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COMPREHENSIVE STUDY ON WEB BASED EXPERT SYSTEMS FOR DISEASE DIAGNOSIS AND TREATMENT

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ABSTRACT:

The Internet has pervaded the life of human being in recent years. For many areas, various and number of web applications are available on the internet. The web applications which offers expert knowledge and assistance in the areas like government sector, military sector, research sector, education sector, medical sector and many more areas available online with single click. Especially in the field of medicine, web applications are coming out as efficient tools in the various diseases diagnosis and treatment. Web applications are also proven its helping hands as assistance tool, advisory tool and reporting tool for medical experts, doctors, medical practitioners and patients too. This paper presents overview of web based expert systems in the disease diagnosis and treatment, its pros and cons as compare to standalone expert systems and comparative study of already developed web based expert systems for various disease diagnosis and treatment.

Keywords: –*:* World Wide Web, Expert System, Fuzzy Logic, Web based Expert System, Fuzzy Expert System.

[1] INTRODUCTION

An Expert system is one of the application areas of Artificial Intelligence where efforts taken to make computer programs imitable like human thinking using expert knowledge database. We found the roots of Expert System application development in the mid of 1960's when rule based Expert Systems like MYCIN, DENDRAL and Prospector etc. were developed and implemented for specific purposes and working domains. Earlier Expert System applications were developed for single machine environments i.e. standalone Expert System applications.

Despite of commercial success, several problems and limitations are often associated with conventional Expert Systems [15]. which are listed as below.

- Availability- Implementation of Expert Systems as and when needed have limitations based on implementation location and its use.
- Expert System Distribution– Implemented Expert System Softwares are updated and necessary documentation provided physically. It results in various problems like record keeping, inconstancy time consumption and incurred costs.
- Communication – Rareness of information exchange protocols among Expert Systems result less development of cooperated and information sharing Expert System applications.

[2] WEB BASED EXPERT SYSTEMS

The World is witness about how internet has grown in its size and use since its origin and become today's World Wide Web i.e. The Internet. The internet is source of huge amount of information and numbers of applications of various domains are available on single click and flooding continuously. To be very specific, several plus that push the internet to become more effective and traditional platform for Expert Systems.

Internet Centred Information and Communication Technologies are changing Expert System applications [14]. Rapid advances in Internet technologies have opened new opportunities for enhancing traditional Decision Support Systems and Expert Systems [16].

Web based Expert Systems Pros/Benefits

The rationale for Expert Systems on the internet with several factors which proves internet as platform for Expert System implementation revealed [16].

- Wide spread access of internet
- Availability of number of web browser with multimedia interface capability
- Several internet compatible tools for Expert System development
- Portability in internet based applications
- Emerging protocols support communication among Expert Systems.

Web based Expert Systems Cons/Challenges

In the design and development of Web based Expert Systems there may be some challenges [13].

- Developer should take knowledge about software and hardware components, system architecture etc.
- Data structures should be identified and can be stored and displayed into databases and dynamic web pages.
- GUI designing and compatibility should be taken into consideration.
- Feedback mechanism, network security should be provided and system evaluation process i.e. performance measurement should be done.

[3] EXPERT SYSTEM DEVELOPMENT ENVIRONMENT

Programming Languages

Symbolic programming languages are commonly used for development of expert systems. Programming languages like PROLOG and LISP are used in the development of Expert Systems as logical inferences can be easily implemented. New generation programming languages like Java, VB.net, C#.net, PHP etc. are also used with their extension capabilities in Expert System development.

Expert System Tools

These are software systems which make Expert System development smooth and easy. These systems provide rich development environment which may consist editors, debuggers, graphical user interfaces, model design facilities knowledge representation techniques and inference design facilities etc. CLIPS, EXSYS, Rule Master and VP-Expert etc. are some of the examples of expert system tools. MATLAB and Scilab are also well known and mostly used expert system development tools.

Expert Shell

The expert system shell is software module which provides facilities for uncertainty reasoning, rule base development, knowledge base editors etc. There are many expert system shells are available, few of them listed as e2glite JESS, PESS, XpertRule, Vidwan etc.

