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Knowledge-Based Systems Survey

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Abstract*: Knowledge-Based Systems (KBS) are computer programs based on technologies established by Artificial Intelligence research, which express some characteristics of human knowledge and expertise to perform tasks normally done by human experts. Thus, a knowledge-based system has two distinguishing features: a knowledge base and an inference engine. The first part, the knowledge base, represents facts about the world. The second part, the inference engine, allows new knowledge to be inferred. Most commonly, it can take the form of IF-THEN rules coupled with forward or backward chaining approaches. The paper introduce the concept of knowledge based systems, Architecture of a Knowledge-Based System, Tools for Building Knowledge-Based System, and brief introduction to the most popular knowledge based systems found in the literatures.*

Keywords: Knowledge-Based Systems, KBS, CLIPS, SL5 Object, Survey

1. INTRODUCTION

Knowledge-based systems were first developed by artificial intelligence researchers. These early knowledge-based systems were primarily expert systems– in fact, the term is often used interchangeably with expert systems, although there is a difference. The difference is in the view taken to describe the system: "expert system" refers to the type of task the system is trying to assist with – to replace or aid a human expert in a complex task typically viewed as requiring expert knowledge; "knowledge-based system" refers to the architecture of the system – that it represents knowledge explicitly, rather than as procedural code. While the earliest knowledge-based systems were almost all expert systems, the same tools and architectures can and have since been used for a whole host of other types of systems – i.e., virtually all expert systems are knowledge-based systems[1-3].

The first knowledge-based systems were rule based expert systems. One of the most famous was Mycin, a program for medical diagnosis. These early expert systems represented facts about the world as simple assertions in a flat database and used rules to reason about and as a result add to these assertions. Representing knowledge explicitly via rules had several advantages [3-5]:

- Acquisition and maintenance. Using rules meant that domain experts could often define and maintain the rules themselves rather than via a programmer.
- Explanation. Representing knowledge explicitly allowed systems to reason about how they came to a conclusion and use this information to explain results to users. For example, to follow the chain of inferences that led to a diagnosis and use these facts to explain the diagnosis.
- Reasoning. Decoupling the knowledge from the processing of that knowledge enabled general purpose inference engines to be developed. These systems could develop conclusions that followed from a data set that the initial developers may not have even been aware of [6-7] .

2. ARCHITECTURE OF A KNOWLEDGE-BASED SYSTEM

A knowledge-based systems tool, or shell, is a software development environment containing the basic components of knowledge-based systems. The core components of knowledge-based systems are the knowledge base and the reasoning engine [8].

- **Knowledge Base**: The knowledge base contains the knowledge necessary for understanding, formulating and for solving problems. It is a warehouse of the domain specific knowledge captured from the human expert via the knowledge acquisition module. To represent the knowledge production rules, frames, logic, semantic net etc. is used. The knowledge base of expert system contains both factual and heuristic knowledge. Factual knowledge is that knowledge of the task domain that is widely shared, typically found in textbooks or journals. Heuristic knowledge is the less rigorous, more experiential, more judgmental knowledge of performance, rarely discussed, and is largely individualistic. It is the knowledge of good practice, good judgment, and plausible reasoning in the field [9].
- **Inference Engine**: Inference Engine is a brain of a knowledge-based system. It uses the control structure (rule interpreter) and provides methodology for reasoning. It acts as an interpreter which analyzes and processes the rules. It is used to perform the task of matching antecedents from the responses given by the users and firing rules. The

major task of inference engine is to trace its way through a forest of rules to arrive at a conclusion. Here two approaches are used i.e. forward chaining and backward chaining [10].

- **Knowledge Acquisition**: Knowledge acquisition is the accumulation, transfer and transformation of problem-solving expertise from experts and/or documented knowledge sources to a computer program for constructing or expanding the knowledge base. It is a subsystem which helps experts to build knowledge bases. For knowledge acquisition, techniques used are protocol analysis, interviews, and observation [11-12].
- **Explanation Facility**: It is a subsystem that explains the system's actions. The explanation can range from how the final or intermediate solutions were arrived at to justifying the need for additional data. Here user would like to ask the basic questions why and how and serves as a tutor in sharing the system's knowledge with the user [12-14].
- **User interface**: It is a means of communication with the user. It provides facilities such as menus, graphical interface etc. to make the dialog user friendly. Responsibility of user interface is to convert the rules from its internal representation (which user may not understand) to the user understandable form [15].

To build the knowledge-based system is known as Knowledge Engineering. Personnel involved in knowledge-based system development are domain expert, user, knowledge engineer, and system maintenance personnel. Domain expert has special knowledge, judgment, experience and methods to give advice and solve problems. It provides knowledge about task performance. Knowledge engineer is involved in the development of the inference engine, structure of the knowledge base and user interface. The expert and knowledge engineer should anticipate user's need while designing an expert system [15].

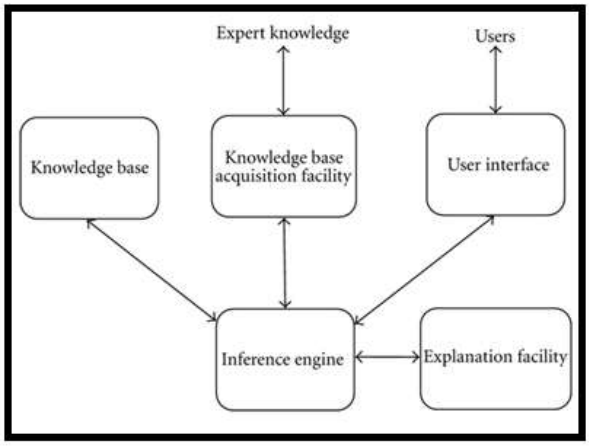

Figure 1: Architecture of Knowledge-Based System

3. Tools for Building Knowledge-Based System

The most popular tools for developing knowledge based systems are:

- **SL5 Object:** The name is an acronym for "Simpler Level 5 Object" Expert System Language. SL5 Object is a rule-based, object oriented, forward chaining language for developing expert systems. The SL5 Object engine is implemented in Delphi Embarcadero RAD Studio XE6 in 2015[22].

- **CLIPS** is a public domain software tool for building expert systems. The name is an acronym for "C Language Integrated Production System." CLIPS were developed at NASA-Johnson Space Center. CLIPS is probably the most widely used expert system tool. CLIPS itself is written in C, extensions can be written in C, and CLIPS can be called from C. Its syntax resembles that of the programming language Lisp.[42]

4. Overview of Existing Knowledge Based Systems

In the following section, the authors will list the Knowledge Based Systems from older to new ones.

► An Expert System For Diagnosing Eye Diseases Using Clips

This work presents the design of an expert system that aims to provide the patient with background for suitable diagnosis of some of the eye diseases. The eye has always been viewed as a tunnel to the inner workings of the body. There are many disease states that may produce symptoms from the eye. CLIPS language is used as a tool for designing our expert system. An initial evaluation of the expert system was carried out and a positive feedback was received from the users [17].

► **A Proposed Expert System for Skin Diseases Diagnosis**

There are many skin diseases having similar symptoms, therefore, the most important objective - in order to prescribe the appropriate treatment - is the right diagnosis of the disease. In this paper the design of the proposed Expert System which was produced to help dermatologists in diagnosing some of the skin diseases (Psoriasis, Eczema, Ichthyosis, Acne, Meningitis, Measles, Scarlet Fever, Warts, Insect Bites and Stings) are presented, an overview about the skin diseases are displayed, the cause of diseases are outlined and the treatment of disease whenever is possible is given. CLIPS language for designing the proposed expert system is used [18].

► **A Proposed Expert System For Guiding Freshman Students In Selecting A Major In Al-Azhar University, Gaza**

In this paper we will present the design and development of a proposed expert system that aims to improve the method of selecting the best suitable faculty/major for student planning to be enrolled in Al-Azhar University. The basic idea of our approach is designing a model for testing and measuring the student capabilities like intelligence, understanding, comprehension, mathematical concepts and others, and applying the module results to a rule-based expert system to determine the compatibility of those capabilities with the available faculties/majors in Al-Azhar University. The result is shown as a list of suggested faculties/majors that are most suitable with the student capabilities and abilities [16].

► **Knowledge Management in ESMDA: Expert System for Medical Diagnostic Assistance**

This research involved designing a prototype expert system that helps patients in diagnosing their diseases and offering them the proper advice; furthermore, the knowledge management used in the expert system is discussed. One of the main objectives of this research was to find a proper language for representing patient's medical history and current situation into a knowledge base for the expert systems to be able to carry out the consultation effectively. Production rules were used to capture the knowledge. The expert system was developed using CLIPS(C Language Integrated Production System) with Java Interface. The expert system yielded good results in the analysis of the medical cases tested and the system was able to determine the correct diagnosis in all cases [19].

