Analysis, Design, and Implementation of Intelligent Expert System for Clothes Style Selection

Yasser A. Nada
Chairman of Department of computer science,
Faculty of Computers and Information Technology,
Taif University, Taif, Saudi Arabia

Hossam Meshref
Computer Science Department
College of Computers and Information Technology
Taif University, Taif, Saudi Arabia

ABSTRACT
There is a difficulty in terms of choosing the right outfit. Also, many people wasting more money for modern fashion to be in beautiful appearance. Hence, in this paper, an expert system for clothing style selection is proposed. This expert system is constructed by using Forward Chaining method in addition to acquiring expert's knowledge and CLIPS, which in turn makes the proposed system intelligent. The expert system comprises garment recommendations, knowledge about aspects of fashion such as materials, colors, body types, and facial features. Furthermore, it provides personalized recommendations. Briefly, the proposed expert system helps people to choose their clothes carefully to highlight the real beauty of it deserved.

Keywords
Expert System, Forward Chaining , CLIPS, clothing style.

1. INTRODUCTION
An Expert System (ES) is a computer based information systems that use expert knowledge to attain high level decision performance in a narrowly defined problem domain [1]. Expert systems can be used as a solution to overcome the scarcity of experts.

The beauty is one of interests sought by humans irrespective of their colors and their communities in different eras, beauty of the human face and body and his clothes (general appearance) have high importance and affect the relationship with others. During the general appearance we configure perceptions about the person that we meet and by a unconscious way, we are passing judgment about he/she.

Fashion is one of the most important manifestations of elegance and less defective will be noted immediately, and elegance does not mean wearing expensive clothes. It means as look at the clean and harmonious appearance which suitable for the proportions of the body. No matter the price of uniforms or the fashion house that produced it.

Personalization in the fashion industry is a new trend that tries to produce garments respecting the idiosyncrasy of every customer and doing so cost effectively, whilst at the same time adding value to the services provided. Typically, a personalized fashion service recognizes its users, collects information about their interests, their needs, as well as their personal physical characteristics (such as body type), and subsequently recommends products based on this information.

Getting an elegant appearance is not that easy; because each body and each skin has its own different rules that determine the appropriate clothing.

Although the external appearance has high importance and its big impact in suppose Personality of the person that we meet, many of ladies lose their pretty and harmony which both of them have to be obtainable.

Ladies may face many troubles from different aspects when they choose their suitable cloths. some of them think the weight is problem which cannot be solve and cause imperfection for their external appearance while some of them see all the colors don't suitable for their skin color.

The solution for all these problems is through an expert system includes the necessary expertise in this field. It provides the tips for the ladies who would like to know what suitable cloths that can support their appearance beauty are. The tips are derived from expertises of experts in this field, through magazines, articles of famous personalities.

2. LITERATURE SURVEY
This research has focused on identifying components of fit that are important to the consumer. In order to produce garments that "fit", manufacturers and retailers must understand consumers' perceptions of physical comfort, psychological comfort, and appearance which all impact the consumer's decision process. Therefore, understanding the cultural, physical, and psychological differences of women in relation to preferences in garment fit in women's ready-to-wear is important.

2.1 Body Cathexis and Body Image
Other personal factors that affect consumer satisfaction or dissatisfaction with fit are body cathexis and body image [2,3]. Labat and DeLong (1990) found that the external factors which affect the satisfaction of fit include: societal messages concerning the ideal body, the fashion industry's portrayal of an "idealized figure", and industry sizing systems.

Body cathexis is determined by feelings of satisfaction or dissatisfaction with one's body and is important to self-concept. Feelings about specific body sites affect a woman's overall perceived body image. Labat and DeLong (1990) found that female consumers are more dissatisfied with their lower bodies, including the buttocks, thighs, hips, crotch, pant length, and waist, than their upper bodies, including the neck, elbow, arm, midriff, and shoulders.

2.2 Analysis of Body Shapes and Sizing
If you want to choose clothes, there are several rules governing how to choose those clothes.
System is provided to the female because she is necessary element in the world of beauty and elegance and as is well known, all girls want to look stylish.

System contains 7 rules to choose the right clothes for the status of each girl. The first rule is age, young girl differ from older lady in the way of selecting clothes. The height and weight are basics elements in choosing the right size clothing.

