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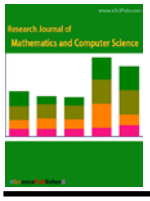

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Expert System Model for Diagnosing Legume Diseases

Rahmon,I.A,Adebola_Akinsanya and Eze M.,.

Computer Science Department Babcock University, Ilishan, Ogun State.

ABSTRACT

There is a current surge in designing expert systems to solve problems like humans in different domains of research but there presently exist dearth of models that can guide designers of expert systems that can be used to accurately diagnose Soya beans diseases. Soya bean is a leguminous plant that is commonly grown in sub Saharan region and it is currently one of the legumes with high Gross Domestic Product (GDP) in the Nigerian economy, but farmers of this product are faced with serious challenges from legume ravaging diseases that are usually similar in symptoms and very difficult to diagnose by the few practising botanist available. Most models available cannot be used to guide designers who are interested in developing secured and reliable expert systems that can accurately classify, identify, diagnose and recommend treatments for Soya beans diseases. The main aim of this paper is to review existing models that are currently being used in designing expert systems and identify their limitations in other to come up with a better, more reliable and secured model. In other to identify inherent gaps from other models, research review method was adopted to critically investigate the weak points in few related and current expert models for classifying and diagnosing legumes diseases.

Keywords: expert system model, diagnosing legume diseases

***Correspondence to Author:**
Rahmon,I.A,
Computer Science Department, Babcock University, Ilishan, Ogun State.

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INTRODUCTION

The significant roles of artificial intelligence system in agricultural science domain cannot be relegated to the background, due to efficient techniques in Artificial Intelligence adopted by many system developers in building expert system for solving pest and disease affecting crops. The optimal advantage of expert systems is its capacity to minimize the amount of information that users need to process and thereby increase output with little personnel cost Kaur (2016). The tremendous advancement in internet technology has contributed to architectural design of expert system globally. Nowadays, both web and mobile technologies have provided useful framework for knowledge engineers and domain experts in various fields to build robust mobile and web-based expert systems for end-users to solve problems.

Fuzzy logic and neural network are among the common useful techniques adopted by software developers in building expert system. And once such a system is developed, uncertainties and imprecise data associated with diagnosis of crop diseases are appropriately handled.

In farming, expert systems are found to be helpful for unprofessional farmers in the rural areas who need professional knowledge on how to diagnose crop diseases and control pests. Although, for effective use of expert system by farmers, there is a strong need for farmers to understand the abnormal symptoms observed on diseased crops in order to find appropriate expert system that could be used for diagnosis.

Findings from researches have established that expert systems that are fuzzy-based or integrated with neural network are more intelligent than traditional expert systems due to knowledge presentation and fuzzy membership functions (technique of describing the degree of belonging of linguistic values within the range of “0” and “1”) adopted by fuzzy logic and learning capacity provided by artificial neural network.

1.1 Background of the Study

Expert system is one of the area of Artificial Intelligence (AI). Other areas of AI are Robotics, Vision, Speech, Natural Language, Artificial Neural system. This paper is focusing on Expert system. According to Prof. Edward Feigenbaun of Standford University, an expert system can be defined as “an intelligent computer program that uses knowledge and inference procedure to solve problems that are difficult enough to require significant human expertise for their solution” (Feigenbaum, 1981).

In other words, we can say that an expert system is a computer system that emulates the decision-making ability of a human expert.

Furthermore, Expert Systems are automatic consulting system. They provide expert conclusions about a specialised area. Expert systems have been built that can diagnose faults in Military Systems like aircrafts, radars etc. taxonomically classify members of a particular species, advise on possible chemical structure, diagnose diseases etc (Akerkar . 2012).

The components of a knowledge-based expert system, as shown in the diagram below include Knowledge Base which is also called the production memory in a rule-based system. Inference Engine determines which rule antecedent is satisfied by fact. Inference Engine may function as forward chaining or backward chaining. Forward chaining reason from fact to conclusions, resulting from those facts. Backward chaining reason a reverse from a hypothesis, a potential conclusion to be proven, to the facts that support the hypothesis.

