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Web-Based Decision Support System for Prescription in Herbal Medicine

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Abstract
This paper presents an integrated method to develop a Web-based Decision Support Systems (DSS) for prescription in herbal medicine. Review of existing research works in herbal medicine revealed that the potential of web platforms was exploited to aid herbal medicine survival. In light of this, an architectural framework of the proposed system was developed. First, a pilot study, in which a number of personal unstructured interviews with health service providers and patients, was conducted. This was done to discuss the purpose of the research study. The framework was evaluated based on the users' assessment to determine the efficiency of the proposed system in terms of ease of usage, reliability and relevance of the system. The proposed system is self diagnostic and does not only have a role to play in enhancing decision making but also in the study of diagnostic protocol, self-assessment and quality control in the domain of herbal prescription

Keywords: web based, herbal medicine, prescription, decision support system (DSS)

INTRODUCTION

Herbal medicine treats diseases and promotes health with plant material. For centuries herbal medicines were the primary methods to administer medicinally active compounds. Medication is an important aspect of human life which deals with the administration of ethical drugs on a health practitioner's advice. In Nigeria, today, the rate of poverty is so high that make impossible for people to afford modern medications (Owonubi, 1988). According WHO report (1996), the issues of fake drugs, drug abuse and excessive side effect of drugs are other major problems in modern medicine. In recent times, herbal medicine has found its way as an alternative to orthodox medicine, it is the oldest and still the most widely used system of medicine in the world today (Acharya and Shrivastava, 2008). It is mainly extracted exclusively from plant. It is used in all societies and is common to all cultures due to its affordability. Herbal medicine is increasingly being validated by scientific investigation which seeks to understand the active chemistry of the plant; many modern pharmaceuticals have been modeled on, or derived from chemicals found in plants (Dash and Sahu, 2007). The therapeutic activity of plant is due to its complex chemical nature with different part of the plant providing certain therapeutic effects (Zheng, et al, 2005). Ancient wisdom has always known the roles herbs have played in the intricate balance of well-being of the human species. They have little or no side effect as a result of their preparation from natural herbs (Ernst, 2007).

In Nigeria today, orthodox medicine has been widely accepted due to the fact that it is the mother of all medicine. Nevertheless, orthodox medicine has its own disadvantages, including issue of price of the medicine and the inability of people to afford it. The present economic situation has made it difficult for people to afford the cost of medication, leading to self medication. Self medication is the administration of ethical drugs by a lay-man without a health practitioner's advice (Adeniji, 2000).

In life, there is always an alternative to everything. The alternative to life itself is death. The alternative to orthodox medicine is herbal medicine, otherwise referred to as traditional medicine. Traditional medicine is practiced in every part of the globe, both developing and developed nations. The practice has reached various degrees of sophistication in response to level of development in different parts of the world. One of the most important components of alternative Medicine is herbal medicine (Astin, 1998).

The problem of herbal medication observed over the years was that their portions are not standardized, nor are they dispensed to patients in specific doses or in strictly regulated quantities. Inadequate information about the drugs and the herbalist may also die with the knowledge of the herbs which may lead to misinformation about the herbs in generations to come (Patterson, 1996). Sequel to this, this paper proposes a web-based decision support system for herbal medicine prescription (Ogirima, 2012). With the development of the Internet, Web-based Decision Support Systems (DSS) have become a new trend in DSS research now provide us with the tools and knowledge that we need to improve health care, enabling solutions that benefit patients as well as healthcare professionals and institutions in both the

private and public sectors worldwide (ITU, 2008), (Zhang and Goddard, 2007) and (Gregory and Rodney, 2002). According to Power in (2007) and (2002), he defined Web-based DSS as: "a computerized system that delivers decision support information or decision support tools to a manager or business analyst using a 'thin-client' Web browser like Netscape Navigator or Internet Explorer". The developed system provides easier way to get herbal prescription without the intervention of herbal practitioners; it is self diagnostic and an alternative medication to orthodox medication (Ogirima, 2012)

