

DANES: Diet and Nutrition Expert System for Meal Management and Nutrition Counseling

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Abstract: “Your body is your temple”

As people across the globe are becoming more health conscious, eating more healthy food and avoiding junk food, a system that can measure calories and nutrition in every day meals can be very useful for maintaining one’s health. Food calorie and nutrition measurement system is very beneficial for dieticians and patients to measure and manage their daily food intake. We also know that it’s difficult to find an affordable nutritionist or a dietician across the street; therefore, we have proposed a system – DIET AND NUTRITION EXPERT SYSTEM. The proposed system is a responsive android application which contains the knowledge and data regarding the fitness of a person and nutrition content values. This application consists of the user interface which will be publicly displayed on the application i.e. the basic information regarding the fitness and nutrition values such as how to maintain good health by adapting healthy eating habits which includes the intake of calories, proteins and carbohydrates etc. in proper proportion. A dietician consults a person based on his schedule, body type, height and weight. The system too asks all this data from the user and processes it. It asks about how many hours the user works, his height, weight, age etc. The system stores and processes this data and then calculates the nutrient value needed to fill up users’ needs.

Keywords: Diet, nutrition, expert system, food, health, BMI

1. Introduction

In artificial intelligence, an expert system is a computer system that emulates the decision-making ability of a human expert. Expert systems are designed to solve complex problems by reasoning about knowledge, represented mainly as if-then rules rather than through conventional procedural code. Artificial intelligence or more specifically, expert systems, have also been developed to solve either meal planning problems or health related problems.

Expert Systems (ES) are intelligent software applications that provide advice to its users through a dialog or a conversation conducted between the user and the ES application. An expert system is divided into two subsystems: the inference engine and the knowledge base. The knowledge base represents facts and rules. The inference engine applies the rules to the known facts to deduce new facts. Inference engines can also include explanation and debugging abilities. Expert systems provide a good platform to implement applications that can be at par with human expert. Since, these days’ people tend to neglect basic health care, food consumption and overall health

awareness, which serve as a motivation to create an expert system in diet and nutrition.

Nutrition is 80% of our fitness goal equation. Nowadays, human beings suffer from many health problems such as fitness problem, maintaining proper diet problem, etc. The effective personal dietary guidelines are very essential for managing our health, preventing chronic diseases and the interactive diet planning helps a user to adjust the plan in an easier way. Nutrition is getting food into the body for growth and energy, and for keeping the body healthy and living. It also includes the environmental, psychological and behavioral aspects of food and eating. The aim is to provide the end user with proper health information which is at hand’s reach, easily accessible and readily available. And none other than smartphones are the way to fulfill these requirements.

Smartphones are no doubt the most widely used means of communication for its ease of use, ease of handling, and increasing capabilities. And therefore, we have proposed an Expert System application to be deployed on Android. Our project is not just another fad diet plan or a calorie counter, but a lifestyle coach to help one create daily habits by

teaching proper nutrition. The app delivers results through tailored, easy to follow meal plans. The app is designed to give a personalized step by step guide accommodating everyone, from beginners to advanced fitness enthusiasts. The application aims to provide customized healthy meals and diet plans, foods to eat and foods to avoid. The application is to be produced on Artificial Intelligence. The user fills the registration form and then logs in to the application. After login users must fill personal information including age, weight, height, gender and activity level. For calculating BMI, age, weight, height, gender and exercise level are necessary. Based on calculated BMI (Body Mass Index) Artificial Dietician will display the calorie intake for logged user. User will be given various options and varieties in their diet chart. The daily calorie intake for each user depends upon his/her BMI, gender and eating patterns. The system provides the user to enter their daily food intake using the tracker methodology. The user will be given an analysis report at the end of their diet session. The application caters to the need of all types of users from infants to senior adults, from teenage children, special diets for pregnant women to people suffering from health problems such as Blood Pressure, Diabetes, etc.

2. Literature Survey

The existing systems help us with the basic knowledge of how to implement the Diet and Nutrition Expert System. We learn from the various elaborate explanations and intend to improvise the existing system and hence come up with our proposed system. Following are the various insights gathered from different papers which have proved helpful for our literature survey.

