ABSTRACT

Nutrition Therapy is deviating from a traditional approach and moving towards a holistic approach to therapy. The current tools available are not sufficient in catering to this holistic approach because of their dependence on processed food sources for essential nutrients, the time-consuming nature of their use during holistic therapy, and their lack of whole foods options. To remediate the afore mentioned drawbacks, a web application is being built. It will allow the nutrition therapist to provide relevant nutritional information about a client and eventually create a whole-foods based menu specific to the client.
ACKNOWLEDGEMENTS

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INTRODUCTION

Most on-line resources that are available for use to registered nutrition therapists, when they make dietary recommendations, are based on the nutrient-intake guidelines set in place following World War II. This approach has since become difficult to work with as more evidence has pointed towards a holistic approach to nutrition therapy. This is exemplified in the medical field by functional medicine, where therapists strive to meet the unique needs of individual clients rather than using medicines which target problem areas independent of the rest of the body. Considering individual nutritional needs means that more therapists are seeking ways to shy away from the standard Recommended Daily Allowance (RDA). To do this, most of them are now using physical copies of nutrition data to look up whole foods with the desired nutrients since most of the tools available online provide options with processed foods. As such, these currently available online tools are not sufficient in catering to this holistic approach because of their dependence on processed food sources for essential nutrients, the time-consuming nature of their use during holistic therapy and their lack of whole food options. To remediate the afore mentioned drawbacks, a web application is being built. It will allow the nutrition therapist to provide relevant nutritional information about a client and eventually create a whole-foods based menu specific to the client.

PROBLEM STATEMENT AND SPECIFICATIONS

One problem with the current practices in nutrition therapy is the use of the nutrient-intake guidelines set in place following World War II as the Recommended Daily Allowance (RDA). This is problematic because it tends towards a “one size fits all” strategy, consequently overlooking the world population’s varying physiological and biochemical composition. As a result, there is a growing acceptance of nutrition therapy approaches that are like the functional medicine approach in the traditional medical field. Functional medicine is medicine that addresses the underlying causes of disease, using a systems-oriented approach and engaging both patient and practitioner in a therapeutic partnership. In holistic nutrition therapy, addressing the underlying causes involves trying as much as possible to retain all the nutrients present in the foods clients consume. It is only through this method that tailoring nutritional advice to a client’s unique biochemical needs can be achieved, hence the growing acceptance. Although a lot of tools are available online for nutrition therapists to use in determining what solutions to recommend to their clients, much of these tools use processed-food ingredients to produce the information that is relevant. This is problematic because for nutrition therapists to help their clients, they must spend a lot of time searching for sources with whole-food ingredients.

Thus, there is a need for a solution that deals solely with whole foods categorized into their base nutrients. Such a solution would seek to answer two important questions:

1. How easy is it to pull data from a trusted USFDA-approved source of food nutrients given search criteria for some related nutritional deficiencies?

2. Can this data be processed in manner that makes it applicable to the whole food-centric approach of nutrition therapy?
Ideally, the solution would pull data from an on-line database of whole foods. Further, it would be able to make recommendations for a periodic menu based on the noted nutritional deficiencies and the client’s unique biochemical composition. Such a solution would be helpful to the nutrition therapist because it would allow the development of a menu recommendation that is healthier and more accurately tailored towards the individual patient. It would make it easy for the nutrition therapist to identify which whole foods are critical to the relevant nutritional deficiencies, therefore eradicating the cumbersome process of looking up nutritional information based on altered or otherwise commercially prepared food ingredients. Further, it would decrease the time it takes for the therapist to make suitably tailored menu recommendations. Last, it would be able to consolidate an entire database of whole foods to a single, easily accessible location.

For this project to be useful, there are requirements and specifications that must be met. The defining requirement is the need for the solution to be accessible on a computer as a web application. The application should be able to take as inputs, deficient nutrients in a client’s diet regimen as determined by the user (holistic nutrition therapist in this case). It should be able to accept a single or multiple deficient nutrients as the inputs determined by the user. The project should be able to use these nutrients as search criteria used in a database of FDA approved foods to extract information about whole-foods that contain these deficient nutrients. Its focus should be on whole-food ingredients and not on processed-food ingredients. This is meant to preserve the project’s driving need for a holistic approach to nutrition. Communication between the database and the application should be sufficient in terms of speed and retrieval of data. Using the results retrieved from the external database, the application should be able to present these whole-food ingredients as a recommendation to the user. The user should be able to sort the results.