Basic Concept of a knowledge-based expert system

Legumes come from the family Legumenosae and a trait all legumes share is that they grow in a type of pod. A bowl of pea soup is full of legumes and so is a bag of peanuts. Lentils, soy and cloves are all legumes. Legumes are

high in protein and not very fatty, so they are generally considered healthy.

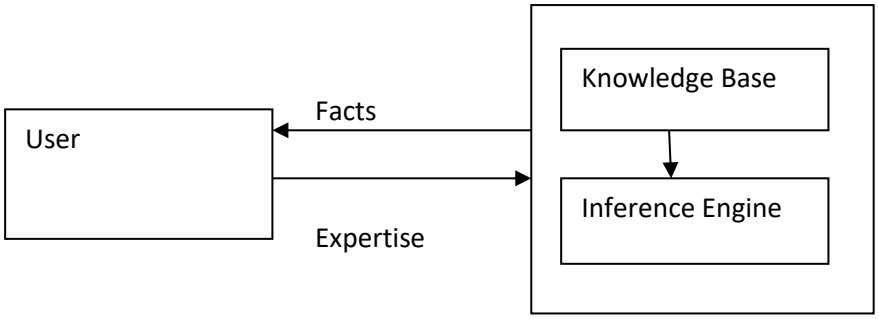


Fig 1

In other words, we can say that a legume is a simple, dry fruit contained within a shed or a pod. The most well-known legumes are peas, beans, peanut etc. Legumes are great sources of fat, protein and carbohydrate. Different varieties contain varying amount of these nutrient, with beans, nut, pea and lentils all having unique nutritional profile. Although these foods are a staple of vegetarian diet no vegetarian can also benefit from eating more legumes. For example, replacing red meat with a serving of black beans lowers fat intake while boosting fiber and protein intake.

Statement of the Problem

In Nigeria there is a knowledge gap between the expert that know the diseases of legume and the local farmer. As a result of this, the diseases have been killing the legumes being planted by the farmers. So this research, is to bridge this knowledge gap by designing an expert system model to diagnose the disease of legumes. If this project is implemented, local farmer does not need to go to a human expert: all they need to do is to consult the expert system to solve his/her problem.

Aims and Objectives

The aim of this work was to develop an efficient fuzzy based expert system model that can be implemented to diagnose leguminous crop diseases. The specific objectives are to:

i. To simulate the model with nine input fields of given symptoms and one output field to determine the classes of disease and their intensity with the aid of MATLab
ii. To implement the model with C# and MS-SQL server by developing a robust system with friendly interface for users to capture relevant input parameters that will be processed by the system in order to generate output for users in making an appropriate decision on the basis of the given diseases affecting the crops.

Significance of the Study

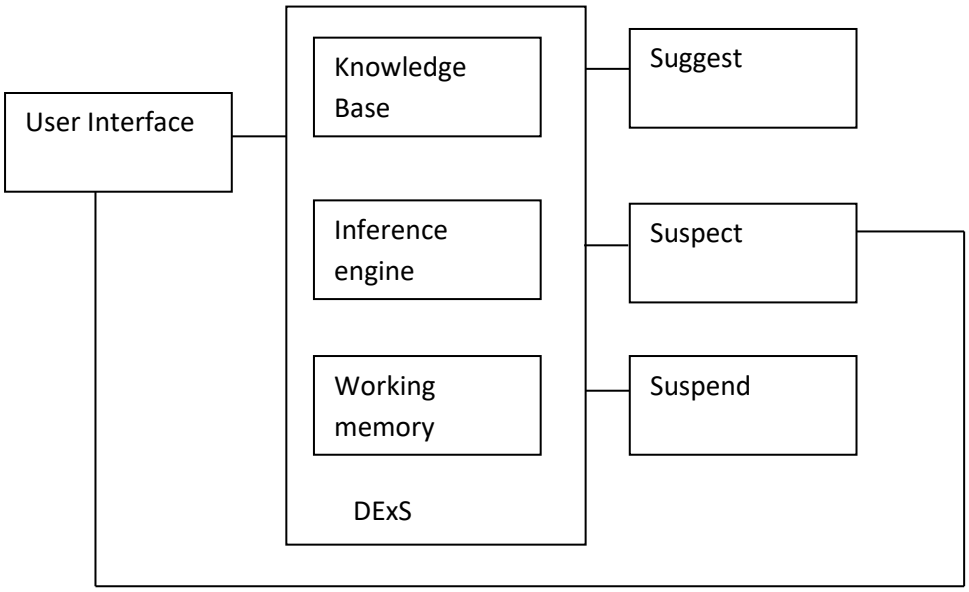
This research work will make contribution in terms of providing an expert system model that will be used to diagnose and treat diseases of legume, which some of the local farmers are ignorant of. Furthermore, it will educate the local farmer and thereby improve their productivity, hence increase National GDP (Gross Domestic Product).

