Early Determination of Cancer in Patients Using Web Based Expert System

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Abstract—As one of the most important branches of Artificial Intelligence is the expert systems, Expert systems are application oriented; it is also a computer application that solves complicated problems that would otherwise require extensive human expertise. Cancer is the uncontrolled growth and spread of cells. It can affect almost any part of the body. The growths often invade surrounding tissue and can metastasize to distant sites. It can be detected earlier than usual either when an individual recognizes symptoms and then quickly consults and is diagnosed by a physician or through the application of a screening test, aimed at diagnosing pre-cancerous changes or cancer itself in generally asymptomatic individuals. The aim of this project is to design and implement a web based expert system for the early determination of cancer in patients. For the development of expert system, free e2gLite expert system building tool (shell) implemented as a Java applet was applied which is equipped with an inference mechanism and a knowledge base, and the web interface was developed with the use of HTML. The system asks questions of the user to elicit the information needed in order to recommend or give final result based on the user input and uses IF-THEN rules to represent knowledge.

Keywords—Expert System, Web, Cancer disease, e2gLite.

I. INTRODUCTION

Interest in cancer has grown during the past decades as infectious diseases have increasingly been controlled as the result of improved sanitation, vaccination and antibiotics. Although this interest is relatively recent, cancer is not a new disease and has afflicted people around the world. However, it is obvious from the low survival from many cancers that if these diseases are to be controlled, we cannot rely solely on increasing the availability of medical care. It is vital to increase our understanding of the genetic, environmental and social factors that foster these diseases, with the aim of applying this knowledge to effective preventive measures.

AI is a system that can reason about facts about the world using rules, and take appropriate actions as a result [1]. In [2], the following definition was provided, stating an expert system is a computer program that represents and reasons with knowledge of some specialist subject with a view to solving problems or giving advice. To solve expert-level problems, expert systems will need efficient access to a substantial domain knowledge base, and a reasoning mechanism to apply the knowledge to the problems they are given. It is also, a computer-based system that emulates the reasoning process of a human expert and serves different purposes like Consulting Diagnosis, Learning, and Decision support, designing and planning, etc. An expert system is a system that can reason about facts about the world using rules, and take appropriate actions as a result [1].

II. RESEARCH MOTIVATION

It has been discovered that most symptoms of cancer are in a way related to other kind of illness which causes confusion and makes patient treat themselves wrongly, also the doctors not having enough skill or training in diagnosing and giving treatment to patients rightly. Hence, the current rate at which people die of cancer globally based on statistics, is increasing year in year out, and the problems faced by patients diagnosed with cancer and its consequences, and the burden of whether it cannot be detected early before it gets to the irresolvable stage leads to this research work.

Statistics on trends in cancer incidence and mortality worldwide reveals how the cancer burden is growing at an alarming pace and emphasizes the need for urgent implementation of efficient prevention strategies to curb the disease. The system will therefore provide an interactive, simple and easy to use graphical user interface application.

2.1 An Overview: Cancer Disease

Cancer is a leading cause of death group worldwide and accounted for 7.4 million deaths (around 13% of all deaths)
in 2004, more than 70% of all cancer deaths occurred in low- and middle-income countries. Deaths from cancer worldwide are projected to continue rising, with an estimated 11.5 million deaths in 2030 [3]. Although cancer comprises of over 200 different types that affect humans, each with its own methods of diagnosis and treatment [4], all cancer cells share one important characteristic: they are abnormal cells in which the processes regulating normal cell division are disrupted. Cancer is the uncontrolled growth and spread of cells. It can affect almost any part of the body. The growths often invade surrounding tissue and can metastasize to distant sites according to [5], therefore to understand what cancer is, it is helpful to understand the behavior of a normal cell. Normal body cells grow, divide to make new cells, and die in an orderly way. Cancer is also a complex genetic disease that is caused primarily by environmental factors. The cancer-causing agents (carcinogens) can be present in food and water, in the air, and in chemicals and sunlight that people are exposed to. Since epithelial cells cover the skin, line the respiratory and alimentary tracts, and metabolize ingested carcinogens, it is not surprising that over 90% of cancers occur in epithelia [6]. There are over 200 different types of cancer that affect humans, each with its own methods of diagnosis and treatment [4]. The grouping of cancer types is presented in The National cancer Institute [7] and Cancer Support Community [8]. The spread of cancer from one part of the body to another is called metastasis National cancer Institute [7]. Some cancers do not form tumors. For example, leukemia is a cancer of the bone marrow and blood.

2.2 How Cancer can be Diagnosed
Cancer often has no specific symptoms, so it is important that people limit their risk factors and undergo appropriate cancer screening. Most cancer screening is specific to certain age groups and your primary-care doctor will know what screening to perform depending on your age. Other signs and symptoms caused by cancer will vary depending on what part of the body is affected, though some general signs and symptoms associated with, but not specific to, cancer are easily identifiable but should not be disregarded. Cancer can be diagnosed either symptomatically or asymptptomatically.

