



Shed: An Online Diet Counselling System

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Abstract: In today's health conscious (or lack of health consciousness) society there is a need for a more personalized, tailor-fit solution for maintaining a healthy diet for users. There are already existing recommendation systems aimed at helping users maintain a healthier diet. However, there is no single software application which is capable of combining all the capabilities (i.e., diet information, recipe recommendation, and recipe information) and thus there is no consolidated source of assistance or reference. Furthermore, there is a lack of recommendations presented in natural language that are produced by existing systems which means that outputs are not yet tailor-fit for users. Because recommendations do not highlight the benefits of choosing appropriate foods, the users may therefore be given irrelevant information or incomplete information that could have motivated them to choosing a healthier meal.

This paper discusses Shed, our diet counselling system, that combines all the essential facilities of existing systems and provides live, on-the-fly healthy diet plan recommendations that are presented in natural language which would be aimed directly at the user's needs and interests. Shed generates personalized meal recommendations by identifying which recipe (available on-line) that promotes weight loss and maintenance. The basis for the recommendations is on the basal metabolic rate (BMR) of the user which determines the calories he/she must take for a day.

Also included in the paper is an overview of the data needed in the processing and the components that comprise the system. Lastly, we present some initial results from user acceptance test.

Key Words: Natural Language Generation; Recommendation System; Diet Plans



1. INTRODUCTION

The United Nations consists of 191 UN member states around the world. All have agreed to try to achieve the eight Millennium Development Goals (MDGs) by the year 2015. The MDGs are derived from the United Nations Millennium Declaration, signed in September 2000, and all have specific targets and indicators.

The Eight Millennium Development Goals are:

- to eradicate extreme poverty and hunger;
- to achieve universal primary education;
- to promote gender equality and empower women;
- to reduce child mortality;
- to improve maternal health;
- to combat HIV/AIDS, malaria, and other diseases;
- to ensure environmental sustainability; and
- to develop a global partnership for development.

The MDGs are inter-dependent. That is, all the MDG influence health, and health influences all the MDGs (WHO, 2013). In February 2013, it was reported that there are at least half a million Filipino children suffer from malnutrition. One cause of malnutrition is poverty. And because there is not enough money for food, children go hungry. Hunger then affects health (diseases and, in extreme cases, cause death) and this also has social effects (i.e., economic needs pushes children to work, rather than to attend school, and those who attend school do not excel because of hunger, poor health, or tiredness from work) (Delfin, 2013). Moreover, the top ten causes of death in the Philippines include cardiovascular diseases, cancer, diabetes, kidney-related diseases, and conditions during the perinatal period (i.e., maternal or neonatal surrounding the time of birth(ing)) (Mella, 2013).

Many of the health-related problems can be prevented or managed by proper nutrition (Lee, Stoppler, & , Shiel, 2013). However, educating people on what is considered proper nutrition is a must. There are several web pages and articles online that provide information and some tools like recommender systems which gives suggestions on what food to consume and how much nutrients are in

these foods.

Unfortunately, existing health recommender systems are currently lacking in the aspect of results presentation. Most of these systems provide the nutritional facts as a table, without explanations of whether it is actually a healthy option or not and without information on why it would be beneficial to consume those foods (in the given ingredients) or the nutrients found in the foods.

One way to augment this gap is through the use of Natural Language Generation (NLG) techniques to provide more information that would hopefully motivate the user / reader to eat certain foods. NLG involves converting computerized data into written text, a technology such as this can be beneficial to health recommender systems.

In this paper, as we present our system Shed, we first discuss some related works in section 2. In section 3, we present our diet counselling system which focuses on providing recipes and information on these recipes that focuses on weight loss and weight maintenance. Section 4 shows our observations on initial user acceptance test. Lastly, in section 5, we present some conclusions and future work.

2. RELATED WORKS

In general, health-related recommendation systems already in existence mostly deal with giving users recommendations that are focused on one specific aspect of attaining a healthy diet. Most make use of a user's Body Mass Index (BMI) in order to recommend possible types of food items suited for weight loss, and the types and formats of these outputs vary greatly (Allan, 2011). What these systems lack is a consolidation of all their different functionalities, but more importantly in giving recommendations to users which are tailor-fit to the user's needs and are actually encouraging enough for the user to try it out.