► **Developing an expert system for plant disease diagnosis**

Plant diseases are one of the most important reasons that lead to the destruction of plants and crops. Detecting those diseases at early stages enable us to overcome and treat them appropriately. This process requires an expert to identify the disease, describe the methods of treatment and protection. Identifying the treatment accurately depends on the method that is used in diagnosing the diseases. Expert systems help a great deal in identifying those diseases and describing methods of treatment to be carried out taking into account the user capability in order to deal and interact with expert system easily and clearly. This requires that the user should be competent in using expert systems. An expert system was developed using two different methods of plant diagnosis: Step by step descriptive and graphical representational methods [21].

► **An expert system for endocrine diagnosis and treatments using JESS**

The aim of the this study was to introduce the design of an expert system which was able to fully diagnoses and treat Pancreas, Thyroid and Parathyroid glands diseases; furthermore, it gave first aids in emergency cases caused by diabetes. Since, diabetes diseases are widely spreads in Gaza, we chose it to be the primary target from the endocrine diseases. Our expert system was not meant to replace the human physician but using such system may be useful in cases like overcoming the problems of the shortage in human physicians and accuracy and speed in processing facts. This system can be used to help the physician in their work. Our expert system was initially evaluated with existing classical test cases. The result of the evaluation was accurate and promising [20].

► **Variable Floor for Swimming Pool Using an Expert System**

The indoor variable floor for swimming pool gives many possibilities of usages in the area where exists, for example, swimming pool, welcoming room, and sport hall. Therefore, we came to the idea of using the indoor variable floor for swimming pool due the shortages of open areas in Gaza Strip. The heating of the water in this pool when it is closed saves a lot of energy and time. During the winter season, people do not go the sea; but the can go to indoor swimming pools. The indoor variable floor for swimming pools can be built in schools for teaching the swimming courses for all ages of students. Since the depth of the water can be controlled, all students with different ages and classes can use the pool with high safety. To insure that, we designed an expert system to determine the height of the water in the pool according to some factors like: age, type usage, and time of the day. In the outdoor variable floor for swimming pool, it can be closed easily when it is not used to keep it clean and avoid falling kids in it [90].

► **Knowledge-based systems that determine the appropriate students major: In the faculty of engineering and information technology**

In this paper a Knowledge-Based System (KBS) for determining the appropriate students major according to his/her preferences for sophomore student enrolled in the Faculty of Engineering and Information Technology in Al-Azhar University of Gaza was developed and tested. A set of predefined criterions that is taken into consideration before a sophomore student can select a major is outlined. Such criterion as high school score, score of subject such as Math I, Math II, Electrical Circuit I, and Electronics I taken during the student freshman year, number of credits passed, student cumulative grade point average of freshman year, among others, were then used as input data to KBS. KBS was designed and developed using Simpler Level Five (SL5) Object expert system language. KBS was tested on three generation of sophomore students from the Faculty of Engineering and Information Technology of the Al-Azhar University, Gaza. The results of the evaluation show that the KBS is able to correctly determine the appropriate students major without errors [38].

► **Sl5 Object: Simpler Level 5 Object Expert System Language**

This paper introduces SL5 Object, the Simpler Level 5 Object Expert System Language. SL5 Object is a rule-based language for specifying expert systems. This paper first introduces the concept of expert systems and production systems, as well as the typical architecture of such a system. Then it presents a thorough outline of the SL5 Object Language: the syntax of rules and Objects, allowed constructs the module structure. It also presents the execution cycle of the SL5 Object engine, as well as a number of methods to influence the default progress of this cycle. Finally, this paper introduces an example of Cars diagnoses problems to illustrate the capabilities of SL5 Object and the concepts presented [22].

► **Proposed Expert System for Calculating Inheritance in Islam**

The truth of every human being is the end his life with death, and this leads to leaving assets and funds for those after him and can lead to hate between the heirs, it has made a point of Islamic law on all aspects of life, including the subject of the inheritance of the deceased. The main problem is how to get the knowledge of the basics of inheritance. This paper reviews work done in the use of expert system software to calculate inheritance in Islam. A proposed expert system was designed and developed using CLIPS language to calculate the inheritance in Islam [39].

► **Detecting Health Problems Related to Addiction of Video Game Playing Using an Expert System**

Today's everyone normal life can include a normal rate of playing computer games or video games; but what about an excessive or compulsive use of video games that impact on our life? Our kids, who usually spend a lot of time in playing video games will likely have a trouble in paying attention to their school lessons. In this paper, we introduce an expert system to help users in getting the correct diagnosis of the health problem of video game addictions that range from (Musculoskeletal issues, Vision problems and Obesity). Moreover, this expert system provides information about the problem and tells us how we can solve it. SL5 Object expert system language was used to design and implement the expert system [27].

► **An Expert System for Mouth Problems in Infants and Children**

In this paper an expert system was designed to help users to correctly diagnose mouth problems in infants and children (teething, gingivitis, impetigo, inflamed papillae, mucocele, oral thrush, allergic reaction, chickenpox, hand-foot-mouth disease, strep throat, cold sores, canker sores, gingivostomatitis) with some information about the disease and how to treat it. SL5 Object expert system language was used to design and implement this expert system [35].

► **An expert system for nausea and vomiting problems in infants and children**

In this paper, we present an expert system to help users in getting the correct 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). Furthermore, this expert system provides information about the disease and how to deal with it. SL5 Object expert system language was used to design and implement this expert system [34].

► **Lower Back Pain Expert System Diagnosis And Treatment**

This paper proposes an expert system that can be used to successfully diagnose low back pain intensity. The suggested systems were found to be advantageous approach in addition to existing unbiased ones. So far as the authors are aware, this is the first attempt of using an expert system in achieving very good performance in a real world application. In light of some of the limitations of this study, we also identify and discuss several areas that need continued investigation. SL5 Object language was used designing the proposed expert system [28].

► **An Expert System for Genital Problems in Infants**

Genital problems in infants is one of the most common problems which requiring fast intervention in the newborn period. A few weeks after the baby was born, the parents finally posed the question that the baby "Is it our baby OK?" It being how the baby look like. Female genital comprises all procedures that involve partial or total removal of the external female genitalia, or other injury to the female genital organs for non-medical reasons. In this paper we present an expert system that help parent diagnose the genital problems in their newly born children. SL5 Object expert system language was used to design and implement this expert system [24].

► **Expert system urination problems diagnosis**

The urinary system is the organ system responsible for the production, storage and elimination of urine. This system comprises urethra, bladder, ureters and kidneys. It corresponds to the major system which filters the blood and any imbalance of this organ can increases the rate of being infected with diseases. There are various Urinary System diseases having related symptoms, therefore, the main important objective -in order to prescribe the appropriate treatment - is the right diagnosis of the disease. In this paper the design of the proposed Expert System which was created to help Urination Problems in diagnosing some of the Urination diseases (Pyelonephritis, Kidney Stone, Bladder infection, Prostatitis, Urethritis, Gonorrhea, Interstitial cystitis, Stress incontinence, Trauma in kidney or bladder) are presented, an overview about the Urination diseases are displayed, the cause of diseases are outlined and the treatment of disease whenever is possible is given. SL5 Object language was used for designing the proposed expert system [37].

► **An expert system for feeding problems in infants and children**

A lot of infants have significant food-related problems, as well as spitting up, rejecting new foods, or not accepting to eat at specific times. These issues are frequently ordinary and are not a sign that the baby is unwell. According to the National Institutes of Health, 25% of generally developing infants and 35% of babies with neurodevelopmental disabilities are tormented by some sort of feeding problem. Some, for example rejecting to eat specific foods or being overly finicky, are momentary and don't cause any health dangers. This paper proposes an expert system that can be used to successfully diagnose Feeding problems in infants and children. The suggested systems were found to be beneficial approach in addition to existing impartial ones. So far as the authors are aware, this is the initial effort of using an expert system in attaining good performance in a real world application. This expert system was designed and implemented to help parents diagnose these problems and get a recommendation of how to deal with infants and children [26].

► **A Proposed Expert System For Foot Diseases Diagnosis**

Background: Foot is a complicated structure with 26 bones, 33 joints, and lots of muscles, nerves, ligaments of different types. Any part of the foot might be affected. Several foot disorders might be present with just dull pain, but on the other hand the other foot disorders can be extremely severe and limit the capability to walk or tolerate weight. The largest part of minor cases of foot pain is treated at home with special care. When severe pain is encountered, it requires some kind of medical care. If appropriate treatment of foot pain is not taken quickly, it can lead to damage in the foot. Objectives: The main goal of this expert system is to get the appropriate diagnosis of disease and the correct treatment. Methods: In this paper the design of the proposed Expert System which was produced to help Podiatric physician in diagnosing many of the foot diseases such as : Clubfoot, In toeing, Stress Fracture, Foot or Ankle Fracture, Foot Sprain, Turf Toe, Flat feet, Plantar Fasciitis, Warts, Bunion, Rheumatoid Arthritis, Gout, Heel Spur, Athlete's Foot, Morton's Neuroma, Cellulitis, Frostbite, and Gangrene. The proposed expert system presents an overview about foot diseases are given, the cause of diseases are outlined and the treatment of disease whenever possible is given out. SL5 Object Expert System language was used for designing and implementing the proposed expert system. Results: The proposed foot diseases diagnosis expert system was evaluated by Medical students and they were satisfied with its performance. Conclusions: The Proposed expert system is very useful for Podiatric physician, patients with foot problem and newly graduated physician [36].

