

Chapter 6.12

A Distributed Approach of a Clinical Decision Support System Based on Cooperation

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ABSTRACT

The incorporation of computer engineering into medicine has meant significant improvements in the diagnosis-related tasks. This chapter presents an architecture for diagnosis support based on the collaboration among different diagnosis-support artificial entities and the physicians themselves; the authors try to imitate the clinical meetings in hospitals in which the members of a medical team share their opinions in order to analyze complicated diagnoses. A system that combines

availability, cooperation and harmonization of all contributions in a diagnosis process will bring more confidence in healthcare for the physicians. They have tested the architecture proposed in two different diagnosis, melanoma, and urological dysfunctions.

INTRODUCTION

Medicine has been one of the most important disciplines in society since mingled with magic and religion in the Egyptian era. The importance that medicine represents in society makes it one of

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the major destinations of technological advances: from elements that provide proofs of diagnosis such as medical image acquisition systems, for example, radiographies, echographies, CAT, PET images, etc. (Rangayyan, 2004); till technical support applied to treatments, for example, electro-stimulation in rehabilitation or prosthesis (Vitenzon, Mironov, & Petrushanskaya, 2005) or telecommunications applied to medicine (Moore, 1999; Wootton, Craig, & Patterson, 2006).

Although technology is used to apply certain treatments or to make diagnosis tests, it is still not considered as a real aid to the main medical task: the diagnosis decision process. On the other hand, medical diagnosis is defined as “the discovery and identification of diseases from the examination of symptoms” (Collins, 2003). This definition involves two steps in any act of medical diagnosis. Firstly, the “research” task in which the specialist tries to determine the symptoms of a patient by using his medical record and diagnostic tests. Secondly, a task of analysis of these symptoms and the decision, based on the medical knowledge, of which illness is associated to the symptoms with the greatest probability. An important detail is noting that medical diagnosis is essentially a decision-making process based on the lesser or greater probability of a patient’s symptoms of being related to specific information.

Medicine has evolved since the days of Esculapio, when the physician was a wise expert on all the medical knowledge, problems and treatments; research and discoveries have broadened the field of medical knowledge, making necessary the creation of specialities: neurology, traumatology, rheumatology, urology or gerontology (one of the last specialities incorporated). Moreover, most of these specialities are divided into two groups: adult and paediatric specialities (Weisz, 2005). Have you ever wondered how many known diseases are presently now? We might have a slight idea of the number of known diseases by checking the International Classification of Diseases proposed by the World Health Organization in its

last revision (ICD-10) (WHO, 2005): the group of infectious and parasitic diseases is divided into 21 subgroups (and each subgroup includes dozens of disease families), the group of tumours is divided into 19 subgroups, the group of nervous system diseases has 11 subgroups, the group of circulatory dysfunctions is subdivided in 10 subgroups, etc. Along with this enormous amount of diseases, we find the corresponding symptoms: physicians must not only know the name and treatment for diseases, they must also be to identify their diagnostic signs and distinguish them from others corresponding to similar diseases.

The evolution of medicine has also led to the gradual change in diagnosis techniques (Adler, 2004; Porter, 2006). In the early days of medicine, diagnosis was based exclusively on clinical data, that is to say, on the symptoms and the physical examination of the patient. With medical advances and the application of technology, new diagnosis tests and laboratory analysis were incorporated. The discovery of new diseases and their grouping into families and specialities has facilitated the development of differential diagnosis, which consists of determining the different illnesses that could affect a patient, after a comparative study of the symptoms and injuries suffered.

The large number of diseases and organic dysfunctions coupled with the growing number of diagnostic signs (that increase thanks to new diagnostic tests) are paradoxically hindering the process of diagnosis. Computer engineering has techniques for the treatment of knowledge that may be useful for the processes of medical diagnosis (Burstein & Holsapple, 2008; Greenes, 2007). Most of these techniques are based on artificial intelligence and have been drawn from biology to be applied to computer science as neural networks or genetic algorithms (Haas & Burnham, 2008; Morbiducci, Tura, & Grigioni, 2005; Rakus-Anderson, 2007). These techniques can classify patients into groups according to whether or not they have certain diagnostic signs. There are many examples of researching applica-

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