Web Server	Apache			
Development Language	PHP			

Figure 2 : Outline of search system

Figure 3 : Functions of portal server

SYSTEM COMPOSITION

Whole composition

The construction of the proposed system is shown in Figure 2. The system is composed of each component of clients, the portal server, databases, and a network communication part. A client accesses the portal server to prepare the search template or to call selected existing template. A search condition is inputted to the template, and a message is transmitted to the portal server. The portal server receives search conditions from the client and delivers those search conditions to the agent. The agent reads the address of the referred database registered in the yellow page. Furthermore, a search condition is delivered to the XML database through the agent on the database side (Sato 2005). Each XML database returns the outline of the data corresponding to the condition to the agent. After that, if a client requires substance data, the client can access the link. The main functions of the portal server are shown in Figure 3.
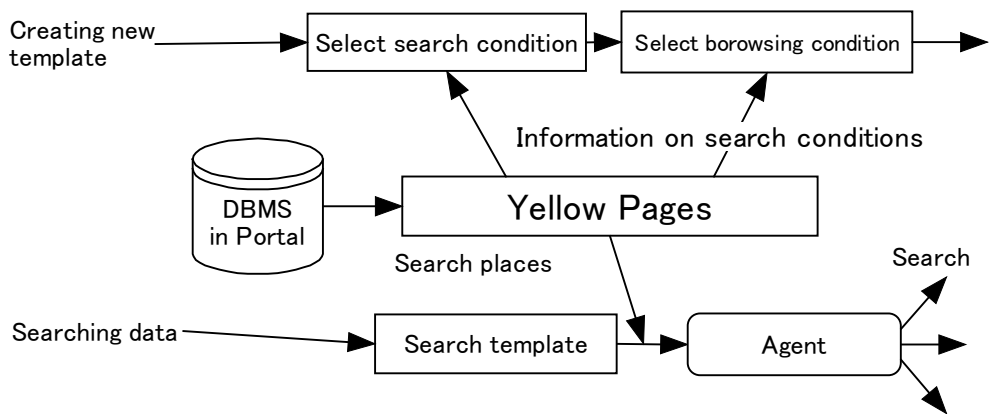

Figure 4 : Functions of Yellow Pages

Yellow pages

A yellow page is the function providing the information which is necessary to search a database. A yellow page exists as a database, and provides necessary information to the portal server, a search template preparation program, and a search template. The function of the yellow page is shown in Figure 4. And, the database composition of the built yellow page is shown in Table 2. System's control can be made easy by possessing connection information and a search condition separately from the system itself.

Table 2 : Contents of Yellow Pages

Infromation on Search Conditions

Field Name	Explanation
ID	Serial number
Server Name	Name of the connected server
URL	URL of the connected server
Port Number	Port number of the connected server
Server Path	Pass of the connected server
Table Name	Table name of the searched object
Field Name	Feld name of the searched object
Type	Type of the data consistiog the field
Explanation	Explanation of the field
Show	Field which can be shown
Search	Field which can be searched
Title	Name of the indicated field

Information on Searched Database

Field Name	Explanation
ID	Serial number
Server Name	Name of the connected server
URL	URL of the connected server
Port Number	Port number of the connected server
Server Path	Pass of the connected server
Explanation	Explanation on the searched server
Owner Name	Owner's name of the DB
Charge Group	Groupname in charge og managing the DB

Referred databases

The electronically delivered database managed in each local office of MLIT is presumed a reference database server. Because control files of the electronically delivered databases are written in XML forms, XML databases are going to be introduced in the near future to manage all the information. Therefore, TX1, which is one of the XML database systems of Toshiba Corporation, was used. Presuming existent databases, sample databases were also built by a freeware of MySQL.

SEARCH TEMPLATE SUPPORT SYSTEM

OUTLINE OF THE SYSTEM

A search template is a style to input search conditions, and exists as an interface between databases and users.   Main functions the system possesses are summarized as follows:

- Supporting preparation of search templates: When a new search template is to be made, search items and databases are listed up to make it easier for a user to make the template by choosing search items.

- Saving the search template to the server: Because a user can use saved templates, users can use the search system easily.

- Modifying any existing search template: Because an existent search template can be modified, the load of the template preparation is reduced. It can be expected that use for the databases is activated by the increase of search templates caused by the cycles of development and modification.

