Medical Expert Systems Survey

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Abstract: *There is an increase interest in the area of Artificial Intelligence in general and expert systems in particular. Expert systems are rapidly growing technology. Expert system is a branch of Artificial Intelligence which is having a great impact on many fields of human life. Expert systems use human expert knowledge to solve complex problems in many fields such as Health, science, engineering, business, and weather forecasting. Organizations employing the technology of expert system have seen an increase in the efficiency and the quality. An expert system is computer program that emulates the behavior of a human expert. The expert system represents knowledge solicited from human expert as data or production rules within a computer program. These rules and data can be used to solve complex problems. In this paper, we give an overview of this technology and will discuss a survey on many papers done in health using expert system.*

Keywords: Expert System, Inference engine, Knowledge-Based System, Medical, Survey.

1. INTRODUCTION

Expert systems are computer programs that are derived from a branch of computer science research called Artificial Intelligence (AI). The scientific goal of AI is to comprehend intelligence by building software that reveals intelligent comportment. AI deals with the perceptions and approaches of figurative inference, or reasoning, by a PC, and how can the knowledge be used to create those inferences will be embodied in the machine [4, 31].

The expression intelligence deals with many cognitive skills such as understand natural languages, the ability to solve problems, and learn.
AI programs that attain expert-level proficiency in solving problems in a field by taking into account knowledge-based or expert systems in a precise field. Usually the term expert system is earmarked for a program whose knowledge base comprises the knowledge used by a human expert, in comparison with the knowledge collected from books or non-human experts. Expert systems, Rules Based System, and Knowledge Based systems are used to give the same meanings [4].

The term building an expert system is recognized as knowledge engineering and its specialists are so-called knowledge engineers. Knowledge engineer duty to assure that the computer has the necessary knowledge wanted to be able solve a problem. The knowledge engineer should be able to select the most appropriate notation of language to represent the necessary knowledge in the computer. Furthermore he should make sure that the computer can use the knowledge effectively by choosing a suitable reasoning method [25, 38].

2. EXPERT SYSTEMS ARCHITECTURE

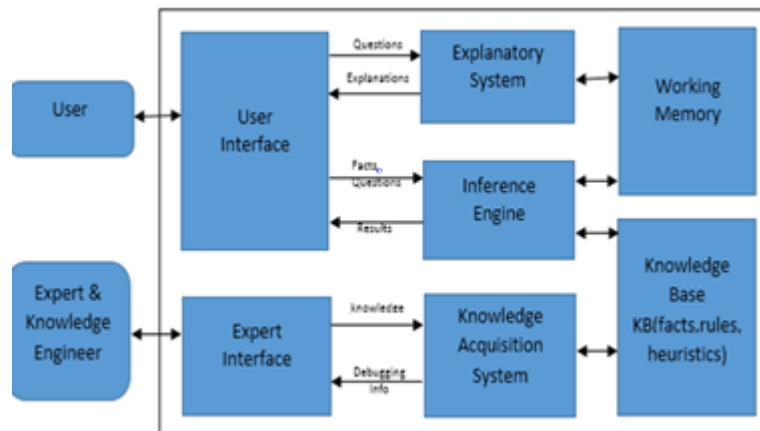The architecture of a typical expert system is shown in the figure 1.

Figure 1: The architecture of a typical expert system

The major components of Expert Systems are [4]:

- **Knowledge Base:** The knowledge base holds facts and rules in a specific knowledge domain.
- **Inference Engine:** The inference engine receives input queries and replies to the questions through the user interface and use this active information with fixed knowledge kept in the knowledge base. The knowledge base is used to develop a conclusion about the present condition that is given to the user. The understanding of the process is done recursively in three stages: Match, Select, Execute.

  During the match state, the stuff of working memory (facts and results) is compared with and rules that are placed in the knowledge base. All rules that can be executed are stored in a set called conflict set. One rule only is selected from the conflict set according to some criteria to be executed. The selected rule is then executed and the results of the rule are stored in the working memory with the initial facts.

