

Developing an Intelligent System for Medical Diagnosis

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Abstract *The clinicsoft system provides a decision support system that helps the physician to take a correct decision in diagnosis then treatment process. It is a Web based system that can help the physician in decision making through the diagnosis process, and knowledgebase user interface for reviewing and updating the knowledge. The system's features are: The importance of easy access to patient data essential for decision support, the commitment to continued measurement and revision of both the logic and the interventional strategy in a decision support application, and the role of clinical reports in supporting the decision making process.*

1. 1. Introduction

Physicians have to keep track of Medicine details all the time, including the new diseases, special cases and new medicine and methodology of treatment. Also they have to keep track of patients' information and medical history to make the right decision of diagnosis and treatment. This information needs to be integrated all the time to reduce the possibility of faults which is very vital to diagnosis and treatment process. The main challenge is to provide a decision support system that helps the physician to take a correct decision in diagnosis then treatment. This needs to be very accurate and flexible to the Medicine updates. As the knowledge of Medicine increases by the time and new methodologies of treatment take place of the old ones. Patients' medical history also is so important in the diagnosis process and treatments, which is very hard and complicated to physicians to handle [3].

There is a range of problems facing Physicians such as

- (1) The usual clinical applications is very attached to patients records and patient's history, It helps the physician in the paper work only. But they still have to keep track of All Medicine details all the time.
- (2) Specialized physicians don't keep track of other fields all the time, which is very dangerous in treatment process if the patient has some treatment cautions due to a specific medical condition.
- (3) Interlaces between diseases' complaints, Medical investigations, and Treatments have a very high factor on the diagnosis accuracy.
- (4) On the other hand, the next lines show the work of others in medical intelligent applications.
- (5) Many intelligent systems have been developed for the purpose of enhancing health-care and provide better health care facilities, reduce cost and etc. As express by many studies such as
- (6) [4] intelligent system was developed to assist users (particularly doctors and patients) and provide early diagnosis and prediction to prevent serious illness. Even though the system is equipped with "human" knowledge, the system will never replace human expertise as human are required to frequently monitor and update the system's knowledge. Therefore, the role of medical specialist and doctors (or medical practitioner) is important to ensure system validity[5-6].
- (7) Early studies in intelligent medical system such as MYCIN, CASNET, PIP and Internist-I have shown to out perform manual practice of diagnosis in several disease domains [7]. MYCIN was developed in the early 1970s

to diagnose certain antimicrobial infections and recommends drug treatment. It has several facilities such as explanation facilities, knowledge acquisition facilities, teaching facilities and system building facilities. CASNET (Causal ASSociational NETWORKS) was developed in early 1960s is a general tool for building expert system for the diagnosis and treatment of diseases. CASNET major application was the diagnosis and recommendation of treatment for glaucoma. PIP an abbreviation for Present Illness Program was developed in 1970s to simulate the behaviour of an expert nephrologist in taking the history of the present illness of a patient with underlying renal disease. The work on Internist-I in early 1982s was concentrated on the investigation of heuristic methods for imposing differential diagnostic task structures on clinical decision making. It was applied in diagnoses of internal medicine[2].

- (8) In 1990s, the studies in intelligent system was enhanced to utilize the system based on current needs. In several studies two or more techniques were combined and utilized the function of the system to ensure system performance. ICHT (An Intelligent Referral System for Primary Child Health Care) developed to reduce children mortality especially in rural areas [1]. The system success in catering common paediatric complaints, taking into consideration the important risk factors such as weight monitoring, immunization, development milestones and nutrition. ICHT utilized expert system in the process of taking the history data from patients. Other expert system have been developed such as HERMES (HEpathology Rule-based Medical Expert System) an expert system for prognosis of chronic liver diseases [8], Neo-Dat an expert system for clinical trails [9], SETH an expert system for the management on acute drug poisoning [10], PROVANES a hybrid expert system for critical patients in Anesthesiology [11]and ISS (Interactive STD Station) for diagnosis of sexually transmitted diseases [12].

Case Based Reasoning (CBR) was employed to utilize the specific knowledge of previously experienced and concrete problem or cases. The system can be used by patients to diagnose themselves without having to make frequent visit to doctors and as well as medical practitioner to extend their knowledge in domain cases (breast cancer).