The composition of this system is illustrated in Figure 5.   When a search template is to be made, information on the search condition is provided from the yellow page.   The body of the search template is saved in the server.   The name of template made, the URL of the database, the name of the user, contents of a reference, search classification, and the date are saved in the search template control database at the same time.   This set of information is called preparation information.   Desirable templates can be referred by the information saved.   A link to the contents is indicated with the information on the search template which is applicable after preparation information is found.

FLOWCHART OF SEARCHED TEMPLATE USAGE

The flow chart to use search templates is shown in Figure 6.   Since preparation information has been saved to the search template control database, desired information can be found and indicated by using input information.   A desired search template can be identified and used again because the name of template, the name of person who made the template, search conditions, and other information are indicated.
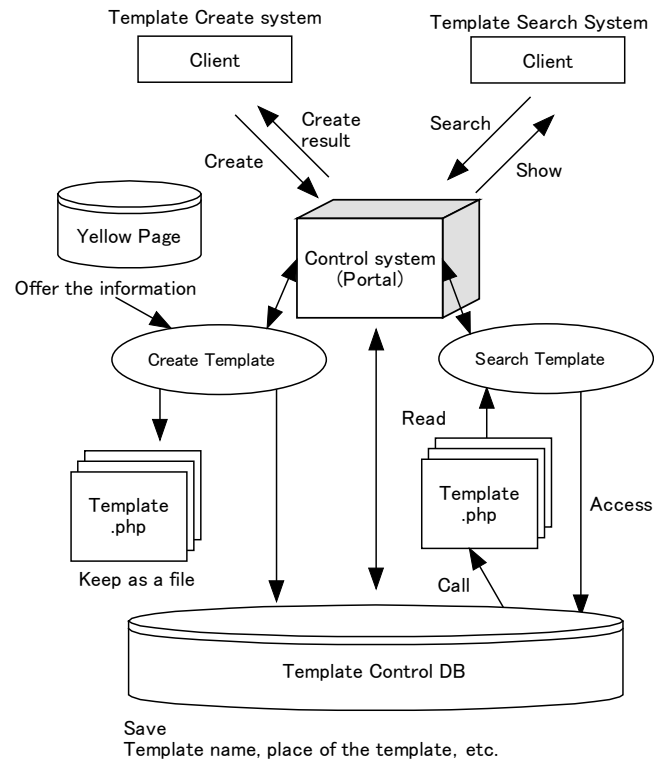
Template Create system

Client

Template Search System

Client

Create
result

Create

Search

Show

Yellow Page

Control system
(Portal)

Offer the information

Create Template

Search Template

Read

Template
.php

Template
.php

Access

Keep as a file

Call

Template Control DB

Save
Template name, place of the template, etc.

Figure 5 : Outline of Search Template Support System

Search Template

Template Name

Creater's Name

Contents

Search

Template Control
DB

Result

Search Result

Template name···use

○○template···use

△△template···use

The key word of the necessary template is inputted.

○○template

Construction place

Search of the data

Construction name
Contents of construction

are shown

A link is being put.

It is chosen from the result and used.
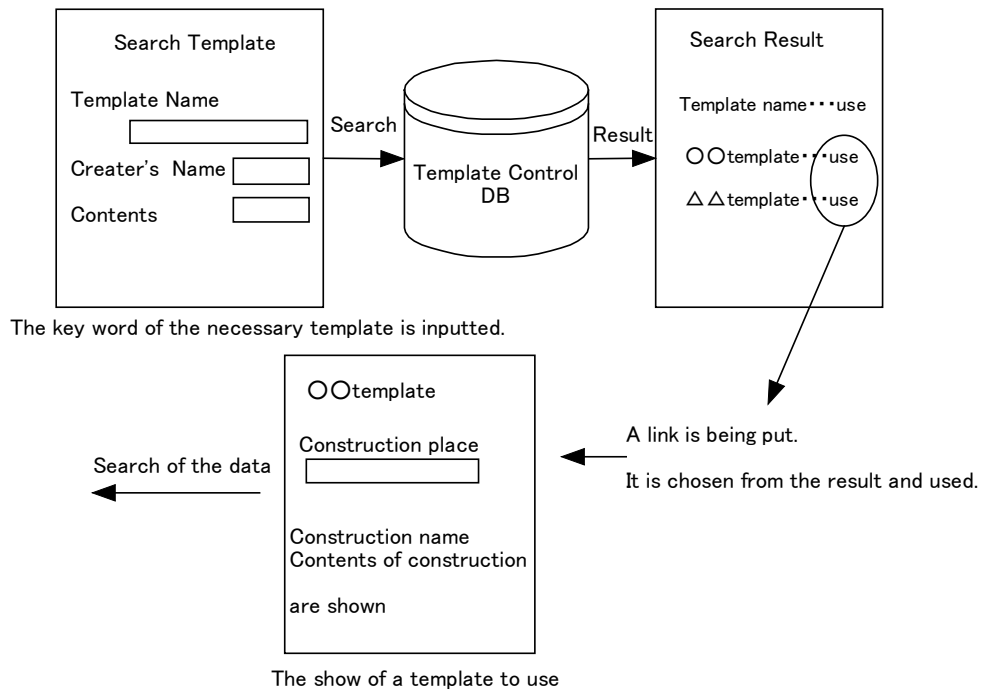
The show of a template to use