- **Interface:-**The interface authorities the user to interconnect with the expert system.

- **Explanation Facility:-**The explanation module offers the user with an explanation of the reasoning process. To be able to answer a query, the explanatory module follows the chain of rules. The set of the rule that leads to the conclusion is then presented to the user in a simplified way. This allows the user to essentially see the reasoning process followed by the system in reaching to the conclusion. If the user is not happy with the reasoning steps showed then they can be modified using the editor.

- **Knowledge Engineer:** A knowledge engineer is a person who can design, build, and test the expert system. The knowledge engineer solicits the experience and knowledge from the human expert and discovers how a problem can be solved. Thus the knowledge engineer identifies the reasoning method to be used to manage the facts and rules in the expert system. Furthermore, he is accountable for testing, modifying, and deploying the expert system.

3. LITERATURE REVIEW OF EXPERT SYSTEMS

During the search for Medical expert systems using Google scholar, many interesting expert systems were found that are worth mentioning:

1- **A Ruled Based System for Ear Problem Diagnosis and Treatment** [19]**.**

This Ruled Based System for Ear problem diagnosis was implemented using SL5 Object language. In this ruled based system ear problems were classified into three main sets:

a- Inflammation of the inner ear
b- Middle ear problems
c- External ear problems

2- Lower Back Pain Expert System Diagnosis and Treatment[11]

This paper proposes an expert system that can be used to positively diagnose low back pain concentration. This system asks for the symptoms then lastly it can pick the illness producing these symptoms and recommends the appropriate treatment.

3- A Proposed Expert System For Foot Diseases Diagnosis [30]

This expert system diagnoses eighteen foot problems of all phases of the human life beginning with baby to the grownup by examining with yes/no questions. The expert system asks the end user to select the right answer in every screen. Latterly, the expert system provides the diagnosis and recommendation to the user.

4- Fuzzy MLP based expert system for medical diagnosis[29]

A fuzzy MLP model, established by the knowledge engineer, was used as a connectionist expert system to diagnose hepatobiliary disorders. It has the ability use uncertainty in the input and the output. The input to the network is modeled in terms of linguistic pi-sets whose centers and radii along each feature axis are determined from the distribution of the training data. In case of partial inputs, the model can query the user for further important feature when needed. Explanation for an inferred decision can be developed in rule form.

5- A Knowledge Based System for Neck Pain Diagnosis[17]

The k**nowledge based system** is can diagnose seven neck diseases of different phases of the human life beginning by asking the user many questions according to their pain symptoms. SL5 Object language, a rule-based language was used in designing and implementing the Knowledge Based System for neck diseases diagnosis.

6- An expert system for shoulder problems using CLIPS[28]

An expert system for Shoulder problems diagnosis was designed and implemented using CLIPS language which was developed by NASA's Johnson Space Center in 1996.

7- Expert system urination problems diagnosis[32]

In this paper the design of an Expert System to diagnose some of the Urination diseases (Pyelonephritis, Kidney Stone, Bladder infection, Prostatitis, Urethritis, Gonorrhea, Interstitial cystitis, Stress incontinence, Trauma in kidney or bladder) was presented, a brief introduction about the Urination diseases were given, the cause of diseases were outlined and the proper treatment of the disease whenever is possible is given. SL5 Object language was used for designing this expert system.

8- A Proposed Rule Based System for Breasts Cancer Diagnosis[21]

This Rule Based System was developed to help people in preventing and early detecting breast cancer; since it is known that this disease does not have medication or cure yet. SL5 Object language was used in the designing of this ruled based system.

9- Development of a Medical Expert System as an Expert Knowledge Sharing Tool on Diagnosis and Treatment of Hypertension in Pregnancy [20]

This article presents the development a Medical Expert System for the diagnosis and treatment Hypertension in Pregnancy to be used in the Reproductive Health Division at Moi Teaching and Referral Hospital in Eldoret, Kenya.

