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Rule-Based Expert System for the Diagnosis of Memory Loss Diseases.

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Abstract

The paper present an Rule-based Expert System for Memory Loss Disease with the help of rules and facts. Also the Case-based approach is used for saving the cases and for comparing the new case with previously saved cases. It will initially discuss different approaches in designing of Medical Diagnosis Expert Systems with focus on all the information about the memory loss. The different symptoms and causes of memory loss at different age groups and the precautions for any kind of memory loss are covered. It is an attempt to focus on some of very important diseases related to memory loss like Alzheimer's disease, Parkinson's disease, Huntington's disease, and dementia which are among the most common types of memory loss diseases. This Expert System will help the patients to get the required advice about the different disorders attack to them due to their nervous system disorders. The expert rules were developed on the symptoms of each type of neurological disease, and they were presented using decision tree and inferred using forward-chaining method. The knowledge base consists of information about the memory loss and all the diseases related to it which is collected from books and doctors (domain experts) about neurology and its disorders.

Keywords: *Expert System, Rule-based and Case-based Expert System, Alzheimer's disease, Parkinson's disease, Huntington's disease, and dementia.*

1. Introduction

Neurology is the branch of medicine that deals with the nervous system and disorders affecting it. An Expert System (ES), sometimes called a Knowledge Base System (KBS) is a computer program that contains some of the subject specific knowledge of one or more human experts. Expert System automates expert's tasks, which require specialized skills and training. Expert system (ES) is one such part of AI, which is widely used as a problem solution provider by Durkin [Durkin, 1994]. ES emerged during early 1970s, has become one of the most important innovations of AI. [Maitri Patel, Atul Patel and et all, 2013]Disease diagnosis has also become a key domain where these tools are very useful. Rule-based feature extraction has been widely used for many applications. With the processing and storage abilities of computers, it is very useful to develop an expert system, which can help physicians with their diagnosis. Expert systems can help physicians by informing them about unrecognized information needs of a diagnosis, standardizing diagnostic and treatment procedures and even as a training tool with detailed information about symptoms, conditions and diagnosis. These kind of expert systems present good results for problems which cannot be formalized very well [Afshin Ameri and Hessam Moshtaghi]. The major problem in developing a medical decision support neural network is its dependency on large number of training cases which are required to gain a good diagnostic ability[L S Goggin, et al.,2007]. These large number of training cases may not always be available.

Requirement Specification

1. Functional Requirements

Maintain Cases

This requirement was concerned about maintaining cases of the patients to provide functionalities for searching existing cases and inserting, modifying and removing cases.

Maintain Rules

This requirement was concerned about developing a feature for updating the rules of the domain. Rules that are in a predefined format such as,IF symptom THEN disease OR further diagnosis need to be validated before inserting or modifying to check if it is in the appropriate format. The features included adding rules, modifying existing rules and deleting rules.

Provide Expert System Solution
This functional requirement explained that the rule-based engine would process the supplied case and the rules to arrive at a solution that would give the list of diseases and the suggestions for further diagnosis. It also described that the case-based engine would compare the supplied case against the past cases to retrieve the most similar cases from the case base.

User Interface
The requirement of this functionality was to provide facilities to interact with the user, collect data, forward them to the back end, receive data from the back-end and to display them for the user.

2. Non-Functional Requirements

Usability
To achieve flexibility and efficiency, a Graphical User Interface is hierarchically organized for novice users, medium users and regular users. Since the system was being built for experts, who use software in regular basis, we focused on efficiency more than flexibility. This would increase the training time but then save a lot of time during regular usage.

Reliability
The requirement was that the system be available all the time. This can be achieved by hosting it in a reliable server during installation.
Architecture of a Rule Based Expert System In the figure above, knowledge base is a declarative representation of the expertise, often in IF THEN rules. Inference engine is the code at the core of the system, which derives recommendations from the knowledge base and problem-specific data in working storage. The knowledge acquisition component acquires new rules that can be added to the knowledge base by using the knowledge acquisition sub-system. The explanation sub-system is to explain its advice or recommendations, and even to justify why a certain action was recommended.

Security
The requirement was that the administrative features like adding and modifying rules be allowed only to a few domain experts with admin rights who are authorized through username and password.Many of the researchers come to the conclusion that age is not only the reason for memory loss. many of the people with the same age group either can have or cannot have memory loss diseases. Ten large studies have shown that the risk of Alzheimer's disease is sharply reduced when inflammation is controlled. How do we control inflammation? The Psychiatry suggests that controlling the Lifestyle can lead to reduction of chances of memory loss diseases. So, while people are waiting for a vaccine to come along, researchers suggest that everyone should work on their lifestyle if they are concerned about dementia. Eat healthy wild fish as like haddock, cod, ocean perch, herring, salmon, sardines, tilapia, trout, whitefish, and lots of colorful organic vegetables and fruits, and organic grains in moderation. Skip the bread, alcohol, and cigarettes too.

