International Journal of Scientific & Engineering Research, Volume 5, Issue 3, March-2014
ISSN 2229-5518

# HL7 Aware Medical Information Exchange

Ajeta Nandal, Usha Batra

**ABSTRACT**

The complexity of sharing information among different databases remains the major issue in achieving patient medical record. There are many researches done to solve issues like differences in data formats ,structures of tables and communication mediums is still far away to achieve the goal. The Middleware application semantically identifies the nodes or concepts between different databases of different applications to perform inform exchange among different hospitals. The architecture of middleware application offers advantages in system robustness and flexibility. Since concept matching is performed automatically, the effort which is required to enable data exchange is construction of the semantic network representation using xml. Pre negotiation is not at all required between different healthcare organizations to recognize data which is compatible or not for exchange between them, and there is no additional overhead to add more databases to the exchange network. Because the concept matching process is dynamic which performs at the time of exchange of information, therefore the system is simple and robust to customize in the available databases till representation of semantic network is updated.

## 1. INTRODUCTION

HL7 is a Standards Developing Organization accredited by the American National Standards Institute to author consensus-based standards representing a broad view from healthcare system stakeholders. HL7[1] has compiled different forms of message formats which are related to clinical standards that hardly defines the principles of clinical information, and side by side the standards provide a framework or platform in which data may be exchanged. HL7[1] standards are in use to set the data for both HL7 Version 2 and Version 3.
Users can be divided into three different segments:
**Clinical interface specialists** who work upon the tasks to create tools[4] which helps in transferring data from one organization to another or to create some clinical application to share data among other systems. These users have the responsibility of moving data between different applications or between healthcare organizations.
**Government or other politically homogeneous entities** that are looking to the future of sharing data across multiple entities or in future data movement – generally, few legacy systems are available.


- *Ajeta Nandal is currently pursuing masters degree program in Software Engineering in ITM University, Gurgaon, ,India.*
  *E-mail: ajetanandal@gmail.com*
- *Usha Batra is currently Senior Assistant Professor in ITM University,Gurgaon, India.*
  *E-mail: ushabatra@itmindia.edu*


Often some users are moving forward to move their clinical data in a new interface which is not covered by present interfaces and should have the ability to mandate a messaging standard.

**Medical informatics** works within the field of healthcare informatics, which is based on the study of logic of healthcare and knowledge of clinical is created. These users seek to create a clinical ontology, sort of tree like structure of healthcare knowledge, terminology, and workflow (how things get done). An informatics is interested in the theoretical representation, interoperability using XML.

**Healthcare Data Dictionary**

The HDD is a server containing vocabulary which allows user to translate and integrate healthcare data. It happens by doing:

- Providing structure of patient data and content in their databases.
- Helps in removing ambiguity by providing all names/numbers of healthcare professionals.
- Helps in translating each and every record which may be available in computerized patient data.

The Healthcare Data Dictionary (HDD) has the rich content and flexible data structure that make it one of the gold standards of the industry. The HDD[10] is built with standard healthcare data sources as well as chosen specific vocabulary pattern. It provides coded[2], computable data that people can understand and applications can use and process in real-time.

HL7 common terminology services [9] is a functional specification standard that describes the functionality to be supported by terminology service implementations to enable client applications to query and access terminological content. HDD implements common terminology services standard to enable communication between the HDD and other applications that are not required to have an understanding of the HDD data structure. This technique allows a wide range of terminological data and functions to be merged across different applications and in messaging without the requirement of significant rewrite or migration of any data. It also releases the organization software developers from being trapped into a specific server design. This technique allows them to create software's that are based on neutral to the internal machinery of the service implementation as long as they both support the common terminology services standard. Common terminology services also provide specific functionality to ease the adoption of HL7 v3 messaging.

