Design and implementation of Intelligent Agent and Diagnosis Domain Tool for Rule-based Expert System

Mohammed Abbas Kadhim[1,2], M. Afshar Alam[1], Harleen Kaur[1]
[1]Department of Computer Science, Hamdard University
New Delhi, India
[2]College of Computer Science and Mathematics, University of Al-Qadisiyah,
Al-Qadisiyah, Iraq
moh_abbas74@yahoo.com, mailtoafshar@rediffmail.com, harleen_k1@rediffmail.com

***Abstract*—The use of expert systems in different organizations can speed-up of human professional work. Expert System (ES) is one of the common application of Artificial Intelligence (AI) has focus on the construction of high performance programs in specific professional domain. In this paper we introduce a tool for constructing rule-based expert system called DDTRES (Diagnosis Domain Tool for Rule-based Expert System), this tool provide variety of functions to facilitate the development of expert systems for practical problems in different diagnosis domain. The DDTRES consists of four components: end-user interface, inference engine, explanation facility, and empty knowledge base. We proposed also an intelligent agent for data mining to extract set of rule from medical dataset and put it in empty knowledge base of DDTRES to capture complete rule-based expert system which can produce advices in that medical field. The proposed system is developed and implemented using visual PROLOG programming language ver. 7.1.**

Keywords—intelligent agent; expert system tool (shell); data mining; rule-based expert system; DDTRES.

I. INTRODUCTION

In the last decade, the techniques of artificial intelligence has been providing solutions to multiple problems in companies of all type. Expert system is one application of AI which is suitable for solving problems that demand considerable judgment, expertise, or rules of thumb [1]. Conventional expert system use human expert knowledge to produce solution for real-world problems that would require human intelligence [2]. The expert knowledge in the knowledge base is often organized and formulated using one approach of knowledge representation. In fact, there are a lot of methods for knowledge representation; the most commonly used methods include production rules representation, semantic network representation, frame representation and logic form representation, and each one has its advantages and disadvantages [3]. The term expert system tools describe the software which are used for constructing expert systems. These tools can aid in a knowledge acquisition process and it is also help a knowledge engineer for building the expert system. There are three software categories tools for development expert system: AI programming languages, expert system shells, and knowledge engineering languages (AI Toolkits) [4]. Most expert systems are implemented and developed using special software tools called shells. These shells come equipped with backward, forward or both inference mechanism, and require knowledge to be entered according to a specified format [2]. Expert system creator or tool is a development and integration environment for expert system construction, knowledge management, and database integration. Building and implementation tools can be defined as programs, editors, or shells used in the papers can be categorized based on the application and system architectures [5,6]. Intelligent agents or software agents are programmed software entities that carry out a series of operations on behalf of a user or another program with some degree of autonomy [7]. It is capable of acting in an environment which can communicate with other agents or resources in order to meet its design objectives [8]. The proposed intelligent agent used data mining techniques to discover a set of rules (knowledge) in a large dataset.

In this paper, we focus on constructing a diagnosis domain tool (shell) for building rule-based expert system and constructing of knowledge base by using intelligent agent for data mining approach. There is a lot of datasets are available now (e.g. UCI machine learning repository and KEEL-dataset repository) we can use one of them for data mining and extracting set of rules to use it in DDTRES using autonomous intelligent agent. In other words, the main objective of proposed intelligent agent is automatically turn these raw data in dataset to rules in knowledge base of proposed tool (shell). The structure of our paper is organized as follows: In section 2 we present an overview on existing tools for the construction of expert systems and related works on using intelligent agent in data mining or knowledge discovery approaches. Section 3

978-0-7695-5013-8/13 $31.00 © 2013 IEEE
DOI 10.1109/ICMIRA.2013.129

discusses the architecture of the proposed system in details. Finally, section 4 describes the conclusions of this work.

II. RELATED WORKS

Nowadays, a number of studies have been proposed and discussed related with expert system tools and intelligent agent used in data mining techniques.

