

Development of Integrated Biomedical Signal Management System Based on XML Web Technology

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Abstract: In these days, HIS(Hospital Information System) raise the quality of medical services by effective management of medical records. As computing environment was developed, it is possible to search information quickly. But, standard medical data exchange is not completed between medical clinic and another organ so far. In case of patient transfer, past medical record was not efficiently transmitted. It be feasible treatment delay or medical accident. It is trouble that medical records is transferred by a person and communicate with each other.

Extensible Markup Language (XML) is a simple, very flexible text format derived from SGML. Originally designed to meet the challenges of large-scale electronic publishing, XML is also playing an increasingly important role in the exchange of a wide variety of data on the Web and elsewhere. Form in system of company product, relative organs that handle bio-signal data is each other dissimilar and integration and to transmit to supplement bottleneck this research uses XML. In this study, it is discussed about sharing of medical data using XML web technology to standard medical record between hospital and relative organization

The data structure model was designed to manage bio-signal data and patient record. We experimented about data transmission and all-in-one between different systems (one make use of MS-SQL database system and the other manage existent bio-signal data in itself form in file in this research).

In order to search and refer medical record, the web-based system was implemented. The system that can be shared medical data was tested to estimate the merits of XML. Implemented XML schema confirms data transmission between different data system and integration result.

key words: XML, Standardization, Biomedical signal data management, Data sharing

INTRODUCTION

Medical information recording is correct unlike general recording and objective recording may not consist because that forms and pattern are various. In case patient undergoes medical examination and treatment in several medical institutions, overlapped form creation and medical examination are possession of medical treatment fault in medical examination and treatment by upper reason between recording and state grasping mutually. Standardization of medical treatment information defining such system that is not come to a standstill in form that is most objective and there is public trust, to do so that objectification about a medical record and consistent medical treatment behavior are possible target put [1].

Medical records standardization includes regulation of all for necessary code and communication style between medical institution to computerize form and terminology, and these as that is actual [2].

Portability between system, extensibility that is developed by various communication method and technology application in Information-Communication, problem was caused diffusion and transfer of an appropriation in the budget of communication service because problem of use interoperability happens mutually [3].

There was effort of the United States of America for medical treatment information standardization of last 20 years and Europe every country to solve these problem in medical information field and several standard format came out. Also, it can take charge data processing business between corporation laying stress on the latest internet and XML (Extensible Markup Language) that is applicable technology electronic commerce and electron document standardization of discipline will appeared and change existent standard code form by XML or take advantage of XML extension technology and gain advantage in

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search of data, opening, transmission etc. along with standardization in medical information field. This research applied XML technology and extension technology to constructed system embodied system to manage bio medical signal data netted after clinical diagnosis by link of electronic medical record that is used in medical institution. Also, standardization system of XML base verified efficient thing than existing system to do data transmission efficiently.

BACKGROUND

XML (Extensible Markup Language) was developed by XML working group of W3C (World Wide Web Consortium) in 1996, and it is normalized data format that is designed to process structured document efficiently in web [5].

There are mentioned HTML and SGML before in existent markup language but SGML is shortcoming that selection item is many and development is difficult because is complicated, HTML is that use predefined tag have shortcoming that do not express logical structure of document [13].

Table 1 show comparison to three markup languages XML was developed to overcome limitation of tag that is made for HTML's expression and solve SGML's complexity. It must be able to be fast and exchange efficiently great many document with several relative organs to do quick information interchange using net. But, institution, corporation, research institute etc. are constructing communication environment of different platform present, and because application that use each other within same institution even gives, document exchange between post does not consist or costs much expenses properly and case that use conversion system.

XML is worthy of notice by technology for efficient exchange of data in web-based information systems because make out standard document that become other organ and disaster caused by HTML with advantage that can solve existent problem that happen in document exchange.

