

Intelligent Knowledge Management in Medical Applications

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Abstract

Current practice for medical retrieval system involves large amount of papers as most patients' data are recorded on paper. Such a practice is not practical since patients' records are manually managed. Electronic database system inevitably increases the practicality and usability of patients' records. However, most of the medical systems developed are stand-alone applications, where each hospital has its own database system to store patients and patients-disease information. Problems arise when the patients consult another hospital or department for treatments. In some cases, medical therapy could give side effects to those that are allergic to certain medicines or drugs. Thus it is vital to provide a centralized database system that can assist doctors in diagnosing their patients' conditions. This paper proposes a web-based model for storing medical records. The knowledge-based technology (Artificial Intelligence) is incorporated in the model for diagnosing and prediction purposes. The importance of centralized database system and the importance of collaboration between medical practitioners in managing and providing a better health care to the public are also discussed.

1.0 Introduction

Bit and Byte are among the most basic components in information technology. As the information technology begins with the bit and byte, the combination of byte (or bytes) is expended to form a data, later as record, information and so on. It is no doubt that the highest level is the knowledge and beyond that is wisdom. Knowledge is a collection of information that comprises of most of the basic thing such as theory, concept and practical. So, it is important to have the entire thing documented and stored in an integrated and centralized document retrieval system.

Since the introduction of computer and information technology in medicine, the practice for medical retrieval system is undoubtedly, well managed. However, the practice is still need to be improved. In some places (hospitals, clinics, etc.) patients record are stored and managed manually. It is agreed that in some places the communications and technical skills are insufficient to use and managed the technology. Places with enough skills and equipment are however, used the technology inefficiently. The efficiency of the technology usage is very important to ensure the benefits of the information technology are optimized. The consumer health information services for example, required more than complacent, passive, static and superficial information services (Gann, 1996). Consumer health information services need to provide the patients with better information by exploiting new technology,

using the current evidence in medicine and involve the patients' in the decision-making processes.

In most places, medical systems are developed as stand-alone applications, where each hospital has its own database system to store patients and patients-disease information. Such practice is practical to the hospital and patients management, however, problems arise when the patients consult another hospital or department for treatment. As the patient's records are confidential, the access to the patients' history records is time consuming and may cause some bureaucracy problems. Another problem with standalone database is that, the database for the same system in another places would differ as the number of patients using the systems increases. This problem affects the knowledge acquired from the databases and thus influence the decision made by the system. In addition, retracing patient's records from a thousand of records in record department requires much time than storing the records. Therefore it is important to have a centralized system where patients' information can be easily accessed by other department or hospitals to provide a better health-care to the patients

Centralized database system can be used to improve patients' management and distribution of knowledge between medial practitioners. In addition, it helps researchers in medical area to collect data, manipulating and transferring the data. Ishak *et al* (2000) summarized the potentials of centralized database in medical as follows:

- a) Improved patients record storage
- b) Information sharing between hospitals
- c) Enhance storing and retrieving patients information
- d) Diagnosis and patients monitoring
- e) Updating and managing databases
- f) Assist management and doctors in preparing annual report and statistics
- g) Promote telemedicine
- h) Distribution of knowledge between researchers in medicine (Detmer dan Shortliffe, 1997).
- i) Encourage research in medicine

Electronic patient record for example reduced doctors' time as the medical information can be easily copied from one report to another. These facilities allowed doctor not to retype the entire documents when preparing their report (Aa *et al.*, 1996). Computer-based patient records can coordinate patient information with medical knowledge to support clinical decision-making. This paper proposes a web-based model for storing medical records. The knowledge-based technology (Artificial Intelligence) is incorporated in the model for diagnosing and prediction purposes. The importance of centralized database system and the importance of collaboration between medical practitioners in managing and providing a better health care to the public are also discussed.

2.0 Requirements and Collaboration of Medical Knowledge

Let consider this situation; a traveller who was in vacation came to a small village. While walking around the villages he claims to have headache and suddenly falls down. The villages have to rush him to near by clinic. The clinician unable to detect any other symptoms to support him in making diagnosis and provide appropriate therapy, whilst, the patient is still unconscious. Using the computer (with Internet access) the clinician search for the patient's medical background from patient's database at the general hospital which stores all patients records. Using the patient's ID the clinician able to open his history medical record and found out that the patient is suffering from a heart attack a few years ago. However, the confirmation has been made only a few weeks ago. According to the record, that patient is still under supervision. Based on the information provided, the clinician gives him some therapy and send him to the general hospital. His doctor at the general hospital is informed about his patient's condition and continues his medication therapy after checking the therapy given by the clinician.

The above situation is one of the common problems faced by clinicians and doctors when providing medical therapy to a patient especially, in unconscious situation. Misinterpretation could make the situation even worse, whilst improper medication therapy could cause complications or even death. However, with the helps of centralized medical information system, the doctor is able to check the patient's medical background and provide the suitable therapy. Developments of information superhighway and communication technology inevitably encourage many organizations including government to develop electronic medical information system and make it available on the Internet. Patients record or patients database could be installed at the main server and the clinician can access the medical records regardless of the location and time. Clinician in rural area for example, with Internet access, can access the database, storing new information, updating and retrieving patient's history record.