10- An Expert System for Endocrine Diagnosis and treatments using JESS [36]

This Rule Based System was developed to help in diagnosing endocrine glands diseases. The authors used JESS (Java Expert System Shell) to implement it.

11- A Proposed Expert System for Skin Diseases Diagnosis [34]

An expert system for skin diseases diagnosis was developed using CLIPS(C Language Integrated Production System) to help user diagnose the following skin diseases (Psoriasis, Eczema, Ichthyosis, Acne, Meningitis, Measles, Scarlet Fever, Warts, Insect Bites and Stings) were presented, an overview about the skin diseases were displayed, the cause of diseases were outlined and the treatment of disease were given whenever possible.

12- Male Infertility Expert System Diagnoses and Treatment[13]

The researchers presented an expert system for male infertility diagnosis which helps men to explore everything related to the problems of infertility and infertility diseases such as: Azoospermia, O.T.A syndrome which mean oligo-terato-astheno spermia, Aspermia and Sexual transmitted disease. This expert system for male infertility diagnosis used 5th generation language called: SL5 Object language [2] for its design and development.

13- An expert system for diagnosing eye diseases using clips[5]

This paper presented the design of an expert system that provides the patient with background for suitable diagnosis of a few of the eye diseases. CLIPS language was used as a tool for developing the expert system. A preliminary evaluation of the expert system was done and the outcome was positive.

14- An Expert System for Mouth Problems in Infants and Children[26]

This expert system ask the user to answer the questions about the symptoms of the patient and end up with some information about the disease and some advices telling the user how to deal with the baby. SL5 Object expert system language was used to develop the expert system.

15- Knowledge Management in ESMDA: Expert System for Medical Diagnostic Assistance[8]

This paper deals with the design of a prototype expert system that assists patients to diagnose their diseases and offer them the suitable advice. The knowledge management used in the expert system was discussed. A main objective of this research was to find a suitable language for representing user's medical history and current situation into a knowledge base for the expert systems in order to carry out the consultation effectively. Rules were used to capture the knowledge. The expert system was implemented using CLIPS(C Language Integrated Production System) with Java Interface.

16- Medical Expert Systems for Diagnosis of Various Diseases[12]

This is a review article that outlines medical expert systems for diagnosis of various diseases. It provides a short-lived overview of medical diagnostic expert systems and offers an analysis of already existing ones.

17- Medical Expert System- A Comprehensive Review[16]

This article summarizes a few of the rule based fuzzy expert systems and artificial neural network based medical diagnostic systems.

18- mMES: A Mobile Medical Expert System for Health Institutions in Ghana[37]

This study presents and suggests a Mobile Medical Expert System (mMES) by mobile devices and computing technology thus Medical Doctors in Ghana can accelerate diagnosis, check their own diagnosis, deliver advice on found diagnosis and offer advice on certain diseases when identified on a patient.

19- Medical Expert Systems-Knowledge Tools for Physicians[18]

In this study the author deliberates largely the expert system ONCOCIN. ONCOCIN is an advanced expert system for medical oncology that has been under improvement at Stanford University School of Medicine ever since 1979. It is intended for use after a diagnosis has been concluded, concentrating in its place on support with the management of patients with cancer who are getting chemotherapy.

20- Knowledge Based System for Long-term Abdominal Pain (Stomach Pain) Diagnosis and Treatment [27].

The authors proposed an expert system which was made to aid internist physicians in diagnosing numerous of the abdomen diseases for example: gastritis, hiatal hernia, ulcer or heartburn; the proposed expert system offers a summary about abdomen diseases are given, the cause of diseases are drew and the cure of disease when possible is shown up. Clips expert system language was used for developing this proposed expert system. The proposed abdomen diseases diagnosis expert system was assessed by medical students and they were content with its performance. The proposed expert system is very valuable for internist physician, patients with abdomen problem and newly graduated physician.