DietFacts.com for example is a resource of different types of food items with their nutritional values supplied for the user to search for (Dietfacts.com). The information provided is potentially useful but its lack of automation and recommendation for users makes it difficult to use. A more complete system would be Changing Shape as

the system provided actually keeps track of the user's bio data, recommends appropriate weight-loss exercises for the user and accepts updates on the user's condition (ChangingShape.com). What it lacks, however, is the functionality to recommend meals which may be appropriate with achieving weight loss. Nutrition Data is another system similar to Changing Shape which also keeps track of the user's bio data and also the calories the user should consume on a daily basis, but it lacks the feature of encouraging the user to use its recommendation (CondeNet, 2011).

A system with a different approach would be The Fit Map, which is a recommender system that focuses on getting its users to exercise. In line with its approach, it is also able to provide the users with the total amount of calories they should take within the day (TheFitMap.com). It does not however, recommend meal outputs as well as the ingredients in order to prepare them which may present users with a hard time in actually finding the meals they should take. Lastly, Weight Loss Resources is an on-line resource that simply provides the user with nutritional facts for food groups (WeightLossResources.co.uk).

3. THE SYSTEM

A diet counselling system, called Shed, is created to generate personalized meal recommendations that promote weight loss and maintenance. In our system, the generated recommendations are based on the basal metabolic rate (BMR) of the user which determines the calories he/she must take for a day. The BMR is calculated through the system's User Query Module. The BMR is used in the Web Information Retriever Module in order for it to retrieve on-line recipes that is applicable based on some recommendation criteria. The Natural Language Generation Module of the system then uses the recipes retrieved online to produce a meal recommendation explanation, which is aimed to encourage the user to follow the meal plan. The meal recommendation generated by the system will compose of the meal plan table, recipes

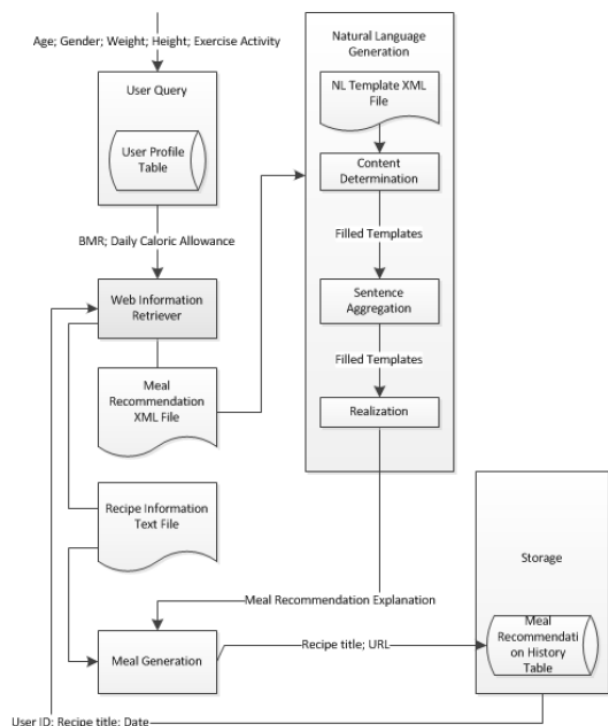
(dish name, ingredient list, preparation process), and a recommendation explanation. To provide these features, the system is composed of three main modules, mainly the User Query (UQ) Module, Web Information Retriever (WIR) Module, and the Natural Language Generation (NLG) Module. Figure 1 illustrates the architectural design and the succeeding subsections discuss more on each of the modules.

3.1 User Query

The User Query Module is the component of the system responsible for retrieving and storing information from the user. The information retrieved is used to calculate the daily caloric allowance of the user. The daily caloric allowance is the amount of calories a person must take in a day in order to maintain or lose weight (depending on the user's choice). The following are the information to be retrieved from the user: username, password, height, weight, gender, birthdate, and exercise intensity. It is necessary for the user to fill up all these fields in order for him/her to use the system.

3.2 Web Information Retriever

The Web Information Retriever (WIR) Module of the system is responsible for retrieving the recipes that will be used for the meal





recommendation, as well as the three main ingredients of each dish (the meal recommendation will focus around three main ingredients of a dish/recipe) (Abidin, et al, 2010). The recipes retrieved by this component of the system will be composed of the dish name, ingredient list, and a preparation process.

