ONLINE DIAGNOSIS ASSISTANCE TOWARDS HEALTHCARE LEARNING SYSTEM

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Abstract

Online learning has started addressing crucial problems associated with healthcare knowledge and information. Knowledge is regarded the most valuable asset of any industry in this era. In healthcare industry experimental knowledge plays a vital role that is attained by experience over the period of time. Such knowledge mostly resides in experts’ minds or in different heterogeneous repositories in unstructured form. We note with interest that management, procurement, retrieval and adaptation of such knowledge require state of the art techniques and strategies so that just in time online knowledge assistance can be made possible. We perceived that CBR (case based reasoning) based systems provides valuable power to make experimental knowledge useful to a range of biomedical/healthcare related tasks. We present in this paper the implementation of Intelligent Online Diagnosis Assistant (ODA) that provides just in time healthcare knowledge assistance for healthcare practitioners, who are facing problems in accessing exact experimental knowledge assistance for the problem in hand, from healthcare enterprise memory based on ontology. ODA also leverages the quality of experimental knowledge by capitalizing the experimental knowledge based on healthcare ontology in healthcare enterprise memory from distributed heterogeneous repositories.

1. Introduction

Learning in healthcare field to a great extent depends on adequate, timely information and knowledge exchange between treating doctors (Tattersall, 2002). The explicit need for reuse of knowledge and experience in performing any clinical-motivated task offers a strong rationale for the application of case base reasoning (CBR) in healthcare education.

In a decision-support context, CBR offers a reasoning technique which combines the knowledge based support philosophy with a simulation of human reasoning when past experience is used, i.e. mentally searching for similar situations happened in the past and reusing the experience gained in those situations (Tautz, 2000). Indeed, the CBR problem-solving strategy bears a close similarity with how healthcare practitioners solve clinical problems.

Cases can be deemed as the most specialized form of knowledge representation. We know that the knowledge of medical practitioners comprises objective knowledge acquired from medical books and journals, plus subjective knowledge in terms of clinical experiences in form of past
cases that they would have treated themselves or colleagues might have told them about it. In diagnostic tasks the problem-solving thoughts of healthcare practitioners tend to revolve around typical cases—they consider the differences between a current patient and past treated patients (or cases). For diagnostic tasks cases are usually described by a list of syndromes or symptoms that describe the problem-situation and the outcome or prescribed treatment as the problem-solution. CBR provides a mechanism to manipulate the healthcare practitioner's tacit subjective knowledge to derive experience-mediated solutions (Arshadi and Badie, 2000). Hence, We note with interest that experience plays an important role in healthcare industry those who are fresh doctors/health care practitioners and want to acquire experience to prescribe the problem they are facing need time or even those who are experienced doctors and want to diagnose and prescribe solution of some cases they need past cases to know how that situation was handled.

This process to find similar knowledge of past cases in similar situation is a big problem for healthcare practitioners.

CBR is grounded in an attempt to establish similarities between the current problem and previously experienced problems and their attendant solutions (Ahonen et. al., 1997). In comparison to RBR, the CBR paradigm offers a set of useful features. CBR greatly alleviates the knowledge acquisition bottleneck, partly because it incorporates a learning mechanism whereby new cases can be readily to the existing ‘knowledge-base’. More so, it is easier to ask domain experts to discuss solved cases rather than all their compiled knowledge! This is particularly true for complex domains where it is impossible to completely specify all the rules, but there are always past solved cases to examine. (Aha et. al., 2000),(Bergmann et. al. 1999).

In this paper, we present a framework for an online diagnosis assistance system towards healthcare learning. This is designed to facilitate optimal querying of evidence-based knowledge bases and hence help meet the information needs of general practitioners when searching online for similar cases.

The techniques and strategies developed for our approach are based on a hybrid approach, since they are drawn from knowledge management, ontology modeling, and natural language processing. The proposed system utilizes CBR (case base reasoning) to detect symptoms, diseases, diagnostic procedures, diagnosis clues, and therapies to help formulate a customized query.