LITERATURE REVIEW

Kaur and Diu (2016) proposed web based expert system that was developed with J2EE as the front-end programming language while Mysql database management system was adopted as the back-end for storing data. The system was easy to maintain because it adopted three-tier architecture in which client, business, and data layers were separated from one another.

But the use of data flow diagram (DFD) that graphically depicts the flow of data within the system was not efficient enough to capture high

Fig 2: Working Model of DexS



level-piece of functional requirements of the system in agreement with the three-tier technology adopted for the system in detecting and diagnosing disease of cereal. Also, the inappropriate modeling language DFD used for the web-based system didn't show the decomposition of the DFD into different layers such as context diagram, and other layers that would have provided the functions of each entity at different levels. As a result of this gap, the researcher would like to model the web-based system with two different UML languages: Use-Case and comprehensive DFD. The use will define what the system has to offer by capturing all the needed functional requirements and DFD (Data Flow Diagram) will provide detail on flow of data at different level within the system.

Patra and Mandal (2010) work on an expert system for diagnosis of human diseases. They design a Diagnosis expert system (DexS) model which is shown in the diagram below:

They collected data and knowledge of DexS from different sources. The first primary source is the medical knowledge of expert doctors and the second source is from specialized database, books and a few electronic website. The proposed system is rule-based system and makes inference with symbols, which require translation of a disease specific knowledge to standard symbolic form. The limitation of this work is that several properties of this model remain to be investigated. It should be tested on several more databases.

Singla et al(2014) work on medical expert systems for Diagnosis of various diseases. Attempts were made to design and develop expert system which can provide advice for physicians and patient to facilitate the diagnosis and recommend treatment to patients. A fuzzy Expert System architecture was designed and the disease diagnosed was Back Pain Diseases Input were; body mass index, age, gender and clinical observation symptoms. It should be noted that the user has to key in parameters such as body mass index, age, gender of patient and experimental examination symptom for this fuzzy expert system. On the basis of these parameters, this fuzzy expert system makes suitable judgement of back pain disease and gives some medical suggestions and diagnosis classifications to the medical practitioners. But the expert system lacks approximation method of neural-network to compute the parameters of a fuzzy expert system. The combination of fuzzy logic and

artificial neural network will produce effective hybrid system called neuro-fuzzy for disease

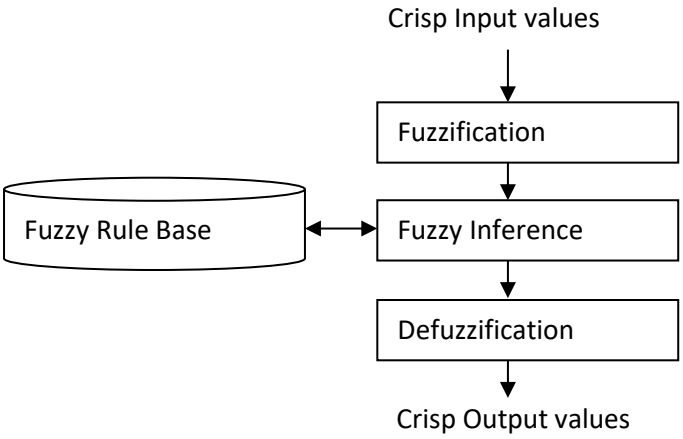


Fig 3: Fuzzy Expert System architecture

Rani et al (2011) developed expert systems for various agricultural crops like wheat, rice, tomato etc. in order to diagnosis various pests and taking management decisions for the benefits of farmers. The If ---- then --- rules architecture adopted in the expert system didn't have capacity to compute the degree of severity of pest diseases in those crops, only produced fuzzy output for the users. There is a need to adopt a complete fuzzy logic technique into the development of expert system in order to allow the premises within the rule-base to be computed to the degree to which they belong in a fuzzy membership functions, always between "0" and "1".

