Hospital Management with Clinical Decision Support System

Alpita Thakur1 Nilesh Singh2 Nithyanthan M. 3 ChiranjieeVI.4 Shrikant Sanas5
1,2,3,4,5 Department of Information Technology
Padmabhushan Vasundhara Patil Pratishthan’s College of Engineering – PVPPCOE,
Mumbai, India

Abstract— The main objective of this research is to develop an Intelligent System using data mining modeling technique, namely, Naïve Bayes. It is implemented as a web-based application in this user answers the predefined questions. It retrieves hidden data from stored database and compares the user values with trained data set. It can answer complex queries for diagnosing heart disease and thus assist healthcare practitioners to make intelligent clinical decisions which traditional decision support systems cannot by providing effective treatments.

Key words: Data mining, naïve bayes, heart disease, prediction

General Terms: Data mining

I. INTRODUCTION

Computer Science is now getting more and more involved in the medical. Many Clinical Decision Support Systems have been implemented. CDSS is a process for improving health-related decisions and actions with organized clinical knowledge and patient information to improve health. CDSS is the word for years amongst the healthcare society and for some of the clinicians. The importance of CDSS has grown. “Clinical decision support system (CDSS) is an interactive decision support system (DSS) Computer Software, which is designed to assist clinicians with decision making tasks, such as determining diagnosis of patient data”. These systems are now widely used in hospitals and clinics. They are proved to be very useful for patient as well as for clinicians in making the decisions. Different methodologies are used for the development of those systems. The way of collecting the patients data and to present output information’s is different in different methods.

The System can discover and extract hidden knowledge associated with diseases from a historical heart disease database. It can answer most complex queries for diagnosing disease and thus assist healthcare practitioners to make clinical decisions which traditional decision support systems cannot. By providing effective treatments, it also helps to reduce treatment costs. To increase visualization and ease of interpretation.

The main objective of this research is to develop a prototype Heart Disease Prediction System using three data mining modeling techniques, namely, Decision Trees, Naïve Bayes and Neural Network [10].

Here the scope of the project is that integration of clinical decision support with computer-based patient records could reduce medical errors, enhance patient safety, decrease unwanted practice variation, and improve patient outcome [9].

II. LITERATURE SURVEY

A. Existing Hospital Management System:

A Hospital Management system is a comprehensive, integrated information system designed to manage all the aspects of a hospital operation.

B. Features of Hospital Management System:

1) Easy access to doctors.
2) Helps in tracking patient’s information.
3) Centralized access
4) Enhances information integrity

C. Disadvantages of Hospital Management System:

1) Didn’t support Decision making.
2) Couldn’t generate diagnostic report.
3) Produce Errors and can’t Improve Outcomes.
4) Can’t assist Doctors.

D. Clinical Decision Support System Classify As:

![Diagram of CDSS](image)

Fig. 1: Classification of CDSS

1) Knowledge Based CDSS:
Knowledge base contains the various inference engine combines rules with the patient data and the communication mechanism is used to show the result to the clients as well as to provide input and knowledge to the system. In certain case, such as of chest pain management, the adaptive guidelines from a knowledge base server prove to be much more effective than others[1].

2) Fuzzy Logic Rule Based:
The Fuzzy Logic Rule based classifier is very effective in high degree of positive predictive value and diagnostic accuracy. For example in diseases like appendicitis, the results predicted by fuzzy logic rule based classifier have an accuracy rate of 95% on average [3]. It is a form of knowledge base and has achieved several important techniques and mechanisms to diagnose the disease and pain in patient. The pattern recognition technique can assist medical staff in measuring the pain which is an extension of Vector machine algorithm. [2].
3) **Rule-Based Systems & Evidence Based:**

They tend to capture the knowledge of domain experts into expressions that can be evaluated as rules. It has the potential to improve quality and safety as well as reducing the cost [4]. When a more number of rules have been executed into a rule base, the working knowledge will be validated against rule base by combining rules until a final result is obtained. It is helpful for storing a large amount of data and information.

**E. Non Knowledge Based CDSS:**

CDSS without a knowledge base are called as non-knowledge based CDSS. These systems instead used a form of artificial intelligence called as machine learning.

1) **Neural Network:**

Neural Networks have been widely applied to nonlinear statistical modeling problem and for modeling more and very complex databases of medical records. Aim of training is to optimize performance of network in calculating output for particular input data. While it requires only a Little proportion of available data to train the network [5]. The neural networks are also very essential especially in complex multi-variable systems to avoid cost of medical treatment and for diagnosis of pain [6].

2) **Genetic Algorithm:**

They are based on evolutionary process. Selection algorithm validates components of solutions to a problem. Solution that comes on top are recombined and the process runs again until a proper solution is observed.

**F. Modern Trends for Implementing CDSS:**

Two Methods for Implementing CDSS:

1) **Statistical Method**
   - It is one of simple and useful method used for data collection. It can be in the form of a survey, experiment result. Development of clinical decision support systems using statistical method as an integral part is very common. For example to focus the economics of post operative pain with focus on opioid and the local regional anesthetic, a bibliographic database survey can be a good option. It can be a better way of quantitative and qualitative assessment of postoperative pain [7].

