DEVELOPMENT OF EXPERT SYSTEMS METHODOLOGIES AND APPLICATIONS

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ABSTRACT
In this particular paper we survey development of Expert System by methodologies and applications from 2005 to 2015 via a literature review of a theoretical and classification papers as a basis. The survey has actually been Dependent on a search in the papers for ‘Expert System’ in the Elsevier and IEEE. In accordance with coverage of 58 articles on Expert System applications, this paper surveys and classifies Expert System methodologies using two categories: Rule-based systems (RBS), Knowledge-based systems (KBS) along with their applications for various research and problem domains. In addition to, discussion has actually been presented, and it also suggests that, the subsequent trends is required to be taken into note very soon regarding the development of Expert Systems in methodologies and applications: first, Expert Systems methodologies are destined to develop through the use of expertise of Expert System applications in the domain. Secondly, it is suggested that different social science methodologies has got to be include to provide more opportunity for explore the methods that used to development of systems. Thirdly, the ability to continually change and get new understanding is the driving power of Expert System methodologies, and will be the Expert Systems applications of future works.

Key words: Expert systems, Methodologies of ES, Applications ES, Literature survey

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1. INTRODUCTION

Expert system is pc software was created for Simulates human expert in acts and activates, as a consequence of system’s capability to find new facts from available facts and give you advice, to teach and execute intelligent tasks[1]. The development surroundings consists of the actions and assist necessary to collect and represent the expertise in addition to in order to make inferences as well as deliver you solutions. The most important players in this particular environment would be the knowledge engineer and of course the domain expert who work as builders. The moment the internal system is finished it can be created for consultation by the non-expert user through consultation environment. The part of expert system that deemed as mind is the inference engine that gives the ways for reasoning about information in the knowledge base. Inference can be executed using semantics networks, production rules, and logic statement. In this particular paper we had work on the way of development of expert system by the survey that has actually been Dependent on a search in the keyword index and papers abstract for ‘Expert System’ in the Elsevier and IEEE. According to the methodologies of ES and applications of ES, the survey duration is 2005 to 2015, the reason behind select this duration is the development of expert system has been accorded and growing up in this duration, and the modern technology and communications that has been play very important roles in the area of expert system. We start working on This literature survey in June 2015 and the survey has actually been Dependent on a search in the keyword index and papers abstract for ‘Expert System’ in the Elsevier and IEEE, and many journal available online, for the duration from 2005 to 2015, which was more than 21,542 papers and article were updated and found on august 2015. After we had the nomination procedure, there have been 58 papers from 47 journals related to expert system in Application and methodology. This paper surveys and classifies Expert System development using two categories: Rule-based systems (RBS), Knowledge-based systems (KBS) with their applications for different research and problem domains. Sections of this survey are organized as follows. Sections 1–3 present the survey outcomes of development of ES based on the above categories, in that order. Section 4 presents some discussion on the development of Expert System. The last Section 5 contains a conclusion.

2. RULE-BASED SYSTEM AND THEIR APPLICATIONS

The Rule-Based Expert System (RBES) is a system that includes important information gathered from a human expert, and this information will gathering from this system will present as rules, that is means for systematize the problem solving of human experts in form of rules, the knowledge (expertise of human) will be represent as a set of rules, each rule will specifies a relationship, recommendation, directive, guidance or Disclosure of knowledge and it will be Follows the rule of:

IF (condition) THEN (action) structure

Rule Based Systems (RBS): this system is providing to us by automatic problem solving tools for gathering the expertise of human and decision making. RBS are means for systematize the problem solving of human experts. Usually the experts will be expressing their opinion on most of their problem solving techniques in terms of antecedent-consequent rules. When the condition section of a rule is satisfied, the rule is released the order for the action section to executed. The Rule Based Expert Systems has a rule base and a fact base. The rule base has a general knowledge (in implicational form) about a confirmed subject area, while the fact base expresses specific knowledge of a particular case. To derive new facts from old facts the rules
based expert system used the inference process and in this process there are two basic reasoning methods: forward and backward chaining. The first reasoning method starts with the known facts and applies rules in order to get a goal in the end the second reasoning method starts with the goal. The repeated selection rules that would deduce a (sub goal) until get the desired goals from giving facts. Of course a bi-directional approach is also possible see Fig.1.

((The Process it will be possible to give same result if it happens in opposite direction.))