Khan et al (2008) developed a robust web-based expert systems for diagnosis of new wheat diseases at that period. The functionalities of the system were able to accommodate both existing and up-coming wheat diseases in Pakistan. The remarkable and commendable contribution of the work was its flexibility and user-friendliness characteristics. Farmers from the rural area found it friendlier to use because of its availability in local languages. Nevertheless, the functional requirements modeling of the system was highly inefficient because certain features like laboratory tests, plant analysis report, soil test report were ignored in the diagnosis.The fuzzy based expert system model is shown below:

modules. This gap is enough for any researcher to build an enterprise web-based expert system that will provide solution to the identified problem.

Sikchi et al (2013) presented a paper on generic medical fuzzy expert System for Diagnosis of Cardiac Disease. They developed a mathematical model to predict the risk of heart disease and to compare with the performance of fuzzy expert system. The parameters used are; age, blood pressure, lipid profile, heart rate and peak. Mathematical model is developed to study the impact of most influencing parameter responsible for causing the heart diseases and compare with the result obtained by fuzzy expert system. For the formulation of mathematical model, the risk of heart disease is considered as dependent parameter and age, blood pressure, cholesterol, heart rate and peak as the independent parameter.

The mathematical model

$Rh = f(a_{ge}, b_p, l_{al}, h_t, P_k)$

Where R_h = Risk of heart disease in %

a_{ge} = age

b_p = blood pressure

h_T = heart rate

P_k = Peak

The system is of predictive type and very effective for the diagnosis of disease related with heart, liver, lung, kidney, abdomen, bladders, brain, prostate, eyes and ears.

Amarathange et al (2015) worked on expert system for diagnosis of skin disease. This work allows user to identify diseases of human skin and to provide advice or medical treatment in a very short time period. So, user upload an image of skin disease to the system and answer questions based on their skin condition or symptoms. This is used to detect diseases of the skin and offer treatment recommendation. The system used technologies such as image