Figure 6 : Flow Chart for Usage of Search Templates

VERIFICATION OF THE SYSTEM

The performance of this search system and the support system is verified.

VERIFICATION ENVIRONMENT

The environment for the verification of the prototype system proposed here is shown in Figure 7.   Users access the databases built in the servers of the T construction company, of an engineer, and inside the laboratory the authors belong, through the portal server built in the laboratory.   Some sets of sample electronically delivered data are saved for the experiment in each database.
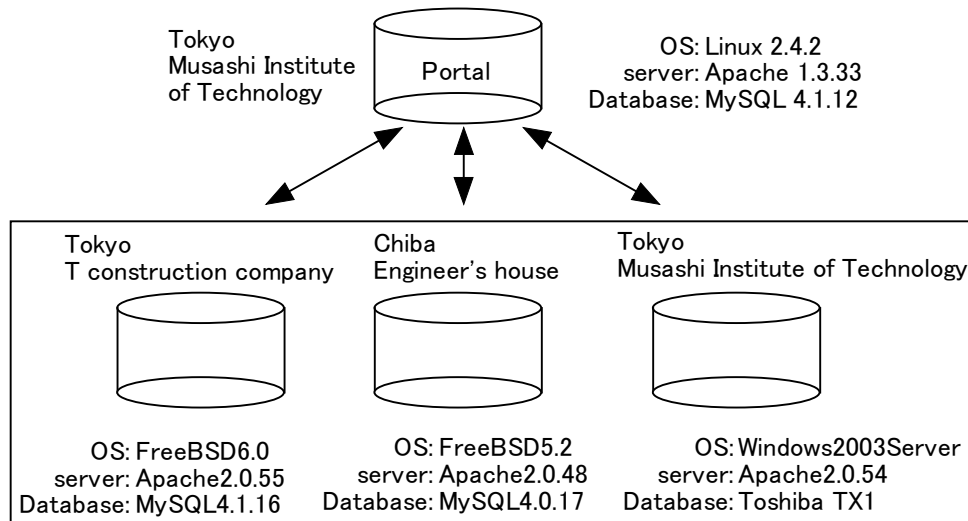

Figure 7 : Environment to Verify the Search System

VERIFICATION RESULT

The example of the result obtained by using a made search template is shown in Figure 8. This figure shows the connection was completed to the database set up in the T construction company and the engineer's house.   Search items chosen in this experiment are the order year, the number of the construction work, the type of construction work.   A verification result is summarized in Table 3.

接続先 (URL of Searched Database)
/jiseki/HAL-API/server_libretto.php
www.toda.jp
80
http://www.toda.jp
検索結果 (result of Search)

工事番号　　工事業種 (The number and type of construction work)

11111111111 土木一式工事 (Civil Construction)

接続先
/jiseki/HAL-API/server_libretto.php
www.satoiku.com
80
http://www.satoiku.com
検索結果

工事番号　　工事業種

11111111111 土木一式工事

工事番号　　工事業種

11111111111 土木一式工事

Figure 8 : Verification Result Obtained by the Proposed System
(Originally indicated in Japanese)

Verificatied Fuctions	Result
Communication between the agents	△
A search with templates	○
Acquisition of the information from DB	○
The show of the result that it was acquired	○

Table 3 : Results of Verification

CONCLUDING REMARKS

- A prototype database management system was proposed to effectively use electronically delivered database managed separately by using multi-agent technology. The search template support system proposed in this paper has a possibility to be used to acquire knowledge of system users. Also, the following effect can be expected by using the system

- Integrated usage of electronically delivered databases

- Effective search of desired information from the enormous quantity of data

- The accumulation of the information retrieval know-how

ACKNOWLEDGEMENT

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