

DESIGN OF KNOWLEDGE ACQUISITION MODEL IN GLAUCOMA MEDICAL TREATMENTS RECOMMENDER SYSTEM

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ABSTRACT

Glaucoma is a progressive eye disease that damages the optic nerve, usually associated with increased intraocular pressure (IOP), that if left untreated, it can lead to blindness. Glaucoma is affecting round 67million people all over the world. In Indonesia it is the second major cause of blindness, with an incidence varies from 0.4 % to 1.6%. There are several option medical treatment for glaucoma, with varying risk and benefit. Before taking any medical treatments, patient or their medical proxy facing the biggest task, which is to decide the best treatment regarding their benefits, risks, cost and the outcome of treatment. In order to make the best suitable treatment, the patient not only need to inform medical option and advice from medical expert but also from other people who already facing the same dilemma. And because we live in a digital era where data and information is scattered and overload, so instead of getting the related knowledge needed, patient get confused and take more time in deciding the best treatment. Sometime it could lead to health condition worsening. This paper proposed a model of the medical treatment recommender system, which could assist patients and their medical proxy in deciding the best treatment and also could share medical information and knowledge needed related to the decision. We propose to explore the ability of knowledge management to provide the decision maker with appropriate technologies, strategies and process to turn data and information into valuable knowledge to make decisions. We will also use classification technique as SVM to make recommended treatment based on extracted rules from data and information. The main methodology is to identify the important factors and the similarities based on classification rules to be extracted. The contribution to these research areas is to analyze the suitable model for the proposed system.

Keywords: *Glaucoma medical treatments; recomender system; knowledge management; data mining*

1. INTRODUCTION

It is well known that every medical treatment has risks as well benefits. the medical ethical principle state that a patient has the right to decide what's appropriate for them, taking into account their personal circumstances, lifestyle, beliefs, and priorities. Mostly on the condition to choose the right medical treatment is a confusing matter and dilematic for patients and their medical proxy. Especially if one of the options is whether to take surgery or other high risk and expensive treatments regarding glaucoma.

Informed decision-making is part of process to give a relevant information regarding to the medical options, by making two-way communication between patient

and one or more health practitioners. But this information still not enough, patient also has the need for finding and get information from another patient with similiar case to make the decision. The better information and knowledge to other people with a similar disease history, personal circumstances and lifestyle are crucial in making the decision.

Today, we live in the digital era, one of methods to gain related information and knowledge of medical treatment are through the web and search engine. But the problem is because of the vast and complex knowledge and the overload information with little or no correlation with the information needed in making the decision and there also will be huge amounts and scatter data that need to be processed and analyze, the

decision process becomes more complex and confusing. Data mining provides the methodology and technology to extract these data into knowledge. One major advantage of data mining over a traditional statistical approach is its ability to deal directly with heterogeneous data field, which is usually contained in medical data sets (Cios, 2000).

The purpose of this study is to explore the applicability of data mining technique in the efforts of medical treatment system, with recommender particular emphasis to build a model that could help to extract patterns of the similarity of patient data and history. We also propose to explore the ability of knowledge management to provide the decision maker with appropriate technologies, strategies and process to turn data and information into valuable knowledge to make decisions. The proposed system will collect patient profile, diagnosis, treatment options (including its risk and benefit), treatment's successful rate, doctor's track records, healthcare provider's track records, and patient's experience (or lesson learned) when undergo certain treatments regarding glaucoma.

The rest of this paper is organized as follows. In section 2, we review several related studies. In section 3 we explained the proposed system model and architecture in detail. Finally, we summarize our research and list some future work in the last section.

2. THEORETICAL BACKGROUND

Glaucoma is a progressive eye disease that damages the optic nerve, usually associated with increased intraocular pressure (IOP). If left untreated, it can lead to blindness. Glaucoma is affecting around 67 million people all over the world (Varachiu dkk., 2001). In Indonesia it is the second major cause of blindness, with incidence varies from 0.4 % to 1.6% (Affandi, 2006). In spite of the high prevalence of vision disorder in this country, so far, few victims receive professional eye care due to one of the following reasons (Kabari and Nwachukwu, 2012):

1. Medical Specialist in eye diseases (ophthalmologist) is few

2. Lack of knowledge that early professional eye care is needed when symptoms are suspected
3. Inability to pay for the needed services and treatment.

