Mid-Term Report

on:

"Neurology Diagnosis System"

by

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Abstract

*'**Neurology Diagnosis System**' is concerned about the construction of a web-based hybrid expert system. The objective of the system is to help the diagnosis process of neurology doctors. This report describes current development status of the project. Of the overall project goal, 70% has been accomplished. The phases completed include the Planning phase, System Analysis phase and the System Design phase. Current phase is the Implementation phase, which is about 75% complete. The two major components of the system (rule-based component and the case-based component) depend heavily upon the domain research. So, much of the development time and effort was used for domain research. The project is expected to complete in next 15 days.*

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1. Introduction

Death is an unavoidable truth. Time and again, it comes close to each of us. Sometimes, it makes us think so deep that we thank everything for keeping us alive. There is another similar fact that keeps visiting us frequently. It is the feeling of being normal. We feel proud that we are not abnormal, and we pray that we stay normal till our death. Abnormality is not very far, rather close to us. So close that a simple accident can leave us paralyzed throughout our life. Studying these abnormalities and visiting patients frequently is not easy, for it greatly consumes our mind. Sometimes, so much that we leave our mind with the patients and move empty skulled.

Our domain research is not easy. Visiting hospital frequently, talking with doctors for about two hours every week and seeing the helpless patients engages a heavy part of our thinking. Moreover, neurology is a complex domain and it is a challenge to model it. Because of the model being complex and entirely different from the technical world, we decided to focus only on a part of the domain that deals with the weakness of our limbs (paraplegia/quadriplegia).

What motivates us to continue our domain research and the overall project development is the interest that we have in ourselves. No field is as interesting as the study of the self. Understanding our self and exploring our body makes us forget everything. This has the greatest impact on us to continue the project development. We are determined to complete the project successfully and make it a working copy.

2. Objectives

The objectives of this report are as follows:

- To provide a brief background to the project.
- To inform the development status of the project.

3. About the Project Title

3.1 The Neurology Domain

Neurology is a medical specialty dealing with disorders of the nervous system. Specifically, it deals with the diagnosis and treatment of all categories of disease involving the central, peripheral, and autonomic nervous systems, including their coverings, blood vessels, and all effectors tissue, such as muscle. Physicians who specialize in neurology are called neurologists, and are trained to investigate or diagnose and treat neurological disorders. Pediatric neurologists treat neurological disease in children (Halperin JJ, 1990).

Neurological disorders are disorders that can affect the central nervous system (brain and spinal cord), the peripheral nervous system, or the autonomic nervous system. Major conditions of disorder include (Halperin JJ, 1990):

- behavioral/cognitive syndromes
- headache disorders such as migraine, cluster headache and tension headache
- epilepsy
- traumatic brain injury
- sleep disorders
- infections of the brain (encephalitis), brain meninges (meningitis), spinal cord
- infections of the peripheral nervous system
- neoplasms – tumors of the brain and its meninges (brain tumors), spinal cord tumors, tumors of the peripheral nerves (neuroma)
- spinal cord disorders – tumors, infections, trauma
- disorders of peripheral nerves, muscle and neuromuscular junctions
- exciting injuries to the brain, spinal cord and peripheral nerves
- speech and language disorders

3.2 Hybrid Expert Systems

Hybrid expert systems are the integration of rule-based and case-based systems. Rule-based systems handle problems with well-defined knowledge bases, which limit the flexibility of such systems. To overcome this inherent weakness of rule-based systems (RBS), case-based reasoning (CBR) will be adopted to improve the performance of the expert system by incorporating previous cases in the generation of new cases.

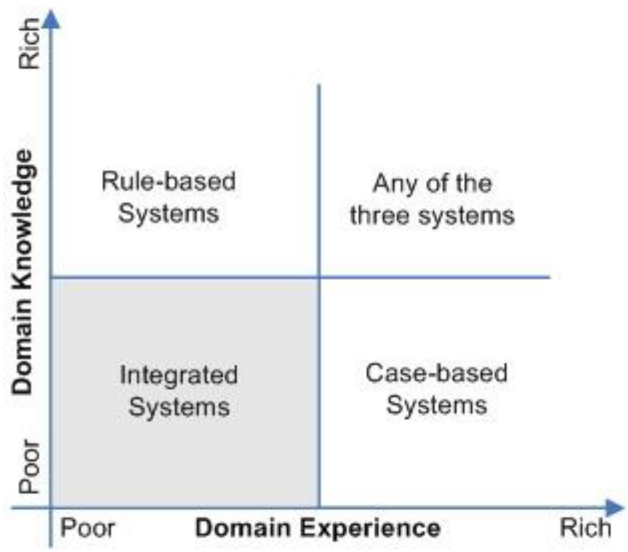


Figure 1 Integration of rule based and case based reasoning

By applying this new approach shown in the diagram above (Robert T.H. Chi, 1991), we will be able to capture both explainable and unexplainable expertise from these two reasoning mechanisms and generate more effective plans for diagnosis support.

