A Decision Support System for Evidence Based Medicine

Giuseppe Polese
Department of Management & Information Technology
University of Salerno, Italy
gpolese@unisa.it

Abstract

We present a decision support system to let medical doctors analyze important clinical data, like patients medical history, diagnosis, or therapy, in order to detect patterns of knowledge useful in the diagnosis process.

1. Introduction

We present a decision support system for Evidence Based Medicine (EBM), which combines data warehouse and data mining techniques [6, 7], together with additional inference mechanisms based on the Schanks theory [5], a non-logical approach widely used in the natural language processing area, with extensions used in the context of visual language understanding [2].

The paper is organized as follows. Section 2 discusses the approach underlying the proposed system, described in section 3. Finally, conclusion are given in section 4.

2. The Approach

We have adopted a case-based reasoning (CBR) approach, which is useful to extract knowledge from previously experienced cases. In particular, we have selected data from a large database of an infectious diseases department of a big public hospital, which has led to the selection of the features described in table 1.

We had to first identify and solve problems like data duplication, inconsistencies between logically associated values, missing data, unexpected use of one or more fields, and inconsistent values possibly due to different conventions, abbreviations, or to data entry errors. A particular effort was required for the presence of free text fields containing significant information, which was handled by using natural language processing and data classification.

Finally, the data mining strategy we have used is based on a sequence clustering algorithm. It is a sequence analysis algorithm, which allows to find the most common sequences by grouping those that are similar or identical.

3. The Proposed System

The system is structured according to a classical three tier architecture, shown in Fig. 1.

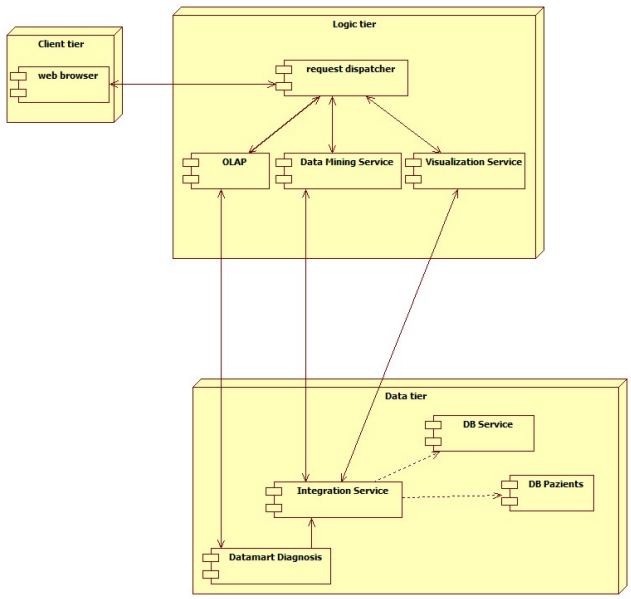

Figure 1. System architecture.

The client tier is composed of a web application representing the user interface.

The *Logic Tier* provides two main services: Data Mining and Visualization, the former of which is responsible for the analysis of clinical records in order to find evidences in diagnostic-therapeutic processes of patients.

The *Data Tier* implements the data model of the application, and contains the *Healthcare Data Warehouse* providing the *OLAP Query and Visualization Service*, and whose

Table 1. Selected Features

Patient id	Patient sex	Patient nationality	...
Pathological medical history	Physiological medical history	Epidemiological medical history	...
Family medical history	Risk factors	Diagnosis	...
Clinical problems	Medical activities	Pharmacological Therapy	

star schema is shown in Fig. 2. Main efforts have been devoted to the analysis and reconciliation of the operational data sources [1].

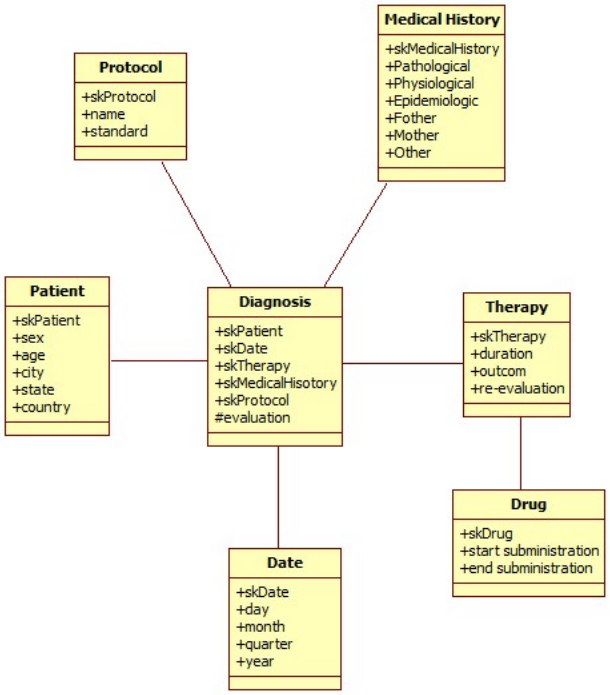

Figure 2. Logical Schema of the Data Mart.

A usability test was carried out to validate the implemented system, through a one-to-one session using the think aloud technique. A group of students of our medical school were asked to use the system to examine medical records of several patients. Then, they were asked to fill in a questionnaire to report on the perceived usability. The questionnaire was subdivided into five categories (see Table 2), and answers were provided through a Likert scale [4]. The general evaluation was fairly good, and nearly the totality of them had a good reaction concerning system usage.

4. Conclusion

We have presented an health-care decision support system for medical guide lines identification, and have performed a preliminary evaluation focusing on system usability. We are currently designing usage scenarios with medical doctors, in order to evaluate the quality of the inferred information, and to design additional inference mechanisms. Finally, since data privacy aspects are extremely critical in this context, we plan to extend the current system prototype with modules enabling the visual specification of role based access control mechanisms [3].

Table 2. The usability questionnaire

Category	Id	Question
General Evaluation	Q.2.1	The tool provides a nice user interface
	Q.2.2	Using the tool is simple
	Q.2.3	The aroused feeling by the tool use is satisfactory
Special Judgment	Q.3.1	The user interface is pleasant
	Q.3.2	The tool is simple to use
	Q.3.3	The tool proposes specific error messages
Tool Learning	Q.4.1	Learning to use the tool is simple
	Q.4.2	The required time to use the tool is appropriate
	Q.4.3	Remembering the commands and their use is simple
	Q.4.4	The number of steps to carry out a task is appropriate
	Q.4.5	The time to examine medical records and therapeutic protocols is appropriate
	Q.4.6	The number of steps to compare protocol applications is appropriate
	Q.4.7	Suggested Therapeutic Activities are correct
Information Grant	Q.5.1	Icon names and objects have a clear meaning
	Q.5.2	Each set of operations produces a predictable result

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