► **An expert system for shoulder problems using CLIPS**

In this paper an expert system was designed to help out users to properly diagnose shoulder problems. Many shoulder problems are caused by the collapse of soft tissues in the shoulder area. Using the shoulder in excess of may cause the soft tissue to break down earlier as people get elder. Doing physical labor and playing sports can reason shoulder problems. Shoulder tenderness can be felt in one small smudge, in a larger region, or down the arm. Pain that moves all along nerves to the shoulder may be caused by diseases such as: Gallbladder disease, Liver disease, Heart disease, Disease of the spine in the neck, with some information about the disease and how to treat it. CLIPS expert system language was used to design and implement this expert system [42].

► **An expert system for men genital problems diagnosis and treatment**

Male genital problems and injuries may occur quite simply because of the scrotum and penis is not protected like other organs. Genital problems and injuries normally happen through: recreational activities (like Football, Hooky, biking, basketball), work related tasks (like contact to irritating chemicals), downhill drop, and sexual activity. A genital injury frequently causes harsh pain that typically disappear fast without causing enduring harm. Home handling is generally all that is required for trivial problems or injuries. Pain, inflammation, staining, or rashes that are coexisting with other symptoms might be a source for concern. Genital problems in men are one of the most common problems which require fast intervention. In this paper we present an expert system that help men diagnose their genital problems and give them the proper treatment. SL5 Object expert system language was used to design and implement this expert system [30].

- **Ear Diseases Diagnosis Expert System Using SL5 Object**

Hearing is considered the most important sense of the five senses, as the sense of hearing human life depends on in all that play and practiced. It is through hearing, human learn speech, languages skills, communication skills and communicate with others. For a patient to recover from any illness or weakness that affects the sense of hearing, he/she requires an accurate diagnosis of his/her the situation. In this paper will present an expert system that quickly diagnosis patient's condition and propose a suitable solution for the problem. This expert system is designed and implemented in SL5 Object language. This expert system was tested by a group of physician and found to be a useful tool that aids physicians and patients suffering from hearing senses problems [41].

- **A Proposed Rule Based System for Breasts Cancer Diagnosis**

Breasts cancer is an important issue in all women's life, not just in current life but also was in the past and is in the future. It is a threat for many people females and males. But it affect females more frequency than male. It is well known that female breast cancer incidence is the largest in proportion among other type of cancers in general; where the annual breast cancer achieves the largest proportion among cancers. In this paper the design of the proposed Rule Based System will be presented and the symptoms of the breast cancer disease and possible ways to prevent it will be outlined. The proposed Rule Based System was produced to help people to Prevent and early detection breast cancer, because it is known that this disease does not have medication or cure yet. SL5 Object language was used in the designing of the proposed ruled based system [32].

- **Rule Based System for Diagnosing Wireless Connection Problems Using SL5 Object**

There is an increase in the use of in-door wireless networking solutions via Wi-Fi and this increase infiltrated and utilized Wi-Fi enable devices, as well as smart mobiles, games consoles, security systems, tablet PCs and smart TVs. Thus the demand on Wi- Fi connections increased rapidly. Rule Based System is an essential method in helping using the human expertise in many challenging fields. In this paper, a Rule Based System was designed and developed for diagnosing the wireless connection problems and attains a precise decision about the cause of the problem. SL5 Object expert system language was used in developing the rule based system. An Evaluation of the rule based system was carried out to test its accuracy and the results were promising [25].

- **A Knowledge Based System for Neck Pain Diagnosis**

Modern life and scientific achievements contributed to the worsening of neck pain problems in great shape. Especially in people who work in offices and students in schools or universities. There are many neck diseases that people encounter in their lives. Therefore, the main objectives of this paper are to help people who suffer from neck pain by diagnosing their conditions through our knowledge based system. Furthermore, this system which we are presenting will give patient the correct diagnosis of the disease and the treatment required. In this paper the strategy of the Knowledge Based System for diagnosing many of the existed neck diseases: (Abnormalities in the bone or joints, Trauma, Poor posture, Degenerative diseases, Tumors, Muscle strain) is presented, an overview about the neck diseases are outlined, the cause of diseases are sketched and the treatment of disease at any time possible is given. SL5 Object expert system language for the suggested knowledge based system is used[31].

- **A Ruled Based System for Ear Problem Diagnosis and Treatment**

The ear is one of the most important senses of living creatures, whether they are sea or land, where it is the sound sensor in what is known hearing. The ear is divided into two parts, the outer part, the visible and which can be seen. The second parties the internal one which is responsible for processing and treatment of the initial sound. The location of the ear differs from one organism to another. The ear is a sensory living organism which enables hearing. The human (man) communicates with each other through speech, and such thing depends mainly on hearing. Hearing is a complicated process where everything is moving creates sound waves, and then such wave enter to the ear which

is converted to nerve signals to the brain, which in turn the brain translates these signals into what we hear from the voice. The ear has another function is to maintain the balance. It includes organisms that give the brain information on any change in the head position who shall send neurological messages to various muscles to keep the head and body balanced in all modes and movements of the human being [40].

- **Knowledge Based System for Long-term Abdominal Pain (Stomach Pain) Diagnosis and Treatment**

Background: the abdomen is called (the belly, tummy, stomach, or midriff) establishes the part of the body between the thorax (chest) and pelvis, in humans. The abdomen contains most of the tube like organs of the digestive tract, as well as several solid organs. Hollow abdominal organs comprise the stomach, the small intestine, and the colon with its attached appendix. Organs such as the liver, its attached gallbladder, and the pancreas function in close association with the digestive tract and communicate with it via ducts. Objectives: the main goal of this expert system is to get the appropriate diagnosis of abdomen disease and the correct treatment. Methods: in this paper the design of the proposed expert system which was produced to help internist physicians in diagnosing many of the abdomen diseases such as: hiatal hernia, gastritis, ulcer or heartburn; the proposed expert system presents an overview about abdomen diseases are given, the cause of diseases are outlined and the treatment of disease whenever possible is given out. Clips expert system language was used for designing and implementing the proposed expert system. Results: the proposed abdomen diseases diagnosis expert system was evaluated by medical students and they were satisfied with its performance. Conclusions: the proposed expert system is very useful for internist physician, patients with abdomen problem and newly graduated physician [49].

- **Photo Copier Maintenance Expert System V.01 Using SL5 Object Language**

The aim of this study was to introduce the design of an expert system which was able to diagnoses photocopier problems specially "the copy too light halftone area only". Our expert system was not meant to replace the human maintenance technician; but using such system may be useful in cases like overcoming the problems of the shortage in human technicians. and accuracy and speed in fixing problems. So this system can be used to help the maintenance technician in their work. This expert system was designed and implemented using SL5 Object language. Our expert system was initially evaluated with exiting classical test cases. The result of the evaluation was accurate and promising [46].

- **Polymyalgia Rheumatic Expert System**

Polymyalgia Rheumatica (PMR) presents with a broad spectrum of clinical manifestations and almost exclusively occurs in the population aged over 50 years. After rheumatoid arthritis, PMR is the second most common autoimmune rheumatic disorder. Visual loss is the most feared complication in temporal arteritis, and extracranial arteries. No specific laboratory parameter exists for diagnosis of PMR. Imaging techniques such as ultrasonography, MRI or F-fluorodeoxyglucose PET may be helpful in the diagnosis and evaluation of the extent of vascular involvement in these diseases. This paper presets an expert system for classification criteria for PMR, recent advances of diagnostic and therapeutic procedures. This expert System was written using SL5 Object Expert System Language [47].

- **Rickets Expert System Diagnoses and Treatment**

Background: The epidemic scourge of rickets in the 19th century was caused by vitamin D deficiency due to inadequate sun exposure and resulted in growth retardation, muscle weakness, skeletal deformities, hypocalcemia, tetany, and seizures. The encouragement of sensible sun exposure and the fortification of milk with vitamin D resulted in almost complete eradication of the disease. Objectives: this paper is going to resolve the exiting problems of rickets by correctly diagnosing and offering the proper treatment. Methods: In this paper, we present an expert system for rickets diagnosis which will helps doctors to explore everything related to the problems of rickets. We look forward to offer simplified answers to most of the rickets disease[45].