21- Knowledge Based System for Ankle Diseases Diagnosis[14]

The authors in this article have recognized seven ankle diseases: Ankle Sprain, Fracture (of Fibula), Rheumatoid Arthritis, Rheumatoid Fever, Gout, and Osteoarthritis (Degenerative Joint) and they developed the expert system for those ankle diseases using SL5 Object Expert System Language.

22- An Expert System for Diagnosing Shortness of Breath in Infants and Children [6]

In this article, the authors presented an expert system for aiding Respiratory physician, pediatrician, newly graduated physician, and children's parents in diagnosing infants and children patients with twelve various shortness of breath in infants and children diseases. They can get the diagnosis quicker and more exact than the traditional diagnosis. It is easy to use and has user friendly interface. The system was developed using SL5 Object expert system language.

23- Polymyalgia Rheumatic Expert System[35]

This article outlined an expert system for classification criteria for PMR, recent advances of diagnostic and therapeutic procedures. This expert System was developed using SL5 Object Expert System Language.

24- Expert System for Chest Pain in Infants and Children[22]

The authors in this article proposed an expert system to assist doctors, parents, and care giver in diagnosing chest pain in infants and children. It was designed and implemented in SL5 Object language.

25- Rickets Expert System Diagnoses and Treatment[10]

The authors in this paper presented an expert system for rickets diagnosis which will assist doctors to discover everything connected to the problems of rickets.

26- Expert System for Hair Loss Diagnosis and Treatment[33]

In this article the authors proposed an expert system for diagnosing eleven diverse hair loss diseases of the human stages from childhood to adults by asking questions with a Yes or No answer. When the dialogue session ends the expert system make available the diagnosis and recommendation of the disease to the user.

27- Expert System for Problems of Teeth and Gums[1]

The authors in this article presented a knowledge based system that assist people with teeth and gums problems to diagnose their problems and receive a recommendation for the treatment. This knowledge based system was developed using SL5 Object language.

28- Ear Diseases Diagnosis Expert System Using SL5 Object[3]

The authors in this article presented an expert system that swiftly diagnosis patient's condition and proposes a appropriate answer for the problem. It was developed using SL5 Object language. It was evaluated by a group of physician and found to be a beneficial tool that supports physicians and patients who are suffering from hearing senses problems.

29- An expert system for feeding problems in infants and children[17]

The authors in this article presented an expert system to diagnose feeding problems in infants and children. This expert system was found to be helpful methodology in addition to existing impartial ones. As far as the authors are aware, this expert system was the initial for attaining good performance in a real world

application. It was developed to aid parents diagnose these problems and get a recommendation of how to deal with infants and children.

30- Detecting Health Problems Related to Addiction of Video Game Playing Using an Expert System[9]
The authors in this article introduced an expert system to assist users in getting the correct diagnosis of the health problem of video game addictions that range from (Musculoskeletal issues, Vision problems and Obesity). Furthermore, this expert system delivers information about the problem and tells us how we can solve it. SL5 Object expert system language was used to develop the expert system.

31- An expert system for men genital problems diagnosis and treatment [15]
The authors in this paper presented an expert system to assist men diagnose their genital problems and give them the suitable treatment. Genital problems and injuries usually occur through: recreational activities (such as: Basketball, Football, Hooky, Biking), work-related tasks (such as: contact to irritating chemicals), downhill drop, and sexual activities. SL5 Object expert system language was used to develop this expert system.

32- An Expert System for Genital Problems in Infants[23]
The authors in this article presented an expert system that diagnose genital problems in infants which is one of the most common problems that need quick intervention in the newly born stage.

33- An expert system for nausea and vomiting problems in infants and children[24]
The authors in this article presented an expert system to aid users in getting the right diagnosis of problems of nausea and vomiting in infants and children (Gastro-esophageal reflux, Gastroenteritis, Systemic Infection, Bowel obstruction, Tumors, A bleeding disease, tonsillitis, and Hepatitis pharynx). Additionally, this expert system offers information about the disease and how to deal with it. SL5 Object expert system language was used to develop it.