2.2.1 Symptomatic diagnosis:
   a. Rectal bleeding
   b. Palpation of breast lump
   c. Coughing up blood/chest pain
   d. Blood in urine
   e. Difficulty swallowing
   f. Hoarseness
   g. Fatigue
   h. Lump or area of thickening that can be felt under the skin.
   i. Weight changes, including unintended loss or gain.
   j. Skin changes, such as yellowing, darkening or redness of the skin, sores that won’t heal, or changes to existing moles.
   k. Changes in bowel or bladder habits
   l. Persistent cough
   m. Difficulty swallowing
   n. Hoarseness
   o. Persistent indigestion or discomfort after Eating.
   p. Persistent, unexplained muscle or joint pain
   q. Persistent, unexplained fevers or night sweats.

1.4.2. Asymptomatic diagnosis
   a. Blood test – PSA, other markers
   b. Screening study (ies) – PAP, PSA, Colonoscopy.
   c. Mammogram, total-body CT scan
   d. Asymptomatic pick up on physical exam
   e. Leads to radiographic or surgical biopsy (operation) and then
   f. To pathology (The pathologist makes the diagnosis of cancer).

The American Cancer Society [8] uses the word C-A-U-T-I-O-N to help recognize the seven early signs of cancer:
   a. Change in bowel or bladder habits
   b. A sore that does not heal
   c. Unusual bleeding or discharge
   d. Thickening or lump in the breast, testicles, or elsewhere.
   e. Indigestion or difficulty swallowing
   f. Obvious change in the size, color, shape, or thickness of a wart, mole, or mouth sore
   g. Nagging cough or hoarseness.

2.3 Consequences Of Cancer
The cancer story is changing. What was once feared as a death sentence is now an illness that many people survive. As survival rates increase, so too will the number of people living with the legacy of cancer and its treatment. Unfortunately, not all cancer patients return to full health once their treatment is over, some are left with debilitating health problems as a direct result of their cancer and its
treatment, and these people often feel abandoned. [9] Help highlight some of these side effects that patients face after treatment:

- Heart problems
- Lung problems
- Endocrine (hormone) system problems
- Bone, joint, and soft tissue problems
- Brain, spinal cord, and nerve problems
- Learning, memory, and attention difficulties
- Dental and oral health and vision problems
- Digestion problems
- Emotional difficulties
- Secondary Cancers
- Fatigue

III. AIMS AND OBJECTIVES
It is imperative that for every new system to be designed or newly designed system must have a major purpose as being the aim of the system to be designed. However, the aim of this research work is to design an Expert system for the determination of cancer in patients, which possesses the following objectives:

- to know the most effective way to raise awareness of potential cancer, its causes and symptoms
- to empower the patient to get tested and present this to their doctor, serving as a temporary assistance before being passed to the appropriate specialist for treatment.

IV. LITERATURE REVIEW
AI research is highly technical and specialized, deeply divided into subfields that often fail to communicate with each other. Some of the division is due to social and cultural factors: subfields have grown up around particular institutions and the work of individual researchers. AI research is also divided by several technical issues. There are subfields which are focused on the solution of specific problems, on one of several possible approaches, on the use of widely differing tools and towards the accomplishment of particular applications.

Artificial intelligence (AI) is technology and a branch of computer science that studies and develops intelligent machines and software. AI textbooks define the field as “the study and design of intelligent agents” [10]. The field was founded on the claim that a central property of humans, intelligence—the sapience of Homo sapiens—can be so precisely described that it can be simulated by a machine. This raises philosophical issues about the nature of the mind and the ethics of creating artificial beings, issues which have been addressed by myth, fiction and philosophy since antiquity [11].

Expert system is an artificial intelligence program that has expert-level knowledge about a particular domain and knows how to use its knowledge to respond properly. Domain refers to the area within which the task is being performed. Ideally the expert systems should substitute a human expert. [12] of Stanford University has defined expert system as “an intelligent computer program that uses knowledge and inference procedures to solve problems that are difficult enough to require significant human expertise for their solutions.”

The source of knowledge may come from a human expert and/or from books, magazines and internet. As knowledge plays a key role in the functioning of expert systems they are also known as knowledge-based systems and knowledge-based expert systems. An Expert system is defined as a computer program that reason using human knowledge to solve complex problems [12], [13]. Other literature used in the research as presented in [14], [15], [16], [17], [18], [19].

4.1 Expert System Design and Development
A precise domain is required by an expert system. The domain must be compact and well organized. The quality of knowledge highly influences the quality of expert system. The first step in the development of any expert system is problem identification. Cancer remains unidentified in initial stage. Carcinogens induce cancers which are present in environment due to pollution. normal genes of body become defective and cause cancer, also, lack of awareness in public to identify the cancer. The problems occur frequently and the consequences on the human expert. The demand for help is increasing rapidly. Therefore expert systems are needed in those areas where the help to human expertise is not readily available.