The eating habits of Costa Rican society are alarming. Obesity rates have increased making our country one of the most obese populations in the Latin American region. Six in ten people suffer a disproportionate increase in their weight because their poor nutritional habits (CACIA 2012). The prevalence of obesity, BMI > 30, is 59 percent (Rosero 2009). Studies estimates Costa Rica will be one of the ten most obese populations in the world by 2020 (Euromonitor 2011). This reality makes it essential to raise public awareness about the need for a much-needed dietary improvement and encourage preventive care. Many people, and particularly students, cannot afford to consult a private nutritional expert (Morales 2012). Hence, public health agencies such as the Office of Welfare and Health of the University of Costa Rica face the challenge of finding alternative methods for educating the population in incorporating healthy eating habits into their daily. One problem in healthcare is the lack of availability for frequently health monitoring. Health software offers less expensive solutions reducing the physician-patient physical relation and provides monitoring solutions. Mobile Internet and the use of Web for medicine have a strong impact on

health-care models that are based on the concept of anytime and anywhere connections. Mobile software applications can help facilitate the distribution of nutritional information, learn to assess their own nutritional level, and acquire better eating habits to improve their current condition. [1]

Nutrition UCR is a prototype expert system for diagnosing, controlling, and monitoring human nutrition. The system assesses the physical characteristics of the user to determine their nutritional status and makes recommendations for reaching nutritional requirements and a balanced diet, consequently generating a knowledge database with the nutritional status and dietary habits of a university population. The system generates challenges, alerts, and constantly motivates the user to use the application and improve their nutritional habits. The expert system is implemented using the JESS, Java Expert System Shell, libraries (Laboratories 2012) and the Java programming language running as a Web Service on a Linux Web Server. The prototype calculates the BMI, Body Mass Index, as in Eq. 1 (OMS 2012), the ideal weight and physical contexture, frame size (Rivas 1991) and uses dietary information from (Bermudez 2012). [1]

Developing the expert system as a standalone application on the mobile phone has the advantage of being available at any time, and any place but it has many disadvantages. First: the application will be bounded by the hardware capabilities of the mobile device which needs special care for knowledge representation, inference engine, and interface design. Second: updating the knowledgebase or the database will require reinstalling the application on the mobile device. Third: A special version should be released for each mobile platform since standalone applications are platform-dependent.[2]

Most people gain knowledge nowadays using technology including artificial intelligence technologies. Artificial Intelligence (AI) aims to develop systems which exhibit 'intelligent' human-like behavior (Anjane, 1998; Becerra-Fernandez et al., 2004). Expert systems, a type of AI technologies, encode human expertise in specific domains by using If-Then rules, and accordingly advise and provide solutions to different problems (Becerra-Fernandez et al., 2004); the five components of expert system are user interface, working memory, knowledge base, inference engine and explanation system. [3]

Neumark-Szteiner (2009) presented five main proposals for preventing obesity and related eating disorders among girls, which include eating healthily rather than following diets, adopting a positive body image, having meals with their families instead of their friends, taking part in physical activities, and involving the families of overweight teenagers when addressing weight related problems. [4]

Usually, a dietitian evaluates a client's dietary conditions and enters those into a computer-based diet construction system. Often the diet constructed by the system requires modification by the dietitian or nutritionist to meet certain integrity constraints, such as ensuring a meat portion in each lunch, juice for breakfast, etc. or simply milk when a cereal is planned for breakfast. Since menu integrity requirements are very difficult to comprehensively formalize, the currently available diet construction systems violate at times such restrictions which are rather obvious for the human user. [5]

Over the years various mathematical models, such as linear programming, have been proposed and applied to diet construction with little success to completely automate the diet construction process

2.1. Study of Existing System

There are several nutrition expert systems reported in the literature; the first one is called "The Nutrition Diet Program" (NDP) which is developed to help the rural population who can't find dietician or the medical doctor near them. This system provides a customized diet plan for patients; the system prepares this plan based on the many details provided by the user (Ramachandran et al., 1992). [3]

Another expert system is for "Nutrition Counseling and Menu Management"; this program makes menu planning and manages the eating habit (Hong and Kim, 2005). [3]

The third one is a "Nutrition Diagnosis Expert System" that utilizes "Nutritional Care Process and Model (NCPM)", which is "defined by American Dietetic Association (ADA) in 2008 and integrate the nutrition diagnosis knowledge from dietetics professionals to establish the basics of building the rule based expert system with its knowledge base" (Chen et al., 2012, p. 2132). The system is built using Microsoft Visual Studio 2008. [3]