The skin color has big difference when choosing colors for clothes ; we have light skin that often fits all colors but sometime some colors is better than the other according to the temperature in that season. And also the body shape of any girl Different from other one but there are four basic forms: the hourglass shape, peach shape, apple shape and banana shape. These are illustrated in figure (1).

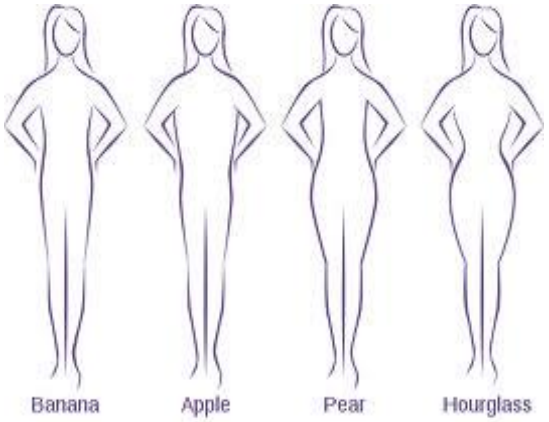

Fig 1: Body shapes

Each shape has suitable clothing styles to hide defects of the body. Also, the type of occasion is important in selecting the appropriate clothes, when the person has work, should not have to wear worn when she was in a big ceremony. The system worked by asking the user about her age, length, weight, and type the appropriate chapter and finally the color of the skin and offers her advice based on that.

An expert system is a computer program that uses expert knowledge to attain high levels of performance in a problem area. It can be used to supplement the availability of human experts and to increase the availability of expert advice. An expert system enables anyone with some experience to outline the process used to solve a problem. Once this has been done, the outline can be used to generate a series of questions that lead a non-expert to solve environmental problems.

Expert systems have been used to solve a wide range of problems in domains such as medicine, mathematics, engineering, geology, computer science, business, law, defense and education. Building an expert system therefore first involves extracting the relevant knowledge from the human expert. Such knowledge is often heuristic in nature, based on rules rather than absolute certainties [4].

Extracting knowledge from the expert in a way that can be used by a computer is generally a difficult task. Experts generally find it very difficult to express exactly what knowledge and rules they use to solve a problem,. i.e., knowledge acquisition for expert systems is a big area of research, with a wide variety of techniques developed. In this paper, the technique for extracting production rules then using these rules as knowledge base of expert systems is based on IF-THEN rules [5].

3. COMPONENTS OF AN EXPERT SYSTEM

Expert System (ES), also called a Knowledge Based System (KBS), is computer application programs that take the knowledge of one or more human experts in a field and computerize it so that it is readily available for use. It can also be integrated with textual database which can be used for explanation purposes of basic terms and operations to confirm and to reach conclusion in some situations [6].

One of the most powerful attributes of expert systems is the ability to explain reasoning. Since the system remembers its logical chain of reasoning, a user may ask for an explanation of a recommendation and the system will display the factors it considered in providing a particular recommendation. This attribute enhances user confidence in the recommendation and acceptance of the expert system [7].

All expert systems are composed of several basic components: a user interface, a database, a knowledge base, and an inference mechanism. Moreover, expert system development usually proceeds through several phases including problem selection, knowledge acquisition, knowledge representation, programming, testing and evaluation. Expert systems have a number of major system components and interface with individuals in various roles. These are illustrated in figure (2). The major components are [8]:

- **Knowledge base** - a declarative representation of the expertise, often in IF THEN rules;
- **Working storage** - the data which is specific to a problem being solved;
- **Inference engine** - the code at the core of the system which derives recommendations from the knowledge base and problem-specific data in working storage;
- **User interface** - the code that controls the dialog between the user and the system.

The below figure explains the Architecture of the Expert System:

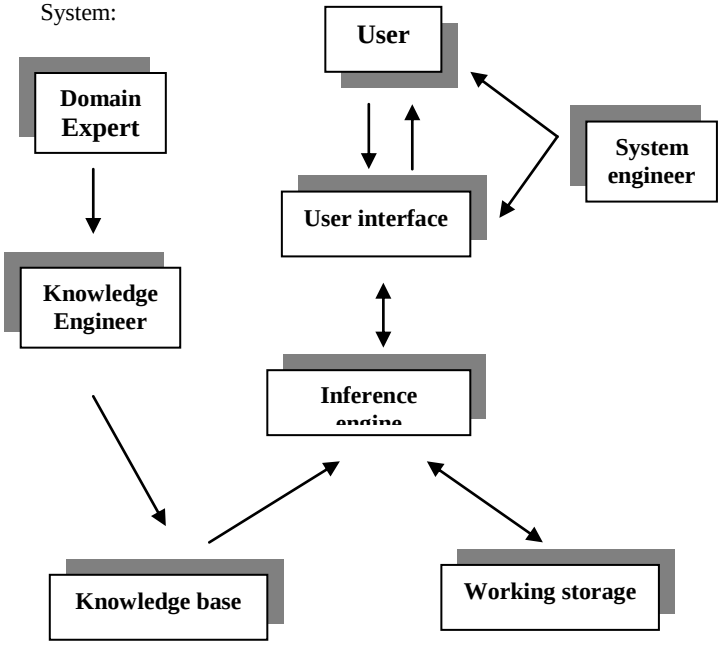

Fig 2 the expert system component

4. IMPORTANCE OF KNOWLEDGE

Knowledge can be defined as the body of facts and principles accumulated by human kind or the act, fact, or state of knowing. The meaning of knowledge is closely related to the meaning of intelligence. Intelligence requires the possession of and access to knowledge. The characteristic of intelligence people is that they possess much knowledge.

Thus, we can say that knowledge includes and requires the use of data and information. But it is more. It combines relationships, correlations, dependencies, and the notion of gestalt with data and information.

5. KNOWLEDGE IN THE EXPERT SYSTEM

The knowledge the expert uses to solve a problem must be represented in a fashion that can be used to code into the computer and then be available for decision making by the expert system. There are various formal methods for representing knowledge and usually the characteristics of a particular problem will determine the appropriate representation techniques employed.

KBS are computer programs which capture and retain expertise that has been gained over many years of engineering experience and also employ knowledge gained from other (than human) knowledge sources. KBS can reason intelligently about necessary action to take in real time, thus freeing operational staff [9].

Moreover, separation of the knowledge base from the control elements allows the inference engine and algorithms to be generic so they can be applied to a variety of processes. This means that it is possible to begin operating a process with an empty knowledge base and create a new knowledge base for the particular process [10].

Knowledge bases can be represented by production rules. These rules consist of a condition or premise followed by an action or conclusion **(IF condition...THEN action)**.

5.1 Knowledge Engineer

A knowledge engineer has the job of extracting this knowledge and building the expert system knowledge base. Having decided that your problem is suitable you need to extract the knowledge from the expert and represent it using your expert system shell. This is the job of the *knowledge engineer*, but involves close collaboration with the expert(s) and the end user(s).

The knowledge engineer is the AI language and representation expert. He should be able to select a suitable expert system shell (and other tools) for the project, extract the knowledge from the expert, and implement the knowledge in a correct and efficient knowledge base. The knowledge engineer may initially have no knowledge of the application domain.

To extract knowledge from the expert the knowledge engineer must first become at least somewhat familiar with the problem domain, maybe by reading introductory texts or talking to the expert. After this, more systematic interviewing of the expert begins. Typically experts are set a series of example problems, and will explain aloud their reasoning in solving the problem. The knowledge engineer will abstract general rules from these explanations, and check them with the expert [11].

In order to develop the initial prototype the knowledge engineer must make provisional decisions about appropriate knowledge representation and inference methods (e.g., rules, or rules + frames; forward chaining or backward chaining). To test these basic design decisions, the first prototype may only solve a small part of the overall problem. If the methods used seem to work well for that small part it's worth investing the effort in representing the rest of the knowledge in the same form.

6. KNOWLEDGE REPRESENTATION

The key problem is to find a KR (and a supporting reasoning system) that can make the inferences your application needs in time, that is, within the resource constraints appropriate to the problem at hand. This tension between the kinds of inferences and application "needs" and what counts as "in time" along with the cost to generate the representation itself makes knowledge representation engineering interesting.

There are representation techniques such as frames, rules, tagging, and semantic networks which have originated from theories of human information processing. Since knowledge is used to achieve intelligent behavior, the fundamental goal of knowledge representation is to represent knowledge in a manner as to facilitate inference (i.e. drawing conclusions) from knowledge [12,13].

Knowledge bases can be represented by production rules. These rules consist of a condition or premise followed by an action or conclusion (IF condition...THEN action).