- **A Knowledge Based System for Diagnosing Shortness of Breath in Infants and Children**

Background: With the coming of the Industrial Revolution, the levels of pollution grow significantly. This Technological development contributed to the worsening of shortness breath problems in great shape, especially in infants and children. There are many shortness breath diseases that infants and children face in their lives. Shortness of breath is one of a very serious symptom in children and infants and should never be ignored. Objectives: Along these lines, the main goal of this expert system is to help physician in diagnosing and describe some common causes of shortness of breath in infants and children by diagnosing their cases through our expert system. Moreover, this system which we are presenting will give patient the appropriate diagnosis of disease and the treatment required. Methods: In this paper the strategy of the expert system for diagnosing a number of the existed shortness of breath in infants and children diseases such as (Asthma, Bronchiolitis, Viral Pneumonia, cough, Shortness of breath' dyspnea ', Epiglottitis, Croup, ABSCESS in the tonsil 'peritonsillar abscess', Bronchitis, Viral Bronchitis, Wheezing, sudden infant death syndrome 'SIDS') is introduced, an

overview about the shortness of breath in children and infants diseases are delineated, the cause of diseases are sketched and the treatment of disease whenever conceivable is given . SL5 Object Expert System language was utilized for designing and implementing the proposed expert system. Results: The proposed shortness of breath in children and infants diseases diagnosis expert system was estimated by Medical students and they were satisfied with its result. Conclusions: The Proposed expert system is very useful for Respiratory physician, pediatrician, recently graduated physician, and for children's parents with shortness of breath problem [44].

- **Rule Based System for Chest Pain in Infants and Children**

Chest pain is the pain felt in the chest by infants, children and adolescents. In most cases the pain is not associated with the heart. It is mainly recognized by the observance or report of pain by the infant, child or adolescent by reports of distress by parents or care givers. Chest pain is not unusual in children. Lots of children are seen in ambulatory clinics, emergency rooms and hospitals and cardiology clinics. Usually there is a benign cause for the pain for utmost children. Certain patients have conditions that are serious and perhaps life-threatening. Chest pain in pediatric patients needs careful physical examination and a detailed history that would point to the possibility of a serious cause. Researches of pediatric chest pain are scarce. It has been difficult to create evidence-based guidelines for evaluation. In this paper we propose an expert system to help doctors and parents, and care giver in diagnosing chest pain in infants and children. This expert System is design and implemented in SL5 Object language [48].

- **Expert System for Problems of Teeth and Gums**

Our gums (gingiva) act as a significant barricade in guarding our teeth and their neighboring support structures. A tiny known fact is that gum disease is the foremost cause of tooth loss in grown persons. Healthy, strong, teeth are reliant on on healthy gums. The core culprit for gum problems is bacteria in dental plaque. The bacteria in plaque yield harmful toxins that generate an inflammatory process that happens in the gum tissue. If left for a sufficient period of time, bacterial plaque causes hurt to our teeth as well as our gums. In this paper, we present a knowledge based system that help people with teeth and gums problems to diagnose their problems and get recommendation for the treatment. This expert system was designed and implemented using SL5 Object language for knowledge based system [43].

- **Expert System for Diagnosing Ankle Diseases**

In recent years, technology has evolved significantly to intervene in the treatment of diseases through diagnosis online before going to the specialist doctor, where it become possible for the patient to know the name of his illness, the specialist doctor who can treat him and the multiple treatment methods through specially designed systems called expert systems. The expert system is based on the principle of asking the user gradual questions about the symptoms he feels, leading him to the result of diagnosing the illness, dealing with it quickly, and tips for permanent treatment. These systems may also help both trainee physicians and physiotherapists. This research paper is a living example of these effective applications, explaining in a simplified manner some of ankle diseases, how to deal with them and methods of physical therapy. The ankle is a small region in the leg. It is two joints, the first consist of three bones (tibia, fibula and talus underneath) which is called true ankle joint. The other is called subtalar joint have two bones: talus on top and calcaneus on the bottom. This tarsus between the end of the leg and the start of the foot facilitates the movement up-down and left-right with no problems in normal case, although, it needs a special case as Physiotherapist when gets injury. We have identified seven ankle diseases: Ankle Sprain, Fracture (of Fibula), Rheumatoid Arthritis, Rheumatoid Fever, Gout, and Osteoarthritis (Degenerative Joint) using SL5 Object Expert System Language in the work of the expert system [51].

- **Expert System for Hair Loss Diagnosis and Treatment**

Though hair loss (alopecia) is not a debilitating or life threatening sickness, the very thought of becoming bald can lead to emotional stress and traumatic experience for those who suffer from premature or excessive hair loss. Many will try anything and everything to bring back their locks. Or at least, some of their once full head of hair. Hair loss sufferers spend billions of dollars annually on remedies ranging from drugs, vitamins to special tonics and shampoos. Conventional treatments of hair thinning includes drugs therapy and hair transplant. Minoxidil and Propecia (Finasteride) are the only two drugs approved by the FDA for hair growth in men. Minoxidil is the only drug available for women with and rogenetic alopecia. These drugs have been proven to show positive results for balding conditions on the vertex region of the scalp. Though these drugs are effective, many are wary of their unknown long-term effect and potential side-effects. This has led to increase interest in alternative remedies such as herbal medicine[50].

- **Cognitive System for Helping Farmers in Diagnosing Watermelon Diseases**

Watermelon is a summer vegetable whose plant has extended branches, producing spherical or cylindrical fruits of light green or dark green color, with a red core that is spread by black seeds and white pulp. Recent studies have shown many health benefits for watermelon, especially with regard to intestinal and kidney safety. Studies have shown that watermelon moisturizes the skin, refreshes the body and may serve as a powerful laxative for intestines, a substance that helps digestion, strengthens the blood, and breaks the kidney stones. The researchers found that the natural compounds found in it help to reduce the severity of skin diseases, as well as its seeds in the reduction of high blood pressure, and can be used to stop bleeding. Objectives: The main objective of this expert system is to assist farmers in detecting watermelon diseases and solutions. Methods: In this paper the design of the proposed Expert System which was produced to help farmers in diagnosing many of the watermelon diseases such as : Downy mildew, Powdery mildew, Anthracnose, Alternaria leaf spot, Fusarium wilt, Bud necrosis disease and Cucumber mosaic disease. The proposed expert system presents an overview about watermelon diseases are given, the cause of diseases are outlined and the treatment of disease whenever possible is given out .E-clips Expert System language was used for designing and implementing the proposed expert system. Results: The proposed watermelon diseases diagnosis expert system was evaluated by group of farmers and they were satisfied with its performance. Conclusions: The Proposed expert system is very useful for farmers, to diagnosing watermelon diseases and treatment it whenever possible is given[52].

- **Black Pepper Expert System**

Background: Plant production provides human and animal life with different requirements. The concern of workers in agriculture in general and those interested in plant diseases, in particular, has been focused on protection from all that is expected to have problems of production. As environmental conditions play a critical role in the treatment of diseases, the plant is prepared and rendered more susceptible to production, which is exposed and may result in the loss of the entire crop. Objectives: The main goal of this expert system is to get the appropriate diagnosis of Black Pepper disease and the correct treatment. Methods: In this paper the design of the proposed Expert System which was produced to help Farmers, people interested in agriculture and agricultural engineers in diagnosing many of the black pepper diseases such as : Foot rot /quick, wilt disease, Pollu disease /anthracnose, Slow decline /slow wilt, Stunt disease, Phyllody disease, Basal wilt, Leaf rot and blight. The proposed expert system presents an overview about black pepper diseases are given, the cause of diseases are outlined and the treatment of disease whenever possible is given out. CLIPS with Delphi were used for designing and implementing the proposed expert system. Results: The proposed black pepper diseases diagnosis expert system was evaluated by Farmers, Agricultural experts and Agriculture teachers and they were satisfied with its performance. Conclusions: The Proposed expert system is very useful for farmers, and those interested in agriculture with black pepper disease and recent graduate students[58].

- **Rule Based System for Diagnosing and Treating Potatoes Problems**

Background: Plant production provides human and animal life with different requirements. The concern of workers in agriculture in general and those interested in plant diseases, in particular, has been focused on protection from all that is expected to have problems of production. As environmental conditions play a critical role in the treatment of diseases, the plant is prepared and rendered more susceptible to production, which is exposed and may result in the loss of the entire crop. Objectives: The main goal of this expert system is to get the appropriate diagnosis of potato disease and the correct treatment. Methods: In this paper the design of the proposed Expert System which was produced to help farmers, people interested in agriculture and agricultural engineers in diagnosing many of the potatoes diseases such as : Bacterial wilt, Septoria leaf spot, Late blight, arly blight, Common scab, Black scurf/ canker, Viral disease (potato virus X, S, Y), Potato Spindle Tuber Viroid (PSTVd), Black leg and soft rot, Pink rot and Black heart- disorder. The proposed expert system presents an overview about potatoes diseases are given, the cause of diseases are outlined and the treatment of disease whenever possible is given out. CLIPS with Delphi were used for designing and implementing the proposed expert system. Results: The proposed potatoes diseases diagnosis expert system was evaluated by Farmers, Agricultural experts and teachers of Agriculture and they were satisfied with its performance. Conclusions: The Proposed expert system is very useful for Farmers, and those interested in agriculture with potatoes disease and recent graduate students[61].