Generally, the management of glaucoma consisted of initial medical treatments and surgical therapy, with various risks and benefits that depend on patient condition. To decide the best and suitable management of glaucoma is not an easy task and could be a dilemma for the patient. In (Klenk dkk., 2001), Klenk et al. discusses the idea of different online sources of data driven medical decision making. The problem of which physician to trust by build architecture of Medical Recommendation System already been discuss by Hoens et al in (Hoens dkk., 2010). Klenk et al presented a method to calculate similarities of patient profiles for recommending people to other members in social network in (Klenk dkk., 2001). But there is still no similar research regarding building a decision support system for glaucoma medical treatment. In parallel with the alternative options for glaucoma management from medical expert, one important output of the proposed system is the potential to give recommendations of the most suitable treatment for the patient based on the experience and the outcome of decisions from other patients with similar case by using data mining technique on medical treatment decision support system.

Decision support system (DSS) are computer based information system designed to assist user to make decisions in semi-structured situation (Turban and Aronson, 1998). On this proposed decision support system we will use data mining technique to gain knowledge as decision based for patient to take. Medical treatment data mining is used in the knowledge acquisition and analyses the information obtained from research reports, medical reports, flow charts, evidence tables and transform these mounds of data into useful information for decision making. The essence of data mining is in the identification of relations, patterns and models that provide support for predictions and of decision making process for diagnoses and treatment planning (Milovic and Milovic, 2012).

In this research, we used data mining tools to help patient to reduce the complexity of medical treatment decision making such as subjectivity or overload or the lack of information of the best treatment to take for certain patient based on clustering and classification "other people with similiar case". Clustering is a descriptive data mining task with the goal to group similar objects in the same cluster and different ones in the different cluster. Process of grouping determines group of data that are similar, but different than other data. In this process variables are identified by which the best grouping is being realized. Classification is the process of finding a function that allows the classification of data in one of several classes, with target variable usually has a small number of discrete values (Milovic and Milovic, 2012). Classification is the most commonly applied data mining technique, which employs a set of pre-classified examples to develop a model that can classify the population of records at large. This approach frequently employs decision tree or neural network-based classification algorithms. The data classification process involves learning and classification. In Learning process, the training data are analyzed and then classify with classification algorithm. And then, the test data set is used to estimate the accuracy of the classification rules. If the accuracy is acceptable the rules can be applied to in the recommended system.

3. RESEARCH METHOD

In this section, we will explained the problem definition, system architecture and data mining methods for the proposed system. The study research is to analyzed the most suitable data maning techniques to be used as algorithm model of the Recommender System For Knowledge Acquisition of Glaucoma Medical Treatments. This section will also explains how well Glaucoma management and data mining are integrated and also describes the datasets undertaken for this work.

3.1 Problem Analysis

We developed model of a knowledge acquisition model in medical treatments

decision support system which bases its recomendation on the patient profile (sex, age, lifeestyle, ect) symptoms , diagnosis and recomend treatment option. the usual complain and symptom of glaucoma are decrease in peripheral field of view, halos around light, redness of aye, hereditary, and age (greater than 45 has more risk) (Kabari and Nwachukwu, 2012). The problem of diagnosis of glaucoma by applying soft computatuonal intelligence methods where tackled by Ulieru et al. In (Ulieru dkk., 2000). the framework of glaucome monitoring discuss also by Ulieru in (Ulieru, 2000). This research will focus on how to design a model of Decision Support System that could give an informed medical option for glaucoma patients, especially for expensive and risky medical option such as surgery and any other treatments that need immediate medical action before the condition worsening. Usually the process to decide the most suitable and correct medical decision is not easy. It is because each patient has different life condition and lifestyle that could influence on how they make decisions and the outcome of treatment they took. The proposed system also design to give a better communication and sharing information between patient and its ophthalmologist, and also to help patients to get recommended medical care based on their preference and condition.