In addition to having access to a United States Food & Drug Administration (USFDA) approved database of whole-food ingredients with certain nutrients, this application has an extended goal of storing the menu plans that would have been generated by the application. Also, the application should be able to allow the user to add, remove and update said recipes through interaction with the recipe database.
DESIGN APPROACH

System Overview

The solution will be implemented as a web application and the goal of this application is to develop a tool that provides whole-foods based nutritional data on demand. As such, there are three critical components essential to making this application useful, as shown in Figure 1. The first is the nutrient data bank database (NDB_Db), which is essentially the backbone of the project. It will provide all the nutritional data for the application as will be discussed in the functional decomposition section later in this proposal. To manipulate this data in an efficient manner, Ruby on Rails is the framework that will be used for this project because of a few considerations. First, it is robust and stable, which makes sense for the proposed application as there is a lot of potential for growth. Second, it also has gems – packages used to accomplish various tasks – which give applications tremendous amounts of functionality very quickly. Finally, in the interest of avoiding code duplication, Rails employs the Model View Controller (MVC) architecture. The model represents the data of the application, the view represents the user interface of the application, and the controller provides the “glue” between models and views. The benefit of this framework is the separation of concerns it provides, which allows easy data encapsulation. The third component is the user interface which will be rendered within Rails by the view component to make the application more user friendly.

Figure 1: Application Overview
**Functional Decomposition**

**Home Page**

To access the web application, the nutrition therapist will have to enter a URL within a web browser. The URL will take the user to a home page which will present five options for actions that the user can take. For the purposes of this project, a page that allows a user to log in to use the application will not be necessary, although it might become pertinent as the application is developed to support more than one user.

**List & Search Functionalities**

To access the food reports, the user would need the unique ndb numbers from the external database that is being used to retrieve information. The search and list functionalities will provide the ndb numbers for specified nutrients and foods. These ndb numbers can then be used to obtain food and nutrient reports.

**US Food & Drug Administration Nutrient Data Bank (USFDA NDB)**

The Nutrient Data Bank provided by the USFDA was chosen as the external database because of its near perfect suitability to the goals of this project. It provides REST access to its food composition database which is compatible with Rails\(^2\). When a user requests data from it, it requires that the user has a key, which it provides upon request. This key is a life-time key which
is beneficial to this application. Although, it allows only 1000 queries in an hour, that number can be increased as the scale of the application grows. Another benefit that arises from using this database as the data source is that its results can be obtained either as nutrient reports, or as food reports. For this application, the food reports will be more useful, although they will need a parser to be written so that the information can be in a suitable format for this application. The nutrient data bank does not require any special permissions or licensing for its use beyond basic citations, which makes it desirable from a cost perspective. It is keyed off using unique NDB numbers and these allow searches to be made based on both these unique ID numbers as well as on the actual names of the nutrients. Deviating, from the functional point of view, this database is constantly updated to reflect the most recent conventions that are agreed upon in the Agricultural Science field. Additionally, it provides a credible source of information.

Recipe Functionality

The Recipe functionality will depend on a remote database, and communications will follow the REST web services API since this is the core of the API of the external database. Since the NDB_db database is external database, it will be used as an Active Resource within Rails. Additionally, this page will allow the nutrition therapist to create a single menu based on multiple recipes. It will be responsible for acquiring the client information, which in this case is the deficient nutrients, that will be used to generate a specific menu. It will also be responsible for saving menu plans to the in-app database for future reference.

Knowledge Base

The knowledge base takes the form of HTTP request to websites with whole food recipe information. This was a change in design from the original intention to generate recipes independently using nutritional information obtained from the application. These HTTP request will use key words to search recipes whose constituents include the key search terms.

Menu Functionality

This page allows the user to interact with saved menu plans. At the lower level, it will interact with the database within Rails. This database will be used as Active Record component found in the Rails framework. The Active Record component is the base for models in Rails and provides database independence. The Saved Menus page will allow the user to search for specific saved menus and it will also allow the user to use arbitrary search key terms to locate specific records. The search functionality will allow various search criteria to be used, and some of these will include the specified nutrients and name of client. Additional functionalities will include the ability to delete and edit a copy of a specified menu plan before saving the copy in the in-app database. For security reasons, database implementation and access will be subject to data encapsulation and will restrict all forms of front end direct access.