- **Knowledge Based System for Diagnosing Pineapple Diseases**

Background: The pineapple (A nanas comosus) is a tropical plant with an edible multiple fruit consisting of coalesced berries, also called pineapples, and the most economically significant plant in the Bromeliaceae family. Pineapples may be cultivated from a crown cutting of the fruit, possibly flowering in five to ten months and fruiting in the following six months.[5][6] Pineapples do not ripen significantly after harvest. In

2016, Costa Rica, Brazil, and the Philippines accounted for nearly one-third of the world's production of pineapples.[8] Pineapple damage is not taken quickly, it can lead to damage in the Pineapple. Objectives: The main goal of this expert system is to get the appropriate diagnosis of disease and the correct treatment. Methods: In this paper the design of the proposed Expert System which was produced to help Fruits Agricultural Specialist in diagnosing many of the Pineapple diseases such as : Phytophthora heart (top) rot, Base (butt) rot or Fruit let core rot (green eye, Pineapple Sprain, Turf Toe, Pineapple disease , Plantar Fasciitis, Warts, Bunion, Rheumatoid Arthritis, Gout, Heel Spur, Athlete's Pineapple , The proposed expert system presents an overview about Pineapple diseases are given, the cause of diseases are outlined and the treatment of disease whenever possible is given out. CLIPS Expert System language was used for designing and implementing the proposed expert system. Results: The proposed Pineapple diseases diagnosis expert system was evaluated by Agricultural students and they were satisfied with its performance. Conclusions: The Proposed expert system is very useful for Fruits Agricultural Specialist, patients with Pineapple problem and newly graduated Agricultural Specialist[62].

- **Rule Based System for Watermelon Diseases and Treatment**

Background: Watermelon is a summer vegetable whose plant has extended branches, producing spherical or cylindrical fruits of light green or dark green color, with a red core that is spread by black seeds and white pulp. Recent studies have shown many health benefits for watermelon, especially with regard to intestinal and kidney safety. Studies have shown that watermelon moisturizes the skin, refreshes the body and may serve as a powerful laxative for intestines, a substance that helps digestion, strengthens the blood, and breaks the kidney stones. The researchers found that the natural compounds found in it help to reduce the severity of skin diseases, as well as its seeds in the reduction of high blood pressure, and can be used to stop bleeding. Objectives: The main objective of this expert system is to assist farmers in detecting watermelon diseases and solutions. Methods: In this paper the design of the proposed Expert System which was produced to help farmers in diagnosing many of the watermelon diseases such as : Downy mildew, Powdery mildew, Anthracnose, Alternaria leaf spot, Fusarium wilt, Bud necrosis disease and Cucumber mosaic disease. The proposed expert system presents an overview about watermelon diseases are given, the cause of diseases are outlined and the treatment of disease whenever possible is given out .E-clips Expert System language was used for designing and implementing the proposed expert system. Results: The proposed watermelon diseases diagnosis expert system was evaluated by group of farmers and they were satisfied with its performance. Conclusions: The Proposed expert system is very useful for farmers, to diagnosing watermelon diseases and treatment it whenever possible is given[91].

- **Expert System for the Diagnosis of Mango Diseases**

Mango fruit is known as a type of fruit, containing within it a nucleus. Mango fruit is a branch of mangier. This species contains many different types of fruits, especially tropical fruits. The plant species is known as the botanical plant species. Mango is not a modern plant discovered in this age, it is an old plant, as it was known about four thousand years ago, and it was among the plants known to the Arabs, they called it (Anabj). Its root length in the soil can be up to six meters, and the height of the mango tree grows between 35 and 40 meters. The leaves are evergreen, with a length of about fifteen and thirty-five centimeters, and the width can be about sixteen centimeters. This type of fruit has many diseases which threaten its production. In this research, we proposed an expert system for diagnosing mango diseases. This expert system was designed and implemented using CLIPS and Delphi languages. A group of farmers, people interested in mango production, agriculture instructors had tested the proposed expert system and found it very useful[60].

- **Banana Knowledge Based System Diagnosis and Treatment**

This research involved the design of an initial expert system which helps farmers and specialists diagnose and provide appropriate advice on banana diseases. The management of knowledge used in the expert system was also discussed. One of the key elements of this research was to find the appropriate language to diagnose the disease and the current situation in the knowledge base. Expert systems enable effective consultation. Production rules were used to capture knowledge. The expert system was developed using CLIPS with the Delphi 10.2 as user interface. The expert system produced good results in analyzing cases of tested banana disease and enabling the system to determine the correct diagnosis in all cases[54].

- **Onion Rule Based System for Disorders Diagnosis and Treatment**

This research included the design of an initial expert system which helps farmers and specialists to diagnose and provide appropriate advice on onion plant diseases; furthermore, the management of knowledge used in the expert system was discussed. One of the key elements of this research was to find the appropriate language to diagnose the onion disease and the current situation in the knowledge base. Expert systems to be able to effectively implement the consultation, production rules

were used to capture knowledge. The expert system was developed using CLIPS with the Delphi language interface. The expert system has produced good results in the analysis of onion disease cases that have been tested and enable the system to determine the correct diagnosis in all cases[53].

► **Breast Cancer Knowledge Based System**

The Knowledge Based System for Diagnosing Breast Cancer is used to assist medical students to improve their education on diagnosis and counseling the process of analyzing the biopsy image of the microscope, determining the type of tumor and the treatment method for each case and identifying the disease related questions. According to the Ministry of Health in its annual report in Gaza, between 2009 and 2014 there are 7069 cases of breast cancer, and in 2014 there are 1502 cases of breast cancer. We are now in the age of visual information where 65% of the populations are visual learners; the Knowledge Based System is the easiest way to ensure students remember the information in the long term, using visual and textual information. The Knowledge Based System has an easy-to-use interface to help students diagnose the disease and enhance their information about the disease; the system can be used on smart phones. This Knowledge Based System can be divided into three main parts: The first part is specific questions for the patient, to help student to know questions type. The second part is the process of analyzing the biopsy sample image, to see if the biopsy image is intact or infected. The last part is the video shows ways to treat breast cancer in the form of animation[55].

► **A Cognitive System for Diagnosing Musa Acuminata Disorders**

Background: Plant production provides human and animal life with different requirements. The concern of workers in agriculture in general and those interested in plant diseases, in particular, has been focused on protection from all that is expected to have problems of production. As environmental conditions play a critical role in the treatment of diseases, the plant is prepared and rendered more susceptible to production, which is exposed and may result in the loss of the entire crop. Objectives: The main goal of this expert system is to get the appropriate diagnosis of musa acuminata disease and the correct treatment. Methods: In this paper the design of the proposed Expert System which was produced to help farmers, people interested in agriculture and agricultural engineers in diagnosing many of the musa acuminata diseases such as: Panama wilt, Mycosphaerella leaf spot, yellow sigatoka, black sigatoka, Anthracnose, Moko disease/bacterial wilt, Tip over or bacterial soft rot, Bunchy top/curly top, Musa acuminata bract mosaic virus (BBMV), Musa acuminata Streak disease (BSV), Infectious chlorosis (CMV). The proposed expert system presents an overview about musa acuminata diseases are given, the cause of diseases are outlined and the treatment of disease whenever possible is given out. CLIPS with Delphi language was used for designing and implementing the proposed expert system. Results: The proposed musa acuminata diseases diagnosis expert system was evaluated by farmers, agricultural experts and Agriculture teachers and they were satisfied with its performance. Conclusions: The Proposed expert system is very useful for Farmers, and those interested in agriculture with musa acuminata disease and recent graduate students[57].

► **Thyroid Knowledge Based System**

Background: Thyroid disease is a group of disorders that affects the thyroid gland. The thyroid is a small, butterfly shaped gland in the front of your neck that makes thyroid hormones. Thyroid hormones control how your body uses energy, so they affect the way nearly every organ in your body works—even the way your heart beats. Therefore, in this paper will identify what is the thyroid and diseases present in thyroid and detect the symptoms in each disease. Objectives: The main objective of this expert system is to obtain appropriate diagnosis of this disease. Methods: In this paper, the expert system is designed for the ability of doctors to detect and diagnose disease of thyroid. The proposed expert system presents an overview about thyroid diseases are given, the cause of diseases are outlined and the treatment of disease whenever possible is given out. SL5 Object Expert System language was used for designing and implementing the proposed expert system. Results: The expert system in the diagnosis of thyroid diseases was assessed by Medical student and doctors they were satisfied and accepted with its quality of performance. Conclusions: The expert system is easy for podiatric physician, patients and people have experience to detect and diagnosis the symptoms that may face this disease[89].