Fig 5: Architecture of BRBES

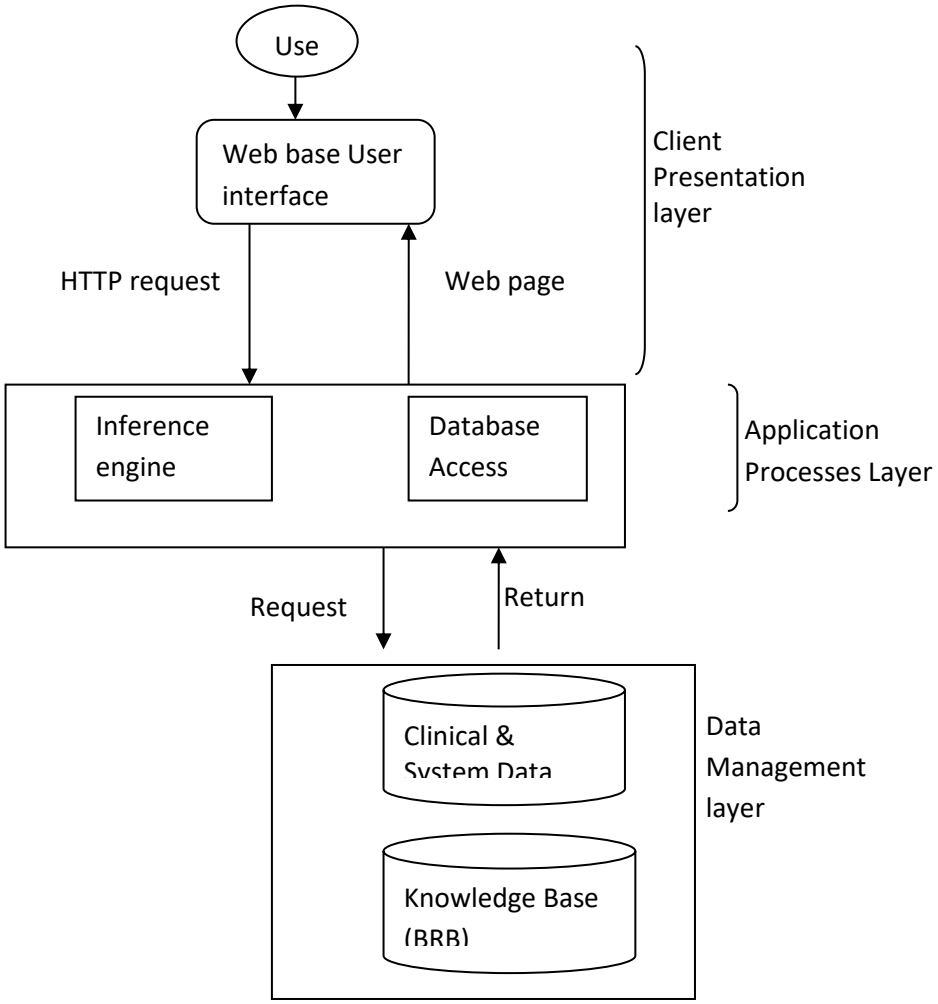
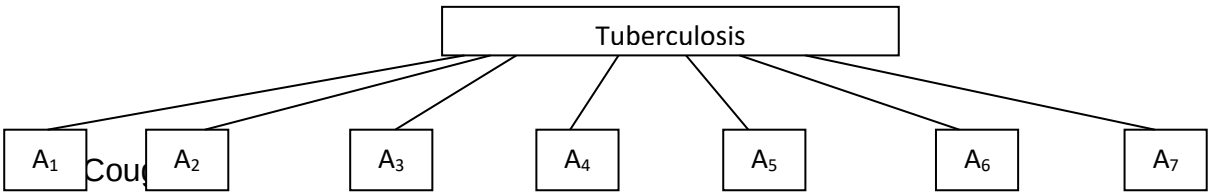


Fig 6 BRB Framework to Access TB



Cou

A2: Blood with cough

A3: Chest pain

A4: Fatigue

A5: lack of Appetite

A6: Weigh loss

A7: Night sweating

processing and data mining for the diagnosis of the disease of the skin. The limitation of this study is that this application was arranged for only three skin disease: Eczema, Impetigo and Melanoma. There is room to conduct research for other skin diseases.

Kaur et al (2013) worked on a paper titled expert system to detect and diagnose the leaf diseases of cereals. This expert system used the coloured image of the defected cereal plant leaves as well as the textual input to identify the disease. It will enable farmers to identify any