Hatzilygeroudis and Kovas [9] introduced a tool called ACRES (Automatic CReator of Expert System), which is can automatically produce rule-based expert systems from a dataset containing knowledge about a problem domain in the form of a large number of cases. Pop and Negru [5] produced a paper presents a commercial software tool for the development expert system, it is an extensible, user friendly environment for expert system development which support the integration of high level knowledge into host projects, data integration from conventional database systems and system's verification, debugging and profiling. CLIPS (C Language Integrated Production System) is one of the most well-known tools (shell) for development of rule-based expert systems and it is widely used throughout the government, industry, and academia. CLIPS provides a concrete tool for control a wide variety of knowledge paradigms such as rule-based, object oriented, and procedural [10,2]. Mezcua, Crespo, Cuadrado, and Carrasco [11] produced an expert system development tool for non AI experts, in that tool they proposed a framework for the development of expert systems based on a knowledge representation model that is easy to understand for people without specific training in AI. They describe a tool for knowledge modeling based on the model referred to an inference engine integrated in the Internet for the exploitation of expert systems created on the basis of the proposed tool.

Warkentin, Sugumaran, and Sainsbury [12] produce a study which discusses the role of intelligent agents and data mining in electronic partnership management. The procedures of data mining used in this process can be enhanced by using intelligent agents. Popa, Pop, Negru, and Zaharie [13] proposed a multi-agent based on intelligent recommendation system called AgentDiscover. The aim of this system is to deal with the complexity of Knowledge Discovery in Database (KDD) processes and produce a tool to support researchers and non-expert users for exploring KDD method and looking for quick results in this field.

III. PROPOSED SYSTEM ARCHITECTURE

In this section we will discuss the components of proposed system which consists of two main sub-system: DDTRES and intelligent agent for data mining as in figure (1) which is illustrate the architecture of proposed system.

A. DDTRES

This sub-system present expert system tool or expert system shell which is help us to construct rule-based expert system in diagnosis domain, expert system shell is an expert system that has been emptied knowledge base or without knowledge base. That means, the developers concentrate only on entering the knowledge base without building the other components of expert system (e.g. user interface and inference engine). Although expert system shell has many advantages for knowledge engineers and system developers, it is inflexible and difficult to modify or change the way of knowledge representation and inference mechanism used by that tools. Now we will discuss in details the components of DDTRES as follows:

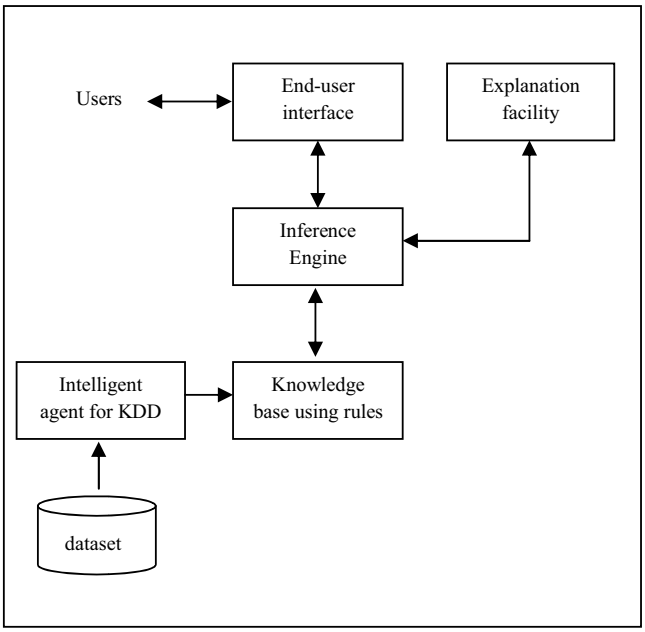

Figure (1): Architecture of proposed system

1. End-user interface

The user can interact with expert system through user interface. It is an important component of any software development tool because it allows interaction between developers and tool. The user interface must be natural in the context applications, user friendly, and hide the other complex components of expert system[14,15]. There are many techniques used to construct user interface such as graphical, questions and answers, menu driven, and natural language interface. In proposed tool we used combine interface (menu driven and questions and answers).