► **An Expert System for Coconut Diseases Diagnosis**

Background: The coconut tree (Cocos nucifera) is a member of the palm tree family (Arecaceae) and the only living species of the genus Cocos, can refer to the whole coconut palm, the seed, or the fruit, which botanically is a drupe, not a nut. The term is derived from the 16th-century Portuguese and Spanish word coco meaning "head" or "skull" after the three indentations on the coconut shell that resembles facial features. Objectives: The main goal of this expert system is to get the appropriate diagnosis of disease and the correct treatment by presenting suggestions on coconut diseases to the user with pictures to be accurately diagnosed. Methods: in this paper the design

of the proposed Expert System which was produced to help farmers in diagnosing many of the coconut diseases such as: Bud Rot, Leaf Rot, Stem Bleeding, Tanjore wilt and Root (wilt). the proposed expert system presents an overview about coconut diseases are given, the cause of diseases is outlined and the treatment of disease whenever possible is given out. CLIPS Object Expert System language was used for designing and implementing the proposed expert system. Results: The proposed coconut diseases diagnosis expert system was evaluated by agricultural engineers and they were satisfied with its performance. Conclusions: The Proposed expert system is very useful for agricultural engineer, specialists in plant pathology, and researchers on coconut plant. Keywords: Artificial Intelligence, Expert Systems[73].

► **Expert System for the Diagnosis of Wheat Diseases**

Background: Wheat is a wild grass belongs to Poaceae (Gramineae), an enormously multipurpose grain. The proteins of the wheat, gliadins and glutenins together referred to as storage prolamines are responsible for viscoelasticity of the dough. Wheat proteins belonging to both the soluble and insoluble fractions can act as allergens and cause allergic symptoms in susceptible individuals. Celiac disease is an auto immune disease characterized by immune mediated enteropathy of proximal small intestine triggered by the ingestion of gluten containing cereals (wheat, barley and rye) in genetically susceptible individuals. The average worldwide prevalence of celiac disease is 1-6%. India confirmed the prevalence rate of 0.3% in adults and 6% in children. The mainstay of the treatment is a strict lifelong adherence to gluten free diet .Objectives: The main objective of this expert system is to assist farmers in detecting wheat diseases and solutions. Methods: In this paper the design of the proposed Expert System which was produced to help farmers in diagnosing many of the wheat The proposed expert system presents an overview about wheat diseases are given, the cause of diseases are outlined and the treatment of disease whenever possible is given out .E-clips Expert System language was used for designing and implementing the proposed expert system. Results: The proposed wheat diseases diagnosis expert system was evaluated by group of farmers and they were satisfied with its performance. Conclusions: The Proposed expert system is very useful for farmers in diagnosing wheat diseases and treatment it whenever possible is given[84].

► **An Expert System for Citrus Diseases Diagnosis**

Background: Citrus, genus of plants belonging to the rue family (Rutaceae), and yielding pulpy fruits covered with fairly thick skins. Economically important plants in this group include the lemon (C. × limon), lime (C. × aurantiifolia), sweet orange (C. × sinensis), sour orange (C. × aurantium), tangerine (C. reticulata), grapefruit (C. x paradisi), citron (C. medica), and shaddock (C. maxima)[1]. Objectives: The main goal of this expert system is to get the appropriate diagnosis of disease and the correct treatment by presenting suggestions on Citrus diseases to the user with pictures to be accurately diagnosed. Methods: in this paper the design of the proposed Expert System which was produced to help farmers in diagnosing many of the Citrus diseases such as Citrus canker, Citrus scab, Citrus tristeza disease, Gummosis, Greening or Huanglongbing, Sooty mould, Powdery mildew and Anthracnose. the proposed expert system presents an overview about Citrus diseases are given, the cause of diseases is outlined and the treatment of disease whenever possible is given out. CLIPS Object Expert System language was used for designing and implementing the proposed expert system. Results: The proposed Citrus diseases diagnosis expert system was evaluated by agricultural engineers and they were satisfied with its performance. Conclusions: The Proposed expert system is very useful for agricultural engineer, specialists in plant pathology, and researchers on Citrus plant[78].

► **Expert System for Castor Diseases and Diagnosis**

Background: The castor bean is a large grassy or semi-wooden shrub or small tree. Any part of the castor plant parts can suffering from a disease that weakens the ability to grow and eliminates its production. Therefore, in this paper will identify the pests and diseases present in castor culture and detect the symptoms in each disease. Also images are showing the symptom form in this disease. Objectives: The main objective of this expert system is to obtain appropriate diagnosis of the disease. Methods: In this paper, the expert system is designed for the ability of agricultural engineers to detect and diagnose disease of castor like as: seeding blight, alternaria blight, cercospora leaf spot, powdery mildew and wilt. This system presents the disease symptoms, survival and spread, favorable conditions and image for each disease. Clips and Delphi expert system languages are used for designing and implementing the proposed expert system. Results: The expert system in the diagnosis of castor diseases was assessed by farmers and agricultural engineers and they were satisfied and accepted with its quality of performance. Conclusions: The expert system is easy for farmers and people have experience in the plant of castor to detect and diagnosis the symptoms that may face this plant from several disease[88].

► **Anemia Expert System Diagnosis Using Sl5 Object**

Background: Anemia is a condition that occurs due to a lower concentration of hemoglobin than the normal level (nonpregnant adult females less than 11 g / dL and males younger than 13 g / dL). Because of the low level

of hemoglobin, the body's organs suffer from lack of enough oxygen, so patients complain of signs and symptoms such as fatigue, headaches, lack of concentration, lethargy and others. Objectives: The main goal of this expert system is to get the appropriate diagnosis of disease. Methods: In this paper the design of the proposed Expert System which was produced to help Doctor in diagnosing many of the anemia diseases such as: Fatigue, Chest pain, Shortness of breath, swelling of the body, Pallor of skin. The proposed expert system presents an overview about anemia diseases are given, the cause of diseases are outlined. SL5 Expert System language was used for designing and implementing the proposed expert system. Results: The proposed anemia diseases diagnosis expert system was evaluated by engineering students[67].

- **Spinach Expert System: Diseases and Symptoms**

The health benefits of spinach include skin care, improved eyesight, regulated blood pressure, stronger muscles, and prevention of age-related macular degeneration and hemophilia. It also helps with health conditions such as cataracts, atherosclerosis, heart attacks, and neurological disorders. It helps in bone mineralization and exerts anti-ulcerative and anti-cancerous benefits. So farmers should have taken care of this plant. In this research we developed an expert system capable of knowing the disease that plants the plant by selecting the symptoms that appear on the plant from the list of symptoms that appear to the farmer to avoid the propagator writing the symptoms wrongly. The expert system was developed using CLIPS language and has been experimented by farmers and has given satisfactory results[70].

- **Grapes Expert System Diagnosis and Treatment**

This research included the design of a preliminary expert system that helps farmers and specialists diagnose and provide appropriate advice on grape diseases. In addition, knowledge management used in the expert system was discussed. One of the essential elements of this research was to find the appropriate language for the diagnosis of grapevine and the current status in the knowledge base. Expert systems have been used to be able to effectively implement consultation and production rules to capture knowledge. The expert system was developed using CLIPS with the Delphi language interface. The expert system produced good results in the analysis of grape cases that have been tested and enable the system to determine the correct diagnosis in all cases[66].

- **Developing an Expert System for Papaya Plant Disease Diagnosis**

The papaya is a plant that grows in tropical climates and also known as pawpaws or papaws, it has many health benefits like reducing risk of heart disease, diabetes, cancer, aiding in digestion, improving blood glucose control in people with diabetes, lowering blood pressure, and improving wound healing. With these big health benefits and with taken into consideration that it's available at most times of the year. The farmers have to take care of this plant. Because of that we developed an expert system to help farmers and people interested in growing papaya to identify the diseases of papaya then they can find the right cure to treat the plant. The expert system was developed using CLIPS and Delphi languages and has been experimented by farmers and people interested in growing papaya and has given satisfactory results[63].