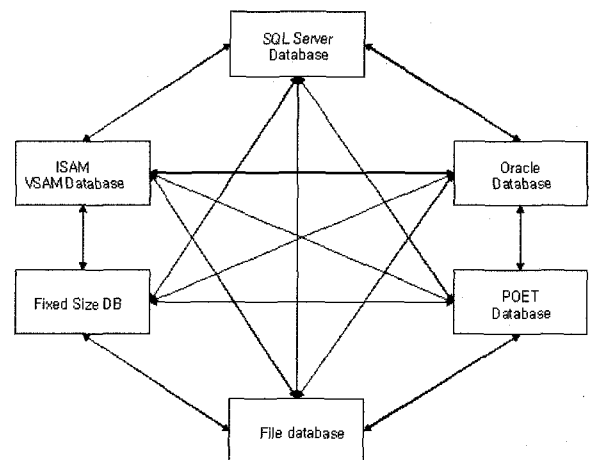
Figure 1 shows that mechanism that transmit information between various kinds database in case use XML standard becomes concise.

XML Is independent from platform and language. It means that is unrelated even if any other computer uses XML. For example, UNIX that have Java code or Microsoft's Operating System that have Visual basic, can use all data in some side. Actually, certain time that computer program requires other program and communication XML in form of data exchange suitable.

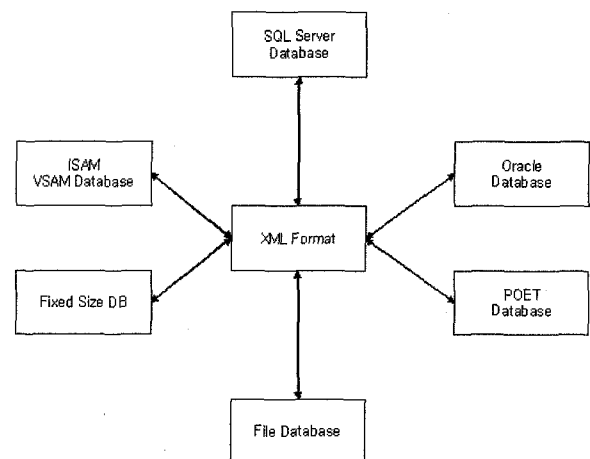
XML spec. is specifying client architecture of two steps to handle XML data as well as explain form and syntax of XML data. First step is XML processor (at XML parser). Parser verify well-formed availability of XML data that use. Also, use to examine effectiveness about user's data structure. Do connection ring of different system following XML spec. Do so that

transmission and all-in-one of data through communication may be available between different system. Also, end system can keep data and structure even if is different because communicate structure of XML data to user to decided method to application secondly.

If use XML, can make suitable tag gathering in specification subject field easily and fast. The all organizations can define own vocabulary, and at equal construction of a sentence and parser, and can share vocabulary of each other using tool. Document and data base through shared XML vocabularies can exchange information between several other structures and computer application can search easily.



(a) Data transmission mechanism between general database



(b) Commonness transmission mechanism of XML based system

Fig. 1. Data transmission comparison between existing system and XML base system

Table 1. Comparison with XML and existing markup language

	HTML	SGML	XML
type	markup	meta	meta
structure complexity	simple	very complicate	simple
tag extensibility	inextensible	extensible	extensible
reusability	impossible	possible	possible
document form language	CSS	DSSSL	XSL/CSS
search	full text search, not effective	exact search, effective structure search	exact search, effective structure search
document creation	simple, not effective in logical structure	very complicate	simple, effective in logical structure
link	HTML (Simple Link)	HyTime	XLL
application field	document of simple structure and contents expression	technological document that need bulky contents and structure	technological document that need bulky contents and structure

DESIGN AND CONSTRUCTION

Composition of System

System that is constructed in this research exchanges and mark patient's bio medical signal data and connection information and targeted that update utilizing data structure model of designed XML base.

Figure 2 shows how 3 hierarchies of client, web server, Database are linked. Web browser of client side is delivered XML document and style sheet and achieve work of array, search, calculation etc[19]. IIS (Internet Information Services) is linked with SQL server using ISAPI extension through Sqlisapi.dll as web server that take charge middle hierarchical. Web server sends data by XML and expression information transmits off once to style seat[20]. That database is relation style database system (RDBMS) or XML welsh onion, can become XML exclusive use DB.

Table 2 is about system composition and development environment.