7. ONTOLOGY

Ontology is a philosophical discipline which can be described as the science of existence or the study of being. It was one of the first philosophers to explicitly mention the world of ideas or forms in contrast to the real or observed objects, which according to his view are only imperfect realizations (or shadows) of the ideas. In fact, It was raised ideas, forms or abstractions to entities which one can talk about, thus laying the foundations for ontology. Later his student shaped the logical background of ontologies and introduced notions such as category, sub sumption as well as the super concept / sub concept distinction which he actually referred to as genus and subspecies. With differentiae he referred to characteristics which distinguish different objects of one genus and allow to formally classifying them into different categories, thus leading to subspecies. This is the principle on which the modern notions of ontological concept and inheritance are based upon. In fact, Aristotle can be regarded as the founder of taxonomy, i.e. the science of classifying things. Aristotle's ideas represent the foundation for object-oriented systems as used today. Furthermore, he introduced a number of inference rules, called syllogisms, such as those used in modern logic-based reasoning systems. In modern computer science parlance, one does not talk anymore about 'ontology' as the science of existence, but of 'ontologies' as formal specifications of a conceptualization in the sense of Gruber [14]. So, whereas 'ontology' was originally a science, 'ontologies' have received the status of resources representing the conceptual model underlying a certain domain, describing it in a declarative fashion and thus cleanly separating it from procedural aspects [15]. Research groups in both America and Europe developed Ontology modeling languages as The DARPA Agent Markup Language (DAML) and Ontology Inference Layer (OIL.(The W3C Web Ontology Working Group has considered DAML+OIL as the starting point for the introduction of standardized and accepted ontology language for the Semantic Web as Web Ontology Language (OWL)[16]. OWL has three sublanguages: OWL Full, OWL DL and OWL Lite [17]. Existing Semantic Web ontology can be grouped into the following four major categories: Meta ontology,

comprehensive, upper ontology, systematic domain specific ontology, and simple specialized ontology [18].

7.1 Fashion Ontology

Knowledge about garments, materials, various human styles, human morphology and social occasion are among the things pertinent in fashion advice. Although there are informal associations between the above types of information sources, most of it is in anecdotal, in non-machine readable or proprietary data formats. The Fashion Ontology (FO) provides a structured and unified vocabulary to represent human, fashion and manufacturing concepts. The ontology shares a number of common terms and concepts from the above domains. This part of the FO has originated from human experts.

8. INFERENCE ENGINE

The Inference Engine forms the heart of the expert system; the knowledge base serves as the brain of the expert system. The inference engine chums through countless potential paths and possibilities based on some combinations of rules, cases, models or theories. Some rules such as predicate logic mimic human reasoning and offer various mathematical arguments to any query [19].

Two methods of inference often are used, forward and backward chaining. Forward chaining is a top down method which takes facts from satisfied conditions in rules which lead to actions being executed. Backward chaining is the reverse. It is a bottom up procedure which starts with goals (or actions) and queries the user about information which may satisfy the conditions contained in the rules [20].

8.1 Expert System Shell

Expert System Shell is a software package containing a generic inference engine, a user interface, and a collection of other tools that enable users to develop and use expert systems.

The development of expert system is implemented in CLIPS programming environment (C Language Integrated Production System) [21-23]. This programming tool is designed to facilitate the development of software to model human knowledge or expertise. CLIPS program is used by reason of the flexibility, the expandability and the low cost. CLIPS keep in memory a fact list, a rule list, and an agenda with activations of rules. Facts in CLIPS are simple expressions consisting of fields in parentheses. Groups of facts in CLIPS, usually follow a fact-template, so that to be easy to organize them and thus design simple rules that apply to them.

The entire control and operation of the system are done by the inference engine; that is developed using C#; The main roles of the inference engine are summarized as: It applies the expert domain knowledge to what is known about the present situation to determine new information about the domain. The inference engine is the mechanism that connects the user inputs in the form of answers to the questions to the rules of knowledge base and further continues the session to come to conclusions. This process leads to the solution of the problem.

We will elicit knowledge from fashion experts who has experience in the clothing design. We must elicit this knowledge in accurate and complete manner.