- **Developing an Expert System for Uveitis Disease Diagnosis**

Our eyesight is one of your most important senses: 80% of what we perceive comes through our sense of sight. By protecting your eyes, you will reduce the odds of blindness and vision loss, one of things that may cause vision loss is Uveitis. Uveitis is a form of eye inflammation. It affects the middle layer of tissue in the eye wall (uvea). Uveitis (u-vee-I-tis) warning signs often come on suddenly and get worse quickly. They include eye redness, pain and blurred vision. The condition can affect one or both eyes. It primarily affects people ages 20 to 50, but it may also affect children. Possible causes of uveitis are infection, injury, or an autoimmune or inflammatory disease. Many times a cause can't be identified. Uveitis can be serious, leading to permanent vision loss. Early diagnosis and treatment are important to prevent the complications of uveitis. Because of that we designed an expert system to help people to know if they got Uveitis early after that they can get treatment and they will save their eyes [64].

- **An Expert System For Diagnosing Sugarcane Diseases**

Sugarcane is one of the most important crops in the world, growing in tropical and subtropical conditions. The crop is economically important due to its industrial potential in terms of products such as crystalline white sugar. Sugarcane is a long-term crop of 10-18 months but diseases are the main concern of Sugarcane, responsible for low yield. The aim is to diagnose diseases in a timely manner to reduce losses. In this research, we proposed an expert system for the diagnosis of sugarcane diseases using CLIPS and Delphi languages and it was tested by a group of farmers interested in producing sugarcane crops and found it to be very useful. The Expert System is of generic nature and can be used in other crop environment with changes in the knowledge base[82].

- **Knowledge Based System for Apple Problems Using CLIPS**

It is a plant species that follows the apple genus, which is a fruit because it contains seeds of the pink family. It is one of the most fruit trees in terms of agriculture. The apple tree is small in length from 3 to 12 meters. Several recent studies have shown many health benefits of apples. It helps with the strengthening of the brain, heart, and stomach. It is used in the treatment of joint pain and limberness. It is opposite. It stops vomiting. It goes to dyspnea. It corrects the liver, purifies the blood of toxins, strengthens the heart muscle, and kills the abdominal dentures. Which are richer in cell nutrition and development, bone strengthening and neuronal regeneration is an important source of detoxification. Viruses, bacteria, and microbes in the body. Objectives: The main objective of this expert system is to assist farmers in detecting apple diseases and solutions. Method: In this paper, the proposed expert system was design and developed to help farmers diagnose many apple diseases such as: Apple scab, Black rot canker, Powdery mildew, Core rot, Brown rot, White rot / root rot Seedling blight. The proposed system of experts provides an overview of apple diseases identifies the cause of disease and treats the disease whenever possible. The language of the expert system was used to design and implement the proposed expert system. Results: A proposed expert system for the diagnosis of apple diseases was presented to group of farmers for evaluating it and they were satisfied with its performance. Conclusions: The proposed expert system is extremely useful for farmers to diagnose and treat apple diseases whenever possible[74].

- **An Expert System for Sesame Diseases Diagnosis Using CLIPS**

Background: Sesame is a flowering plant in the genus Sesamum also called benne. Numerous wild relatives occur in Africa and a smaller number in India. It is widely naturalized in tropical regions around the world and is cultivated for its edible seeds, which grow in pods or "buns". World production in 2016 was 6.1 million tons, with Tanzania, Myanmar, India, and Sudan as the largest producers. Sesame seed is one of the oldest oilseed crops known, domesticated well over 3000 years ago. Sesamum has many other species, most being wild and native to sub-Saharan Africa. Sesamum indicum, the cultivated type, originated in India and is tolerant to drought-like conditions, growing where other crops fail. Objectives: The main goal of this expert system is to get the appropriate diagnosis of disease and the correct treatment. Methods: In this paper the design of the proposed Expert System which was produced to help Agriculture experts in diagnosing many of the sesame diseases such as: Phyllody, Dry root rot, Phytophthora blight and Alternaria blight. The proposed expert system presents an overview about sesame diseases are given, the cause of diseases are outlined and the treatment of disease whenever possible is given out. CLIPS Expert System and Delphi languages were used for designing and implementing the proposed expert system. Evaluation: The expert system in the diagnosis of Sesame diseases was assessed by farmers and agricultural engineers and they were satisfied with its quality of performance and ease of use. Conclusions: The Proposed expert system is very useful for Agriculture experts, patients with sesame problems and newly graduated Agricultural students[80].

- **Silicosis Expert System Diagnosis and Treatment**

Background Silicosis (particularly the acute form) is characterized by shortness of breath, cough, fever, and cyanosis (bluish skin). It may often be misdiagnosed as pulmonary edema (fluid in the lungs), pneumonia, or tuberculosis. Silicosis resulted in 46,000 deaths globally in 2013 down from 55,000 deaths in 1990. Objectives The main goal of this expert system is to get the appropriate diagnosis of disease and the correct treatment by presenting suggestions on Silicosis disease to the user by asking about symptoms. Methods SL5 Object Expert System language was used for designing and implementing the proposed expert system. Results The results obtained from the system were evaluated whether the patient was infected with the disease or not through specialists in lung diseases. The results were satisfactory at a very good rate compared to the basic symptoms of the disease[79].

- **Hepatitis Expert System Diagnosis Using Sl5 Object**

Background: Your liver is your body's largest solid organ. This organ is vital to the body's metabolic functions and immune system. Without a functioning liver, a person cannot survive. The liver's position is mostly in the right upper portion of the stomach, just below the diaphragm. A portion of the liver goes into the left upper abdomen as well. There are many types of diseases that can affect the liver and its functions. Objectives: The main objective of this expert system is to assist doctors in detecting Hepatitis diseases. Methods: In this paper we will implement an expert system using SL5 Object programming language so that it diagnoses the patient's condition and provides the appropriate solution. Results: This program was evaluated and tested by a group of doctors and patients with liver problems and they were satisfied with its performance. Conclusions: The Proposed expert system is very useful for doctors; to diagnosing liver diseases and treatment it whenever possible is given[83].

- **A Proposed Expert System for Diagnosing Skin Cancer Using SL5 Object**

Skin is considered the largest organ of the body, with a total area of about 20 square feet. The skin protects us from microbes and the elements, helps regulate body temperature, and permits the sensations of touch, heat, and cold. For a patient to recover from any illness or weakness that affects the skin, he/she requires an accurate diagnosis of his/her the situation. In this paper will present an expert system that quickly diagnosis patient's condition and propose a suitable solution for the problem. This expert system is designed and implemented in SL5 Object language. This expert system was tested by a group of physician and found to be a useful tool that aids physicians and patients suffering from skin cancer diseases[75].

- **Knowledge Based System for Diabetes Diagnosis Using SL5 Object**

Diabetes is a major public health issue that affects the nations of our time to a large extent and is described as a noncommunicable epidemic. Diabetes mellitus is a common disease where there is too much sugar (glucose) floating around in your blood. This occurs because either the pancreas can't produce enough insulin or the cells in body have become resistant to insulin. The concentration in this paper is on diagnosis diabetes by designing a proposed expert system. The main goal of this expert system is to get the appropriate diagnosing of the illness, dealing with it quickly, and tips for permanent treatment whenever possible is given out. SL5 object expert system language was used for designing and implementing the proposed expert system[77].

- **An Expert System for Diagnosing Tobacco Diseases Using CLIPS**

Background: Tobacco is an herbaceous annual or perennial plant in the family Solanaceae grown for its leaves. The tobacco plant has a thick, hairy stem and large, simple leaves which are oval in shape. The tobacco plant produces white, cream, pink or red flowers which grow in large clusters, are tubular in appearance and can reach 3.5-5.5 cm (1,25-2 in) in length. Tobacco may reach 1.2-1.8 m (4-6 ft) in height, Tobacco is one of the most widely abused substances in the world. It is highly addictive. The Centers for Disease Control and Prevention estimates that tobacco causes 6 million deaths per year. This makes tobacco the leading cause of preventable death, Nicotine is the main addictive chemical in tobacco. It causes a rush of adrenaline when absorbed in the bloodstream or inhaled via cigarette smoke. Nicotine also triggers an increase in dopamine. This is sometimes referred to as the brain's "happy" chemical. Objectives: The main goal of this expert system is to get the appropriate diagnosis of disease. Methods: In this paper the design of the proposed Expert System which was produced to help Doctor in diagnosing many of the tobacco diseases such as : Damping off, Frog eye leaf spot, Leaf blight / black shank, Anthracnose, Sore shin, Fusarium wilt, Brown spot, Tobacco mosaic disease, Tobacco ring spot disease, Cucumber mosaic disease, Tobacco leaf curl disease. The proposed expert system presents an overview about tobacco diseases are given, the cause of diseases are outlined. CLIPS and Delphi languages were used for designing and implementing the proposed expert system. Results: The proposed tobacco diseases diagnosis expert system was evaluated by engineering students and found to be positive[68].