3.2.1 Rule-based Reasoning

The idea of rule-based systems is to represent a domain expert's knowledge in a form called rules. 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 as illustrated in Figure 2 (Nomusa Dlodo, 2007, pp. 43-44).

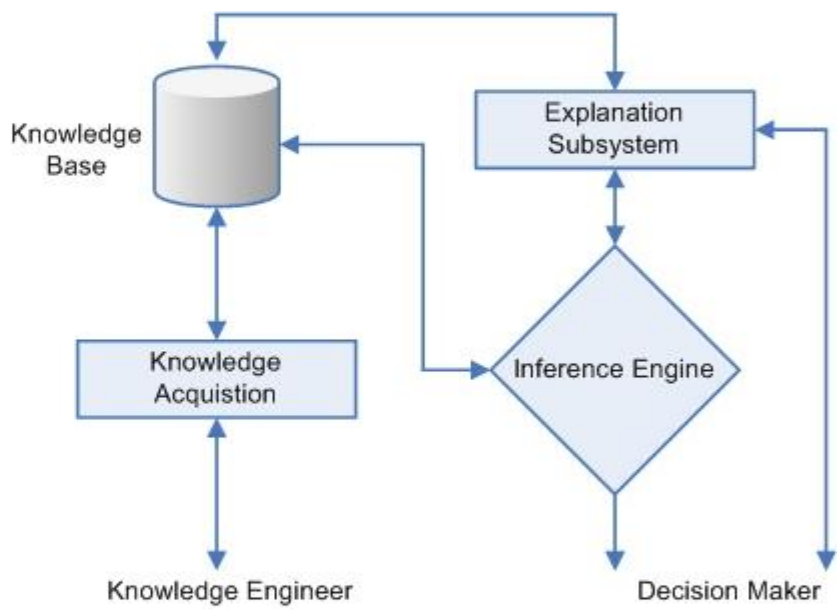


Figure 2 Rule Based Expert System

Knowledge base: a declarative representation of the expertise, often in IF THEN rules.
Inference engine: the code at the core of the system, which derives recommendations from the knowledge base and problem-specific data in working storage.
Knowledge acquisition: new rules can be added to the knowledge base by using the knowledge acquisition sub-system.
Explanation sub-system: is its ability to explain its advice or recommendations, and even to justify why a certain action was recommended.

3.2.2 Case-based Reasoning

A general CBR cycle may be described by the four basic processes (Claus-Dieter Althoff, 2008). An initial description of a problem defines a new case. This new case is used to RETRIEVE a case from the collection of previous cases. The retrieved case is combined with the new case - through REUSE - into a solved case. Through the REVISE process this solution is tested for success, e.g. by being applied to the real world environment or evaluated by a doctor, and repaired if failed. During RETAIN, useful experience is retained for future reuse (Shankar K. Pal, 2004). The cycle is shown below (Leake, 1996).