8.2 Forward Chaining

Forward Chaining is a tracking process that begins with displaying a collection of data or evidence convincing to the final conclusion [24]. Forward chaining also called a search driven data. So starting from the input information (if) first and then to the conclusion (derived information) (then) that can be modeled as follows:

IF (input information)

THEN (conclusion)

The model uses input information and conclusions called production rules [24]. Input information may be the data, evidence, finding, or observation. While the conclusions may be the purpose, diagnosis or explanation. So that the Forward Chaining logic can be started from the data to the destination, from the findings to the explanation, and/or from the observations to the diagnosis.

Example for Forward Chaining tracking process in the form of production rules:

RULE 1:

If age is youth and tall is short and Wight is skinny and event is family and shape is sand glass and season is summer and complexion is dark complexion

Then Wear bright colors and various models, prefers to wear one color clothes to look taller ,wear heels have a color close to skin color, Wear models with thick lines and heavy fabrics , Wear simple and convenient clothes, It is better wear long jacket in which slit on the sides or in the back, while the sweaters have V-shaped cut chest and does not fully cover the chest from the top at the neck area, in summer, it is prefer to wear light colors and ware cotton and cold fabrics, since you dark-skinned, you are lucky because most of the colors suit them but must keep away from dark brown or faded colors that do not give them the lighting to the color of their skin.

RULE 2:

If age is youth and tall is long and Wight is skinny and event is family and shape is sand glass and season is summer and complexion is white skin

Then Wear bright colors and various models, You need to look away of your height by choosing clothes with bold lines ,many pockets and broad belts and the color must be difference between the two parts of clothing , Wear models with occasional lines and heavy fabrics ,Wear simple and convenient clothes, prefers to wear the jacket long the slots on the sides or in the back and does not fully cover the chest from the top at the neck area.

9. RESULTS AND TEST THE SYSTEM

The system was evaluated with different users, including developers, and staff. The system has validated by experts in the domain of clothing style. Tests of the system were carried out by the developers to make sure the system would work correctly. Figures (3, 4, and 5) show the snapshots of the developed system.