REVIEW OF RELATED WORKS

Douglas et al and RAND Electronic Prescribing Expert Advisory Panel (2004) compared electronic prescribing systems. The authors argued that commercially available electronic prescribing systems may differ in their effects on patients' health outcomes and on patients' ability to manage costs. They convened experts' panel to recommend specific features that would enable electronic prescribing systems to advance these goals. The panel authored sixty recommendations and rated each using a modified Delphi process. Ratings identified fifty-two recommendations as clearly positive for patient safety and health outcomes and forty-three recommendations as achievable in the average clinician's office within three years. Overall, these recommendations offer a synthesis of evidence and expert opinion that can help guide the development of electronic prescribing policy.

According to the Medication Errors Panel (2005), they studied and reported on prescription for improving patient safety and how medication errors could be addressed. The panel suggested a system approach to managing medication errors resulting from prescriptions. After spending considerable time examining each part of the medication-use process – prescribing, dispensing, using administering/self-administering and monitoring – and the inter-relationships of each component, the panel identified four key medication-use systems/processes and three key stakeholder groups which served as the focus of its recommendations.

The four key processes which the Panel believes could be better designed to reduce and prevent medication errors are those related to the transcription and transmission of prescriptions (i.e. the methods prescribers use to document a prescription order and communicate that order to the pharmacy where it will be filled); the education of the consumer regarding the purpose of the treatment, the effective use of the medication, and the monitoring of signs and symptoms that may indicate efficacy or toxicity; healthcare provider payments and incentives which can directly or indirectly influence providers to pursue behaviors designed to reduce medication errors and healthcare provider training and licensure which could foster a better understanding among providers about the seriousness of medication errors and the behaviors to adopt that will reduce them.

Nelson (2009) worked on E-Prescribing as a micro-organizational network in search of an analysis framework. He suggested that the organizational form of e-prescribing is a temporal ad-hoc micro-organizational network (MON) centred on the e-script (engineered artifact) transaction between a single prescriber and a single pharmacy. He claimed that each transaction requires a MON so the structural form of e-prescribing is a network of MONs. A synthesis approach was used to explore both the e-prescribing reference design and available theoretical frameworks to further understand the design of the network. He later concluded that studying the MON for e-prescribing as an organizational form is essential as future care coordination among healthcare organizations will become increasingly computer-mediated.

Arora and Sinha (2012) classified Web applications as the fastest growing classes of software systems today. Web applications are being used to support wide range of important activities: business transaction, scientific activities like information sharing, and medical systems such as expert system-based diagnoses. Web applications have been deployed at a fast pace and have helped in fast adoption but they have also decreased the quality of software.

As observed from existing research works on e-prescription, little or nothing has been done on the web-oriented prescription in herbal medicine which is the focus of this paper.

MATERIALS AND METHOD

The detail of the methodology and approach adopted are described as follow.

Architectural Framework of the Web-based DSS for Herbal Medicine Prescription

In this paper, an architectural framework for a web-based decision support system for herbal medicine prescription is developed and presented in Figure 1. The framework defines the components of the developed system together with the interactions between each component. During the design stage, the architecture of the system was developed taking into account the constraints imposed by the user requirements and the available technology