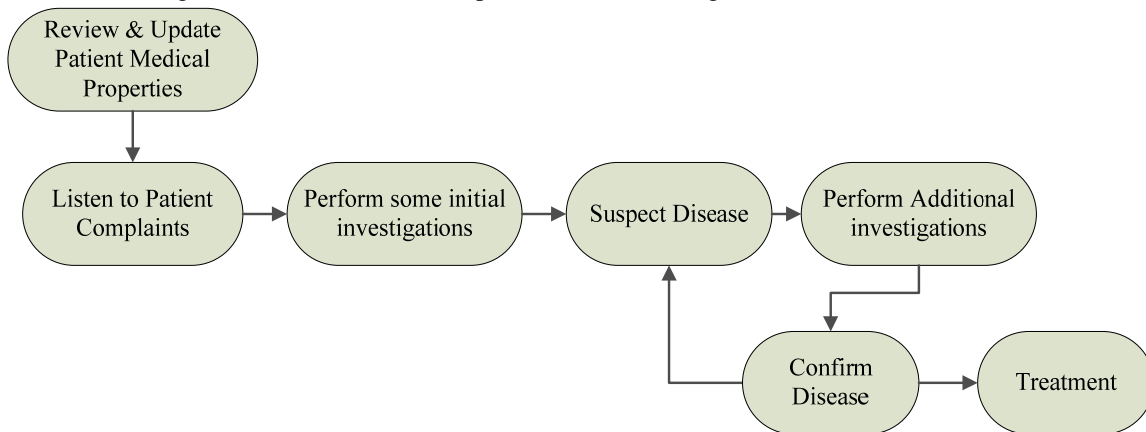
The paper is organized such that, section 2 points out brief description of the system workflow and implementation methods. Section 3 points out description of the system (clinicsoft) functionality through liver disease case study .section 4 points out achievements of the system.

1.1. 2. Cycle of implementation

ClinicSoft is a web based active knowledge system which integrates medical knowledge and patient data to generate case specific advice. It’s an open system that can be applied on different medical domains. The web based architecture of ClinicSoft enables its usage remotely on the internet, in advance it will enable physicians to share and update their medical experience within its knowledgebase. ClinicSoft can help physicians to manage and make use of patient data by integrating it with the medical knowledge to generate some specific advices in diagnosis like suggesting medical investigations to perform, possibilities of infection, and the best treatment of the case. Simplifying the knowledge of medicine through some rule based abstraction is the basis of decision making in the system. It has a dynamic modeling of relating medical knowledge, using a simple web based interface that enables users to manage and update knowledge and relations.

22.1 Medical diagnosis workflow

The medical diagnosis workflow can be simplified as shown in Figure(1).



Figure(1). Workflow of clinical diagnosis

In this model the physician has to make more than decision depending on the case attributes (clinical variables) like:

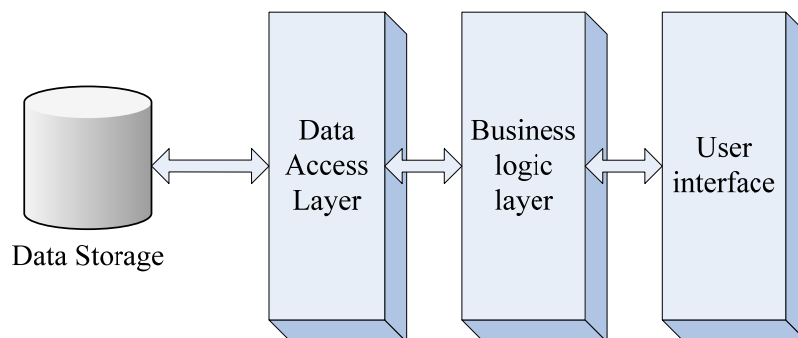
- What investigations to be performed.
- Choose a disease from a set of possible options.
- Selecting the appropriate treatment for the case.

In the early stages of diagnosis, identifying the disease is not an easy task. The set of known diseases can interlace from the domain variables perspective. Some disease are so similar in their properties, they may differ in one or two property. So the doctor has to narrow the area of search by performing some initial investigations depending on the set complaints that the patient have. The investigations values can lead the physician to few possibilities depending on his experience. If the physician suspected the existence of a certain disease, he should confirm its existence and its level to give the appropriate treatment. This confirmation may lead to another disease suspicion. Finally the physician has to choose the appropriate treatments for the case depending on its attributes, some treatments has cautions of use.

2.2 Methods

ClinicSoft is designed using 'N-tier' model as shown in which the user interface, functional process logic ("medical rules"), computer data storage and data access are developed and maintained as independent modules. As shown in Figure (2) ClinicSoft consists of four tiers.

Apart from the usual advantages of modular software with well defined interfaces, the N-tier architecture is intended to allow any of the N tiers to be upgraded or replaced independently as requirements or technology change.



Figure(2). N-tier architecture of *ClinicSoft*

3. Analysis

ClinicSoft is composed from two main modules:

- (9) 1. Diagnosis wizard, included most of the decision support functions. It consists of a series of ordered steps that defines the diagnosis process on patient from reviewing the medical information of the patient, then identifying his complaints. The system starts to suggest some primary investigations to be performed on the patient to help the system and the physician to identify the disease. The outcome of the performed investigations on the patient will lead the system to suspect the existence of a certain disease. Then the physician is about to choose the appropriate treatment for the patient, the system will suggest the set of treatments needed.
- (10) 2. Knowledgebase manager, this module defines all the information, relations, and rules used in the diagnosis process. The physician will be able to view update all the set of diseases and their treatments, the set of known complaints and their relation with diseases, and the set of medical investigations and medical lab analysis.
- (11) As shown previously that ClinicSoft can be applied on different medical domains, it has been applied on Liver diseases domain. After supplying the domain information to the system as shown in figure (3) , it had provide valuable medical advices like :
- (12) the system can suggest performing some medical investigations depending on the correlation between patient's information and his complaints as shown in figure (4) .