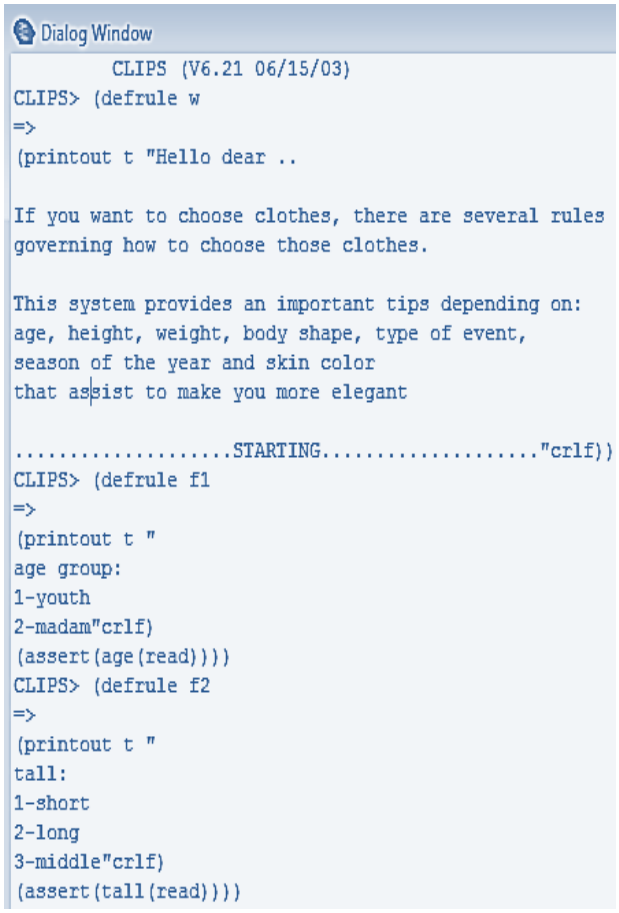

Fig 3 Domain selection screen

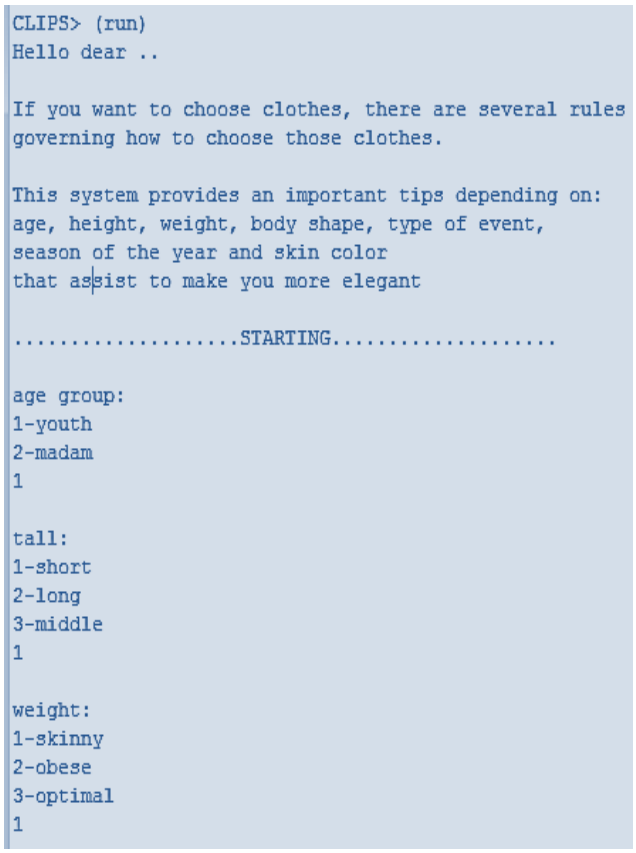

Fig 4 Run the system

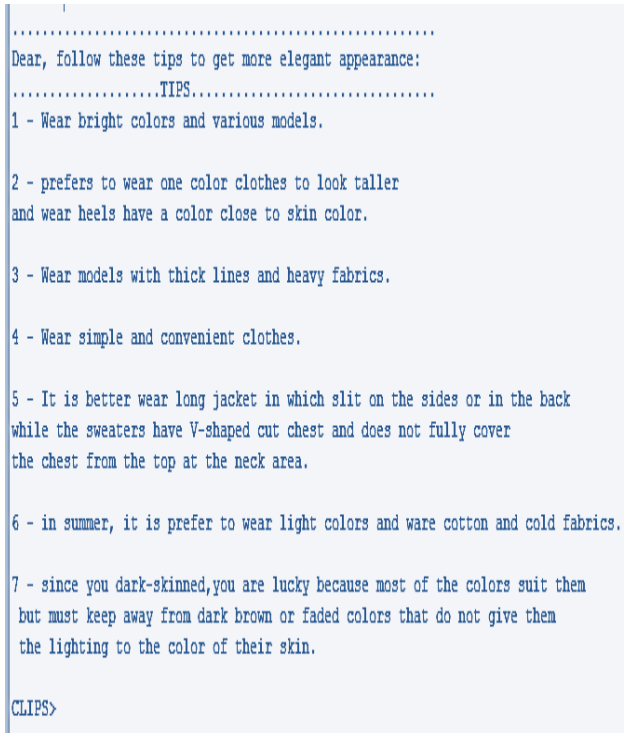

Fig5 Final result

10. CONCLUSIONS

This paper discussed the current trends and the practical usage of multiple domain experts' knowledge in clothing style using Forward Chaining method. This expert system is built based on acquiring expert's knowledge and using CLIPS as programming instrumentation. The experimental results proved that the proposed system is effective. it provides personalized recommendations. Briefly, the proposed expert system helps people to choose their clothes carefully to highlight the real beauty of it deserved. Finally, the expert system aided consumers and manufacturers in decision making related to the fit of women's apparel.

11. REFERENCES

[1] Turban, Efraim. Ramesh Shard, and Dursun Delen. "Decision Support System and Business Intelligent Systems", Prentice Hall. 9th Edition., 2011.

[2] Labat, K.L., DeLong, M., " Body cathexis and satisfaction with fit of Apparel", Clothing Textile Research Journal, 8 (2), 43-48, 1990.

[3] Garner D.M., Kearney-Cooke, A., "Body image 1996", Psychology Today, 29(2), 55-58, 1996

[4] Sarhan, A. M., W. F. Abd El-Wahed, T. E. Danf, and M. M. Tokhy; " Developing a Rule Extraction Methodology for Expert System Based Artificial Neural Network Ensembles" Fourth International Conference on Informatics and Systems INFOS2006, 25- 27 March 2006.