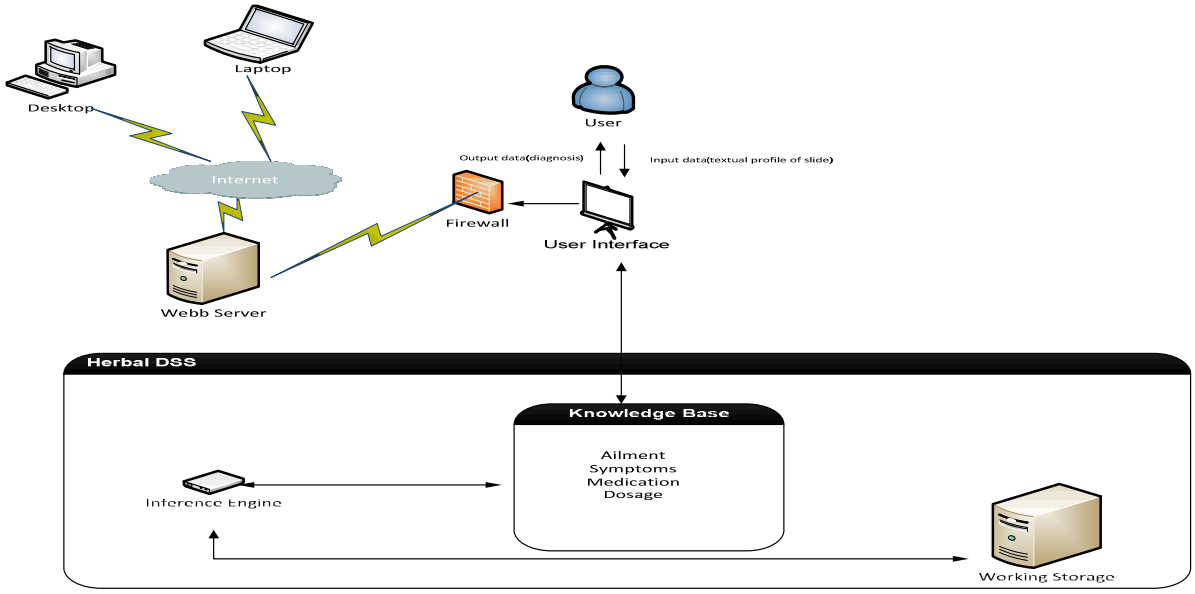

Figure 1: Architectural Framework of Web-based DSS for Prescription Herbal Medicine

The components of the Framework are explained as follows.

1. Internet terminal/Devices (Desktop, Laptop, PDAs)
2. User Interface for Herbal Medicine Prescription
3. Web server
4. Firewall
5. Herbal Medicine Knowledge base
6. Inference engine
7. Database

Internet Terminals / Devices: The user's desktop send message to the dedicated internet devices connected to the server where the application resides with the help of internet protocol provided by the internet operator. The information is got from the server by using the internet protocol; this enables the client to send information to the server and to be able to receive information back from the server.

User Interface: User input data (diagnosis request) through the user interface, which consequently calls the knowledge base, feeding the user input data, the knowledge base is being consulted then the inference engine comes to a final diagnosis, which is displayed by the user interface to the user.

Web Server: Is the gateway application that enables you and your applications to send/receive internet messages through internet devices to your computer. It has an easy to use user interface, and an excellent internal architecture.

Firewall: Firewall is software that checks information coming from the internet or a network, and then either blocks it or allows it to pass through to the attempted system depending on the firewall settings. Allowing information through the firewall, sometimes called unblocking, is when an exception is created to enable a particular program to send information back and forth through the firewall.

Knowledge Base: Knowledge base consists of some encoding of the domain of expertise for the system. This can be in the form of semantic nets, procedural representations, production rules, or frames. These rules occur in sequences and are examined by the inference engine; actions are executed if the information supplied by the user satisfies the conditions in the rules.

Inference Engine: Inference engine is the dialogue conducted by the user interface between the user and the system. The user provides information about the problem to be solved and the system then attempts to provide insights derived or inferred from the knowledge base. These insights are provided by the inference engine after examining the knowledge base.

Database: The database is a fundamental part of the system. It is also called as the working storage and it works hand in hand with both the knowledge base and the inference engine as a means of storing data. It stores all important and detailed information of the Herbal and that of the administrator. Besides, it stores the detail set of prerecorded messages dropped by user, which are suitable for different guidance cases. In addition, the database server has both temporal validity and precise timing constrains which allow it to store the most recent data and effect instant changes as soon as they occur.