3.2 Functional Requirement

Our proposed design of the knowledge acquisition model in medical treatments DSS is to assist the patient in acquiring needed information and knowledge to facilitate the process of decision making. To achieve those goals, the proposed system should have these following characteristics:

1. Build a medical social web site to provide patients to exchange thoughts, experiences and share other related medical information
2. Store patient profile, disease and treatment they take, and other trivial information regarding the outcome of treatment and extract data mart from those data
3. Have privacy filter, so the patient could hide their identity on other private matter.

4. Have a knowledge management system, by combining data from point 1 and treatment option for glaucoma and its risk and benefit
5. Allow patient to find another patient(s) with similar case and conditions and use classification techniques of data mining based and weighing of personal value and similarity degree.
6. Inform patient of DSS limitation and mission as educational tools, clearly disclaiming DSS as substitutes for medical specialist based diagnosis and care .

All sixth characters of the proposed system as stated above are important to develop a similarity measure for glaucoma patients which could calculates influence values for data on the 2nd characteristics of this system, thereby facilitates a profile matching. In this proposed system, different aspects of data on 2nd characteristics will also weighted differently. For instance, the fact that two glaucoma patients have a different medical treatment recommendation, because they have different age, other related disease (such as diabetes) and other medical complexity problem. This leads to a profile matching and provides better recommendations on who might have had similar experiences or who might have knowledge other patients can get benefit from. Funding relationship and extracted the knowledge is the very basis of this proposed system.

3.3 Architecture of The Proposed System

In this research, in order to achieve system goal and characteristics as state on previous part, we proposed a system that could record and share all significant information about glaucoma patient regarding to patient profile, treatment they took, and the outcome of the treatment. Then we will adopt data mining techniques to discover important information to another patient that need information regarding another patient with similar case and the outcome of the medical actions. The knowledge that extracted from the data mining process will be used by the proposed system to generate medical treatment recommendation in order to make a better informed medical decision making. The

knowledge also can be used to to predict the possibility of medical treatment outcome based on patient profile, lifestyle and condition. The schematic model of the proposed system illustrated in Figure 1. With the Step of the Schematic Model of proposed system (Figure 1) are:

1. Generation of patient profile data
2. Generation of alternative medical treatment for glaucoma
3. The proximity measures of these objects based on it weight of different proportion of data to find similarity are calculated.
4. Based on the previous step, convergence of patient profile and medical alternative through data mining SVM classification based on satisfied or unsatisfied outcome of medical option.
5. These classified medical option added in extended metadata in the metadata repository.
6. Based on user query and clustering technique a reduce and relevant medical option and a set of relevant information can be delivered to a user as a recommendation to make decision.

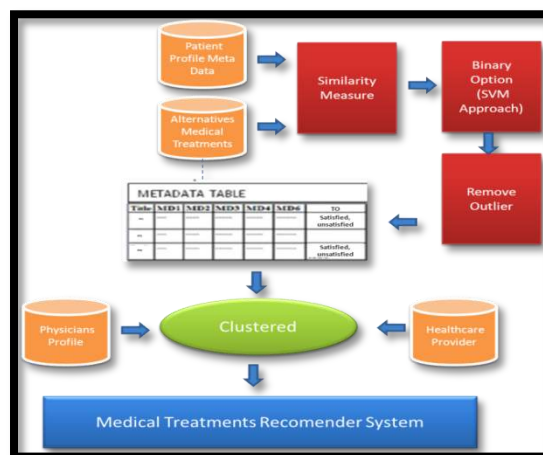


Figure 1. Schematic Model of Medical Treatments Decision Support System

The data source of data mining process is come from four major database, which are user profile (age, gender, lifestyle, diagnosis), list of alternative medical treatments glaucoma, list of the treatments outcome with its degree of success, list of doctor's history and list of health care provider historis. All data would processed before it could be extracted to gain pattern and knowledge. The primary purpose of using

a metadata on the proposed system is because its ability to describe a resource and allows user to fetch it. Metadata is descriptive information like text, image which enhances find the ability to share information, with its attributes are abstracts, keywords, subject, file format among others.