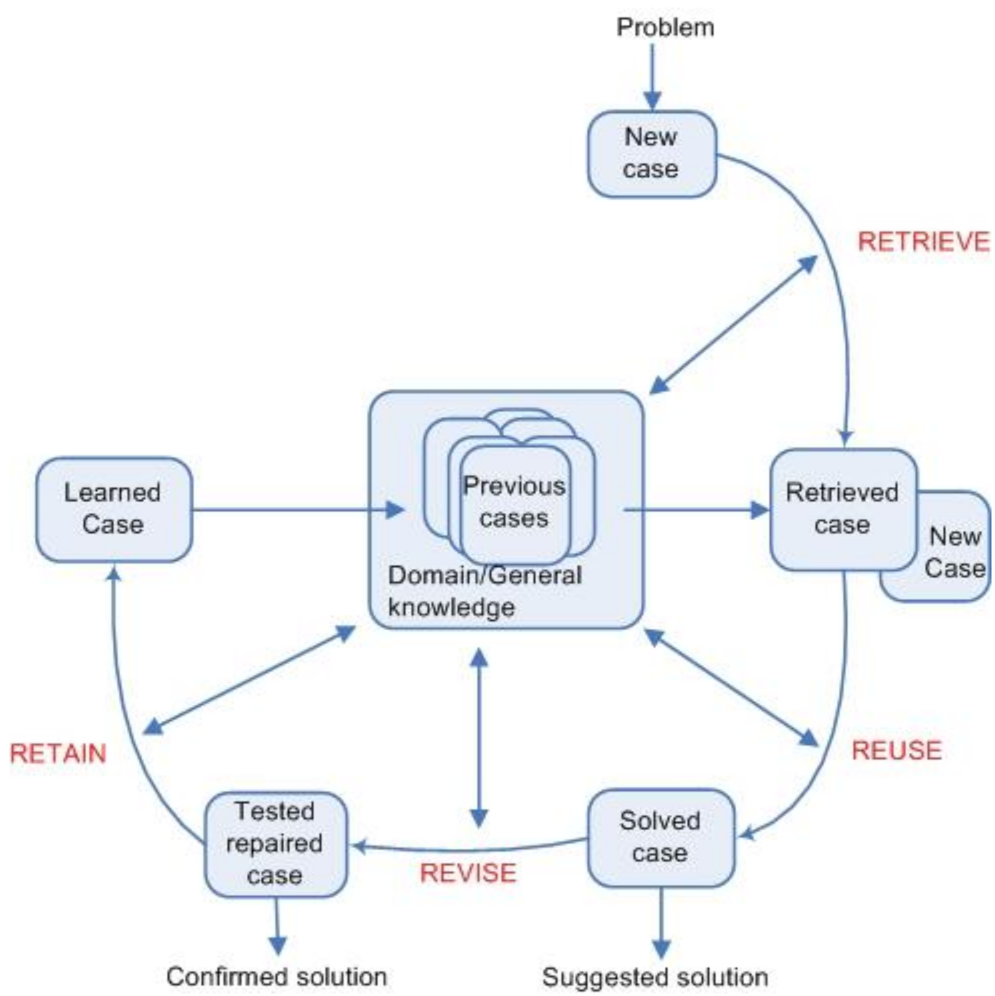


Figure 3 Case-based Reasoning Life Cycle

3.3 Expert systems for Medical Diagnosis

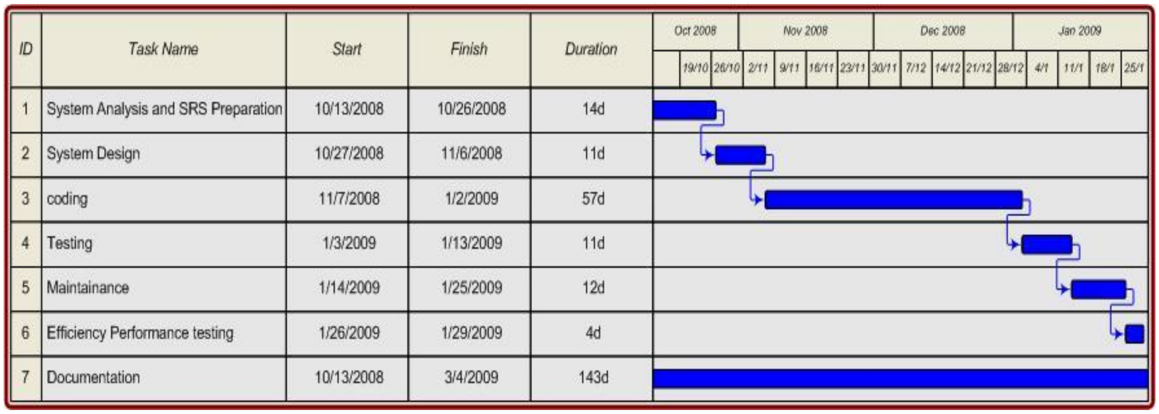
Expert systems have already been applied in a number of different applications in medicine. Expert systems are not really replacing doctors but are being used to help them. Some real expert systems for medical diagnostic support are:

1. CaDet (http://www.abdn.ac.uk/ims/imaging/research/CADET/index.php).
2. Dxplain (http://lcs.mgh.harvard.edu/projects/dxplain.html).
3. Germwatcher (http://www.openclinical.org/aisp_germwatcher.html).
4. PEIRS (www.openclinical.org/aisp_peirs.html).
5. MYCIN(http://www.mycin.com).
6. SHYSTER-MYCIN (http://cs.anu.edu.au/software/shyster/tom/)

The advantages of using an expert system over the mere dependence on doctors are mentioned below.

- A large database of knowledge can be added to and kept up-to-date - it can store more knowledge than a person.
- The system cannot 'forget' or get facts wrong.
- It survives forever. There is no loss of knowledge as there is when a doctor retires.
- The computer can access specialist knowledge that a doctor may not have.