The DSS Design for the developed Herbal Medicine Prescription

The system design, Figure 2 depicts the sequential flowchart of activities of use and the actions that will be performed when an operation is being executed. Figures 3 show the structure knowledge of the database and the relational of the structure of the developed system. The sequence diagram (Figure 4) describes how the objects in the system interact over time. The objects identified in the system are the patients (users) and herbal practitioner using the system, user interface and the DSS. They interact in the sequence shown by passing messages across the timelines. These messages are the actions carried out by the objects in the system in a chronological order. The activity diagram (Figure 5) shown depicts the sequential flow of activities used to model actions that would be performed when an operation is being executed as well as the result of those actions. Figure 6 shows the pictorial design of how the user and system administrator interact with the proposed system. The user interface displays the ailments, symptoms, medication and prescription for each corresponding ailment. The system is user friendly at this stage. The system administrator has interface that includes the buttons that is necessary for the updating of the database. The database stores the information about the new discovery ailment, and their likely symptoms and cure.

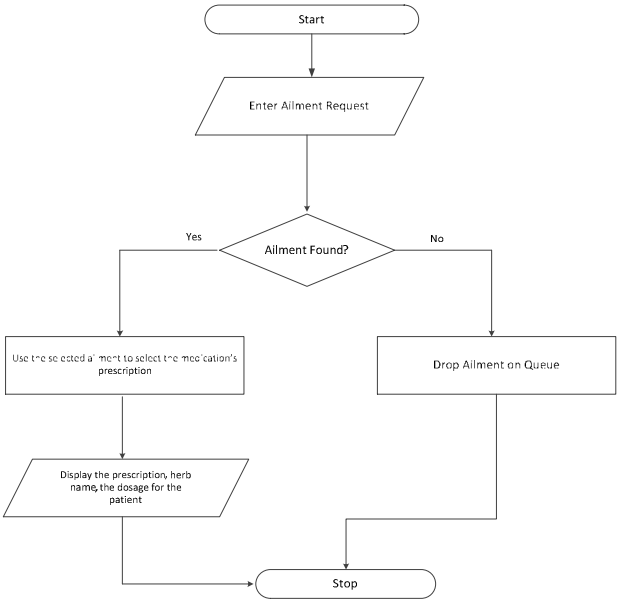

Figure 2: User Server of the developed system

