International Journal of Advances in Computer Science & Its Applications
Volume 6 : Issue 2 [ISSN 2250-3765]
Publication Date : 31 August, 2016

Prototype of Case Based Reasoning for Recommendation of Tropical Disease

Sri Mulyana Retantyo Wardoyo Aina Musdholifah

***Abstract*—Case Based Reasoning is widely used in conluding problems based on cases happened in the past. The conclusion is based on the similarity of the case in the case base to the problem. Some problems might occur is any uncertainty in the case or in the problem to be solved. This paper presents a computational model of uncertainty in case based reasoning. This model is implemented as a prototype for diagnosing tropical disease.**

Keywords*— *Case Based Reasoning, Uncertainty, tropical disease

I. Introduction

Tropical disease is a disease which is prevalent in tropical and subtropical regions. This disease is less common in temperate regions, partly due to the winter which controls insect population by forcing hibernation. Insects such as mosquitoes and flies are the most common carriers of the disease by spreading parasites, bacteria, or viruses that infect humans and animals. The disease is most commonly transmitted by the bite of an insect, which causes the transmission of infectious agents through blood exchange sub-cutaneous. An increased incidence of tropical diseases due to several factors, among others, exploration of tropical forests, deforestation, increased migration and international travel as well as other travel to the tropics. Therefore the environment is an important factor that affects the balance between host and agent of the spread of tropical diseases.

Based Special Programme for Research TDR (Tropical Disease), there is a wide range of tropical diseases, including:

1. Chagas disease (also called American trypanosomiasis) is a parasitic disease which occurs in US, particularly in South America.
2. Leishmaniasis is caused by protozoan parasites of the genus Leishmania and transmitted by the bite of certain species of sand flies.
3. Malaria is caused by a protozoan parasite transmitted by the Anopheles mosquito. The disease is caused by a species of the genus Plasmodium. Malaria infects 300-500 million people each year and kills more than 1 million.
4. Tuberculosis (TB) is a bacterial infection in the lung. TB is a type of infectious disease, and is transmitted by aerosol expectorant through coughing, sneezing, talking, kissing, or spit
5. Several other tropical diseases are very rare, but can occur as sudden outbreaks, such as Ebola fever, Lassa fever and Marburg virus.

According to the World Health Organization (WHO), nearly 2 billion people, one third of the world's population, have been exposed to the tuberculosis pathogen. Annually, 8 million people become ill with tuberculosis, and 2 million people die from the disease worldwide. The World Health Organization (WHO) states that tuberculosis is a common disease worldwide require special attention (Djam and Kimbi, 2011), (WHO, 2011). Globally, there were an estimated 8.8 million (ranging from 8.5 to 9.2 million) cases in 2010 and about 1.1 million (ranging from 0.9 to 1.2 million) of deaths due to tuberculosis and an additional 0.35 million (ranging from 0.32 to 0.39 million) cases of TB with HIV deaths (WHO, 2011).

Indonesia lies between latitudes 11°S and 6°N, and longitudes 95°E and 141°E. It consists of 17,508 islands, about 6,000 of which are inhabited. According to the 2010 national census, the population of Indonesia is 237.6 million with high population growth at 1.9%. Such conditions lead to that Indonesia is a country that has a number of very large incidence of tropical diseases, especially tuberculosis. Until the year 2013 there have been 900,000 cases of tuberculosis, even Indonesia was ranked 4th in the world. It requires serious treatment of all stakeholders including the government, especially the Ministry of Health and all the people. Knowledge and understanding of the disease and ways of prevention and treatment, especially tropical diseases needs to be improved in line with the potential threat of these diseases.

Based on these conditions, we should be pursued in earnest a variety of methods to provide an understanding of tropical diseases and treatment affordable for all Indonesian people. Especially in fact occur discrepancy between the number of people with health workers available. The ratio of general practitioners in Indonesia is only 14 per 100,000 inhabitants, whereas the ideal condition is 40 per 100,000 population. Therefore, it becomes very dufficult if the education community to enhance the understanding of prevention and treatment of disease is only carried out by the Health Workers. Utilization of Information and Communication Technology (ICT) is a necessity for the Indonesian nation in order to provide knowledge and a true understanding of the disease and its treatments

Cases related to tropical diseases, especially tuberculosis (TB) is very much kept in various hospitals performed by many physicians. In some cases, there may be some diagnoses were made inappropriately. Sometimes past cases were worth to use as a method of recommendation for diagnosing. The doctor can benefit a lot from these prior cases as an addition the his/her knowledge.