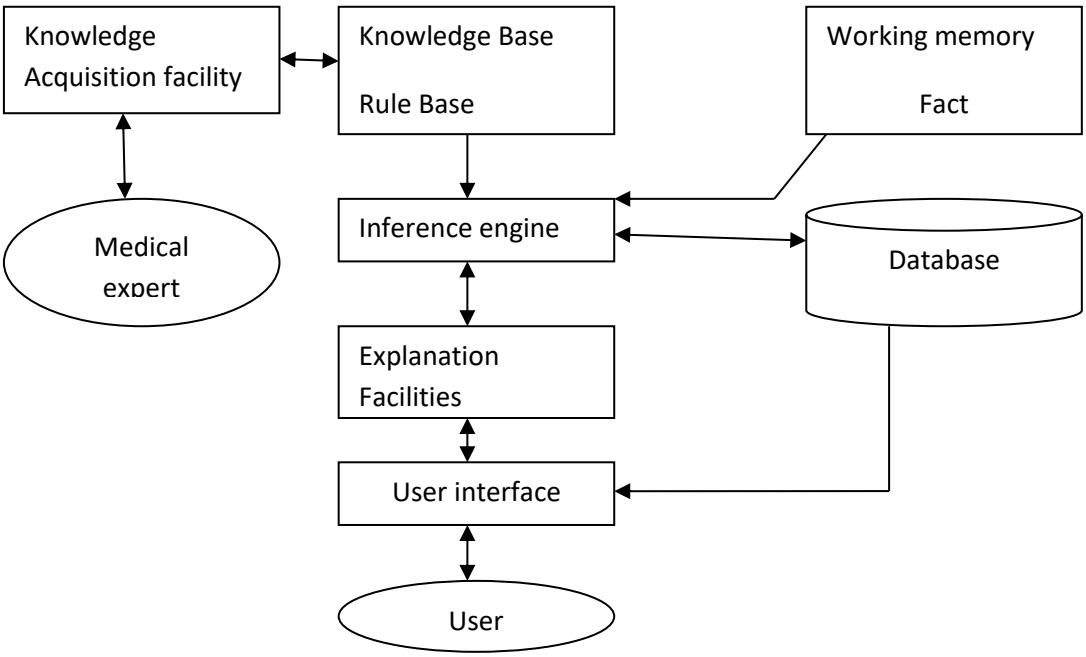


Fig 8: Proposed framework for the MES

disease, make the right decision and choose the right treatment. The future research can add more cereal and their leaf diseases with image as this research focused on the leaf diseases for three crops (rice, maize and wheat).

Zeki et al (2012) focuses their work on an expert system for Diabetic Diagnosis. The main objective of this research was to design an expert system for diagnosis of all types of diabetes. Data were acquired and a rule-based expert system was designed. This system has been coded with VP-expert system shell and tested in a hospital. It has been concluded that the expert system can be used effectively in all areas of medical sciences. But, it was observed that, the system lack scalability due to the programming tool that was used as a framework.

Hossein et al (2017) in a paper titled “A belief Rule Based Expert System to Access Tuberculosis under uncertainty”. Pulmonary Tuberculosis (PTB) and Extra – Pulmonary Tuberculosis (ETB) affect lung and can attack any organ of the body except brain, spine, heart, pancreas, skeletal striated muscle and thyroid respectively. ETB is not contagious whereas in case of PTB nearly everybody can easily be infected during inhaling. The symptom un-intentional weight loss, chest pain, prolonged fever, lack of appetite and night sweating. An expert systenm can be considered as an appropriate tool to address the uncertain phenomenon to accurately detect the suspicion of TB. Therefore, this paper presents the design, development and application of a Belief Rule Based Expert System (BRBES) with the ability to handle various types of uncertainties to diagnose TB.

Flores et al (2016) presented a paper titled “Generation of explanations from a Rule-based Expert System and a Domain Ontology. “This research describes an algorithm that automatically generates explanations on the process of inference of an expert system based on linking a domain ontology inference with an inference – tree generated by the expert system and reporting patterns. The domain ontology describes the dynamic system on which the explanation will be obtained. The inference tree is built by the expert system using the Drools Rules management System and presentation pattern are defined form of

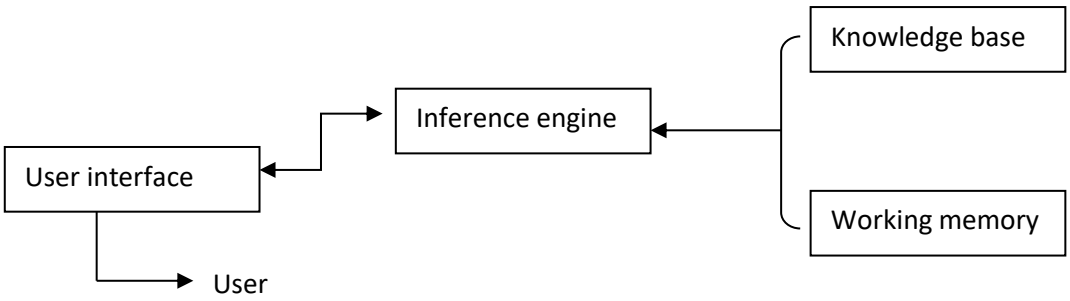
rules. The proposed algorithm manages various kinds of knowledge. The performance of the pro-posed algorithm reduced if the number of parameters or input variables increases.