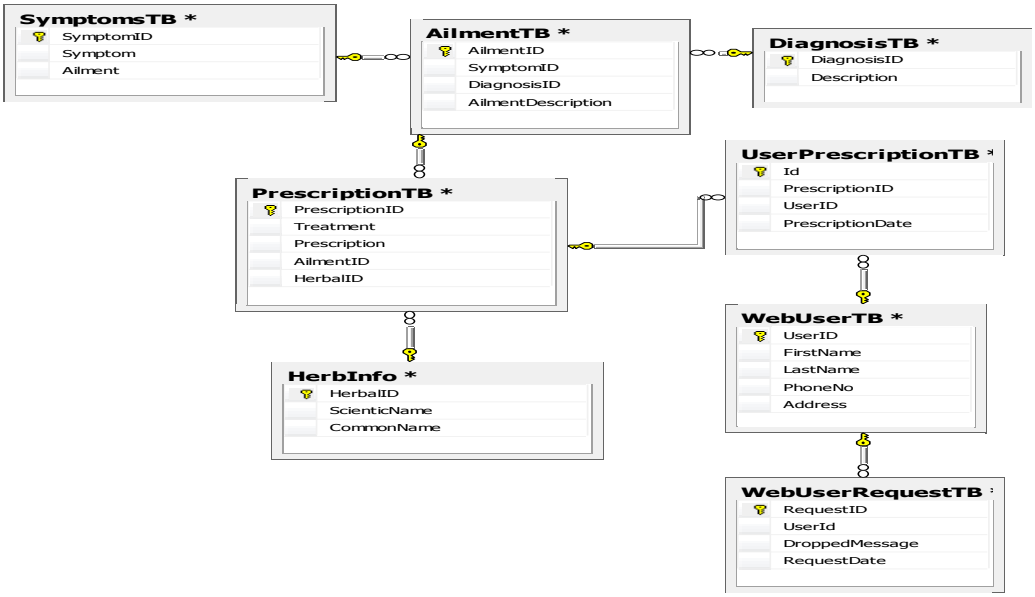

Figure 3: The structure knowledge of herbs database

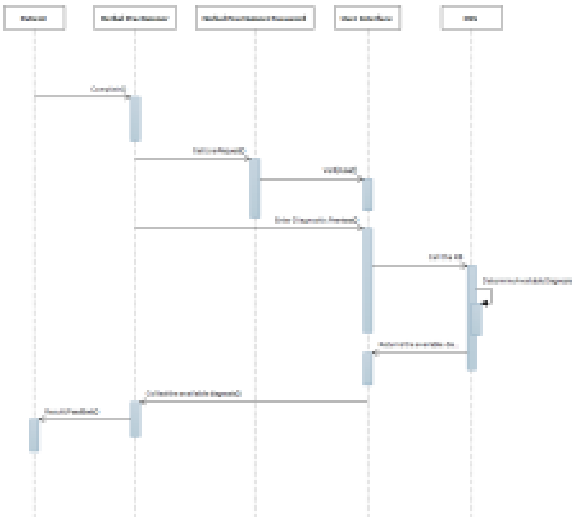

Figure 4: Sequence Diagram of the developed system

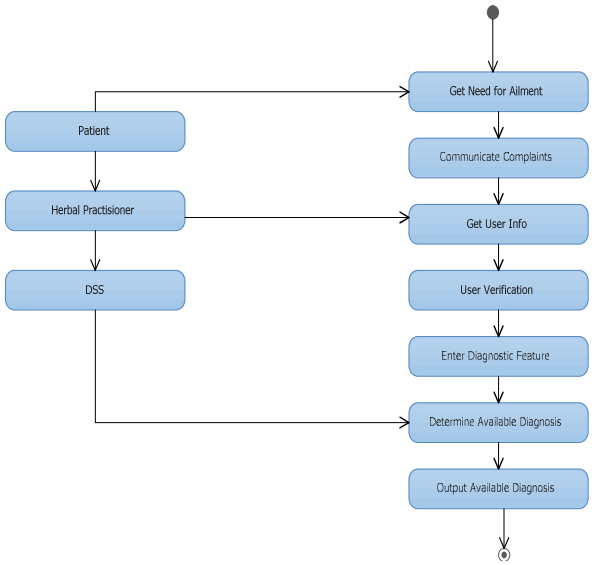

Figure 5: Activity Diagram of the developed system

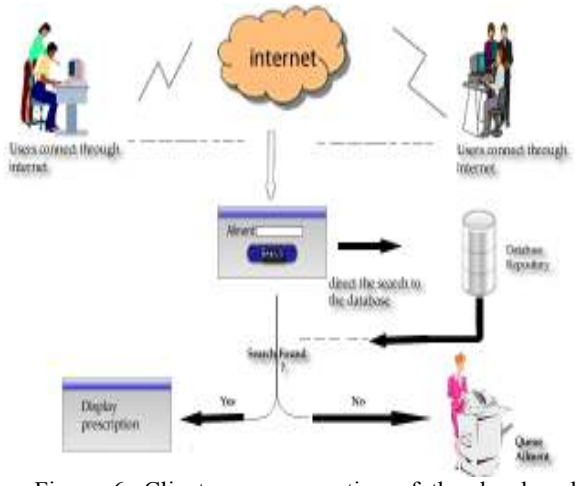

Figure 6: Client server operation of the developed system

Implementation Tools

The programming tool used to implement the design is C# using Microsoft Visual Studio 2008 integrated development environment (IDE). Visual Studio *.NET* is Microsoft's integrated development environment (IDE) for creating, running and debugging programs for the development of the designed system.

THE STUDY AREA AND SAMPLE SIZE

The population of the study comprises of the entire health service providers and patients at the LAUTECH teaching hospitals situated in Oyo and Osun States, Nigeria. The health service providers consist of Doctors, Nurses, Midwives, the hospital maids, attendants, nursing and medical students. Consequently, there was adoption of a purposive technique to determine those to be interviewed (sample size) because the population in the study area is large. Purposive sample is drawn to aid the ease of data collection or special features of the members of the sample. Therefore, the selection of the respondents was based on identification made by the health stakeholders in the study area of those who can serve the research purpose.