[5] Moawad, I. F., S. Gamalel-Din, M. Zaki, and A. Rafea, " Converting Traditional Diagnostic Expert System Into Negotiating Agent " Fourth International Conference on Informatics and Systems INFOS2006, 25- 27 March 2006.

[6] Khumukcham R., Shikhar Kr. S, "JESS Based Expert System Architecture for Diagnosis of Rice Plant Diseases:

Design and Prototype Development", 2013 4th International Conference on Intelligent Systems, Modeling and Simulation, P 674-676, 2013.

[7] Tanimoto, S. L. , " The Elements of Artificial Intelligence " , Computer Science Press. , 1990.

[8] Schnupp, P.H.; "Building Expert System in Prolog ", Amiz, 2000.

[9] S.G. Tzafestas, H.B. Verbruggen, "Artificial intelligence in industrial decision making control, and automation: an introduction", in: S.G. Tzafestas, H.B. Verbruggen (Eds.), Artificial Intelligence in Industrial Decision Making, Control and Automation, Kluwer, The Netherlands, , pp. 1–39, 1995.

[10] H. Wang, D. Linkens, Intelligent supervisory control", A qualitative bond graph reasoning approach, World Scientific, Singapore, 1996.

[11] Jain, L. and A. M. Fanelli; " Recent Advances In Artificial Neural Networks Design And Applications " , CRC Press, 2000.

[12] George F. Luger and William, A. Stubblefield; " Artificial Intelligence and the Design of Expert Systems", The Benjamin/ Cummings publishing Co., Inc., 1989.

[13] Keith D., "The Essence of Expert Systems", Prentice Hall, 2000.

[14] Gruber, T. "Toward principles for the design of ontologies used for knowledge sharing". In Formal Analysis in Conceptual Analysis and Knowledge Representation. Kluwer 1993.

[15] C. Philipp, "Ontology Learning and Population from Text Algorithms, Evaluation and Applications", ISBN-10: 0-387-30632-3, Springer Science, Business Media, LLC, 2006.

[16] G. Antoniou, F. V. Harmelen, "Handbook on Ontologies in Information Systems", Springer-Verlag , pp. 76-92, 2003.

[17] L. Deborah McGuinness, F. V. Harmelen, "OWL Web Ontology Language Overview", W3C Recommendation , Tech. Rep., 10, Feb, 2004.

[18] Li Ding, et al., "Using Ontologies in the Semantic Web: A Survey", Department of Computer Science and Electrical Engineering , University of Maryland Baltimore County, Baltimore, Tech. Rep. TR CS-05-07, July, 2005.

[19] Byrd, T., Cossick, K. & Zmud, R., "A Synthesis of Research on Requirements Analysis and Knowledge Acquisition Techniques", MIS Quarterly, 16(1), 117-138, 1992.

[20] Awad, E. & Lindgren Jr, J., " Skills and Personality Attributes of the Knowledge Engineer: an Empirical Study", International Association of Knowledge Engineers '92 Proceedings, 1992.

[21] Qi Ming Cui, Sheng Wei Liu, Rong Xing Liu, and Zhi Rai Wang, "Application Research of the Production System type Expert System Shell Pro/3 under Smart Grid", IEEE PES ISGT ASIA 2012.

[22] Giarranto J. C., "CLIPS User's Guide", Version 6.22, 1998.

[23] Da-peng Tan, Shi-ming Ji Shu-ting Chen, "Continuous Casting Slag Detection Expert System Based on CLIPS", 2010 Ninth International Symposium on Distributed Computing and Applications to Business, Engineering and Science, IEEE, 2010.

[24] Giarratano, Joseph. Riley, Gary., "Expert Systems Principles and Programming", International Thompson Publishing. 3rd Edition, 1994

12. AUTHOR'S PROFILE

DR. Yasser Ahmed Nada was born in Ismailia, Egypt, in 1968. He received the BSc degree in pure Mathematics and Computer Sciences in 1989 and MSc degree for his work in computer science in 2003, all from the Faculty of Science, Suez Canal University, Egypt. In 2007, he received his Ph.D. in Computer Science from the Faculty of Science, Suez Canal University, Egypt. From September 2007 until now, he worked as Assistant Professor of computer science. Chair, Department of computer science, Faculty of Computers and Information Technology, Taif University, KSA. His research interests include Expert Systems, Artificial Intelligence, Object Oriented Programming, Computer Vision, and Genetic.