With special interface facilities, patients can also use the information and monitor their risk level from their home or office without having to consult the physician (Manickam and Abidi, 1999). In Britain for example, patients' are given right to access to an explained version of their medical record as doctors are not able to provide the explanations required by the patients (Binsted *et al.*, 1995). Health-care providers could access the electronic record and the data could be stored and updated frequently. By using this method, the system knowledge will always be updated. The interface for the interactions between the database (and the system) and the clinician (health-care providers) would be through World Wide Web (WWW). The current and further developments of WWW contribute to huge bodies of knowledge in medicine (Maurer, 2000). Long *et al* (1996) describe that web based interface enable a number of enhancements to their program where initial experience with physicians is positive.

The Internet supports two-ways communications between users around the world at minimum cost (*see Figure 1*). In medical, communication is very important as new information or new discovery is the key for the future survival (*see for example Shortliffe et al.*, 2000). In addition, communications help doctors sharing their

knowledge or expertise (Detmer and Shortliffe, 1997). As an example, a specialist from Sydney can provide on-line medical assistance to doctor at Kuala Lumpur who is treating a patient that suffers from serious cancer problem. Another doctor from other country such as United Kingdom can share his experience dealing with the same cases. Communications between doctors or specialist from other region helps doctor at Kuala Lumpur diagnosing his patient and provides appropriate treatment. The Internet also supports multimedia applications, which is one of the important components in delivering images such as X-Ray images (*see for example* Ohlsson, 1999). In telemedicine, Multimedia and Internet (or computer network) are two of the main tools that support the collaboration and distribution of information. Multimedia is a combination of media such as text, audio, visual and graphics can be used in medical application such as in image transmission (X-Ray images, pictures and etc.). The full integration of medical image data plays an important role as most of decision-making is made by looking at the images (Horsch *et al.*, 1997).

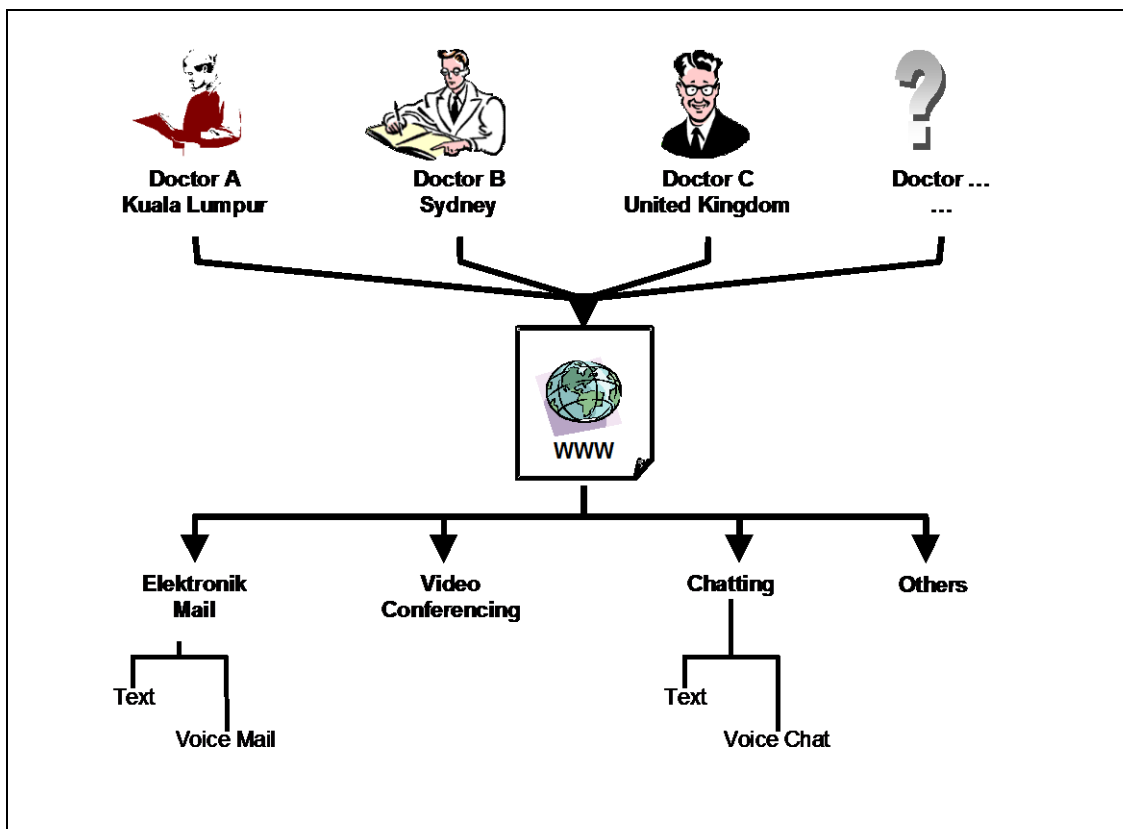


Figure 1: Information Sharing

3.0 Intelligent Medical System

The patients records are valuable information for the knowledge-based system. For system using AI techniques, when the number of patients is high the system will produce more accurate results compared to the system with less number of patients. The current patients data would enhance and strengthen the validity of the system reasoning (Manickam and Abidi, 1999). The proposed model for Web-Based medical diagnosis and prediction (see **Figure 2**) consists of four components, they are