Kahraman and Seven (2005) presented a computer system that utilized the branch-and-bound method to minimize a diet in terms of cost, while attempting to include most of a certain individual's food preferences. [4]

Frega et al (2012) developed a program that could be used to evaluate the average dietary needs in a typical Mozambican household and present a healthy diet for such a family. Although the system provided feasible solutions regarding dietary constraints and requirements, the resulting diets were not generally very affordable. [4]

Vienna expert system for parenteral nutrition of neonates (VIE-PNN) [22] is designed to perform specific task of calculating the daily changing composition of parenteral nutrition for small new-born infants. [5]

3. DANES: Your personal nutritionist

Understanding the above-mentioned quotes on significance of human body and its health, an artificially intelligent dietician expert system is being designed to monitor/ track the user's everyday diet and suggest the end user an appropriate and healthy diet plan. It aims to provide variety of food options to the user. The application must also consider the medical history of the user (as there are many people who have various diseases due to which they are not allowed to consume some types of food items. For example, a diabetic patient is not allowed to consume food items that contain high level of sugar.) The application must be able to suggest diets as per the person(s) current situation; like, for a pregnant lady, the diet will be different than a normal lady. The system will also enable the user to keep a track of the daily activities and produce a daily, weekly and a monthly report of the user.

3.1 System Analysis

DANES is application software that provides the customer with the information of the importance of a healthy lifestyle along with a dietician recommended diet. The system, first takes in the personal details of the user such as age, weight, height, medical history etc. Based on this information, the system generates a diagnosis report which consists of the BMI along with the estimated calorie goals of the user.

The medical history of the user is considered as there are many people who have various diseases due to which they are not allowed to consume some types of food items. For example, a diabetic patient is not allowed to consume food items that contain high level of sugar. Similarly, a person suffering from blood pressure should preferably consume less amount of salt. The expert system outputs (advices) are different for people with different ages and genders. From a knowledge engineer perspective, a decision table is utilized to improve building the logic in the knowledge base of the expert system. A decision table is a good way to deal with combinations of 1371 Vision 2020: Innovation, Development Sustainability, and Economic Growth things (e.g. inputs). Decision tables provide a systematic way of stating complex business rules, which is useful for developers as well as for testers.

Different decision tables are developed depending on age groups: young children (1-3 years), 4-8 years children, adolescent male (9-13 years and 14-18 years), adolescent female (9-13 years and 14-18 years), adult males (19-30, 31-50, 51-70, and >70 years), and adult females (19-30, 31-50, 51-70, and >70 years). This categorization is recommended by the Omani guide to healthier eating by the Ministry of Health (2009). It is categorized in this way

because every level of age need different requirement of nutrients. It differs from young to adults and from male to female as well. The developed nutrition and diet expert system, first calculates the body mass index (BMI) based on this formula: $BMI = \text{weight}/\text{height}^2$. By calculating the BMI, the system concludes about the “body type”: whether the person is under weight, Normal weight, overweight or obese. Consequently, based on the concluded “Body type”, and other inputs, the expert system then advises the identified above nutrition and diet outputs.

$$BMI = \frac{(\text{weight in kilograms})}{\text{height in meters}^2}$$

The user is then given a chance to select the type of diet which he may prefer i.e. vegetarian, eggetarian or non – vegetarian. System then queries the knowledge base for the diet; a suitable diet is prescribed to the user. We have also included a tracker that will take daily input from the user regarding the food that he/she has consumed today, any physical activities that are done etc. The system will keep a track of all the details entered by the user and will generate a day to day report which will help the user to know if he/she is under the estimated calorie goals or not. The entire activity of the user is tracked and analyzed over the diet tenure. After the completion of the prescribed diet, the user will have to give a feedback, this feedback will be analyzed by the analyzer and an end term report will be generated. This report will contain a detailed analysis of how much weight you have lost and the estimated weight loss. If the user decides to continue with the diet plan, then he/she will be given a strict/lenient to normal diet plan according to the feedback given to him. This rule-based system captures nutrition and diet knowledge from human expert and relevant websites and then presents it in if-then statements format, and provides solutions.

3.2 Overall System Overview

The overall system overview can be viewed as 2 modules: Management and Menu Generating. The Management Module includes two processes. First is extraction of personal information which is passed to the next process of extraction of medical and dietary information. The management module has links to the patient’s database and the various documents.