Table 2. System composition and development surrounding

	Spec.
Server operating system	Windows 2000 Adv. Server
Database	MS-SQL 2000 Server, Plaintext independent XML file
Web sever	IIS(Internet Information Services)5.0
Web programming language	ASP, Java applet
Client	IE 6.0, Pocket IE
Wireless lan	SWL-3500RG

XML Schema Model Definition and Database Design

Bio-medical signal that is acquired in presence at a sickbed adopts binary data form being digitalized usually. But, item that become administration's target stores and should be managed because mutual relation with information connected each other, result that analyze data indeed as well as binary data itself or existing data is involved and so on with various kinds information.

We designed model of data structure for bio-medical signal management taking advantage of XML schema technology to express various kinds information related with actuality data structurally in these research. And we Designed XML schema (XSD) that can fill bio-medical signal data and connection information structurally.

Table 3 is example of XML document that satisfy XML schema

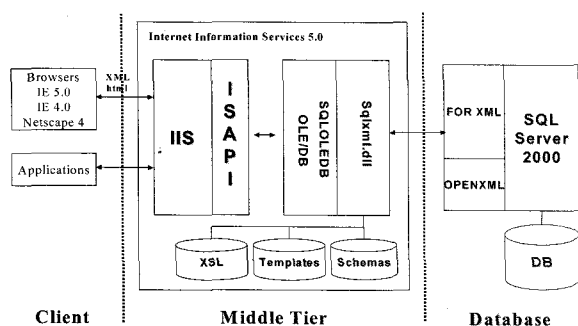
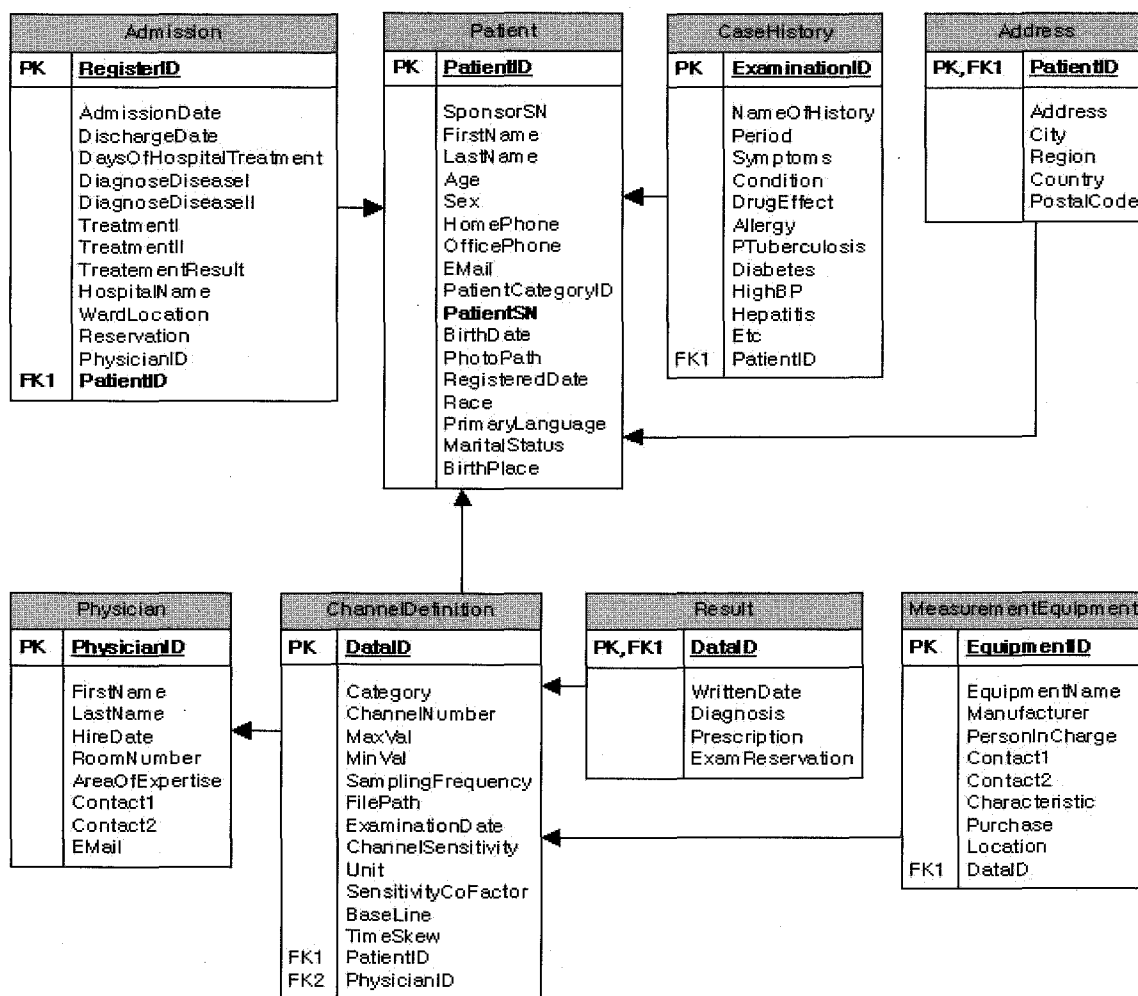
**Fig. 2 .** System composition for XML supper