2. Rule-based Expert System

The idea of rule-based systems is to represent domain experts knowledge in a form called rules. Generally the knowledge representation used in the expert system is done using the if-then rules [M Sasikumar, S Ramani, and et all,2007]. In a typical rule-based expert system, a rule consists of several premises and a conclusion. If all the premises are true, then the conclusion is considered true. The components of a rule-based expert system include the knowledge base, inference engine, knowledge acquisition component, and explanation system.
The two broad kinds of inference engines used in rule based expert systems are forward chining and backward chaining system.

- Forward chaining: It starts with the facts and works forward to reach the conclusion. It involves checking the condition part of the rule to determine whether it is true or false. If the condition is true then the action part of the rule is also true. This procedure continues until the solution is found or a dead end is reached. Forward chaining is commonly referred to as data driven reasoning.

- Backward chaining: It is the process of starting with the conclusion and working back-ward to the supporting facts. It is the reverse of forward chaining. Backward chaining is very good when all the outcomes are known and the number of possible outcome is not large. In this case a goal is specified, and the expert system tries to determine what conditions are needed to arrive at the specified goal. Thus backward chaining is also called goal-driven reasoning.

3. Case based Expert System

Case-based reasoning is often used where experts find it hard to articulate their thought processes when solving problems. Human case-based reasoning is quite successful in integrating, problem-solving and learning, combining different problem solving strategies, utilizing different kinds of knowledge, and becoming experts for specific areas of responsibility.

4. Objectives

The type of disease among memory loss diseases can be diagnosed using the symptoms of particular disease. For the dementia and Alzheimer's disease there can be the primary test on the basis of Mini Mental State Examination (MMSE).

Mini Mental State Examination (MMSE) : The MMSE is a quantitative measure of cognitive status in adults. It can be used to screen for cognitive impairment, to estimate the severity of cognitive impairment at a given point in time, to follow the course of cognitive changes in an individual over time, and to document an individual's response to treatment. It is most widely used measure of cognitive function.
The original validity and reliability of the MMSE were based on 206 patients with a variety of psychiatric disorders, the successfully separating those with dementia, depression, or a combination of the two. The test has a range of 30 points, from normal (30) to severe impairment (0) and is to be performed by the patient himself. A cut-off score of 23 for the presence of cognitive impairment has been suggested, with variation depending on lack of education.
MMSE is easy to perform at the bedside or on an out-patient basis. The MMSE assesses nine items: Memory, Orientation, Attention, Verbal Fluency, Nominal aphasia, Receptive aphasia plus receptive apraxia, Alexia, Agraphia and Constructional apraxia[Folstein M and et al,1975].

Limitations of MMSE:
Education levels affect Mini Mental State Examination scoring: It may fail to detect mild/moderate cognitive impairment in people of high educational level or premorbid intelligence. Equally, poorly educated people may score badly simply because they find the questions difficult. It also has floor effects in terms of its inability to detect change in established severe dementia, it may give misleading results in the context of poor education or language/sensory difficulties or poor motivation (e.g depression).

For the diagnosis of memory loss disease, four diseases are covered which are Alzheimer Disease, Dementia, Parkinson Disease, Huntington Disease. The different symptoms are checked against all diseases. Though every disease have their own symptom in which some of the symptoms are same as other disease of memory loss and some symptoms are different than other disease symptoms. So among all the symptoms, the identical symptoms of all diseases are extracted and on the basis of that symptoms, disease is diagnose.

5. Applications

- The development and testing of computerized systems to assist in the diagnostic process is a time honored research activity in medical information science.
- The Proposed system will enable a patient to find out the diseases, when no other help is possible.
- Diagnosis expert system can help a great deal in identifying those diseases and describing methods of treatment to be carried out taking into account the user capability in order to deal and interact with expert system easily and clearly.
- The proposed system will not only simplifies task of the doctors but also helps the patients by providing initial medicines for small diseases in emergency.

6. Conclusion

The rule-based and case-based reasoning can be used for designing diagnostic system. Case-based reasoning is often used where experts find it hard to articulate their thought processes when solving problems. Expert system is a computer program designed to model the ability of solving a problem by a human. In this dissertation an expert system has been introduced to diagnose and suggest the treatments for the type of memory loss diseases. Hence, first the purpose and goals of an expert system were defined and then the relevant research reviewed. The case-based medical expert system prototype that supports diagnosis of common diseases was developed. Several properties of this model remain to be to be investigated. It should be tested on several more databases. Unfortunately databases are typically

proprietary and difficult to obtain. Future prospects for medical databases should be good since some hospitals are now using computerized record system instead of traditional paper based.It should be fairly easy to generate data for machine diagnosis.

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