Automated Recommendation of Healthy, Personalised Meal Plans

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ABSTRACT

Poor health due to a lack of understanding of nutrition is a major problem in the modern world, one which could potentially be addressed via the use of recommender systems. In this demo we present a system to generate meal plans for users which they will not only like, based on their taste preferences, but will also conform to daily nutritional guidelines. The interface allows the selection of recipes for breakfast, lunch and dinner and can automatically complete a daily meal plan or can generate entire plans itself.

Keywords

Health, Recommender Systems, Planning, Prevention

1. INTRODUCTION AND MOTIVATION

Poor dietary habits are a major cause of today's world health problems, however lifestyle-related illnesses can be prevented and sometimes even reversed through good nutrition [1]. Since people often lack the requisite knowledge to implement positive changes [2] food recommender systems (RS) have been touted as a potential means to assist people in nourishing themselves more healthily [3].

Food RS make sense as part of a strategy for behavioural change as suggesting a change that is less painful, i.e. based on something the user might like, is more likely to be accepted and followed. Recommenders are likely to be effective at predicting which changes will be painful or not but they have a serious drawback when aiming for positive change: they learn user preferences for ingredients and food styles. This leads to users who like fat- and calorie-laden meals being recommended fat- and calorie-laden meals [3] - an outcome not conducive to improving nutritional habits.

This demo presents a web-based system able to automatically create daily meal plans for users. It does so by calculating the nutritional requirements of the user based on their personal *personas* (age, gender, height,etc.) and, using the top recommendations given by a state-of-the-art recipe recommendation algorithm [3], attempts to generate a plan which corresponds to guidelines published by international health agencies. The planner is designed to form part of a larger web site where users can share, rate, search and browse recipes. After rating recipes, the user can receive recommendations of other recipes they might like and can even submit their own. The nutritional properties of the recipes are automatically estimated by the system using a state-of-the-art algorithm [4].

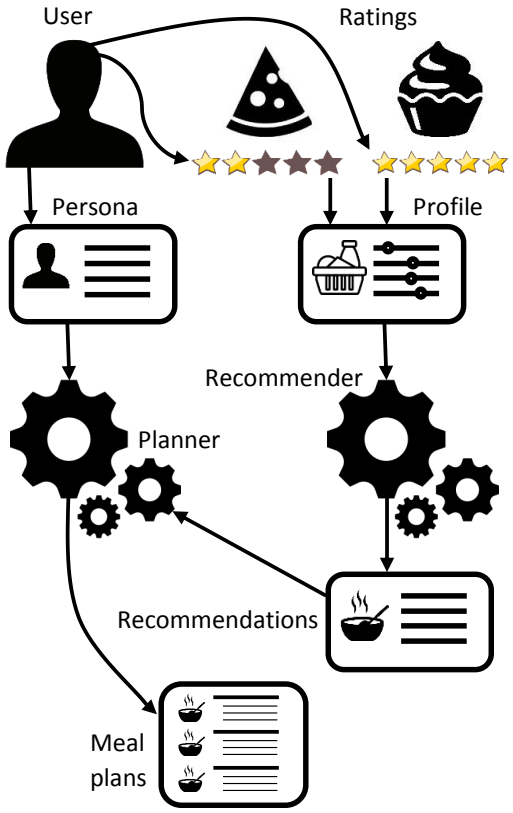

Figure 1: Diagram of system architecture.

2. SYSTEM ARCHITECTURE

Figure 1 shows the main components of, and flow of data within, the meal planning system. The user first provides information about their tastes by rating a number of recipes in the system via a typical 5 star rating paradigm. These are used to build the user's taste *profile* which is fed into the