2. Inference engine

The main objective of inference engine is to look for information and relationships in the knowledge base and to provide answers, predictions, and suggestion in the way a human expert would [14]. It is can recognize the stored

knowledge based on the method of knowledge representation. The inference engine contain the strategies of reasoning process (forward chaining, backward chaining, or both), it is carry out the reasoning process by link the contains of the knowledge base with the symptoms which input by users through user interface to find appropriate decision situation. The inference engine must find appropriate decision, right facts, interpretations, and rules to collect them correctly. The inference method used in proposed tool is backward chaining which includes the process of starting with conclusions and working backward to the supporting facts.

3. Explanation facility

This facility used to explain the process through the system has arrived at a decision. It is allow the user to understand and follow how the proposed tool arrived at certain results and explain to him why it reaches to that results through reasoning process [2,14]. The purpose of explanation facility is to increase the user's confidence with the results that produced by the system, it is also provide a convenient and efficient means for capturing and storing all components of the knowledge base. The explanation facility in proposed tool can answer for HOW & WHY questions, the HOW & WHY questions mean how and why the system give this decision. The system after these questions describe to the user the reasoning chaining process to satisfy him with its decision.

4. Knowledge base

The knowledge base in proposed system tool is empty and it is ready to full by facts and rules which are produced by intelligent agent for data mining (discuss in next section). The knowledge base will be store all relevant information, facts, rules, and relationships used by expert system. The fact is a relationship between two objects (or more) without condition, while the rule consist of two parts: a consequent which is the relationship between two objects (or more), the second part is antecedent which is the set of relations that must be satisfied to carry out of the consequent part [15]. The domain of problem solving knowledge will be saved in knowledge base depend on a dataset domain used by intelligent agent for data mining.

B. Intelligent agent for data mining

In traditional system, the knowledge engineer extract the knowledge from its resources to construct knowledge base in expert system. In this paper, we proposed intelligent agent to discover knowledge from large dataset using data mining techniques to discover useful patterns from a volume of data. Then, save the extracted knowledge in empty knowledge base of DDTRES to obtain complete rule-based expert system. Intelligent agent for data mining consist of:

1. Intelligent agent for KDD

Knowledge Discovery in Databases (KDD) has become one of the fastest growing research topic in computer science because the continually change and acquire new understanding is driving force for its applications. Data mining is a very important analysis activity of the Knowledge Discovery in Databases (KDD) process, which is an interdisciplinary field of computer science; this refers to a very broad process of finding knowledge in a large database. In order to find knowledge, a standard process has been developed [17,18]. The most important step in intelligent agent for KDD is knowledge extraction from dataset. The proposed intelligent agent contains specific algorithm for knowledge extraction or rule generation process. There are different algorithms which have been used to generate rules such as Apriori, FP-Growth, Predictive Apriori, and Tertius algorithms. They will mine frequent item sets as well as they have two parameters, support and confidence. They are specified by the user and enable result filtering by the algorithm. These parameters when well define filter only important association rules from the system [16,18]. In proposed intelligent agent we used Apriori algorithm to discover and generate rules from dataset. Apriori algorithm has become a standard approach in rule mining. It was first introduced by Agrawal and Srikant in (1994) [16]. The Apriori algorithm finds frequent itemsets from databases by iteration. At each iteration i the algorithm attempts to determine the set of frequent patterns with I items and this set is engaged to generate the set of candidate itemsets of the next iteration. The iteration is repetitively performed until no candidate patterns can be discovered [16]. The output of Apriori is a set of rules which will be saved in empty knowledge base of DDTRES.

2. Datasets

A dataset is a collection of data usually presented as a table form or a single statistical data matrix, where each column of the table represents a particular variable, and each row corresponds to a given member of the dataset in question. There are many medical datasets are already available on Internet used for scientific researches especially for data mining field such as UCI machine learning repository and KEEL-dataset repository. We can also constructing a dataset by collecting data from different organizations such as companies, hospitals, statistical data centers… etc. and use it for scientific researches.

IV. CONCOLUSION

In this paper, we discussed the design and implementation of expert system tool (shell) in diagnosis domain. This tool can be used to easily create a rule-based expert system not only can produce advices in specific domain, but also it is help the domain expert to take decision for complex problem in

that domain. It is also can help the knowledge engineer for constructing of rule-based expert system. He/she will focus only the construction of knowledge base without care with other components of rule-based expert system. We produce also the intelligent agent for KDD to interact directly with dataset to extract set of rules using Apriori algorithm. That means, the proposed intelligent agent produce knowledge base automatically and submitted to proposed DDTRES to obtain complete rule-based expert system without interference of knowledge engineer.