4.2 Method and Source of Data Collection
In this work knowledge was acquired by consulting an expert in the medical field (medical professional). Books and journals written by medical professional were reviewed and the internet for facts, articles, related to cancer such as signs, symptoms, causes, diseases, kidney etc on expert systems. The knowledge acquired was represented in simple production rules constructed in E2glite comprises of JavaScript and Java Applets. No server side processing was needed.

4.3 Representation of Knowledge
In the representation of knowledge into knowledge base, the knowledge acquired from knowledge acquisition process is represented into structured form. This involves encoding and representation of the facts and relationships that constitutes the knowledge. In this case, a Web based user interface module for the domain experts to allow them enter rules and basic facts about the 10 types of cancer was used in this research work.

The rules and facts are based on the consultation process, with specific information on the cancer basic symptoms. The domain experts can monitor and automatically test the execution of the expert system in Web browser before deployment for the users and this is achieved with the help of E2glite a rule-based expert system shell. E2gLite which comprises of Java applet and is a development toolkit (a 'shell') developed by eXpertise2GO which was developed with Java. The other development tools include; HTML (Hyper Text Mark-up Language), JQuery and Cascading Style Sheet (CSS).

V. THE NEW SYSTEM

The system, “a web based expert system for the determination of cancer in patients”, is a rule based medical system for diagnosis of 10 types of cancer using E2glite as the knowledge base. Forward chaining inference mechanism is used. This method involves checking the condition part of a rule to determine whether it is true or false. If it the condition is true, then the action part of the rule is true. This procedure continues until a solution is found or a dead end is reached. Forward chaining is commonly referred to as data-driven reasoning, it begins with known facts and an attempt to move towards the desired goal it is an antecedent driven. The system consists of multiple options to diagnosis, viewing various symptoms and terms and overview information of cancer diseases. As the system uses plane English language to interact with user no special knowledge is required for individual to use.

5.1 Managing From Web Based To Expert System

To manage from the web-based to expert system, the .jar file which is an executable file must be embedded in the html page in order to run on the web. To use the expert system, a Web page that loads the applet and identifies the knowledge base is needed. The e2gLite consist of 3 main components which are;

1. E2gLite. jar file
2. The .KB files
3. The. HTML file

5.2. Expert System for Diagnosis and Early Determination of Cancer

For the development of expert system, free e2gLite expert system building tool (shell) implemented as a Java applet was applied. To use the expert system, a Web page that loads the applet and identifies the knowledge base is needed. The system can be used without network connection under the requirement for putting the Web page (index.html), the knowledge base (CancerRules.kb) and the e2gLite applet archive (e2glite.jar) in the same subdirectory.

5.3 Cancer Diagnose Start-Up Page

This is the page where proper consultation will start, but before the consultation starts, the user must be able to identify the changes and symptoms for which he/she feels either internally or externally. When the user click on start consultation, it will link to another page which is Fig. 3 where the user will interact with the system and ask various questions about their sex, age, and series of symptomatic questions. It is the submission of each response to the question that prompt another question, it is now based on the input provided by the user that the system (Expert system) will now draw out the final conclusion and let the user know the type he/she has, as illustrated in Figs: 1 and 2.

![Fig.1: Cancer Diagnose Start-Up Page](image1)

Fig.1: Cancer Diagnose Start-Up Page

![Fig.2: Cancer Diagnose](image2)

Fig.2: Cancer Diagnose
5.4 Question of expert system

The system gives questions to a user in Fig. 3. When the user submits his response, he can continue to another question. After clicking the “Why ask?” button, the user can see the inference engine’s explanation of the question. The user can find out the goal or sub-goal, the inference engine is currently working on, attribute that is trying to find and the rule that needs the value of this attribute.

![Fig.3: Question of expert system on cancer disease](image)

(1) Explanation of the question: After answering the questions, the inference engine has enough information to conclude the interview with high risk of kidney disease: if you are above 60, have a family history, have heart problem, and have high blood pressure, obese and a smoker. The expert system will now give the recommendation that there is high risk of having kidney disease. As illustrated in Figs: 4, and 5

![Fig.4: Explanation of the question (Output)](image)

VI. CONCLUSION

The a web based expert system for cancer diagnosis has been designed and implemented in other to be used to solve problems of too many patients seeking daily medical attention. The system has been able to review various causes and symptoms of cancer disease and also enhance early diagnosis and refer for better treatment; it also serves as a temporary assistance to those who are in need of instant help when expert consultant is not readily available.

Furthermore, the system has been carefully designed to be user friendly, interactive and accessible to anybody that intends to use it irrespective of their location, and time, to manage or diagnosis various kidney diseases based on user input. The results given by the system have been validated with domain experts after tested with domain dataset. The knowledge is represented in the form of IF-THEN rules which reasoning by forward chaining. This expert system does not need intensive training to be used, it has simple interface and attractive, it is developed using E2glite a rule-based expert system shell and can be used in DOS/Windows environment. In this study we recommend that teaching Hospitals and all other public and private Hospitals should develop a web based expert system that will serve as temporary assistance to those who are in need of instant help when a human expert is not readily available due to time or distance.

REFERENCES

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