[4] WEB BASED EXPERT SYSTEM DEVELOPMENT

Design principles should be considered while designing the web application for expert system. Along with expert system design steps, web applications design processes should be followed and most of design issues need to be resolved by the developer.

Expert System Design Steps

Software engineering methodologies would be preferable and feasible to design and develop expert systems [12]. Following are the steps used to design an expert system.

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- Problem Analysis
- Knowledge Acquisition
- Knowledge Representation
- Architecture Design and Development
- Validation and Implementation

Web Application Development Process

In the web application developments traditionally following steps are carried out mainly.

- Requirement Analysis
- System design- database design, software and hardware environment selection, UI design
- System Development- Coding, Testing

- Implementation
- Maintenance

Web Application Design Issues

Following are the few design issues in web application development.

- Request Processing
- Authentication and Authorization
- Navigations
- Page Layout
- Page Rendering
- Session management
- Validation
- Performance and Scalability
- Distribution
- Deployment

Web based Expert System Architecture

The architecture of web based expert system comprises Client-Server architecture with Expert System architecture [13].

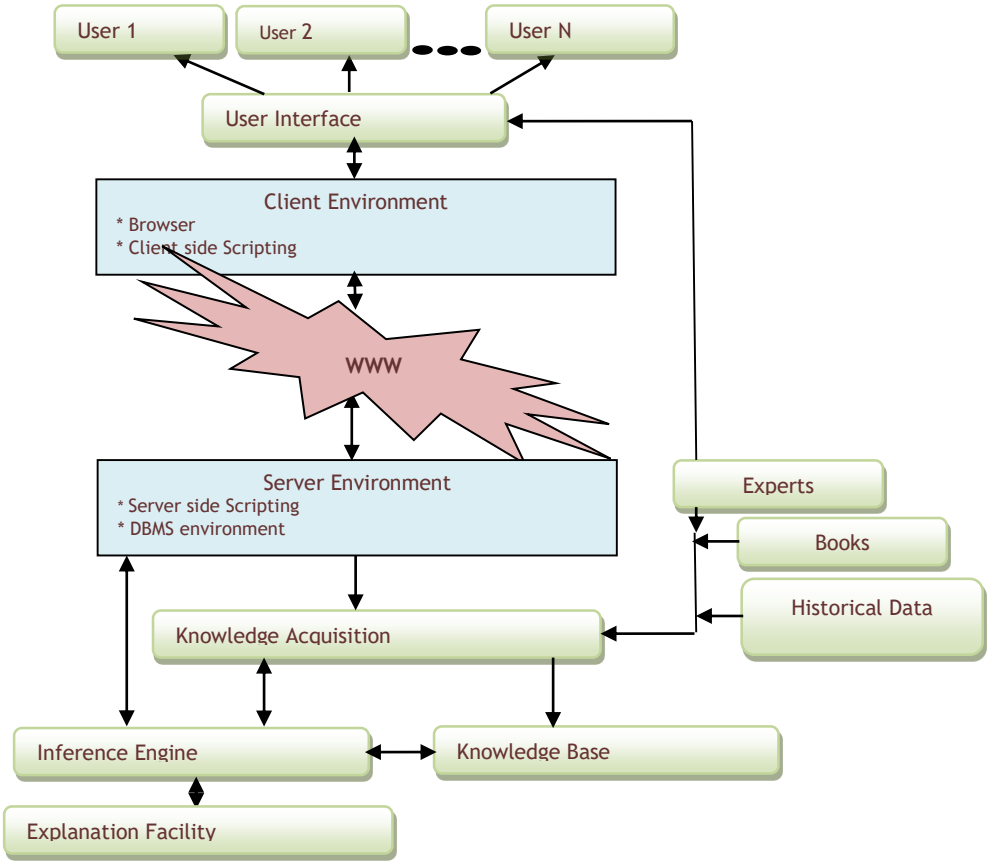

Figure: 1. The architecture of web based Expert System

[5] REVIEWED WORK

The background study of Web Based Expert Systems for Disease Diagnosis and Treatment is done by reviewing recent research work publications and this study is categorised into three groups which are as follow:

1. Web Based Expert Systems for Human Disease Diagnosis and Treatment
2. Web Based Expert Systems for Animal Disease Diagnosis and Treatment
3. Web Based Expert Systems for Plants/Crops Disease Diagnosis and Treatment

Web Based Expert Systems for Human Disease Diagnosis and Treatment

Ms. Kalyani Baghel et al. [1] proposed a web based Expert System application for Human Disease Diagnosis. In proposed system there are three stages from which first is symptom identification where symptoms are selected by user which patient is suffering from. In stage second, disease and its type identification is done by asking questions and finally based on identified disease, again questionnaire is asked to calculate probability of disease which patient is suffering from.