A total of one hundred (100) copies of questionnaire were distributed to these respondents from diverse educational background while ninety-five (95) copies were returned, representing a response rate of 95% as follows:

i. Pharmacists = 22
ii. Patients = 32
iii. Nurses / Midwives = 9
iv. Doctors = 11
v. Others (Hospital Management staff, Nursing and Medical Students) = 21

The respondents were asked to indicate the factor (s), according to how strong each feels, that can significantly influence the choice of web to convectional face-to-face treatment by herbal practitioners.

DATA COLLECTION INSTRUMENT

A well-structured questionnaire and oral interviews were used to gather primary data for the study. The questionnaire was validated and tested for reliability. A Cronbach alpha reliability co-efficient of $\alpha = 0.72$ was achieved.

METHOD AND TOOLS FOR DATA ANALYSIS

Microsoft Excel was used to capture and analyze the data obtained from the duly-filled copies of questionnaire while frequency and percentage distributions were the descriptive techniques used. The descriptive survey was adopted to obtain the opinion of a representative sample of the target population so as to be able to infer the perception of the entire population.

RESULTS AND DISCUSSION

The evaluation carried out in this work was based on users' assessment to determine the efficacy of the proposed system in terms of ease of usage, reliability and relevance of the system. This is accomplished by administering a questionnaire developed on a 5-point Likert rating scale. A Likert rating scale is a psychometric scale commonly used in questionnaire, and is the most widely used scale in survey research (Mogey, 1999). When responding to a Likert questionnaire item, respondents specify their level of agreement to a statement. The most common scale is 1 to 5. Often the scale will be 1 = strongly disagree, 2 = disagree, 3 = not sure, 4 = agree and 5 = strongly agree. Similarly Likert items were combined using the Likert summing analysis to formulate the three parameters used for the evaluation. One hundred (100) copies of the questionnaire were administered to collect user's assessment of the developed system. Ninety-five (95) out of one hundred (100) copies of the questionnaire were received from users of diverse educational backgrounds indicating a response rate of 95% and data retrieved from the duly-filled questionnaire were captured and analyzed using Microsoft Excel. The proposed system was tested using the statistical analysis of individual Likert items is presented in Table 1 and the bar chart representations of the analysis is presented in Figures 9**.** The Q1, Q2, Q3, Q6, Q7 and Q10 from the set questionnaire were not a Likert item, therefore it was not analyzed.

The assessment carried out in this work was based on users' preference between Web based and face to face herbal prescription in terms of security, cost, ease of usage, privacy and mobility of the system. In figure 7, the gender distribution of the respondents is presented; while 68% of the respondents are male, 32% are female.

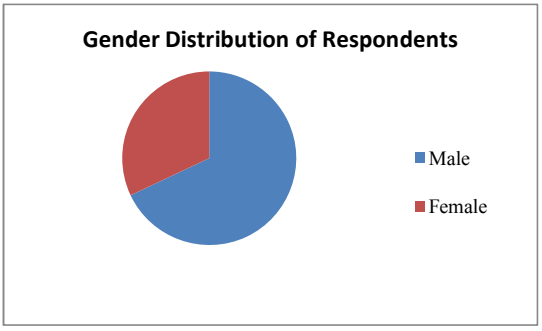

Figure 7: Gender Distribution of Respondents

However, figure 8 shows the distribution of occupation of the respondents in the study area. The degree of responsiveness of the respondents decreases from the patients, to the pharmacists, the others (management staff of the hospital, the nursing and medical students), the doctors and the nurses in that order.

