Chapter 2.18
An Integrated System for E-Medicine:
E-Health, Telemedicine and Medical Expert Systems

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ABSTRACT

This chapter presents an overview of an integrated system for eMedicine that the authors propose and implement in the Republic of Macedonia. The system contains advanced medical information systems, various telemedicine services supported by modern telecommunication technologies, and decision support modules. The authors describe their telemedicine services that use wireless broadband technologies (WiMAX, 3G, Wi-Fi). A significant part of the chapter presents a web based medical expert system that performs self training using a heuristic rule induction algorithm. The data inserted by medical personnel while using the e-medicine system is subsequently used for additional learning. The system is trained using a hybrid heuristic algorithm for induction of classification rules that we developed. The SA Tabu Miner algorithm (Simulated Annealing and Tabu Search based Data Miner) is inspired by both research on heuristic optimization algorithms and rule induction data mining concepts and principles.

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INTRODUCTION

E-medicine can be viewed as a symbiosis between medicine, informatics and telecommunication technologies. Basically, e-medicine incorporates the use of computer technologies, multimedia systems and global networking in the provision of medical services. It is an area of great scientific and research interest, followed by fast implementation of novel commercial functionalities. A common simple definition describes e-medicine as the use of multimedia technologies like text, pictures, speech and/or video for performing medical activities.

The goal of our research is to define a prototype of an integrated system for e-medicine that enables application of information and communication technologies over a wide spectrum of functionalities in the health sector including medical personnel, diagnostics, therapy, managers, medical insurance and patients. Additionally we aim at incorporating artificial intelligence in various modules of the system making it a useful partner to all entities using the system. We present algorithms for building medical decision support and expert systems as part of the e-medicine system.

The chapter is organized as follows. The first section gives a short overview of e-medicine, telemedicine and medical expert systems. The second part explains in detail our model of a system for e-medicine, its main modules, the used technologies and the implemented functionalities. The third section gives as overview of the medical expert subsystem we implemented, along with the SA Tabu Miner rule induction algorithm for classification that we developed for that purpose.

BACKGROUND

E-medicine (sometimes referred to as e-medicine or eHealth) is a rather new term for describing the medical care that is supported by modern electronic processes and modern telecommunications. It is sometimes used to describe the use of computers in health institutions, for providing medical services via Internet or simply a new name for telemedicine. In fact, it is used to describe a wide spectrum of services that are part of the medical practice supported by the aid of information technology. The provided services include:

- The use of Electronic Medical Records (EHR) for easy storing, retrieving and sharing data between medical personnel (doctors, pharmacists, therapists etc).
- Telemedicine, as a way to provide medical services remotely and as a way for providing teleconsultations and assistance to other doctors
- Public Health Informatics, where the population and/or patients could get informed about relevant medical information.
- Management of medical information and medical knowledge, using the data in data mining research
- Mobile e-medicine, a field that includes the use of mobile devices for various purposes including real-time monitoring of patients, diagnosis, gathering and providing data for the doctors and mobile telemedicine

Medical Information Systems

Information systems have been developing rapidly through the past decades, and we have now means of managing and organizing large quantities of data, methods of validating the data, and ways of processing the data for retrieving valuable information as well as learning from the data. However, for practical implementations, there are a lot of requirements that should be satisfied in order to make a healthcare information system usable. A lot of the tasks are concerned with gathering and manipulation of data provided by patients, doctors and insurance companies. The medical information is critical, and should be accessible, up to date and coherent at all times. Also, the data must be secure, confidential and protected from