Reports Functionality

This functionality allows users to generate report on specific foods and their nutrient content. For each food, the report is supposed to give information about the individual nutrient components and their nutritional value. For each nutrient, the reports will provide the content of that nutrient in different foods.
Rails Database
This database will be within the Rails application therefore its basic operations will be based on the Structured Query Language (SQL). It will be keyed off incrementally by ID numbers which will be based on the order in which they are entered into the database. For this project, the speed of the search is the most important aspect and the search algorithm will reflect that. It will have data fields such as ID number, nutrient, client name etc. to allow for good search functionality.

Front End Design
Using the Model View Controller (MVC) architecture, all the pages will be structured using HTML, styled using Bootstrap and CSS, and furnished using a scripting language – all as part of the View component. The goal is to produce a simple user interface which will display nutritional data in clear and legible format. Bootstrap has been chosen since it combines the benefits of CSS and scripting to provide aesthetic user interfaces

Alternate Design Approaches

Knowledge Base
Initially the knowledge base was going to be implemented as simple database of rules like those found in expert systems. The rules were going to be very generic and will use the ability of the NDB to return results either as 100g based food data or as meal-based food data. Using that data, it would make inferences and decisions based on the client information provided by search functionality. Most of the rules that were to be implemented would follow an IF-THEN-ELSE structure. It was decided that implementing minimal rules would be insufficient to the functionality required for this application and that implementing extensive rules was too big of an undertaking to meet the time frame for this project.

Front End Design
Initially Semantic UI was going to be used instead of Bootstrap, but it was quickly discovered that support for Semantic UI in the rails community was neither reliable nor extensive enough to be useful for this project.
RESULTS

**Figure 3: Application Dashboard**

After more than 140 hours of implementation, most of the core requirements of the Nutrition Data App have been met, with most functionalities implemented. The nutrition therapist can use a computer or any other mobile device to log into the web application. With the responsive design that was implemented, it is easy to adapt the screen to use on the go or in an office setting. The dashboard shows the five main functionalities that have been implemented.
Recipes Functionality

Recipe lookup functionality allows the nutrition therapist to enter the name of a main ingredient or nutrient that they would like to be present in a recipe. Relevant recipes are displayed based on their ranking and popularity from the source database. Further, the recipes can be saved to a menu that is associated with the current session.

General Search Functionality

Figure 4: Recipes Dashboard

Figure 5: Search Dashboard
The general search functionality allows the nutrition therapist to enter the name of a nutrient or food and it will display relevant nutrients or foods based on the user’s search terms. This functionality has no restrictions and allows the user to obtain the nbd numbers for the foods they might want to use to generate food and nutrient reports.

**List Functionality**

The list functionality is a helper functionality that allows users to search nutrients, foods or food groups so that they can be used to generate reports using ndb numbers. It allows the nutrition therapist to obtain ndb numbers for specific foods so that they can be used in generating reports.

**Reports Functionality**

![Image of Reports Dashboard](image)

**Figure 6:** Reports Dashboard

Reports functionality allows the nutrition therapist to enter either the ndb number of a food or the ndb number of a nutrient. The ndb numbers can be retrieved by using the list functionality. If the user enters the number corresponding to a food, a report will be generated that shows all the nutrients in that food. If the user enters the number corresponding to a nutrient, the application provides lists of foods and their nutrient values for a specified set of nutrients.
CONCLUSION

The core functionalities of searching nutrients in a whole foods database and generating recipes from an external whole foods source were implemented and are mostly functional. The nutrient search is fully functional, and a nutrition therapist can retrieve nutrient information for various foods via reports and in app displays. The application successfully lists food and nutritional information in the database based on relevant search terms. Although the recipe search works for most whole foods, there are instances where the returned results do not return whole food only recipes.

The application will be rolled out to the sponsor on May 2nd and any issues and bugs that arise from its will be addressed accordingly. As a web application that deals mostly with whole foods, the alternate knowledge base design is an improvement that can help with the accuracy of the application. It can be able to generate more accurate results and reduce the scope of error. The project engineer will keep improving this web application for even better compatibility with different web browsers and different devices.
REFERENCES


3. Terry Mast, personal communication.


BIOGRAPHY

The project engineer, Kudzaishe Mandingwa, is a software engineer born and raised in Harare, Zimbabwe. He attended college at the University of Evansville and graduated with a Bachelor of Science degree in Computer Science. He has a passion for web development technologies. Mandingwa has been heavily involved in campus student organizations which include UE Leadership Academy, International Club and the Association for Computing Machinery. After graduation, Mandingwa hopes to become a Full-Stack Web Developer.