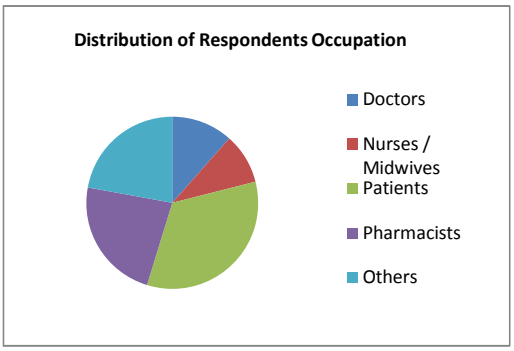

Figure 8: Distribution of Respondents Occupation

The results obtained from the analysis of the respondents' data revealed that the proposed system offers high degree of ease of usage and reliability. Most respondents ascertain that it has a highly efficient emergency system with high relevance to realize immediate response to health symptoms and challenges of individuals. The system's knowledge base was evaluated by some experts who tested the system to query the diseases and the corresponding medications. Based on the result obtained, the system is capable of assisting herbal practioner to make an accurate and timely decision-taking, substantial eliminating error in wrong medication and thereby increasing the efficiency of diagnostic skills.

Table 1: Data Analysis of the Administered Questionnaire

	Likert Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Response Mean	Response Mode
Q4	Would you agree that the developed herbal prescription system is a suitable alternative to orthodox medicine?	13	16	22	32	12	3.15	4
Q5	Would you agree that developed herbal system is better than orthodox medicine?	14	14	13	31	23	3.37	4
Q8	Would you agree that the ingredient for treatment prescribed by the developed herbal system for various ailments are readily available?	15	16	15	33	16	3.20	4
Q9	Would you agree that the developed system could be used for treatment of ailments considered terminal by orthodox medicine?	11	18	20	33	13	3.20	4

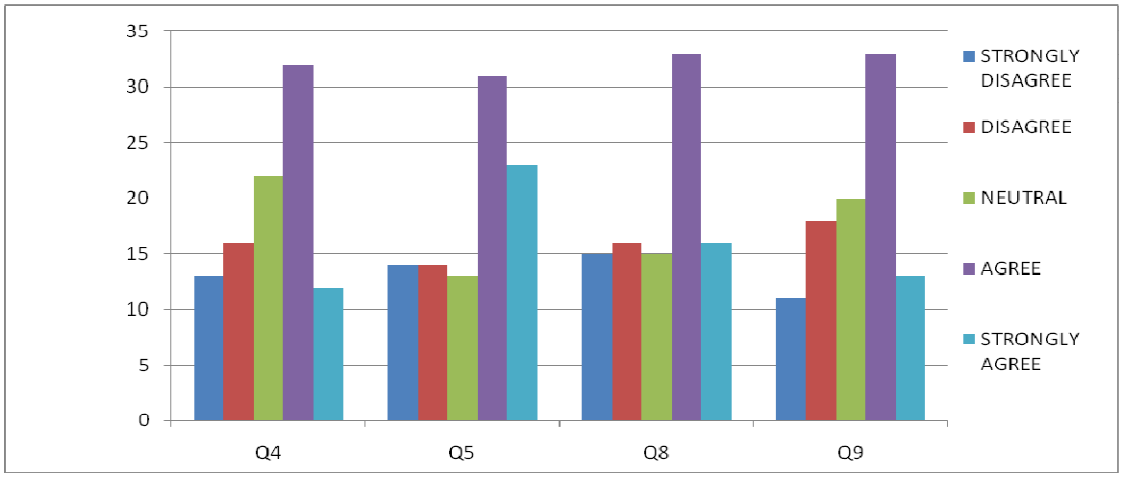

Figure 9: Bar Chart Representation of Numerical Frequency of Response of Table 1.

The symptoms interface (Figure 10) shows the diseases and their symptoms in which user or patient can check for the symptom of the ailment he or she is suffering from. If such symptom or ailment is not found then the patient drop request as shown in Figure 11. The client's prescription interface shown in Figure 11 gives the detailed herbal prescription entities (i.e. ailment, treatment herbs, and the dosage). Users of the application are free to choose from the ailment catalogue. Treatments show how the herbs are to be administered or used by the patient and the dosage to prevent the patient from taking excess. The users get feedback of herbal medication for the requested ailment with the dosage prescription immediately if there is cure else the user need to drop a request as shown in Figure 13, pending the cure is found.