Table 3. Designed schema structure and validity XML document

XML Schema (XSD)	XML
<pre> <Schema name="Schema1" xmlns="urn:schemas-microsoft-com:xml-data" xmlns:dt="urn:schemas-microsoft-com:datatypes"> <ElementType name="signal.dbo.image" content="eltOnly" model="closed" order="many"> <element type="pid"/> <element type="pname"/> <element type="age"/> <element type="gender"/> <ElementType name="pid" content="textOnly" model="closed" dt:type="i4"/> <ElementType name="pname" content="textOnly" model="closed" dt:type="string"/> <ElementType name="age" </pre>	<pre> <signal.dbo.image> <pid>1</pid> <pname>kim</pname> <age>20</age> <gender>male</gender> <phone>011-555-1234</phone> <address>may street</address> <history>none</history> <ht>177</ht> <wt>75</wt> <race>-</race> <exam_date>2005-01-24</exam_date> <category>12Ch</category> <ventrate>120</ventrate> </pre>

**Fig. 3.** Relation style data base structure

Also, it can designed relational database structure by same structure with XML Schema and received data in XML form by SQL Server's XML support function. Such common XML schema permits data exchange between different system later. Data table consists of admission into a hospital information, the past history of a patient, measurement equipment with patient connection information, medical personnel, measurement bio-medical signal, diagnosis result. PK displays primary key that is peculiar identification data in table and FK means foreign key that refer from outside

RESULT AND CONSIDERATION

Bio-medical Signal Data Search/figure Processing That Take Advantage of XML Technology

It was Examined functions of system that is embodied and system that use estimation about web program and XML connection standard. XML acts as standard format for data into web-based, but this category is not limited to web application. But, It was considered advantage of mentioned web and user accommodation and embodied web program to web server of middle tier.