4. CONCLUSION

Tremendous contribution to the health area has been made by the expert system from the last ten years. Expert system will continue to play an increasingly important role in the health field. In the survey done in this paper biomedical and medicine comes under the diagnosis of diseases and recommending a treatment. This paper is based on the review of the expert system and the important research field of expert system and anyone can create expert system research.

REFERENCES

[1] Abu Ghali, M. J., Mukhaimer, M. N., Abu Yousef, M. K., & Abu Naser, S. S. (2017). Expert System for Problems of Teeth and Gums. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 71-88.

[2] Abu Naser, S. S. (2015). Sl5 Object: Simpler Level 5 Object Expert System Language. International Journal of Soft Computing, Mathematics and Control (IJSCMC), 4(4), 25-37.

[3] Abu Naser, S. S., & Abu Hasanein, H. A. (2016). Ear Diseases Diagnosis Expert System Using SL5 Object. World Wide Journal of Multidisciplinary Research and Development, 2(4), 41-47.

[4] Giarratano, J. and G. Riley. (2004). Expert Systems:Principles and Programming, Fourth Edition. Boston, MA, Thomson/PWS Publishing Company. ISBN: 0534937446.

[5] Abu Naser, S. S., & Abu Zaiter, O. A. (2008). An Expert System For Diagnosing Eye Diseases Using Clips. Journal of Theoretical & Applied Information Technology, 4(10).

[6] AbuEl-Reesh, J. Y., & Abu Naser S. S. (2017). An Expert System for Diagnosing Shortness of Breath in Infants and Children. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 102-115.

[7] Abu Naser, S. S., & Alawar, M. W. (2016). An expert system for feeding problems in infants and children. International Journal of Medicine Research, 1(2), 79-82.

[8] Abu Naser, S., Al-Dahdooh, R., Mushtaha, A., & El-Naffar, M. (2010). Knowledge management in ESMDA: expert system for medical diagnostic assistance. AIML Journal, 10(1), 31-40.

[9] Abu Naser, S. S., & Al-Bayed, M. H. (2016). Detecting Health Problems Related to Addiction of Video Game Playing Using an Expert System. World Wide Journal of Multidisciplinary Research and Development, 2(9), 7-12.

[10] Al Rekhawi, H. A., Ayyad, A. A., & Abu Naser, S. S. (2017). Rickets Expert System Diagnoses and Treatment. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 149-159.

[11] Abu Naser, S. S., & AlDahdooh, R. M. (2016). Lower Back Pain Expert System Diagnosis And Treatment. Journal of Multidisciplinary Engineering Science Studies (JMESS), 2(4), 441-446.

[12] Singla, J. (2014). Medical Expert Systems for Diagnosis of Various Diseases.

[13] Abu Naser, S. S., & Alhabbash, M. I. (2016). Male Infertility Expert system Diagnoses and Treatment. American Journal of Innovative Research and Applied Sciences, 2(4).

[14] Qwaider, S. R., & Abu Naser, S. S. (2017). Expert System for Diagnosing Ankle Diseases. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 89-101.

[15] Abu Naser, S. S., & Al-Hanjori, M. M. (2016). An expert system for men genital problems diagnosis and treatment. International Journal of Medicine Research, 1(2), 83-86.

[16] Nohria, R. (2015). Medical Expert System- A Comprehensive Review.

[17] Abu Naser, S. S., & ALmursheidi, S. H. (2016). A Knowledge Based System for Neck Pain Diagnosis. World Wide Journal of Multidisciplinary Research and Development (WWJMRD), 2(4), 12-18.

[18] Shortliffe, E. (1986). Medical Expert Systems-Knowledge Tools for Physicians.

[19] Abu Naser, S. S., & Al-Nakhal, M. A. (2016). A Ruled Based System for Ear Problem Diagnosis and Treatment. World Wide Journal of Multidisciplinary Research and Development, 2(4), 25-31.