The basis for retrieving recipes will be the daily caloric allowance value computed in the UQ Module. The daily caloric allowance is then divided into six parts for the meal consumption for a day. The distribution of the daily caloric allowance values is based from Wegman's distribution formula which has the following breakdown: breakfast: 15%, 3 snacks of 5-10% each, lunch 20-25%, dinner 25-30% (www.wegmans.com).

Fig. 1. Shed System Architecture

3.3 Natural Language Generation

The Natural Language Generation (NLG) Module of the system handles the meal recommendation explanation feature of the system (used in order to encourage the user to follow the meal plan). The output produced by this component of the system is a generated text that is understandable and relevant to the user (Borra, nd). Meal recommendation explanations are generated one at a time for each meal of the day. The module adapts template-based NLG technique, where there predefined textual parts (like Introduction, Benefit of Main Ingredients, Relation of Benefit to Target Weight Plan, etc.) that has to be presented. Refer to Figure 2, label D for the sample explanations generated.

There are a total of three steps in the NLG Module which are content determination, sentence aggregation and realization. Content determination decides what content is to be used in the

recommendation, and inserts it into the system's templates. The content to be used is the three main ingredients of a particular recipe produced by the WIR module. Sentence aggregation is where similar filled templates produced by content determination are merged in order to avoid repetitiveness. The final step of the process, realization, is where the arrangement of the templates occurs. It decides in what order the filled templates will be shown and adds in some words in between for text cohesion (e.g. first, next, lastly etc.) (Yael, nd).

3.4 Meal Generation

The Meal Generation Module is in charge of presenting the meal plan to the user. It retrieves the outputs produced by the WIR Module and NLG module, specifically the recipes and recommendation explanations, in order to generate the meal plan. Refer to Figure 2 for the sample screen shot of the presented meal plan. The meal plan is presented in table form as a preview for the user (labeled as A in Figure 2), then each meal's food recommendation is presented in tabs (labeled as B in Figure 2) for viewing of the recipe information (labeled as C in Figure 2), including the description of the recommended food (labeled as D in Figure 2).

3.5 Storage Module

The Storage Module of the system is responsible for storing the previous recommendations of the user. The system adds a new record every time the system generates a recommendation. The system does this in order to avoid repeating meal recommendations.