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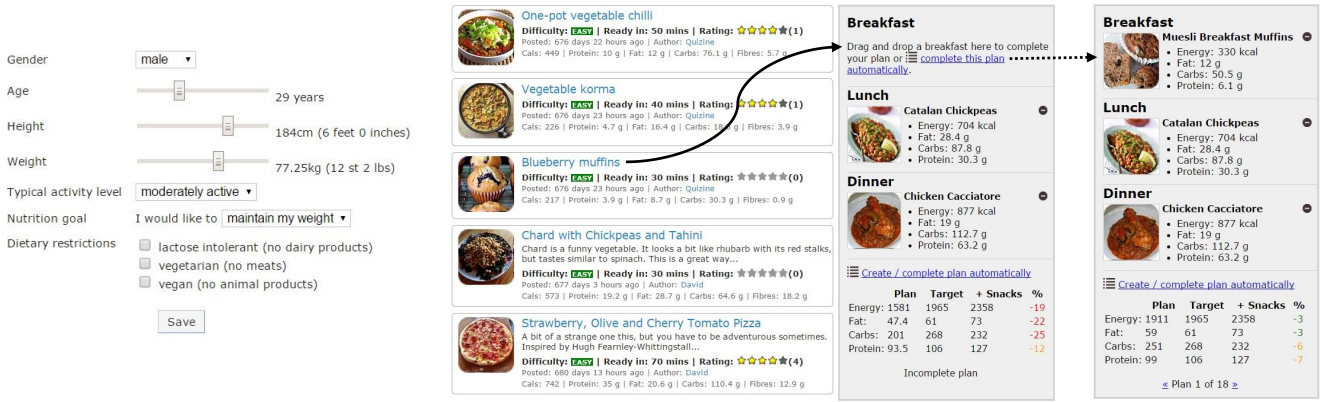

Figure 2: Screenshots showing meal planning interface (centre and right) and user *persona* creation (left).

RS detailed in [3]. The user also provides information about their height, weight, age, daily activity level and goal (to lose, gain or maintain weight). This is the user's *persona* and is an input to the planning algorithm and used to calculate their nutritional needs.

We calculate nutritional requirements using a version of the Harris-Benedict equation revised by Roza and Shizgal [5] which estimates an individual's basal metabolic rate (BMR) and daily calorie requirements. The estimated BMR value is multiplied by a number between 1.2 and 1.9 corresponding to the individual's activity level giving a recommended daily energy intake to maintain current body weight. We add or remove 500 kcal for individuals who wish to gain or lose weight which would result in the safe gain or loss of 0.45 kgs per week. We assume that 20% of the required energy will come form drinks and between-meal snacks and use standard measures for the proportion of calories that should come from proteins, fats, carbohydrates and fibres [1].

The RS generates predicted ratings for as yet unrated recipes and sends a ranked list of these (along with the recipes the user rated 4 or 5) to the planner. We can create plans for a given user (persona-profile combination) by first taking the top x recommendations from the RS for the taste profile. This set of recipes is then split into two separate sets, one for breakfasts and one for main meals. A full search is performed to find **every combination** of these recipes in the sequence [breakfast, main meal, main meal] which meets the target nutritional requirements defined above. Combinations with the same meals cannot be repeated, e.g. [R1, R2, R3] and [R1, R3, R2] are treated as only one plan.

The planner calculates the nutritional needs of the user based on the *persona* and attempts to build plans from the top x recommended recipes that can combine to provide all of the user's daily needs within an error margin of 10%. These plans are outputted for the user to evaluate and use. Note that it is also possible for the user to directly choose 1 or 2 meals for a plan and in this case the planner must complete the plan by filling in the blank meals (not shown).

2.1 Demo System

Figure 2 shows screenshots of the demo application. On the left is the interface for creating a user *persona*. The centre screenshot shows a list of recipes that can be dragged and dropped into the planning interface on the right. The system also provides a number of features for searching, sorting and browsing recipes which (not shown). The user has already chosen a lunch and dinner and can either have their plan automatically completed by clicking the "complete this plan" link (dashed line) or can try dragging another recipe of their choice into the breakfast slot (solid line). The screenshot on the extreme right shows one of the 18 generated meal plans for this example in which the system has chosen a breakfast which fits in to the existing meal plan. The table near the bottom summarises the nutritional properties of the plan and compares this to the target values for the user. The final column shows a colour-coded percentage indicating how far away from the ideal value the current plan is.

[1]https://www.nrv.gov.au/chronic-disease/summary

3. SUMMARY

This demo presents a first attempt at incorporating health and nutrition into the food recommendation problem by generating meal plans. This shows it is possible to combine recommended recipes into balanced meal plans according to nutritional guidelines.

4. REFERENCES

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