databases, prediction module, diagnosis module and user interface. The databases consist of patients database and patients-disease database. Patients database will be used to store patient's information such as name, addresses, and others particulars details. Patients-disease database stored all the information about patients and their illness. The information stored in the database includes types of diseases, the treatments and other details about the test and administering therapy. Patients information are separated in a different database to enhance the patients records storage, so that other departments could use the records when the patients are referred to them. This method could prevent other departments or unauthorized users from accessing the information about patients diseases and provide a centralized information access for the patients records.

Prediction module and diagnosis module are two of the main features in Web-Based Medical Diagnosis and Prediction. Prediction module utilizes neural networks techniques to predict patients illness or conditions based on the previous similar cases. Data from the patients and patients-disease database will be used for training and testing. The weight from the training will be stored to predict a new data fed into the system. Diagnosis module consists of expert system and fuzzy logic techniques to perform diagnosis tasks. A set of rules will be defined using the patients and patients-disease databases as well as the expert knowledge on the disease domain. Expert system uses the rules to diagnose patient's illness based on their current conditions or symptoms. In addition, fuzzy logic is integrated to enhance the reasoning when dealing with fuzzy data. The combination of expert system and fuzzy logic that forms a hybrid (expert-fuzzy) system could increase the system performance.

In the proposed model, WWW acts as the user interface for the interaction between the users and the systems. Several processes involve in the models are collection data (patients information and patients illness), diagnosis, prediction and managing databases or systems administering.

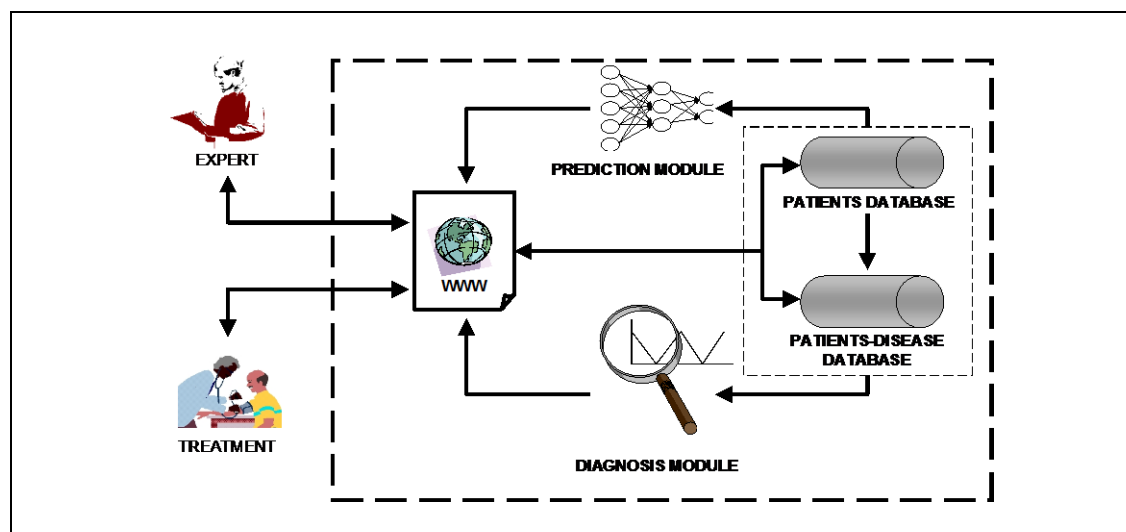


Figure 2: A model for Web-Based Medical Diagnosis and Prediction

4.0 Conclusion

Centralized databases over the WWW have many advantages. Information sharing, collaboration between medical practitioners, on-line discussion, on-line treatment and diagnosis are among the main features which enable the doctors from around the world to share their knowledge and expertise. Centralized medical record helps doctors to improve the quality of treatment and provide a better diagnosis based on patients medical history. In addition, researchers in medical applications could use the data in their investigation of a new medical solution, patient management and treatment (Shortliffe *et al.*, 1996a; Shortliffe *et al.*, 1996b).

The medical data is knowledge to the intelligent medical system that enable the system to perform accurate diagnosis and prediction tasks. Intelligent computer systems that store and process vast stores of knowledge would become perfect "doctors in box" assisting or surpassing clinicians with tasks like diagnosis (Coiera, 1997). The proposed model consists of databases specifically to store patient and patient-disease information. In addition, the databases will be used to store information about all types of diseases. Such approach is vital to ensure completeness of information in medical therapy as one disease may cause by other diseases.

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