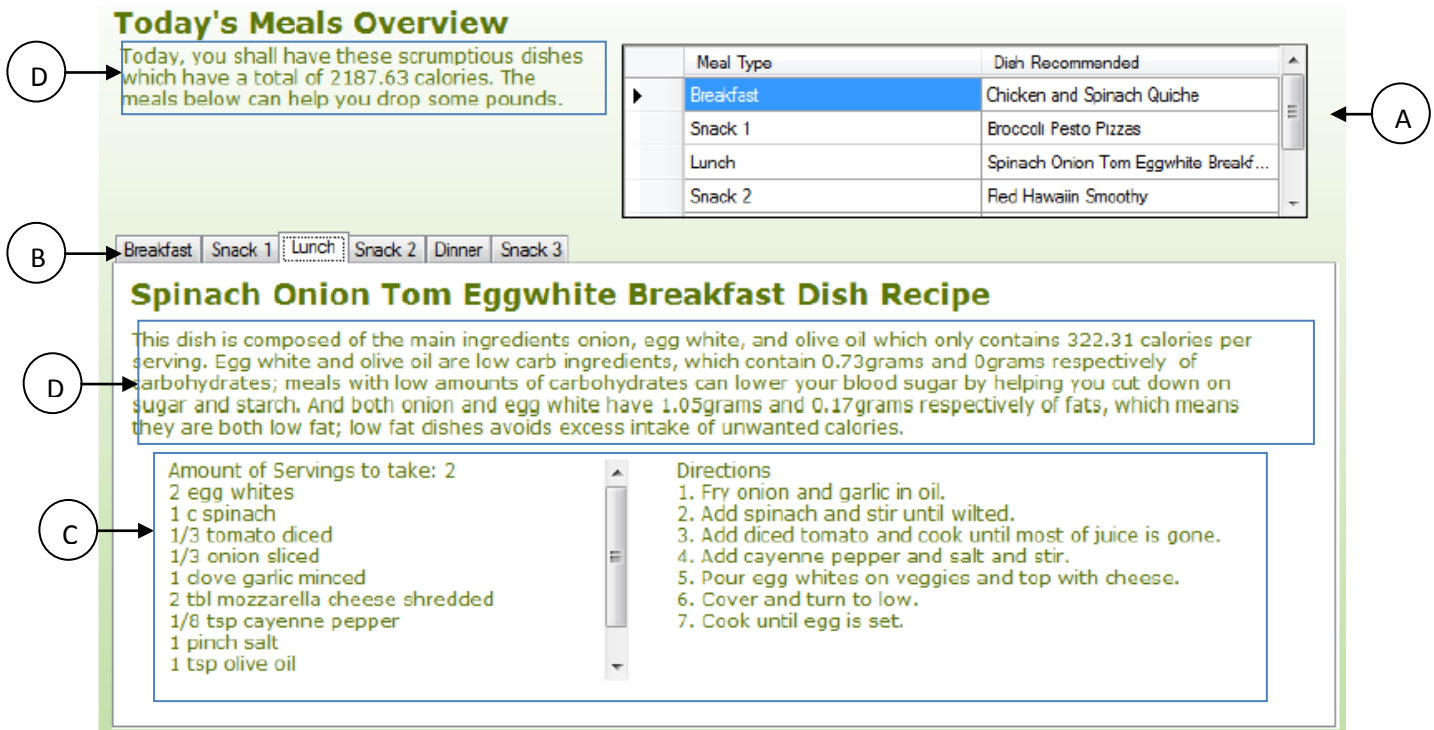


Fig. 2. Sample Shed Screen Shot of Meal Recommendation

4. RESULTS AND OBSERVATION

External evaluations were conducted for the system wherein casual users and weight-conscious users evaluated the system on the aspect of ease of use and correctness and relevance of recommendation. The system was also evaluated by a nutritionist. In the quantitative evaluation, users evaluated the system based on their personal experience with using the system. The criteria for evaluation and results are shown in Table 1. For each criteria the highest score is 5 (being strongly agreeing to the statement) and lowest score is 1 (being strongly disagreeing with the statement).

Table 1. User Acceptance Test Result

Criteria	Average Result
The organization of information is not overwhelming	4.6
The sequence of the process allows you to sign up efficiently and	4.1

systematically

The sequence of the process allows you to plan your meal efficiently and systematically 4.3

The system is effective in helping the user complete the task 4.3

The Introductory text and Meal information use well-formed, sensible, and understandable English. 4.2

The Introductory text and Meal information are relevant to you and your weight management plan. 4.2

As can be seen in the results in Table 1, the system is generally effective in terms of being able to supply the users with understandable English outputs and appropriate recommendations. Some respondents raised, though, that even though the outputs are informative (fat content, carbohydrate



content, etc.), not all people are interested in these types of information; therefore these information may be uninteresting and may even be irrelevant to their actual needs.

Moreover, it was noted that some of the computed caloric count of recipes were inaccurate. This is due to some missing information in the ingredient database (e.g., the ingredient in the recipe is low-fat cheddar cheese, but the ingredient database only has information on a “generic” cheddar cheese), thus the value used in the computation may be different.

5. CONCLUSION AND FUTURE WORK

The initial test results show that the developed system has promise. We have created a system that will provide all the necessary features to manage the user’s information (relevant to their diet / weight plan), produce meal recommendations, and generate information in natural language to provide more data in the meal options.

Future improvements of the system would include adding more information to the ingredient database or automatically searching in the internet for the necessary information, possibly retrieving the data directly from posted data of suppliers (i.e., specific to the brand, as some recipes indicate a specific brand of ingredient). Also, future recommendations may take into consideration other bases like fats and carbohydrates, rather than just calories for weight management. Furthermore, improvements can be done for the system to consider special dietary needs based on the clinical conditions (e.g. pregnancy, anemia, lactose-intolerance, etc.). Another feature that can be added into the system would be to generate meal recommendations based on user ingredient input. Also, the system may be improved to generate meal plans for longer periods like meal plan for the week or for the month (rather than per day).

Currently, the sources of recipes are limited only to specific websites. Expanding the current scope of the sources, in order to retrieve a wider variety of recipes and also specialized retrieval that can specify country or even region-specific recipes would be beneficial such that

ingredients needed in the recipe are available locally. Providing specialized templates for special diet cases will also enable the system to personalize information generated to provide more relevance to users with special needs.

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