[20] Gudu, J., Gichoya, D., Nyongesa, P., & Muumbo, A. (2012). Development of a Medical Expert System as an Expert Knowledge Sharing Tool on Diagnosis and Treatment of Hypertension in Pregnancy. International Journal of Bioscience, Biochemistry and Bioinformatics, Vol. 2, No. 5.

[21] Abu Naser, S. S., & Bastami, B. G. (2016). A Proposed Rule Based System for Breasts Cancer Diagnosis. World Wide Journal of Multidisciplinary Research and Development, 2(5), 27-33.

[22] Khella, A. R., & Abu Naser, S. S. (2017). Expert System for Chest Pain in Infants and Children. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 138-148.

[23] Abu Naser, S. S., & El Haddad, I. A. (2016). An Expert System for Genital Problems in Infants. EUROPEAN ACADEMIC RESEARCH, 4(10).

[24] Abu Naser, S. S., & El-Najjar, A. E. A. (2016). An expert system for nausea and vomiting problems in infants and children. International Journal of Medicine Research, 1(2), 114-117.

[25] Russell, S., & Norvig, P. (2002). Artificial Intelligence: A Modern Approach, Prentice Hall, Englewood Cliffs, NJ, Second Edition. ISBN 0-13-103805-2.

[26] Abu Naser, S. S., & Hamed, M. A. (2016). An Expert System for Mouth Problems in Infants and Children. Journal of Multidisciplinary Engineering Science Studies (JMESS), 2(4), 468-476.

[27] Mrouf, A., Albatish, I., Mosa, M., & Abu Naser, S. S. (2017). Knowledge Based System for Long-term Abdominal Pain (Stomach Pain) Diagnosis and Treatment. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 71-88.

[28] Abu Naser, S. S., & Hilles, M. M. (2016). An expert system for shoulder problems using CLIPS. World Wide Journal of Multidisciplinary Research and Development, 2(5), 1-8.

[29] Mitra, S. (1994). Fuzzy MLP Based Expert System For Medical Diagnosis. Fuzzy Set and Systems, 65:285-296.

[30] Abu Naser, S. S., & Mahdi, A. O. (2016). A proposed Expert System for Foot Diseases Diagnosis. American Journal of Innovative Research and Applied Sciences, 2(4), 155-168.

[31] Gath, S. J., & Kulkarni, R. V. (2012). Review: Expert System for Diagnosis of Myocardial Infarction, (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 3 (6), 2012,5315-5321

[32] Abu Naser, S. S., & Shaath, M. Z. (2016). Expert system urination problems diagnosis. World Wide Journal of Multidisciplinary Research and Development, 2(5), 9-19.

[33] Nabahin, A., Abou Eloun, A., & Abu Naser, S. S. (2017). Expert System for Hair Loss Diagnosis and Treatment. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 160-169.

[34] Abu Naser, S. S., & Akkila, A. N. (2008). A Proposed Expert System for Skin Diseases Diagnosis. Journal of Applied Sciences Research; www.aensiweb.com/JASR/, 4(12), 1682-1693.

[35] El Agha, M., Jarghon, A., & Abu Naser, S. S. (2017). Polymyalgia Rheumatic Expert System. International Journal of Engineering and Information Systems (IJEAIS), 1(4), 125-137.

[36] Abu-Naser, S., El-Hissi, H., Abu-Rass, M., & El-Khozondar, N. (2010). An expert system for endocrine diagnosis and treatments using JESS. Journal of Artificial Intelligence; Scialert, 3(4), 239-251.

[37] Asabere, N. (2012). mMES: A Mobile Medical Expert System for Health Institutions in Ghana.

[38] Michalsky, R., & Chelausky, R. (1980). Knowledge Acquisition by Encoding Expert Rules Versus Computer Induction From Examples: A Case Study Involving Soybeans Pathology.