- **Kidney Expert System Diseases and Symptoms**

Kidneys are an important part of the human body, both sides of the spine and above the waist. The lower ribs protect the kidneys. In the kidneys there are filtration units which are tiny units and the functions of the kidney where the excess fluid and dissolved particles are filtered and converted to urine, purification and cleaning of blood, balancing the fluids contained in the body, production of the renin enzyme, which helps control blood pressure and adjust the level Salts and other chemicals to keep the body functioning properly. In this research, we developed an expert system capable of identifying the disease that affects the kidney by identifying the symptoms that appear from the list of symptoms that appear to the doctor to avoid the user typing the symptoms wrongly. The expert system was developed using SL5 Object language and has been experimented by doctors and has given satisfactory results[71].

- **Expert System for the Diagnosis of Seventh Nerve Inflammation (Bell's palsy) Disease**

Background: The occurrence of any disturbance in the seventh facial nerve in the nerves of the brain called inflammation of the seventh nerve or paralysis in the face of half (Bell's paralysis), where paralysis affects one side of the face, and occurs when the seventh nerve, which controls the muscles of the face loses the patient control of the facial muscles on The side of inflammation is the seventh nerve because it controls the muscles on both sides of the face that enable us to express the smile, laughter, crying and other facial expressions to any injury that affects the facial expressions of the motor. Objectives: This paper will solve the problems of treatment of seventh nerve inflammation through correct diagnosis and treatment. Methods: In this research, we provide an expert system for the diagnosis of seven nerve inflammation which will help doctors to explore everything related to the problems of seventh nerve inflammation. We look forward to providing simplified answers to seven nerve inflammation[87].

► **An Expert System for Depression Diagnosis**

Background: Depression (major depressive disorder) is a common and serious medical illness that negatively affects how you feel, the way you think and how you act. Fortunately, it is also treatable. Depression causes feelings of sadness and/or a loss of interest in activities once enjoyed. It can lead to a variety of emotional and physical problems and can decrease a person's ability to function at work and at home. Depression affects an estimated one in 15 adults (6.7%) in any given year. And one in six people (16.6%) will experience depression at some time in their life. Depression can strike at any time, but on average, first appears during the late teens to mid-20s. Women are more likely than men to experience depression. Some studies show that one third of women will experience a major depressive episode in their lifetime. Objectives: The main goal of this expert system is to get the appropriate diagnosis of disease and the correct treatment and give the appropriate method of treatment through several tips that concern the disease and how to treat it and we will see it through the application on the expert system. Methods: in this paper the design of the proposed Expert System which was produced to help Psychologist in diagnosing depression disease through its symptoms such as: a loss of energy, a change in appetite, sleeping more or less, anxiety, reduced concentration, indecisiveness, restlessness, feelings of worthlessness, guilt or hopelessness and thoughts of self-harm or suicide. The proposed expert system presents an overview about depression disease is given, the cause of diseases is outlined and the treatment of disease whenever possible is given out. SL5 Object Expert System language was used for designing and implementing the proposed expert system. Results: The proposed depression disease diagnosis expert system was evaluated by psychologist students and they were satisfied with its performance. Conclusions: The Proposed expert system is very useful for psychologist, patients with depression and newly graduated psychologist[72].

► **An Expert System for Arthritis Diseases Diagnosis Using SL5 Object**

Background: Arthritis is very common but is not well understood. Actually, "arthritis" is not a single disease; it is an informal way of referring to joint pain or joint disease. There are more than 100 different types of arthritis and related conditions. People of all ages, sexes and races can and do have arthritis, and it is the leading cause of disability in America. More than 50 million adults and 300,000 children have some type of arthritis. It is most common among women and occurs more frequently as people get older. Common arthritis joint symptoms include swelling, pain, stiffness and decreased range of motion. Symptoms may come and go. They can be mild, moderate or severe. They may stay about the same for years, but may progress or get worse over time. Severe arthritis can result in chronic pain, inability to do daily activities and make it difficult to walk or climb stairs. Arthritis can cause permanent joint changes. These changes may be visible, such as knobby finger joints, but often the damage can only be seen on X-ray. Some types of arthritis also affect the heart, eyes, lungs, kidneys and skin as well as the joints. Objectives: The main goal of this expert system is to get the appropriate diagnosis of disease and the correct treatment and give the appropriate method of treatment through several tips that concern the disease and how to treat it and we will see it through the application on the expert system. Methods: in this paper the design of the proposed Expert System which was produced to help Orthopedist in diagnosing Arthritis disease through its symptoms such as: pain on pressure in a joint , Inflammation indicated by joint swelling, Stiffness especially in the morning , Loss of flexibility of joint, Limited, joint movement, Deformity of the joints , Weight loss and fatigue , Non-specific fever and Crepitus. The proposed expert system presents an overview about Arthritis disease is given, the cause of diseases is outlined and the treatment of disease whenever possible is given out. SL5 Object Expert System language was used for designing and implementing the proposed expert system. Results: The proposed Arthritis disease diagnosis expert system was evaluated by Orthopedics students and they were satisfied with its performance. Conclusions: The Proposed expert system is very useful for Orthopedist, patients with arthritis and newly graduated Orthopedics students[81].

► **Knowledge Based System for Diagnosing Guava Problems**

The importance of agriculture stems from its ability to strengthen the economy. Agriculture also contributes to the employment of workers in the capacity of agriculture to achieve a high percentage of this equation, in addition to the ability of agriculture to achieve a high degree of self-adequacy, and the development of other sectors. Although the problems and obstacles to agriculture cannot be reduced and limited, both because of problems related to natural and environmental resources, technical problems and obstacles and many other reasons. But here we will take care of the most important problems are diseases affecting plants and trees and how to deal with them before the incursion of the disease. The concentration in this paper on guava disease, so the designed expert guava system aims to help farmers and people interested in guava development to learn about guava diseases to enable them to find and treat the right treatment of the disease.

The Guava system calls on farmers or users to observe the symptoms that they see at the guava plant so that the expert system can identify the disease and give the user some information that may help farmers grow guavas[76].

- **A Rule Based System for the Diagnosis of Coffee Diseases**

Coffee beans are grown in more than 60 countries. The coffee tree is different from the rest of the trees in terms of the climate it needs to grow. This affects the taste of the grain. In order to produce the fruit tree, it takes 3 to 5 years to start the production process. Arabic coffee is considered one of the best and best coffee types in the world, for several reasons, the most important of which is the volcanic mountainous soil rich in nutrients necessary for the better growth of this tree, giving it a taste more aromatic than the other. The coffee tree has many diseases that threaten its production. In this research, we proposed an expert system for diagnosis of coffee tree diseases and this system of experts was designed and implemented using CLIP. A group of farmers, people interested in coffee tree production and agricultural teachers tested the proposed system of experts and found it very useful [86].

- **Knowledge Based System for the Diagnosis of Dengue Disease**

Background: Dengue Disease is a mosquito-borne tropical disease caused by the dengue virus, symptoms typically begin three to fourteen days after infection. This may include a high fever, headache, vomiting, muscle and joint pains, and a characteristic skin rash. Dengue serology is applied in different settings, such as for surveillance, in health care facilities in endemic areas and in travel clinics in non-endemic areas. The applicability and quality of serological tests in dengue endemic regions has to be judged against a background of potential cross reactivity with other flavi-viruses, difficulties in distinguishing primary from secondary infections and technological problems related to the fact that most dengue endemic regions are relatively poor of resources .Objectives: to help doctors and patients in diagnosing Dengue Disease and give them the information of how to prevent Dengue Disease and to be able to understand the signs and symptoms of Dengue Disease. Methods: We collected all relevant material for Dengue Disease. Then we designed and implemented a knowledge based system for diagnosing Dengue Disease using SL5 Object Language. Results: The knowledge based system was evaluated by a group of Patients and specialized doctors and they found it very friendly and easy to use [85].

- **Knowledge Based System for Uveitis Disease Diagnosis**

Our eyesight is one of your most important senses: 80% of what we perceive comes through our sense of sight. By protecting your eyes, you will reduce the odds of blindness and vision loss, one of things that may cause vision loss is Uveitis. Uveitis is a form of eye inflammation. It affects the middle layer of tissue in the eye wall (uvea). Uveitis (u-vee-I-tis) warning signs often come on suddenly and get worse quickly. They include eye redness, pain and blurred vision. The condition can affect one or both eyes. It primarily affects people ages 20 to 50, but it may also affect children. Possible causes of uveitis are infection, injury, or an autoimmune or inflammatory disease. Many times a cause can't be identified. Uveitis can be serious, leading to permanent vision loss. Early diagnosis and treatment are important to prevent the complications of uveitis. Because of that we designed an expert system to help people to know if they got Uveitis early after that they can get treatment and they will save their eyes [92].

5. Conclusion

In this paper we surveyed 77 existing knowledge based system found in the literature up to the date of publishing this paper. There might be other knowledge based systems that we have missed; but when found, they will be added to the next release of the knowledge based systems survey.

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