Patel et al. [2] developed and proposed a web based Expert System to diagnosis the diarrhea with core objective to check functionality of the web service and inference mechanism of fuzzy expert system. In this application user selects the symptoms with its severity and sends the request which is further directed to web service and then forwarded to inference engine. Finally, FES response is sent back as a result on result page.

Hustinawaty et al. [3] developed a web based system for diagnosing children diseases. In this system, production rule is used as model of knowledge representation. The decision tree and decision table is used in production rules. Certainty Factor calculation is done by selecting symptoms from diagnostic page. Then id_symptom field of symptom table is used to find certainty factor value of each symptom and its relation with the disease in the rule_relation table. Finally disease certainty factor is calculated.

Sadaf Anbarzadeh et al. [10] proposed web based fuzzy diagnosis system for few diseases. Infectious mononucleosis, Scarlet fever, Pharyngitis and Tonsillitis are the name of the diseases. Diseases symptoms are considered in the development. Expert system provides some symptoms to user from which user needs to select some of them and needs to answer the questions. Then knowledge is inferred and diagnosis conclusion is drawn.

Web Based Expert Systems for Animal Disease Diagnosis and Treatment

Libin Rong et al. [4] developed web based expert system for Milch cow disease diagnosis in china. This system is composed of four subsystems out of which Diagnosis is main subsystem where user needs to submit sick and symptoms information of cows. Based on predefined rule base, symptoms and disease information mapping is done and result is displayed. After disease confirmation, its prevention and cure is given and result is updated in data store as case history after user's positive response.

Duoliang Li et al. [5] proposed Fish Expert as web based expert system for fish disease diagnosis. Proposed application mimic human fish disease expertise and diagnosis number of fish diseases with user friendly GUI. It contains a large amount of fish diseases data and images which are used to conduct online disease diagnosis.

Chutchada Nusai et al. [6] developed Swine-Vet: a Web-based Expert System of Swine Disease Diagnosis for swine farmers. Proposed expert system is divided into three steps. In first step disease screening is done where in second stage disease diagnosis is done by using symptoms and in last step disease diagnosis is done by using animal necropsy lesion. Swine age and gender is considered in the disease screening.

Munirah M. Y et al. [11] designed and developed online Dog diseases diagnosing system. This system provides diagnosis module and treatment module where data of symptoms, diseases and treatments along with rules is updated and final result is drawn on diagnosis and treatment of dog diseases.

Web Based Expert Systems for Plants/Crops Disease Diagnosis and Treatment

Hui Li et al. [7] designed Web based Intelligent Diagnosis System for Cotton Diseases Control. Proposed system consist four distinct modules: Query, Diagnosis, Management and Expert online. Back propagation neural network is used to execute knowledge.

S.S.Patil et al. [8] designed Web Based Expert System for diagnosis of Micro Nutrients Deficiencies in Crops. This system is based on deductive inference and its knowledge base contains rules derived from literature and interviews.

Fahad Shahbaz Khan et al. [9] presented Dr. Wheat: A Web Based Expert System for Diagnosis of Diseases Pests in Pakistani Wheat. In this system logical model of diagnosis is designed by using knowledge of wheat ailments and its symptoms.

[5.1] COMPARATIVE STUDY OF REVIEWED WORK

Comparative study is done [Table-I] by considering development, ES methodologies, database or knowledge base used, development environment used and usability of expert systems.