![Rule-based system architecture](image)

**Figure 1** Rule-based system architecture

The applications of rule base system on ESs are including: Rule base reduction [2], mumbo [3], visual models [4], web site verification [5], detecting syntactical regularities [6], structural operational [7], mechanise refactoring [8], integrated modelling [9], a rule-based method [10], intelligent adaptation [11], attributive logic [12], filtering [13], concurrency [14], educational [15], economic analysis [16], classification systems [17], mamdani [18], interpretability of linguistic [19], a stock trading expert system [20], sparse fuzzy rule-based systems [21], emerald and rule responder [22], stock evaluation [23], learning resource systems [24], instance selection techniques [25], imbalanced big data [26], deduction inference [27], a semantics core [28], earthquake prediction [29], revisiting evolutionary [30]and consultation system [31]. We will categorize the applications of this method in the bellow Table 1.

<table>
<thead>
<tr>
<th>Rule-based system/application</th>
<th>Author Name</th>
<th>Country</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rule base reduction</td>
<td>M. K. Ciliz</td>
<td>Turkey</td>
<td>2005</td>
</tr>
<tr>
<td>Mumbo</td>
<td>B. Aktemur</td>
<td>USA</td>
<td>2006</td>
</tr>
<tr>
<td>Visual Models</td>
<td>H. J. Kreowski, K. Hölscher, and P. Knirsch</td>
<td>Germany</td>
<td>2006</td>
</tr>
<tr>
<td>Web site Verification</td>
<td>D. Ballis and J. García-Vivó</td>
<td>Italy, Spain</td>
<td>2006</td>
</tr>
<tr>
<td>Detecting Syntactical...</td>
<td>E. Kitzelmann and U. Schmid</td>
<td>Germany</td>
<td>2007</td>
</tr>
<tr>
<td>Structural Operational</td>
<td>C. Braga and A. Verdejo</td>
<td>Spain</td>
<td>2007</td>
</tr>
<tr>
<td>Mechanise Refactoring</td>
<td>A. Carvalho Júnior, L. Silva, and M. Cornéio</td>
<td>Brazil</td>
<td>2007</td>
</tr>
</tbody>
</table>
3. KNOWLEDGE-BASED SYSTEM AND THEIR APPLICATIONS

The knowledge-based system is a program that uses artificial intelligence or techniques of expert systems to solve problems. In the knowledge-based system the programs include a store (database) of expert knowledge with connection links designed to facilitate its retrieval in response to specific queries, or to transfer expertise from domain to another. The knowledge base include knowledge that will help the system to understanding, formulating and for solving problems. Knowledge-based system is a store of specific knowledge has gathering from the human experts by the knowledge acquisition module. The knowledge base of expert system has two types of knowledge the first is factual knowledge and the second is heuristic knowledge. A host of government and commercial agencies and corporations has been given a number of major research and development contracts in the topic of knowledge base system see Fig.2.
The applications of Knowledge-based system on ESs are including: Euler diagrams [32], logic-based systems [33], forwarding industry [34], temporal logics [33], framework [34], plant control [35], strategic planning [36], keyword discovery [37], diagnostics [38], early warning system for health [39], efficient selection and assignment [40], knowledge-based systems for development[41], health care [42], rough set theory [43], problem solving [44], a context-aware system [45], product-service systems [46], integrated knowledge [47], energy demand forecasting [48], argument-based reasoning [49], medical [50], automated design [51], fault detection [52], movie showtimes [53], decision support systems [54], decision support system[55], transforming knowledge [56], process engineering design [57] and bioinspired techniques [58]. We will categorize the applications of this method in the below Table 2.