Every healthcare organization and integrated delivery organization understands the importance of linking their information techniques, but the value that a strong data dictionary gathers to the process of information/data integration [7] and data mapping is often paid more attention. Unless a data dictionary is robust enough to "translate" data snippets, interpret data management and map each node/data element to an actual leaf node, data as basic cannot be shared between software's or merged with patient's data. The data dictionary must "know" how vital signs are expressed and stored in each of the organization's information systems and be able to relate and reconcile those phrases. When dictionary can perform this, an organization decreases the cost and time of merging and maintaining the interfaces. Data mapping also come up with the value of ad hoc reporting capabilities to a healthcare business. For example, during its super planning, an organization can perform so much of studies by facility to see how and where resources and specialties are best deployed.

## 2. METHODOLOGY

Different [2] databases of different applications face difficulties in communicating with each other as the data stored in both databases have different structure, hierarchy and data types. If one system changed in the frame of another then it will be for two different systems to communicate with each other. However, most healthcare providers are reluctant to alter their existing information systems because of the risk of losing important data, having it modified. Instead, these collections of data can be integrated with the use of a schema mapping. Data transmission between heterogeneous systems can be enabled by developing a map between the source schemas/nodes into that of the target schema/nodes. In the following sections, the schema matching and data translation [3] techniques proposed in literature and commercially available software solutions are discussed for their suitability in the healthcare arena.

### 2.1 Security

This is the architecture for highly secured communication of databases [5] of different structure using some security features to enhance the security while transferring data from hospital A to hospital B.

The disadvantage could be the possible fraud by spy while transferring; Hacking of the electronic records or interception of a transmission is another risk. There is also the risk of human error or equipment failure which can jeopardize the accuracy of transmissions or records. Patients or healthcare providers should check their records carefully for unfamiliar or unauthorized communication. So data communication is not much secure until unless some security is provide to it. So as the solution to the problem we provide "data communication with high security" by using some security concepts:-

DSA (Digital Signature Algorithm):-Electronic Signature can prove the Authenticity of Alice as a sender of the message.

IJSER

DES (Digital Encryption Standard):-DES was designed by IBM and adopted by the U.S.govt.as the standard encryption method.

Steganography: - Steganography means science of writing messages in such a way that no one apart from the intended recipient knows of the existence of the message.
We are securing client side schema using these three algorithms i.e. DSA, DES and Steganography. Each algorithm has its own significance. DSA is used to prove authenticity, DES is used to encrypt the data and Steganography is used to hide the data behind any carrier file and we will use audio carrier file

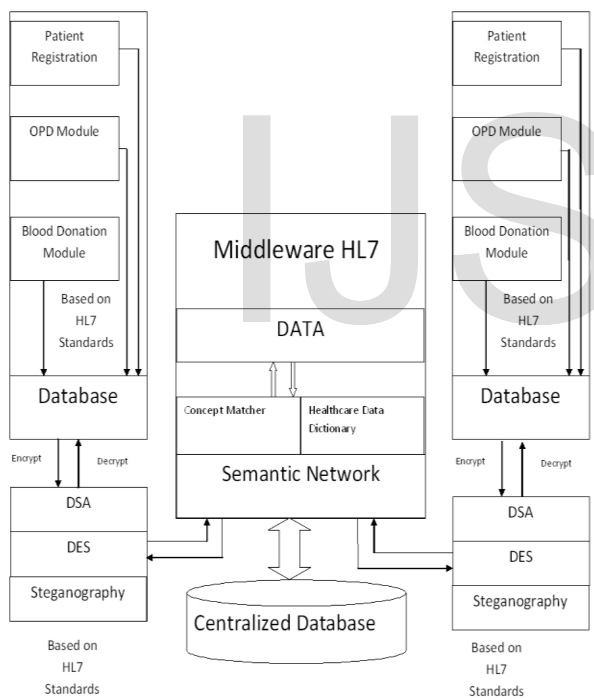


Fig 1.1: Details Description of Architecture

## 2.2 Context/Schema Matching

Two main schema matching techniques are: instance based and schema based techniques. Instance based techniques rely on analyzing data instances from source and target schemas to generate mappings. Because of privacy issues of patient healthcare records, the instance based process is not a best way, however, schema based techniques are based on similarities between schemas of source and target to generate mappings; therefore this can be the better solution. Looking more closely at schema based techniques; they can be broken down into two further classifications: constraint based techniques and linguistic techniques. Constraint based techniques generate mappings between source and target schemas by identifying similarities in data types an schema structure, while linguistic techniques are based on identifying linguistic similarities between table names and data elements of the source and target schemas.