Author and System Name	Database/ Knowledgebase Used	Expert System Methodology	Development Methodology	Development Environment	Usability
Baghel, M. K., & Mehta, M. N. A Web Based Fuzzy Expert System for Human Disease Diagnosis.	Developed and maintained by experts around the world.	Fuzzy Expert System	Not Mentioned	Not Mentioned	GUI is provided with two phases for disease diagnosis and expert learning.
Patel, M., Patel, A., & Virparia, P. (2013). Web based fuzzy expert system implementation using jFuzzyLogic and JAX-Web service for diarrhea diagnosis.	50 diarrhea patients database	Fuzzy Expert System	Not Mentioned	JFuzzyLogic, GlassFish Web Server, XML Web Services (JAX-WS)	Iinput and output screen for symptoms and severity input and result respectively.
Hustinawaty, R. A. (2014). The development of web based expert system for diagnosing children disease using php and mysql.	5-12 years children's database	Rule Based Expert System	Traditional Approach	PHP and MySQL	Diagnostic, Consulting Form is designed
Anbarzadeh, Sadaf, and Hossein Davari. "Web based fuzzy diagnosis system and evaluation for five diseases with sort throat symptom."	Not Mentioned	Fuzzy Expert System	Not Mentioned	Not Mentioned	Symptom selection form questions form, diagnosis form.
Rong, Libin, and Daoliang Li. "A web based expert system for milch cow disease diagnosis system in China."	67 types of dairy cow diseases database	Case Based Expert System	Traditional Approach	C#, ASP.NET, HTML, MS SQL Sever2000	User Friendly Interface
Li, Daoliang, Zetian Fu, and Yanqing Duan. "Fish-Expert: a web-based expert system for fish disease diagnosis."	Questionnaire, survey and interviews of 130 fish farmers to form knowledgebase	Rule Based Expert System	Traditional Approach	DHTML Java Script, Java, VB script and ASP, MS SQL Server 7.0, Windows NT 4.0 and Windows 2000 Server, Visual InterDev, Visual J++, Photoshop 5.0	Symptoms interface, fist inspection interface, interface for diagnosing result.

Author and System Name	Database/ Knowledgebase Used	Expert System Methodology	Development Methodology	Development Environment	Usability
Nusai, Chutchada, et al. "Swine-Vet: a Web-based Expert System of Swine Disease Diagnosis."	40 swine diseases, with 86 symptoms database	Rule Based Expert System	Traditional Approach	ColdFusion Markup Language, SQL server 2008	Admin interface, User interface for gender-age, symptoms, and result form.
Munirah, M. Y., S. Suriawati, and P. P. Teresa. "Design and Development of Online Dog Diseases Diagnosing System."	Not Mentioned	Rule Based Expert System	Knowledge Engineering Approach	PHP and Java Script for front end design, Dreamweaver CS4 for interfaces design, MySQL, WAMP web server.	Admin Interface, Questions interface, Result
Li, Hui, et al. "WEB-based intelligent diagnosis system for cotton diseases control."	8 major diseases of cotton and 32 symptoms with 5 categories are summarized as knowledgebase.	Back Propagation neural network based DSS.	Not Mentioned	Not Mentioned	User friendly Interface
Patil, S. S., et al. "Web based expert system for diagnosis of micro nutrients deficiencies in crops."	KB is designed by interviews of International Potash Institute researchers and literature.	Rule Based Expert System	Interactive and Incremental Approach	ServCLIPS	User friendly Interface
Khan, Fahad Shahbaz, et al. "Dr. Wheat: a Web-based expert system for diagnosis of diseases and pests in Pakistani wheat."	Surveys, interviews of farmers, domain experts conducted for KB design.	Rule Based Expert System	Traditional Approach	e2gLite Expert System shell	UI for series of questions

Table - I. Comparative study of reviewed work

[6] CONCLUSION

This paper present study of web based expert systems in the area of disease diagnosis and treatment. The literature survey and study is thoroughly done. Whole study is carried out with keeping few questions in mind like knowledgebase development, methodologies, development environment and implementation or deployment etc. We found, in most expert systems traditional development methodology is used, many of the expert systems studied are not deployed on the internet for its use and in very few expert systems; open source development environment is used.

The world is only away from single click on the internet; especially in field of medicine web based expert systems should be developed and deployed effectively to overcome the challenges of various diseases and its diagnosis and treatments around the world.

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