Herbal information list (Figure 12) provides the patient or the user information about the herbs needed for the treatments requested for (i.e. showing the botanical and their common name). Users can visit this site provided they are connected to the internet to see the available herbal plants. This will now aid the user or patient to check for the herbal plant within his/her locality

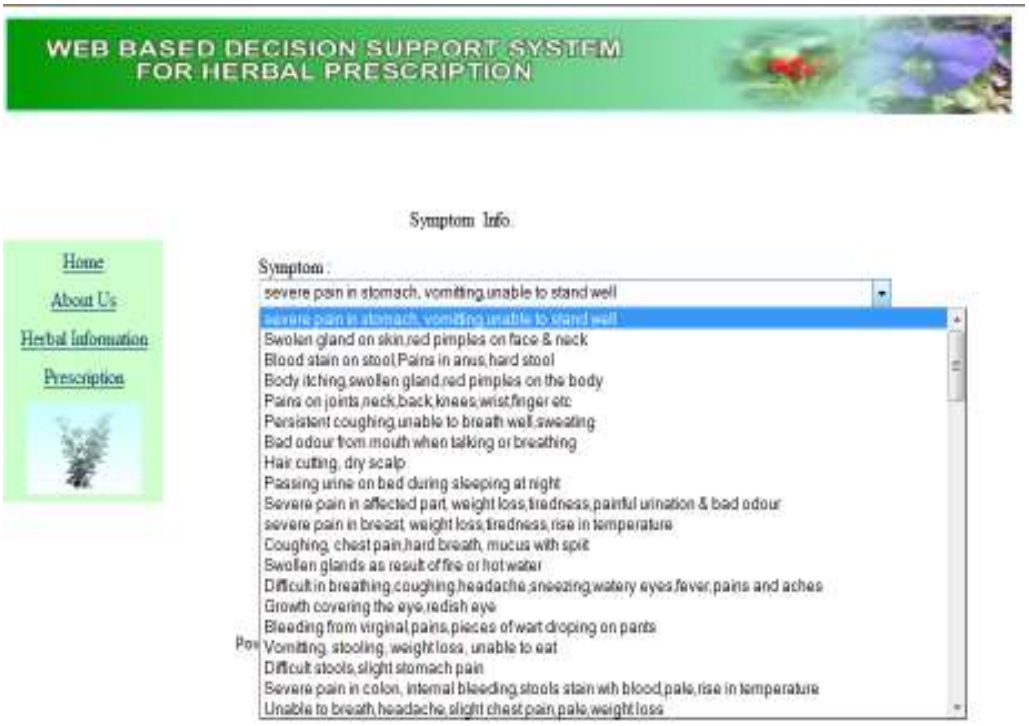

Figure 10: Ailment symptoms for user's request for medication

Figure 11: Clients Prescription screen

Figure 12: Herbal information list

Figure 13: Patient Ailment Request.

This system is developed for internet users. The users check the site where the application resides with the help of the site protocol provided by the internet operator and get the information from the server. This enables the client to send information to the server and to be able to receive information back from the server based on the action it performs and the information retrieved from the database.

CONCLUSION

For any sustainable enviroment good heath is parmount to reduce death rate. Therefore this system is not intended to replace orthodox medication but rather to pave way for the usage of herbal medication through the use of internet to reduce poverty level of those that cannot afford convention medication. The system attempts to enhance the effectiveness of herbal medication which has its information in the knowledge base that improves efficiency in decision making. Therefore, the diagnosis made by the user of the system are at least as good as those of human herbal practioners', since at each point or step the user makes request for medication, the system gives a feedback cure for the ailment.

Also, DSS, such as this, does not only have a role to play in enhancing decision making but also in the study of diagnostic protocol, self-assessment and quality control in the domain of herbal prescription. It will also assist people in the remote area with internet facilities to use their PDA or palmtop to obtain herbal prescriptions on their relative health challenges. Hopefully, the proposed system would boost the courageous effort of pioneer health practitioner players like Oko Oloyun, OgiHerbs, Yoyo Bitters, Yemkem, Ayodele slimmer, etc based in Nigeria.

Therefore, for any National capacity building strategy for sustainability and poverty alleviation we need good health.

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