Adewole et al (2015) presented a paper titled, “rule-based expert system for disease diagnosis. “A rule-based expert system is developed to diagnose Malaria, Typhoid Fever, Cholera, tuberculosis and Breast Cancer, the software used is the medical Expert System (MES) which contain forty six (46) rules to effectively diagnose the diseases. In the proposed model, MES, the MES user interview the patient regarding their disease and search the symptom in database. If the symptom matches what is in the database then the user gives the prescription to the patient. The proposed framework for the MES is shown in the figure below:

Hossain, Hasan, Uddin, Islam and Mustafa (2015) presented a paper titled “A belief rule based expert system to assess lung cancer under uncertainty” Assessing Lung cancer is complex due to the presence of various types of uncertainties such as vagueness, ignorance, imprecision, incompleteness associated with the signs, symptoms and risk factors. The researcher develop an expert system called BRBES to assess this disease. The system can deal with various types of uncertainties found in the clinical signs, symptoms, and risk factors. The knowledge base as made up of the real patient data as well as the consultation of the specialist.

Farahani and Ahmadi (2015) worked on a paper titled “Fuzzy rule base expert system for diagnosis of lung cancer”. This paper aimed at designing a fuzzy rule based medical expert system for diagnosis of lung cancer. The proposed system consists of four modules working memory, knowledge base, inference engine and users interface. The system takes the risk factor and symptoms of lung cancer in a two-step process and store them as fact of the problem in working memory. The rule-base consist of two different rule set related to risk factor and symptom of lung cancer respectively. Formally type 2 – fuzzy inference engine fires relevant rules under appropriate condition and provide the probability of disease as output of the system.

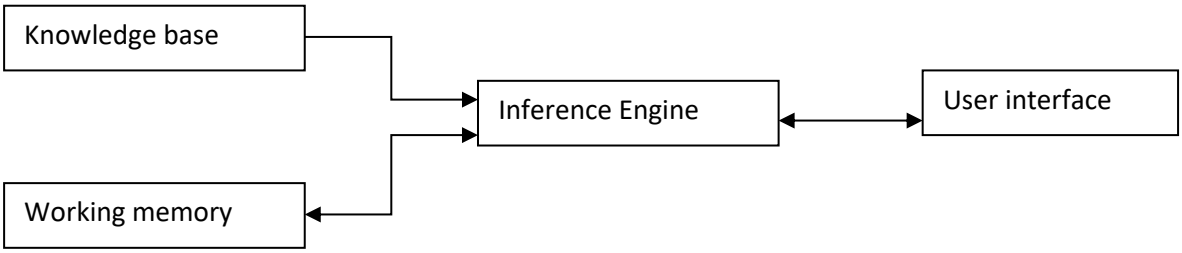
Fig 9: Proposed expert system



Tunmibi et al (2013) presented paper on a rule based expert system for diagnosis of fever. Knowledge is collected from expert in the medical field in Nigeria. Using if / then rules a knowledge base was designed for the expert system. Some programming codes were also written in VB.Net for making deduction of new fact from rules in the knowledge base. It is a desktop application that can only run on window operating system. It cannot run on Unix and other operating systems due to the limitation of the programming tool used for the system development.

The future research can also update it if the need arises.

Fig 10: Expert System architecture



Conclusion

Expert System is a computer that emulates the decision making ability of human being. In this paper, we examined how expert system can be used to diagnose legume diseases and other crop diseases. Few related works on application of expert system in diagnosing human diseases are also investigated and research gaps are identified in all the papers that were reviewed.

Generally, most current expert systems for diagnosing crop diseases lack common artificial intelligent techniques: fuzzy-logic, neural network, neuro-fuzzy and so on. To develop high performance, scalable and reliable expert system that can predict specific plant diseases, then, there is a need for researchers to adopt most appropriate AI techniques into development of expert system, so that every form of imprecise and uncertainty in diseases diagnosis can be solved. Also researchers must migrate away from web-based expert system into mobile-based expert system due to its portability and convenience.