- (13) the system analyzes the case attributes to give graphical report of suspected diseases and its infection rates as shown in figure (5) .
- (14) the system can suggest the set of appropriate treatments taking into consideration patient's medical conditions and can define the set of forbidden treatments that cautions examined on the patient as shown in figure (6) .

Haemochromatosis (HFE) Complaints Investigation Items Treatments	Edit	Delete
Hepatic Encephalopathy Complaints Investigation Items Treatments	Edit	Delete
Hepatocellular Carcinoma (HCC) - (Hepatoma) Complaints Investigation Items Treatments	Edit	Delete
HRS chronic or acute liver disease Complaints Investigation Items Treatments	Edit	Delete
NASH - NAFLD Non alcoholic Steatohepatitis Complaints Investigation Items Treatments	Edit	Delete
Primary Biliary Cirrhosis (PHC) Complaints Investigation Items Treatments	Edit	Delete

1 2

[Back](#)

Figure (3). An example of Knowledgebase manager – Diseases page

Suggested Investigations:

General Investigation 1
 General Investigation 4
 Primary Investigation 1

Add Extra Investigations Primary Investigation 1 Add

Back
Next

General Investigation 1
 General Investigation 2
 General Investigation 3
 General Investigation 4
 General Investigation 5
Primary Investigation 1
 Primary Investigation 2
 Primary Investigation 3
 Primary Investigation 4
 Primary Investigation 5
 Primary Investigation 6

Figure (4). An example Suggested investigations

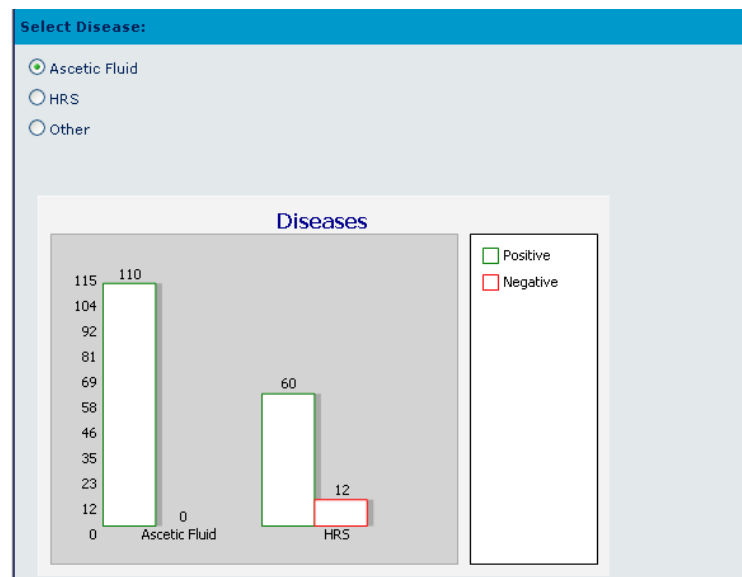


Figure (5). An example Bar chart displaying the suspected diseases and the infection rates

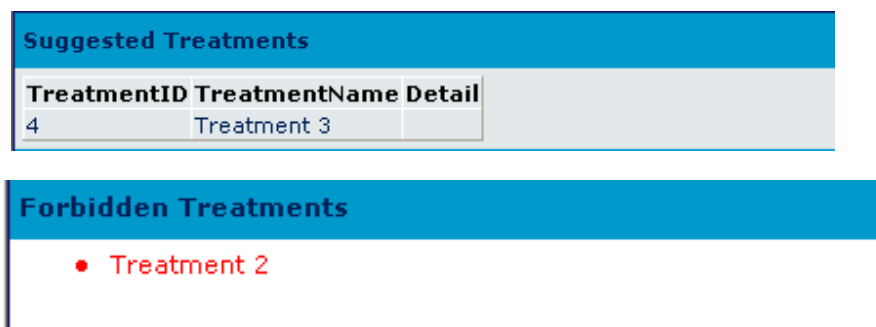


Figure (6). Examples of suggested treatments & forbidden treatments page

4. Conclusions

ClinicSoft system could accomplish the four key functions of electronic clinical decision support systems are outlined in [13]:

1- Supporting clinical coding and documentation, authorization of procedures, and referrals.

ClinicSoft provides a powerful administration tool that enables the physician to control the knowledgebase of the system. In addition to the authorization techniques built to prevent unauthorized access to the system or the patient records.

2- Managing clinical complexity and details, Keeping patients on research and chemotherapy protocols; tracking orders, referrals follow-up, and preventive care.

The design of ClinicSoft has simplified the workflow of medical diagnosis into some rule based techniques, In addition to the friendly user interface in the diagnosis wizard.

3- Monitoring medication orders; avoiding duplicate or unnecessary tests.

On the other hand , In the diagnosis wizard, The investigations performed can't be duplicated, as they grouped in one unit called the case investigations. Even the duplications that may happen in lab tests are avoided.

4- Supporting clinical diagnosis and treatment plan processes; and promoting use of best practices, condition-specific guidelines, and population-based management.

The developed system provides decision support in multi phases of diagnosis, like the primary investigations to be performed, the disease identification, and treatment selection.

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