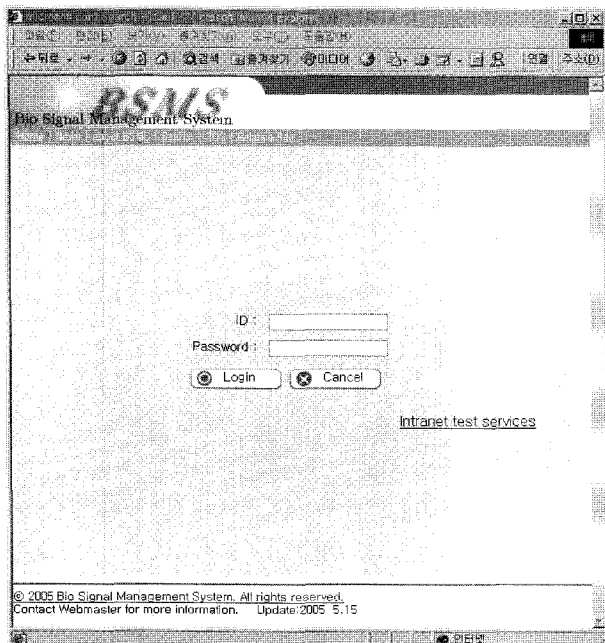


Fig. 4. Early screen view to log

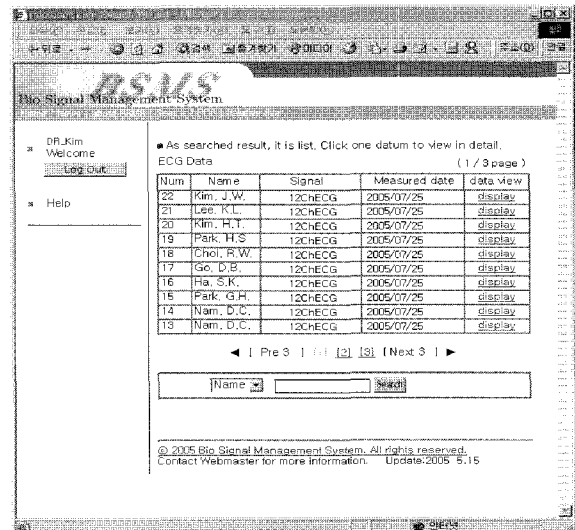


Fig. 5. Diagnostician initial page

Figure 6 show other web page to user category that is stored to session individual after login.

This recognizes special quality of account information that web server is stored to session individual being screen that log in by diagnostician and show charge patient's list and page that can search on early screen after certification. Search condition is divided by name of patient, signal kind, examination date.

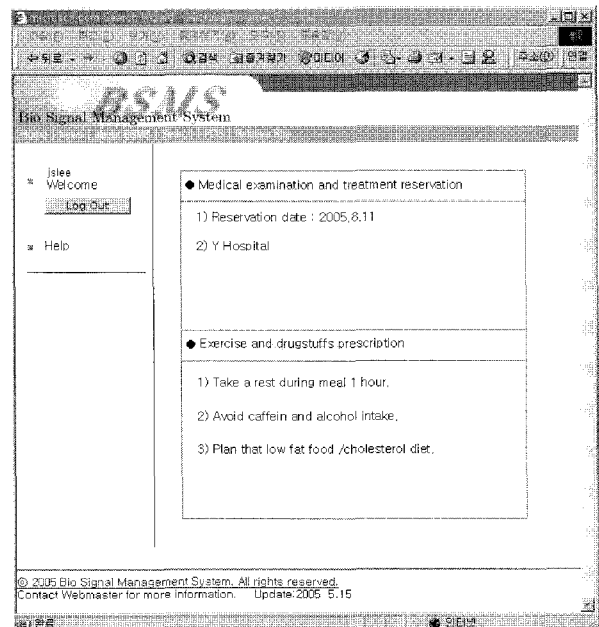


Fig. 6. Initial page for general

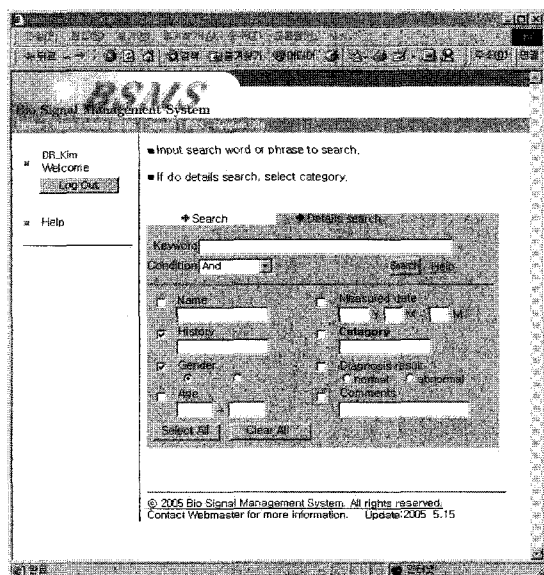


Fig. 7. Conditional search in details

Figure 7 shows condition of details search. Condition of details search finds each node and can search on duplicate condition about each item using XPath that is XML connection standard. If it was choose inquiry about signal in searched list, show result window depending on correct user defined format in various signal. Figure 8 shows electrocardiogram data and analysis contents. Result window embodied and manufactured suitable graph component to mark graph to web-based by Java applet.