References

Adewole, K.S, Hambali, M.A, & Jimoh, M.K (2015). Rule-Based Expert System for Diseases Diagnosis: Book of Proceedings, International Science Technology, Engineering, Arts, Management and Social Sciences (ISTREAMS), vol 7, pp. 183-190

Akerkar, R., (2014). Introduction to Artificial Intelligence: PHI Learning Pvt. Ltd., Delhi

Amarathunga, A.A, Ellawala, E.P, Abeysekara, G.R, & Amalraj, C.R (2015). Expert System for Diagnosis of Skin Diseases: International Journal of Scientific and Technology Research, vol 4, issue 01, pp. 174-175

Barr, A. , & Feigenbaum, E. (1981). Handbook of Artificial Intelligence: vol 1, LOS Altos, LA : Milliam Kaufmann

Farahani, F.V, Zarandi, M.H, Amadi, A, (2015). Fuzzy Rule-Based Expert System for Diagnosis of Lung Cancer: IEEE Explore Digital Library, Fuzzy Information Processing Society (NAFIPS), World Conference on Soft Computing (WCONSC), pp.1

Flores, V., Hadfes, Y., Beckos, J. & Claudio, M. (2016). Generation of Explanations From A Rule-Based Expert System And a Domain Ontology: Researchgate Publication, pp.2

Hossain, M.S, Ahmed, F., Tuj-johora, F., & Anderson, K. (2017). A Belief Rule-Based Expert System to Access Tuberculosis Under Uncertainty: Journal of Medical Systems, vol 41, issue 3

Hossain, M.S, Hassan, M.A, Uddim, M., Islam, M.M, & Mustafa, R (2015). A Belief Rule-Based Expert System to Access Lung Cancer Under Uncertainty: 18th International Conference on Computer and Information Technology (ICCIT), pp. 1-2

Kadhim, A.K, Afshar, M., & Kaur, H. (2016). A Multi-Intelligent Agent System For Automatic Construction of Rule-Based Expert System: Intelligent Systems and Applications, vol 9, pp 62-68

Kaur, R., & Din, S. (2016): Web Based Expert System to Detect and Diagnose the Leaf Diseases of Cereals in Punjabi Language: International Journal of Computer Science and Information Technologies (IJCSIT), vol 7, issue 4, pp. 1771-1773

Kaur, R, Din., S. & Panru P.S. (2013). Expert System to Detect and Diagnose the Leaf Disease of Cereal: International Journal of Current Engineering and Technology, vol 3. issue 4

Mlakic, D., & Majdandzic, L. (2016). Fuzzy Rule Based Expert System for SCADA Cyber Security: retrieved at https://www.researchgate.net/publication/307607103

Patra, P.S, Sahi, D.P, & Mandral, I. (2010). An Expert System for Diagnosis of Human Diseases International Journal of Computer Application: vol 1, issue 13

Rani, P.M, Rajesh T., & Saravana, R. (2011). Expert system in Agriculture :A review, Journal of Computer And Application, vol 3. issue 1, pp. 59-71

Rizzo,L., Dondio,P., Delany, S.J, & Lungo,L. (2016). Modeling Mental Workload Via Rule Based Expert System: A Comparison with NASA-TLX and Workload Profile, Retrieved at https://www.researchgate.net/publication/307585558

Sikchi, S.S., & Sitchi, A.M. (2013). Generic Medical Fuzzy Expert System For Diagnosis of Cardiac Disease: International Journal of Computer Application, vol 66, issue 13

Singla, J., Grover, D., & Bhandari. A. (2014). Medical Expert System for Diagnosis of Various Diseases: International Journal of Computer Application, vol 93, issue 7

Tunmibi, S., Aregbesola, A., & Dasylva, A. (2013). A Rule Based Expert System for Diagnosis of Fever: Retrieved at https://www.researchgate.net/publication/257655660

Zeki, T.S., Malakoti, M.V., Ataapoor, Y., & Tabibi, S.T. (2012). An Expert System for Diabetes Diagnosis: America Academic & Scholarly Research Journal, vol 4, issue 5