Table 2 Applications of knowledge-based system

<table>
<thead>
<tr>
<th>Knowledge-based system / applications</th>
<th>Author Name</th>
<th>Country</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euler Diagrams</td>
<td>G. Stapleton</td>
<td>UK</td>
<td>2005</td>
</tr>
<tr>
<td>Logic-Based Systems</td>
<td>A. K. Seda</td>
<td>Ireland</td>
<td>2006</td>
</tr>
<tr>
<td>Framework</td>
<td>Y. Biletskiy and G. R. Ranganathan</td>
<td>Canada</td>
<td>2008</td>
</tr>
<tr>
<td>Plant control</td>
<td>R. Marumo and S. E. M. Sebusang</td>
<td>Botswana</td>
<td>2008</td>
</tr>
<tr>
<td>Strategic planning</td>
<td>H. C. Huang</td>
<td>Taiwan</td>
<td>2009</td>
</tr>
<tr>
<td>keyword discovery</td>
<td>Y. L. Chi</td>
<td>Taiwan</td>
<td>2009</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>S. Ribarić, D. Marčetić, and D. S. Vedrina</td>
<td>Croatia</td>
<td>2009</td>
</tr>
<tr>
<td>Early warning system for health</td>
<td>N. Li, R. Wang, J. Zhang, Z. Fu, and X. Zhang</td>
<td>China</td>
<td>2009</td>
</tr>
<tr>
<td>Efficient selection and assignment</td>
<td>S. H. L. Mirhosseyni and P. Webb</td>
<td>UK</td>
<td>2009</td>
</tr>
<tr>
<td>Knowledge-Based Systems for Development</td>
<td>E. S. Akerkar</td>
<td>India</td>
<td>2010</td>
</tr>
<tr>
<td>Context-Aware Decision</td>
<td>O. Anya, H. Tawfik, A. Nagar, and S. Amin</td>
<td>UAE</td>
<td>2010</td>
</tr>
<tr>
<td>Health care</td>
<td>Y. Meiller, S. Bureau, W. Zhou, and S. Piramuthu</td>
<td>France, USA</td>
<td>2011</td>
</tr>
</tbody>
</table>
4. DISCUSSIONS, LIMITATIONS, AND SUGGESTIONS

The Discussions has been attended in our survey as well as describe of the limitations in the development and we get some suggestions about how development the expert systems as bellow:

4.1. Discussions

Expert System techniques and apps are a extensively classification of research issues on Expert System. Some of them are introduced as examples for discovering the ideas and solutions to certain Expert System problem domains [59]. Which is the reason, methodologies and applications of Expert System are enticing greatly interest and endeavors, both the educative and practical. We are able to understand out of this literature review that Expert System methodologies and applications developments are diversity because of their authors’ knowledge, and problem domains. This is why some authors can appear in the literature on various methodologies and applications. Further, some methodologies have common concepts, and kinds of methodology. Just for example: intelligent agents, or System architecture methodology. However a very little of the authors has been accomplish the task in several methodologies and applications of expert system. This shows that the path of development on methodology is varied too due to the author’s research interests and capacity in the methodology and problem domain. This may refer to that the development of Expert System methodologies is Going towards experience orientation. Moreover, there is some applications have a high degree of nip up in different methodologies. Example
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of this methodologies applications, teaching, training, medical, Production planning, system design, system development, modeling, decision making, biomedical, robotic systems, ecological planning, agriculture planning are all topics for applications of different methodologies, and this will lead to development of Expert System [60]. We has been discussed in this paper different paper from various categories, this categories are: Computer science, ecology, education, energy, engineering, entomology, environmental sciences, genetics, geochemistry, health care sciences, hematology, hydrology, materials, mathematics, mechanics, medical, military, operation research/management sciences, ontology, plant science, remote sensing, robotics, and water resources, all this paper has been downloaded from Elsevier SDOS, IEEE Xplore. We do not include Expert System methodologies and applications that are not used to improve the systems in other fields. However, we could just like to find out more Expert System ways to development in methodologies and applications of different research fields.

4.2. Limitations
From our survey we get some limitations as follow:

1. Most of the author has a limited knowledge about how to presenting all idea of the subject.
2. The practical papers and reports are not included in this survey.
3. Some papers have been publishing in non-English journals so they will not consider in this survey.

4.3. Suggestions
From our survey we get some suggestions as follow:

1. Other methodologies like social science. In this paper, we definition the Expert System methodology but some methodologies didn’t mention there, like the methodologies of social science, because it is not in our area and it need long time to read and understand. However, other methodologies such as qualitative questionnaires and statistical methods are another research that used to solve problems in social studies. Therefore, other social sciences methodologies may include in future work.
2. Merging of methodologies. Expert System is multi specialization research topics. For this reason, future Expert System developments need implementation with different methodologies, and this Merging of methodologies.
3. Change is a resource of development in Expert System over time. The change really should be depending on ideas in social science.

5. CONCLUSION
In this particular paper we survey development of Expert Systems by methodologies and applications from 2005 to 2015 via a literature review of a theoretical and classification papers as a basis. Our survey dealt with two methods Rule-Based System and Knowledge-Based System according to their applications. In this survey we observed that Expert Systems methodologies and applications developments have inclination to develop according to authors’ knowledge and expertise of Expert Systems applications in problem domain. So we should take into consideration that we can use other methodologies from other area such as social science to develop expert system. Therefore, other methodologies may include in future work. Also we suggest to merging methodologies of different area because Expert System is multi
specialization research topics. Moreover, changing the resource of development of Expert System in future, because that change will offer more chance to the scientists to develop the expert systems.

REFERENCES


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