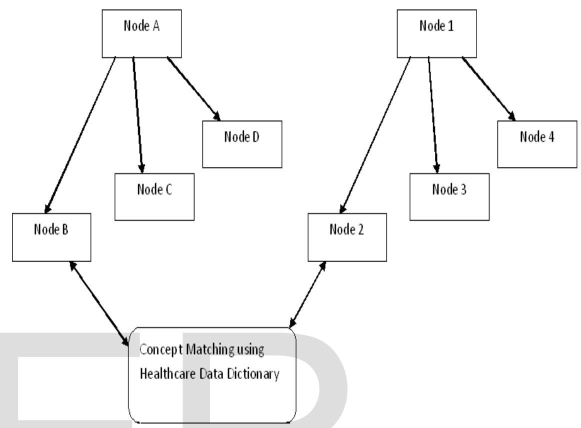


Figure 1.2: Schema Matching

The system supports method of retrieving data from remote databases. The first method retrieves the matching nodes from the target database. For example, if "nodeA" in Hospital A is matched with "node1" in Hospital B, then when Hospital A's system makes a data request for "nodeA", Hospital B's database will return the data elements for "node1".

Constraint [6] based techniques are best when the data exchange is required to occur between different schemas that follows similar structure of semantics. However, this does not suit the requirements of communication between a pre-hospital system and hospital ED system since the schemas in which the source and target schemas are almost certain to be different. For this reason, the linguistic mapping techniques are the best suited for machine supported mapping in the healthcare context.

IJSER

Although the semantic network representation provides the data abstraction layer to support information exchange, the complementary process of concept matching provides the computational functionality that actually powers middleware application. Together, these components provide the foundation for the process of data exchange between heterogeneous medical databases.

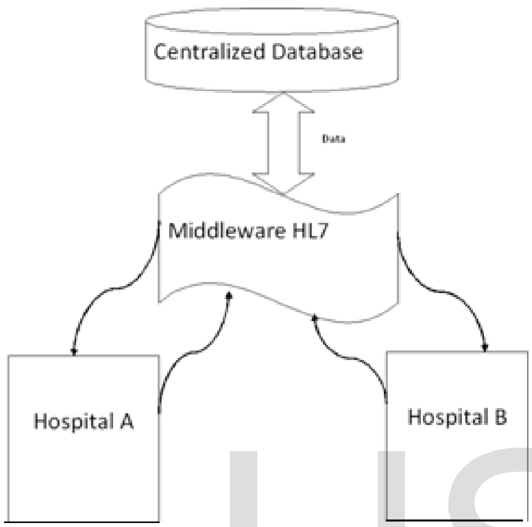


Fig 1.3: Architecture of our proposed work

### 2.3 Algorithm

1.) Implement two applications for two different organizations with different database structure.
2.) Create[6] a middleware based on standards of HL7 and XML

   i) Semantic Network Components
   ii) Concept Matching using Healthcare Data Dictionary(HDD)
   iii) Query Processing

3.) Share data among two organizations using middleware applications.

### 2.4 Data Exchange

In order to enable seamless data exchange between different schemas, a mapping must be generated between the client schema and each schema data will be transferred. Neither the source nor the target schemas should be altered in the process, the only input is the mapping, and as the number of client schemas increase, the number of mappings can potentially increase exponentially.