The Menu Generating Module has 4 components. The first component identifies the nutrient requirements, the second component generates exchange table by foods and then by meals. The fourth component suggests menu. The extraction of medical & dietary information and the identifying nutrient requirements components are linked to the Food Composition Database. The generation of exchange table’s components follow a consistent set of Rules and Constraints.

The suggestion menu has links to the different databases like Case Base, Food Exchange Database and Diet Plan Menu database. All the components work together to give the required output.

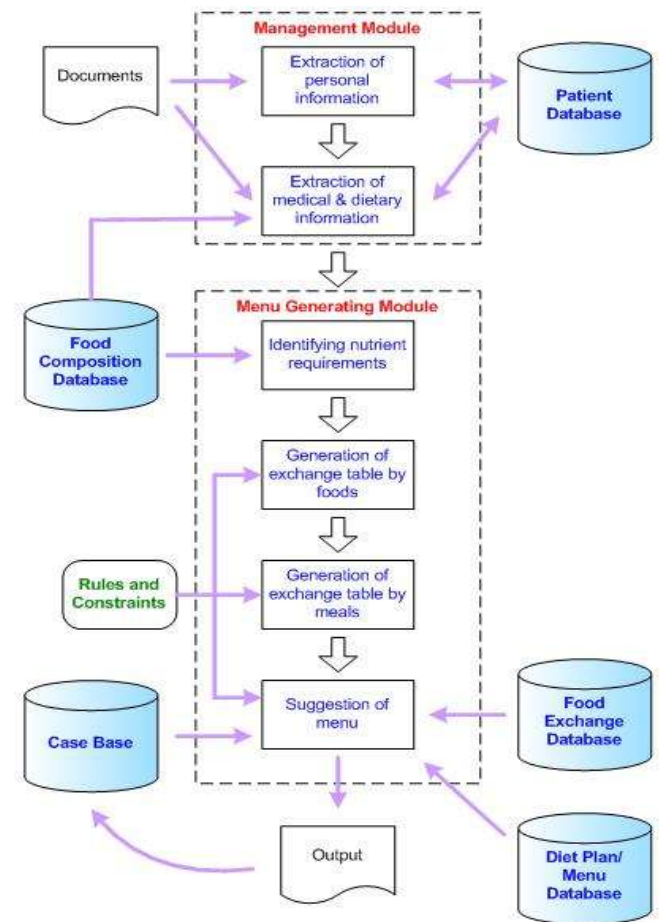


Figure 6.1: System Overview

4. Applications

The system eliminates the travelling cost in visiting a dietician and reduces the time required to get the best diet plan. As we know, dieticians are not available at every corner of the street; they are scarce and expensive. It is difficult to get access to a good dietician easily. This app overcomes that problem. It also overcomes the travelling cost to visit a dietician recurring times. It takes time for Dietician to come up with the best diet plan, this app aims to be quicker and at par with human expert. Dietitians can use this system to make sure what they recommend their patients. The system can also be utilized in gymnasium particularly for calculating the customers' calories and diet plans. Hospitals can also implement this system for recommending diets to their patients.

The diet suggested to the user will be as per his/her own BMI which ensures greater chances of reaching the goal. Individual can also use this software especially for themselves at home with step by step guidance process. This system can be very well used in medical colleges for

teaching and practicing purposes so that student can learn from it. Individual can also use this software especially for themselves at home. The system can be used by people of all age categories. The application will also be useful to celebrity individuals, sports persons' and home makers to assist them in keeping track of their diet and to help them make lifestyle changes.

5. Conclusion

People these days are more concerned about their health; they are always searching ways to lead a healthy lifestyle. The use of expert systems can improve people's awareness and help them get a proper advice. Providing an expert system for Diet and Nutrition adds value to people's life especially in developing countries. The expert system will provide expertise in nutrition consulting. It will offer a wide range of advices about the quantity of various nutrients that may meet the basic needs of the body; such as proteins, vitamins, fibers, and minerals. Also, the system will help the user to decide, to increase or decrease their weight by knowing their body type. Moreover, the system will also provide the user with meal plans and the food they need to consume for their body type. In addition, the system will save time required to consult a human expert and would be easier to access the diet plan.

In conclusion, this paper illustrates the process of developing Diet and Nutrition Expert System prototype and the potential benefits of developing such system.

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