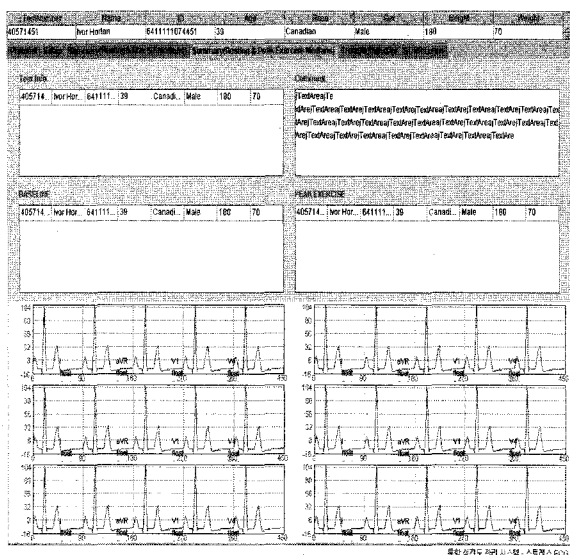


Fig. 8. Electrocardiogram inquiry after search

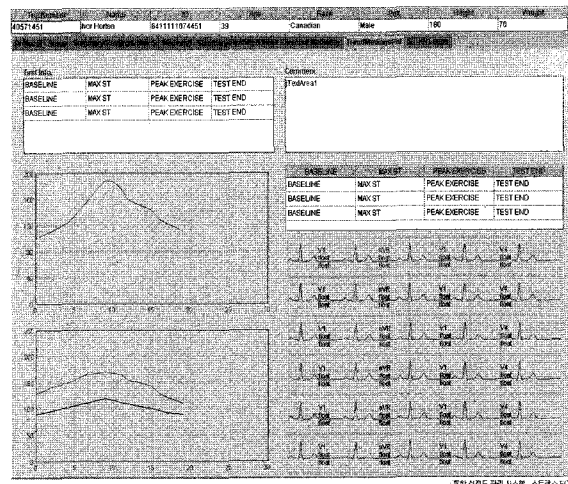


Fig. 9. Multiplex view inquiry after search

It can integrate discrete data of several medical institutions, posts, and areas by standard data transmission format. It used SVG (Scalable Vector Graphics) that is a XML base graphic tool to can get various kinds figure information through these work and display these information. This technology can be passed more expressively and visually than information expression of general text base. Because SVG creates graphic that follow vector base image or form express can [5].

Figure 10 data statistical information using 2 dimensions vector graphic topology and text SVG graphic paint .

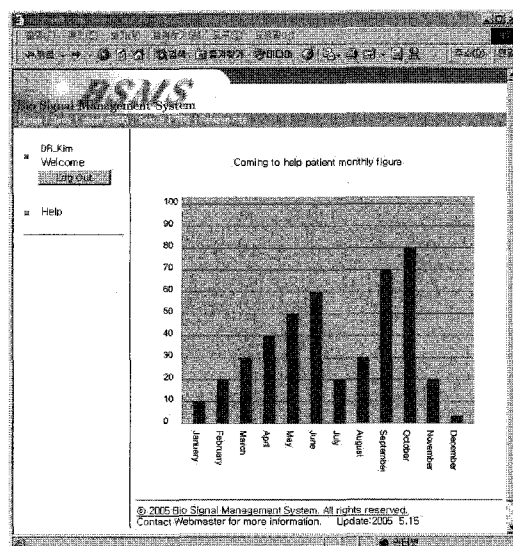


Fig. 10. statistical graph processing that use SVG

Result Analysis About Data Transmission and Integration

XML's maximum advantage is standardization of data. Therefore, it can minimize expense that drip in data conversion that integrate discrete data to several systems and is engaged handling.

It Process that integrate XML data each other in embodied system brings correct XML document individual in specification system in standard XML schema from priority general file or database.

XML document that bring each using DOM new integration document individual make. It can do search and data inquiry as DOM's function using one document individual.

Medical information system of XML base sees medical examination and treatment figure, efficient hospital operation, medicine research, the external institutions and reference data for medical examination and treatment estimation activity, medical treatment service availability investigation, hospital standardization, service estimation investigation that is flexible to do offer integration. It can produce figure that is regular by day, month, year, can produce figure of addition in condition of other distinction of gender, name of diagnosis, age etc. It can be applied in hospital standardization judging, business of patient investigation tabulation, medical treatment service estimation and public health center presenter fare etc. Standardization about medical information transmission in addition to standard format existent database standardization supplementing done shortcoming applicant's satisfaction elevation and easy of business processing maintain.