2) **Hybrid Method:**
   - A combination of two or more methods within a design of single system results into a hybrid system. Hybrid systems extract the best from all methodologies and provide an optimal solution for clinical decision support systems [8]. For example to identify the clinically relevant aspects of MEDLINE automatically, the combination of knowledge-based and statically techniques can be good approach. The extracted elements then served as an input to the algorithm to score a relevance of citations with respect to structured presentation of data needed, based on the principles of evidence based medicine.

**III. PROPOSED SYSTEM**

A clinical decision support system (CDSS) is an application that analyzes data to help healthcare providers to make clinical decisions. A CDSS is an adaptation of the decision support system commonly used to support business management. There are numerous clinical tasks that a CDSS can perform or assist in.

The list below shows some of the most common CDSS Features:

A. **Alerts and Reminders:**

A CDSS will alert the doctor or physician when certain inputted data is alarming or a potential risk to the patient. For example, if a patient has a history of cardiac issues and the system reads that their blood pressure is abnormally high it can alert the doctor of the abnormality.

B. **Diagnostic Assistance:**

Patient data can be compared to the system knowledge base in order to present possible diagnoses. This is beneficial when the clinician is not confident with his or her knowledge on a certain condition or if there is new medical knowledge that has recently come to light on a condition (i.e. a GP trying to assess a neurological problem) or when the patient's symptoms are complex or seemingly unrelated.

C. **Information Retrieval:**

CDSSs can assist in the location and retrieval of appropriate and accurate clinical data which may be used for diagnosis or treatment planning. Depending on the complexity of the system, the CDSS may simply perform as a filter to search queries or be able to assess the importance, applicability, or utility of the information it retrieves.

**IV. DATA SOURCES**

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>value 1: Male; value 0: Female</td>
</tr>
<tr>
<td>Chest Pain Type</td>
<td>value 1: typical type 1 angina, value 2: typical type angina, value 3: nonangina pain; value 4: asymptomatic</td>
</tr>
<tr>
<td>Fasting Blood Sugar</td>
<td>value 1: &gt; 120 mg/dl; value 0: &lt; 120 mg/dl</td>
</tr>
<tr>
<td>RestECG</td>
<td>resting electrographic results (value 0: normal; value 1: 1 having ST-T wave abnormality; value 2: showing probable or definite left ventricular hypertrophy)</td>
</tr>
<tr>
<td>Thal</td>
<td>value 3: normal; value 6: fixed defect; value 7: reversible defect</td>
</tr>
<tr>
<td>Thalach</td>
<td>maximum heart rate achieved</td>
</tr>
<tr>
<td>Age</td>
<td>In years</td>
</tr>
<tr>
<td>Height</td>
<td>In cms</td>
</tr>
<tr>
<td>Weight</td>
<td>In kgs</td>
</tr>
</tbody>
</table>

Table 1: Data Sources

**V. ALGORITHM**

A. **Naive Bayes:**

In probability theory, Bayes' theorem (often called Bayes' law after Thomas Bayes) relates the conditional and marginal probabilities of two random events. It is often used to compute posterior probabilities given observations[11]. A naive Bayes classifier is a term dealing with a more probabilistic classification based on applying Bayes' theorem.
An advantage of the naive Bayes classifier is that it needs a small amount of training data to evaluate the parameters necessary for classification. Because independent variables are assumed, only the variances of the variables for each class require to be determined and not the entire covariance matrix. A naive Bayes classifier is a term dealing with a simple probabilistic classification based on applying Bayes theorem. In simple terms, a naive Bayes classifier assumes that the presence of a particular character of a class is unrelated to the presence (or absence) of any other characteristics. The Bayesian Classifier is capable of calculating the most probable output depending on the input data. It is possible to add new raw data at runtime operation and have a better probabilistic classifier. A naive Bayes classifier assumes that the presence (or absence) of a particular characteristics of a class is unrelated to the presence (or absence) of any other feature, given the class variable.

B. Theorem:
This is a simple probabilistic classifier based on the Bayes theorem. It provides a way of calculating the posterior probability, $P(c|x)$, from $P(c)$, $P(x)$, and $P(x|c)$. Naive Bayes classifier assume that the effect of the value of a predictor ($x$) on a given class ($c$) is independent of the values of other predictors. This assumption is called class conditional independence:

$$p(c|x)= \frac{p(x|c). p(c)}{p(x)}$$

$$p(c|X)=p(x1|c)*p(x2|c)*...*p(xn|c)*p(c)$$

1) $P (c|x)$ is the posterior probability of class (target) given predictor (attribute).
2) $P(c)$ is the prior probability of class.
3) $P (x|c)$ is the likelihood which is the probability of predictor given class.
4) $P(x)$ is the prior probability of predictor.

VI. ISSUES AND CHALLENGES
Medical diagnosis is considered as a significant yet intricate task that needs to be carried out precisely and efficiently. The automation of the same would be highly beneficial. Clinical decisions are often made based on clinician’s knowledge and experience rather than on the knowledge rich data hidden in the database. This practice leads to unwanted bias, errors and excessive medical costs which affects the quality of service provided to users. Data mining have the potential to increase a knowledge-rich environment which can help to improve the quality of clinical decisions.

VII. ACKNOWLEDGMENTS
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VIII. CONCLUSION
Decision Support in Heart Disease Prediction System is developed using Naive Bayesian Classification technique. The system extracts hidden knowledge from a historical heart disease database. This is the most effective model to predict patients with heart disease. This model could answer complex queries, each with its own strength with respect to ease of model interpretation, access to detailed information and accuracy.

REFERENCES