Expertise is domain specific and relates to a defined area of knowledge. Clinical expertise means to look at how individuals make decisions in their area of expertise. Medical

expertise can be determined on the basis of decision performance and in relation to their length of experience and type of decision making. While some doctors may have both high consistency in decision-making and the ability to discriminate between cases, some have low consistency and poor discrimination [10]. These two groups do not differ significantly on the basis of length of experience or work setting but they differ on the basis of intervention chosen and their type of decision-making. This means that there is a knowledge gap between doctors according to their clinical expertise. In the circumstances where strong evidence about the efficacy of interventions is not yet available, reference to expert judgment may be undertaken. Experts differ from novices in the methods they employ when solving problems. For a simple case of symptoms, even between expert physicians, there may have different opinions and different notions, so may use different drug-dosing, even may be different decision making. To support decision making, reduce the knowledge gap, and reuse the knowledge, the medical diagnostic knowledge memory gained from the prior treatment process has to be built.

II. Related Work

Today, medical knowledge is expanding rapidly to the extent that even experts have difficulties in following all the new results, changes and new treatments. Decision support systems (DSS) that bear more similarities with human reasoning are often easily accepted by physicians in the medical domain [2], [3], [4], [5]. Today many clinical DSS are developed to be multi-purposed and often combine more than one AI method aud technique [3], [6], [7], [8].

Many of the early AI systems attempted to apply rule-based reasoning (RBR) for decision support. However, for broad and complex domains with a weak domain theory, i.e. the domain is not so well understood, rule-based systems encountered several problems. For instance, knowledge acquisition bottleneck (since the medical knowledge evolves rapidly, updating large rule-based systems and providing their consistency is expensive), transparency (rules become increasingly complex in medical applications) and reliability (one faulty rule makes the whole system unreliable) [1]. Casebased reasoning (CBR) is inspired by a cognitive model on how humans solve a certain class of problems e.g. solve a new problem by identifying a similar previously solved problem and adapting the solution to the current problem [9], [10]. Aamodt and Plaza have introduced a CBR life cycle with four RE-s: Retrieve, Reuse, Revise and Retain [9]. The advantages of CBR in the medical domain have been identified in several research works i.e. in [2], [3], [6], [II], [12], [13], [14], [15]. Cases including textual features or textual cases with ontology are explored in [4]. The authors in [16], [17], [18] introduce Fuzzy logic with CBR in similarity measurements. The integration of CBR and RBR is explored in systems like CASEY [19] and FLORENCE [20].

This paper presents a prototype of Case-Based Reasoning for recommendation for tropical disease treatment. In this proposed approach, CBR is used as the core technique. ... The Fuzzy similarity technique incorporated into the CBR system can handle vagueness, uncertainty inherently existing in clinicians' reasoning better than other similarity techniques. A survey of trends and advancements of recent medical CBR systems is presented in our previous work [8]. In [5] and [21] a stress diagnosis system is outlined. In [22] we look on how a CBR system can support biofeedback treatment for stress management. In this publication we build our previous work and address a combination of diagnosis, classification aud treatment of stress integrating several AI techniques in a novel hybrid CBR system.

III. Proposed Model

In case based reasoning, all cases are strored in somewhat database containing:

- Knowledge Based consisting of symptoms, Gij, disease, Di, and the contribution factor of each symptom to the disease, Wij
- Case Based consisting case Ci of symptoms, Gij and diagnose result of the symptoms, Di, and the level of believe of the doctor in resulting the conclusion, Wi.

Suppose there is a new problem P with the jth symptom Gj and its Certeainty Factor Fj. Similarity function for the new problem to the ith case on j'th symptom $Sim(Gj, Gij)$ shows how close Gj to Gij, and represented as the value of 0-1. Sim(Gj,Gij) is calculated as follows:

If both Gj and Gij are nominal, then

$$Sim(Gj, Gij) = \begin{cases} 1 & if\ Gj = Gij \\ 0 & if\ Gj \neq Gij \end{cases}$$

If both Gj and Gij are numeric, then

$$Sim(Gj, Gij) = 1 - \frac{|Gj - Gij|}{\sqrt{Gj^2 + Gij^2}}$$

If both Gj and Gij are enumerated, then they are converted to numeric by their ratings.

Therefore total similarity of P to Case Ci:

$$SIM(P, Ci) = \frac{n(P \cap Ci \cap Di)}{n(Ci \cap Di)} \sum_j Sim(Gj, Gij) * Wij$$

where n(P∩Ci∩Di) is the number attributes in P that match the attributes in case Ci and knowledge Di, and n(Ci∩Di) is the number of attributes in Ci and Di.

The case to be used is the case with the highest total similarity, that is case Ck where

$$SIM(P, Ck) = \max_i \{SIM(P, Ci)\}$$

If SIM(P,Ck) > a threshold value, then the conclusion is the disease Dk with certainty $Bk * \sum_j Fj * Wkj$, otherwise the new problem is sent to the expert to provide a judgment, and stored in the case based as a new case.

IV. Conclusion

The model presented in this paper provides a computational method for case based reasoning involving uncertainty. Two methods of uncertainty are applied: fuzzy logic and certainty factor.

V. Future Work

This computational method can be developed with other methods of uncertainty.

Acknowledgment

Special thanks are given to the university, especially to PUPT for providing the researcch grant, the dean and the head of department..

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