REFERENCES

[1] K. W. Chau, and F. Albermani, " Expert system application on preliminary design of water retaining structures", Expert systems with applications, 22(2), pp.169-178, 2002.

[2] Ajith Abraham, "Rule-based Expert Systems", John Wiley & Sons, 2005.

[3] W. Rui, and L. Duo, "The Study on Construction of Knowledge Base of Grinding Expert System Based on Data Mining", 2011 International Conference on Mechatronic Science, Electric Engineering and Computer pp. 845-848, IEEE, Jilin, China, 2011.

[4] Khalid Eldrandaly, "An Intelligent MCDM Approach for Selection the Suitable Expert System Building Tool", The International Arab Journal of Information Technology, Vol. 4, No. 4, October 2007.

[5] D. Pop, and V. Negru, "An Extensible Environment for Expert System Development", In V. Palade, R. Howlett, and L. Jain editors, LNCS (LNAI), vol. 2773, pp.1016-1022. Springer, Heidelberg, 2003.

[6] S. Sahin , M.R. Tolun, and R. Hassanpour, "Hybrid expert systems: A survey of current approaches and applications", Expert systems with applications, 39(4), pp. 4609-4617, 2012.

[7] Y. Duan, V. K. Ong, M. Xu, and B. Mathews, "Supporting decision making process with "ideal" software agents – What do business executives want ?", Expert System with Applications, 39(5), pp. 5534-5547, 2012.

[8] J. Rajan, and V. Saravanan, "A framework of an automated data mining system using autonomous intelligent agent", International conference on computer science and information technology, IEEE, pp. 700-704, 2008.

[9] I. Hatzilygeroudis, and K. Kovas, "A Tool for Automatic Creation of Rule-Based Expert Systems with CFs", IFIP International Federation for Information Processing, AIAI, IFIP AICT 339, pp. 195–202, 2010.

[10] C. Culbert, Riley, G., Donnell, B.: CLIPS Reference Manual, Vol. 1-3. Johnson Space Center NASA, 1993.

[11] B. Ruiz-Mezcua, A. Garcia-Crespo, J.L. Lopez-Cuadrado, and I. Gonzalez-Carrasco, "An expert system development tool for non AI experts", Expert systems with applications, 38(1), pp. 597-609, 2011.

[12] M. Warkentin, V. Sugumaran, and R. Sainsbury, "The role of intelligent agents and data mining in electronic partnership management" Expert Systems with applications, 39(18), 13277-13288, 2012.

[13] H.Popa, D. Pop,V. Negru, and D. Zaharie, "AgentDiscover: A Multi-Agent System for Knowledge Discovery from Databases" 9th International Symposium on Symbolic and Numeric Algorithms for Scientific Computing, pp.275-281, IEEE, 2008.

[14] Hassan Mathkour, Israa Al-Turaiki and Ameur Touir, "The Development of a Bilingual Fuzzy Expert System Shell", Journal of King Saud University, Comp. & Info. Sci., Vol. 21, pp. 27-43, 2009.

[15] M. Abbas Kadhim, M. Afshar Alam, "To Developed Tool, an Intelligent Agent for Automatic Knowledge Acquisition In Rule-based Expert System". International Journal of Computer Applications, 42(9), pp. 46-50, 2012.

[16] J. Nahar, Imam, T., Tickle , K., and Chen Y., "Association rule mining to detect factors which contribute to heart disease in males and females", Expert Systems with applications, 40(4), pp. 1086-1093, 2013.

[17] U. Fayyad, G. P. Shapiro, and P. Smyth, "The KDD process for Extracting Useful Knowledge from Volumes of Data", Communication of the ACM, Vol.(39), No.(11), pp. 27-34, 1996.

[18] B. K. Foguem, F. Rigal, F. Mauget, "Mining association rules for the quality improvement of the production process", Expert Systems with applications, 40(4), pp. 1034-1045, 2013.