Our method prove efficacy in matching query and challenging processing time. Section 2 presents short description about the functionality of our proposed framework. The detailed descriptions are discussed in section 3. Experimental Knowledge Representation is discussed briefly in section 4. Development and test plan are presented in section 5 and 6. Finally section 7 presents the conclusion of this paper.
2. Proposed System Framework

The architecture of our system is shown in Figure 1. Our system framework consists of (a) A healthcare experimental knowledge web (b) Intelligent access to, and procure of, healthcare knowledge by approximate matching of resources, content navigation, and content correlation. System’s focused knowledge search is grounded in five fundamental principles (i) it employs specific functionality – autonomous knowledge retrieval; module for healthcare constitute repository ;(ii) it employs a common ontology modeling the knowledge objects; (iii) It collects knowledge by leveraging a medical ontology that assist knowledge matching; (iv) it populates the healthcare repository(case base/database) from only those sources that need to be accessed for relevant content; (v) it deploys state of the art compositional and structured case based reasoning representation and technique. Here in system, user’s information needs are specified as an information specification (IS) akin to query. The typical structure of an information specification is as follow:

For example, if a practitioner needs information pertaining to heart attack situation, it would select first domain i.e healthcare then class cardiology and the sub–class heart attack and then would key in the keywords and phrases defining the situation (symptoms) of the problem along with the threshold value which would be recomposed based on the ontology by query optimizing module and then autonomous retrieval module will be activated to retrieve specific knowledge from the healthcare repository—i.e. case–base.

Figure 1. Architecture for automatic medical information processing framework
3. Operational Workflow of the System

The operational workflow of the system has been characterized by a framework comprising the following components:

**Manager:**
Manger is main controlling body for system which controls and manages different tasks of the systems. It controls all four modules shown in figure 1. It accepts user query and dispatches that to QOM (query optimization module) to be optimized and send optimized query to case broker for the retrieval of desired experimental knowledge and sends results back to presentation module. From acquisition point of view, manger follows the same flow to populate cases into case bases via case broker and records case number and its symptoms in vector form on knowledge index.

**Query Optimization Module:**
This module accepts user queries and in turn recomposes the queries in line with the medical ontology and the inherent knowledge access protocols of the healthcare case repositories.

**Case Broker (CB):** This module is responsible for the autonomous navigation, approximate matching, and content co-relation features of system Based on the optimized query from the QOM, this broker retrieves the relevant knowledge from the healthcare repository and populates healthcare repository(case base).

**Knowledge Index:**
Knowledge index main task to help retrieve past cases from case base. It keeps the record of all the cases being populated to the case base with their symptoms and case number with a pointer of the case in case base. It helps case broker to apply similarity measure algorithm for the procurement of similar pat cases.

**Presentation Module (PM):** This module prepares and formats the search results to be presented to the user via manager. The results are presented in an intuitive manner so as to allow the healthcare learner to make informed decisions.

4. Experimental Knowledge Representation

The knowledge representation for experimental healthcare knowledge is shown below in figure 2. It is completely hierarchical in nature so that knowledge can be retrieved from and populated to the repository in efficient manner. We are focusing only on healthcare enterprise that is why this domain in figure has been elaborated. We have split experimental knowledge in to three levels first level is called domain which specify the area of experimental knowledge second level is called class which divides the domain into well defined sections to narrow down the search, every class then
has sub classes to fine grain the search and provide efficient way for retrieval. In each sub-class related cases are packed into vectors.

5. Development Environment

The target machine is a single processor computer. Therefore, all the modules and sub modules have been developed using a single processor machine. Networking plays an important role, as the system being developed is a web-based application.

6. Test Plan

The Object-Oriented Test approach is applied. This involves Class Tests (as a unit test) and Interclass Tests (as an integration test) to be conducted on the classes. In every Object-Oriented Test, random sequence is selected. A wide range of input will be used and the corresponding output will be examined carefully. If an unexpected output is produced, debug will not stop until an explanation is found.

Many time have been spend for testing during the development process. Performing tests during the development process will cause the least overhead. The philosophy is: a class can only be fully developed if it had passed all the class tests. Most error occurs during the Interclass tests. This is because the communication between classes generally needs more attention.
Conclusion

The work presented in this paper provides the online diagnosis assistance to healthcare practitioners particularly for those who want to gain the experience and are fresh in their fields. It also provides equal benefits for those who are novice users and want to know about any problem and how it was solved in the past related to the healthcare.

It does not only provide assistance but also populates the case base from distributed locations by authorized professional healthcare practitioners. It provides an interface to the administrator for managing domains, classes, and subclasses along with knowledge standardization and noise of the user query. It has deployed the ontology for standardization of knowledge which leverages the system accuracy to grasp the cognition sense of the human mind. The structured and hierarchical knowledge representation leverages the performance of the system during finding past cases search and validates the knowledge according to the specific domain, class, and sub-classes. The presentation of the system is state of the art in a sense that it provides the holistic view of the procured cases to the user to select those procured cases which seem to be more related without going through all the procured cases. An interface adds value towards the strength of the online system by providing an option to the user to fine grain the search after cases have been procured without going back to the procurement interface page.
References