However, if middleware based data translation [3] mechanisms are employed; the number of translations between different heterogeneous schemas will rise only by the factor, which is more desirable outcome from a developer's perspective. Previous approaches propose the use of middleware to generate a single integrated schema from multiple client schemas to enable data conversion among client's schemas. While this method declines a huge number in increasing mappings, its main disadvantage is the complexity related to semantic conflicts that will arise because of heterogeneity among the client schemas. As there is increase in number of client schemas, the definition of semantic, possible data elements, and relationships within each node or element of schema must be noticed for in the joint schema. Additionally, if any customization occurs in a single client schema, few changes should occur in the joint schema and in mappings between the client and joint schema.

Assuming that data could be restricted, another approach was the use of independently developed schemas based only on predefined data requirements. Apart from relational schema [3] a client schema could also be specified as hierarchical schema or as an XML based message. This approach proposes a translation mechanism for data translation between relational schemas and hierarchical and nested schemas represented by XML like representations.

## 3. CONCLUSIONS

The aim of making two databases to communicate can be approached in many ways. Middleware application [1] was designed to address the critical issue of identifying semantically similar concepts, a task that must always be performed at some level in order to correctly interpret information transmitted between disparate systems. The representation system and computational

IJSER

processes chosen for Middleware application enable the equivalence inference to be performed in an automated fashion, and support the functional goals delineated at the start of this investigation. To reiterate, these goals include reducing the semantic ambiguity of transmitted data, representing the internal structure and granularity of native databases, and facilitating the retrieval of “useful” information even in the absence of direct correspondence between data concepts. Automated matching of equivalent concepts from two different databases was accomplished , the representation system supported all levels of information granularity, provided clinically relevant information for many concepts that would otherwise have produced null fields in a database query. The system limitations of middleware application appear resolvable with further investigation and sufficient motivation. As in all real world systems, compromises and optimizing assumptions will inevitably be required. Indeed, the results show promising performance characteristics given the disparity between the test databases. Compared to other systems, middleware application offers potential benefits in the areas of scaling, robustness, efficient use of legacy databases, information navigation, documentation, and preservation of local semantics for each participating institution. Further testing will prove whether these benefits are realizable on a more ambitious level.

## References

[1] T. J. Eggebraaten, J. W. Tenner, and J. C. Dubbels, “A health-care data model based on the HL7 reference Information model,” IBM Systems Journal, vol. 46, no. 1, pp. 5–17, 2008.

[2] Y.-W. Shuli, X.-P. Yang, and H. Li, “Research on the EMR storage model,” in Proc. of Int. Forum on Computer Science-Technology and Applications, Beijing, 2009, pp. 222–226.

[3] S. Abiteboul, S. Cluet, T. Milo, Correspondence and translation for heterogenous data, Proc. of Internat. Conf. on Database Theory—ICDT, Athens, Greece, 1997.

[4] Y.-W. Shuli, X.-P. Yang, and H. Li, “Research on the EMR strorage model,” in Proc. of Int. Forum on Computer Science-Technology and Applications, Beijing, 2009, pp. 222–226.

[5] Multidatabase Management in Pegasus. With Rafii, A. & al. Multidatabase Systems: An Advanced Solution for Global Information Sharing. Hurson, A., R., Bright, M., W., Pakzad, S., H., (ed.). IEEE Press, 1993, 373-380. Reprint of Conf. paper (43).

[6] D. Fensel, C. Bussler, and A. Maedche. Semantic webenabled web services. In Proceedings of the International Semantic Web Conference 2002, LNCS, Springer, pages 1–2, 2002.

[7] Doan A., Domingos P. and Levy A. (2000) “Learning source descriptions for data integration” Proceedings of the International Workshop on The Web and Databases (WebDB), pp. 81–92.

[8] Beeler, G.W., Jr., On the Rim: the making of HL7's Reference Information Model. MD Comput, 1999.

[9] Russler, D.C., et al., Influences of the Unified Service Action Model on the HL7 Reference Information Model. Proc AMIA Symp, 1999.

[10] Van Wingerde, F.J., et al., Linking multiple heterogeneous data sources to practice guidelines. Proc AMIA Symp, 1998.

IJSER