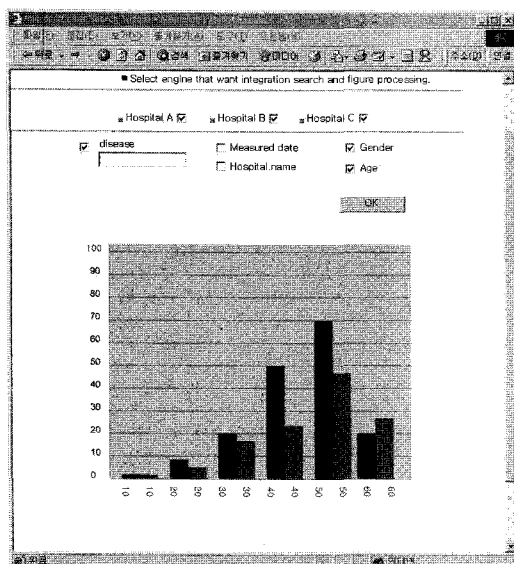


Fig. 11. Data integration between medical treatment information system

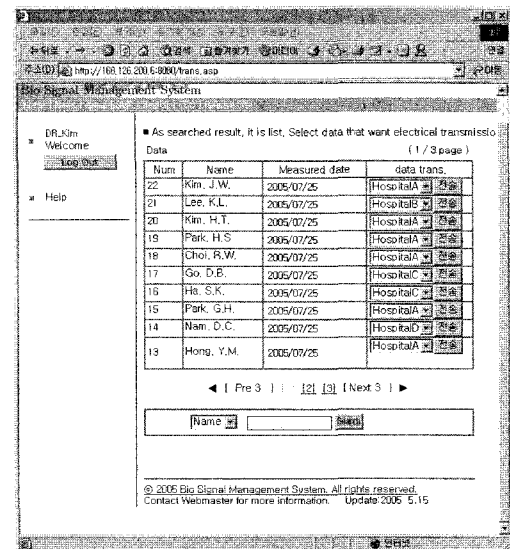


Fig. 12. Data transmission between relational organs

Figure 12 is screen for patient information transmission between system that use SQL Server and small scale system that manage data as file. When exchange of medical records need past, user who have competence can search specification patient and transmit data to other system. As well as can short-circuit data exchange between become independent business system using DOM, offer ability about recording or inquiry of data [5].

Communication protocol that is existent that is difficult to be modified. For example, individual brokers such as CORBA or DCOM achieve similar work in form that is each other exclusive. That is, can not call object of each other without broker. At past, these interfaces made out by individual broker of pair or each other inconsistent protocol. If use XML, can use general middle format such as XML-RPC or SOAP. This may develop protocol converters effectively. Finally, is going to use XML into commission that many protocols are fundamental, and extension or internationalization, and is going to glorify several advantages regarding transmission in Internet.

CONCLUSION

Problem of medical information interchange and studied about standardization data model design of XML base and system construction to improve medical treatment data management's efficiency. XML supplements shortcoming of existing markup language as markup language that extension is possible that can display form and structure of data according to user's request and support various application in

transmission and conversion of data.

Because using XML connection standard of XSL and so on that convert DOM and XPath for description and XML schema for effectiveness verification, search of data and renewal, server side XML data to other form of HTML and so on in this treatise, constructed system and evaluate about each advantage.

Data structure designed vocabulary about bio-medical signal data connection item using XSD.

Implemented system could confirm compatibility between SQL server that transmit electric medical information data or it is relational database with general file DB in integration.

Management's target is data of text-based patient information and so on and various bio-medical data of binary data.

Various system plains that is used in medical treatment environment so far do not consider concept that is standardization at that time that is developed and developed case was much and defined data structure and form voluntarily in each medical institution.

It can do so that can bring information that need in well-timed time between medical institution using middle class system between new hospital computerization of XML base or existing system. Industry data vocabulary (Vocabulary) that use present XML is made and HL7 3.0 versions that is part of existent medical treatment information standardization introduced XML.

Because have to become medical records supervision, prescription, nursing business, hospital management business, discussion and verify about standardization of comprehensive hospital computerization such as decision-making assistance and take advantage of XML connection technology, is more efficient and research about medical treatment service of good quality must be continued with that expense medical information data management.

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