3.4 Data Mining Methods

This paper proposed model of with data mining methods as illustrate on Fig. 1. This following part will explained in detail how data mining technique integrated to gather the informed medical option with its degree of satisfied outcome. The first phase of this research is to build a social network of glaucoma patient, with two common approaches:

1. Content based decision support system which uses the information and knowledge the user enter into social network application.
2. Relationship between information traces to find another patient with similiar case and conditions. The proximity measures of these objects based on it weight of diferent proportion of data to find similarity are calculated

To find the similiarity we will used matching coefficient as state on table 1

Table 1. Allocation Scheme For Matching Coefficients

		Object 1	
		Number of variables with categories treatment option 1	Number of variables with categories treatment option N
Object 2	Number of variables with categories treatment option 1	a	c
	Number of variables with categories treatment option N	b	d

Based on the allocation scheme shown in table 1, different matching coefficients compute with equation (Cios, 2000)

$$SM = \frac{a+d}{a+b+c+d} \quad (1)$$

The coefficient is usefull because dataset on this proposed system has both positive

and negative values with equal degree of information. For example, gender and disposable income are a symmetrical attributes because the number of males and female, or low and high income provides an equal degree of information. Itegration of data mining in healthcare information dan decision support system could reduce subjectivity in decision making an provides a better and useful medical treatmet, especially for glaucome patient. One of the biggest problems in data mining in medicine is that the raw medical data is voluminous and heteroneneous (Cios, 2000).

In this proposed system after finding similarity based on matching coefficient, then based on classification data mining technique support vector machines (SVMs) to find the best match similarity of patient condition or medical treatment option. SVMs are one of the best text classification methods (Kisow and Ochota, 2010) and feature selection methods (Mooi and Srstedt, 2010). In this system, we use the ability of SVMs for binary classification by creating a hyper plane in original input meta data to separate data point. We use SVMs because it has better accuracy as compared to other classifier, as well its ability to to easily handle complex nonlinear data points (Yang and Liu, 1999).

The next step in the data mining process is to build clusters from the extracted patterns from a meta data table and doctor and health care provider records history. In more detail, clustering the trigger factors that have the same glucose status and the degree of severity to help discovering treatment outcome rules. Clustering uses to make groups of objects, each group has similar characteristics but has different characters from the objects in another group. Usually the suitable number of clusters is not clearly shown. One difficulty in this proposed data mining process is that we don't have any prior knowledge about the structure of the data, or its labels, because clustering is considered to be an unsupervised learning problem (Forman, 2003).The final step in the data mining process is to build a classifier for each cluster with the extracted patterns. Once the rules are learned from a clustering, they can be used for predicting the class type of previously unseen outcome

of glaucoma option treatment, with classification technique all phases of model systems as seen on figure 1 we could develop tools to help patients to reduce the complexity of medical treatment decision making such as subjectivity or overload or the lack of information of the best treatment to take for certain patient based on clustering and classification from similar case and condition for glaucoma medical treatment.

4. CONCLUSION

Before taking any medical treatments, patient or their medical proxy facing the biggest task, which is to decide the best treatment regarding their benefits and risks. Unfortunately, they often make the decisions without completely understanding their options that could lead to choose the wrong treatments. to make decision patient also need advice not just from medical expert but also from other people who already facing the same dilemma. There are numerous medical and health information available on the internet. But the information is scattered, overload and most of the time not related to the medical advice that needed, so instead of getting information, patient get confused and take more time in deciding the best treatment that could lead to health condition worsening.

We have presented a model of medical treatment decision support system that could calculate similarity of patient profiles for recommending the most suitable treatment for a glaucoma patient. The real power of this proposed medical information for the glaucoma patient is to provide high-quality information to ease sharing information between patient and physician in order to make a better informed medical decision through a web based system. However to adopt data mining technique such as SVMs, we face several challenges which are compared to the other methods training process takes more time, even though because we use it to solve the problem of binary class (satisfied or unsatisfied outcome of treatment) it went as computationally expensive as a multi class problem. The result of our work offer many perspectives or further research at both the theoretical and practical level by

developing models for of Medical Treatments Decision Support System that still need detailed algorithm and social network model for medical information sharing.

This study will help glaucoma patients to have a better understanding of their treatment option and outcome, that could lead to improvements in their medical treatment decision making. It also to identify those trigger factors and taking appropriate medical action at the right time. The future work of this research is to build the prototype system and generated data for the mining proposed.

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