4. Initial Plan



ID	Task Name	Start	Finish	Duration
1	System Analysis and SRS Preparation	10/13/2008	10/26/2008	14d
2	System Design	10/27/2008	11/6/2008	11d
3	coding	11/7/2008	1/2/2009	57d
4	Testing	1/3/2009	1/13/2009	11d
5	Maintainance	1/14/2009	1/25/2009	12d
6	Efficiency Performance testing	1/26/2009	1/29/2009	4d
7	Documentation	10/13/2008	3/4/2009	143d

Figure 4 Gantt chart - The initial project plan

5. Completed Activities

5.1 System Analysis

The system analysis was performed and the software requirement specification was prepared. The report may be downloaded with the help of a SVN client from http://dev.d2labs.org/svn/nds/Specs.

The Software Requirement Specification contains:

1. High Level Requirements
2. Functional Requirements
    a. Maintain Cases
    b. Maintain Rules
    c. Provide Expert Solution
    d. User Interface
3. Nonfunctional Requirements

5.2 System Design

For system design, high level design and detailed design was completed. The report may be downloaded with the help of a SVN client from http://dev.d2labs.org/svn/nds/Specs.

The Design report contains:

1. High Level Design
    a. System architecture
    b. Package diagram
    c. Object diagram
    d. ER diagram
    e. Deployment diagram
    f. Frameworks, platforms, and third-party components used
2. Detail Design Specifications
    a. View
    b. Front Controller and Page Controllers
    c. Inference Engine
    d. Knowledge Base
    e. Retrieve Component
    f. Adapt Component
    g. Data Access Component
    h. Database Schema Diagram
    i. Sequence Diagrams
    j. Detailed Design Showing the Control Flow

6. Current Status

6.1 Phase Status

Serial	Activity	Status
1.	Project Plan	Completed
2.	Software Requirement Specification	Completed
3.	High Level Design	Completed
4.	Detailed Design	Completed
5.	Implementation	Under progress… (75%)
6.	System Testing	-
7.	Final Presentation	-

6.2 Configuration and management

The project configuration and management is being carried out in D2Labs at http://dev.d2labs.org/gf/project/nds/. The tool and the resources are being used for the following purposes:

1. Maintaining the source codes at the SVN repository.
2. Publishing project news.
3. Discussing the project related issues through the forums.
4. Maintaining the project artifacts.
5. Assigning tasks to the team members and maintaining the trackers.
6. Listing the 'to do' activities.

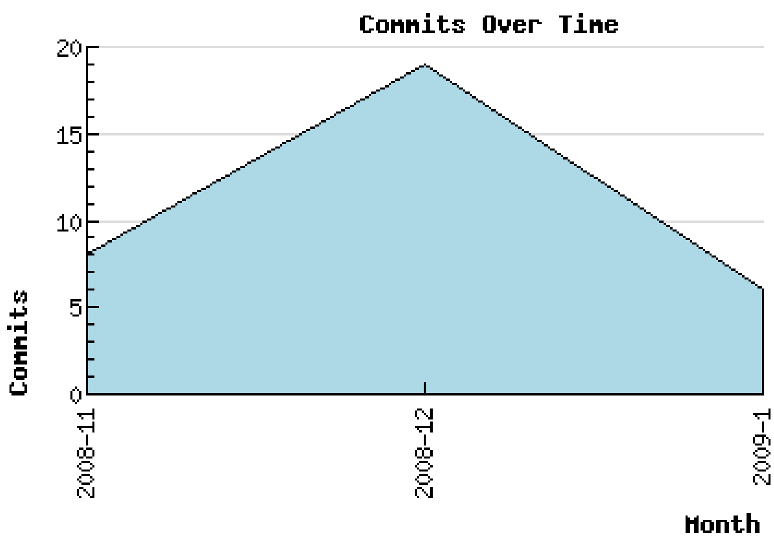


Figure 4 SVN commit statistics at the SVN repository

6.3 Implementation status

Sub-Activity	Progress Status
Rule-based components	80% complete
Case-based components	70% complete
Domain research	100% complete
Overall Implementation Progress	75% complete

6.4 Domain Research

A great deal of time is being spent on the domain research i.e. the study of neurology and neurologic diseases.

Our study is focused on:

1. Preparation of a decision tree for the diseases resulting to paraplegia/quadriplegia.
2. Collection of all the attributes necessary for representing a neurologic case of a patient.

7. To do Activities

Activity	Assignee
Form Handling Part of CBR	Badri Adhikari
Database Part of CBR	Md. Hasan Ansari
Adding Diseases information to RBR Component	Priti Shrestha
Implementing rules update functionality	Susma Pant

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