RAMAIAH Institute of Technology

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Open Day – Project Exhibition

Multi-Factor based Nutrition Management System and Recipe Recommendation Engine

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PROJECT PRESENTATION

OBJECTIVES

The project is developed to create an intelligent recipe recommender that would aid in the development of a diet that allows all users to make healthy choices in their daily lives.

The main objectives of this project are :

- To develop an algorithm that maps the required nutrients tailored for every user to the information put in by them like age, gender and allergies.
- Develop a clustering model that can output food groups that are rich in specific groups of nutritional values.
- A ranking system that maps the users and recipes for the right diet.

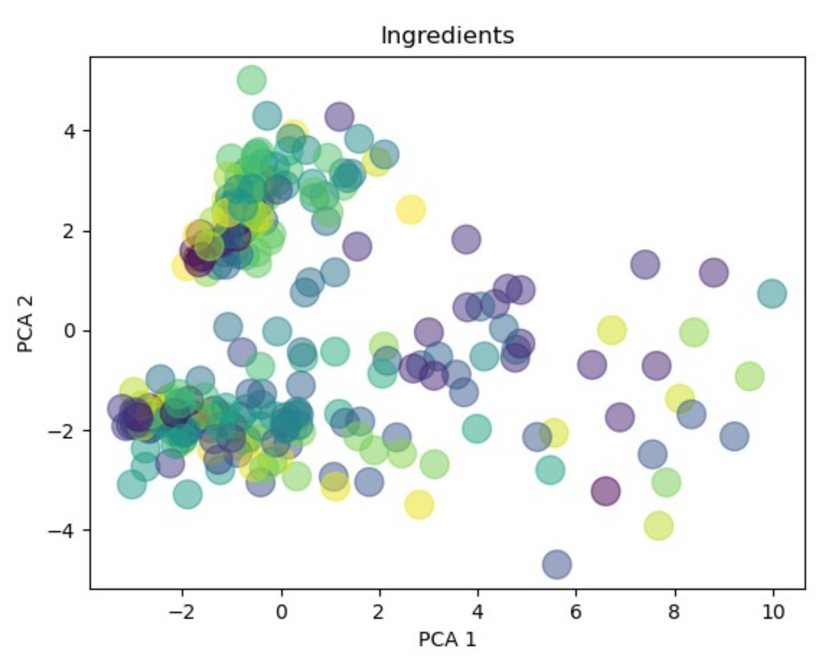
BACKGROUND

- This research was born out of the collaboration with TDU and RIT. Further work is being done on it as part of RIT Seed fund.
- There is a requirement of a nutrition deficiency aware recipe recommendation system for nutrition experts or researchers wherein it uses a standard database. This project attempts to develop a system which may be used by nutrition experts.
- Ever-growing consciousness amongst individuals and lack of existing research in the domain of recipe recommendation based on nutrition analysis is the base for this project.

APPLICATIONS

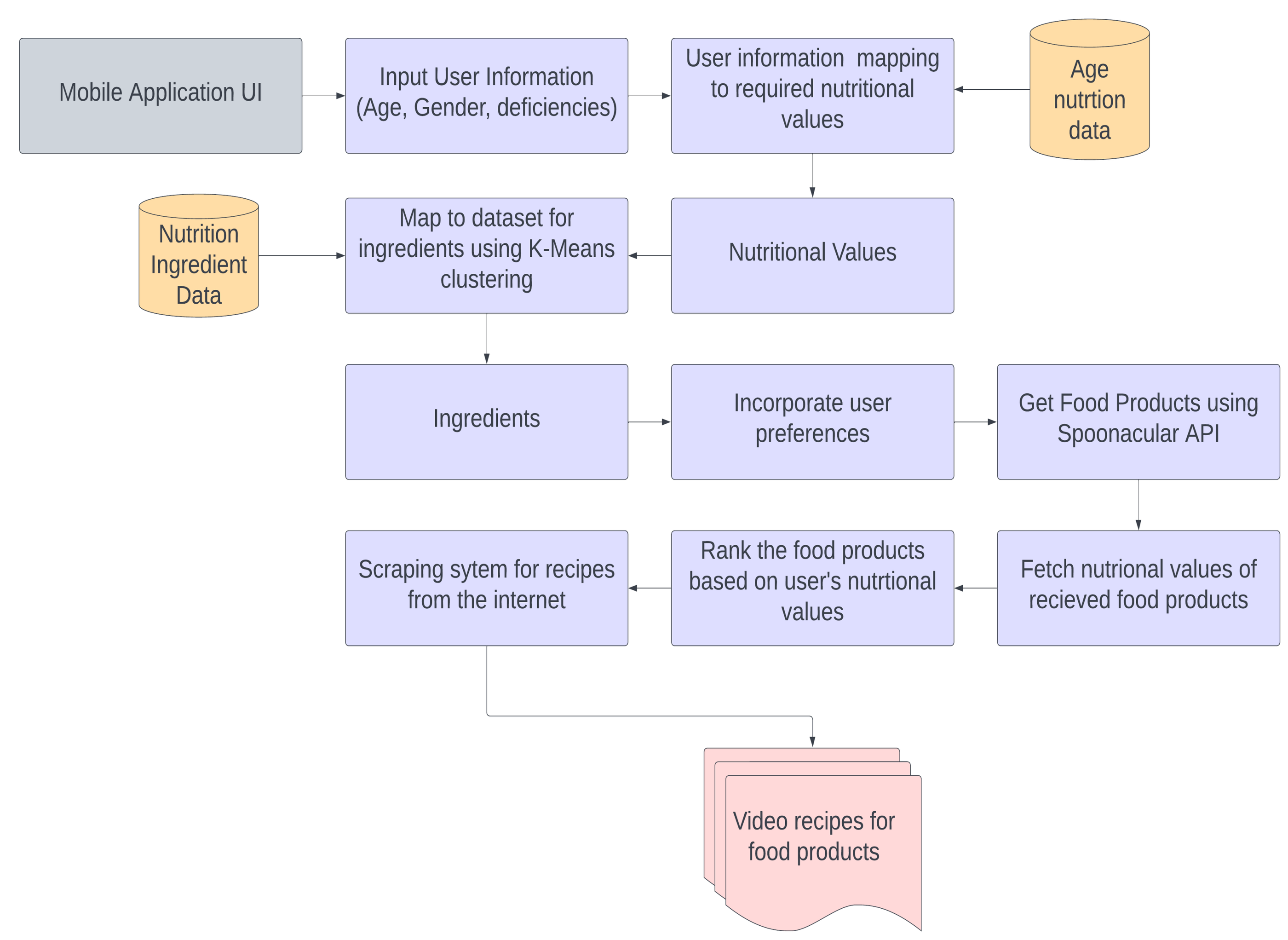
- A smart recipe recommendation engine which provides the user with a list of personalized recipes in video and text format based on the user's nutritional profile, age, gender and preferences.
- A general-purpose section that suggests various recipes for each of the macro nutrients considered and can be used by the user when looking for specific nutrient consumption.
- A dedicated backend server with multiple endpoints with unique functionality for research. An easy-to-use full-fledged mobile application for general users to input their data and obtain customised recipes.

EXPERIMENTAL DETAILS



The visualization above comprises of 30 clusters with 10 data points (ingredients) in each cluster. There is no visible hyperplane in this 2D visualization that segregates the clusters because there exists numerous features (nutritional components) based on which its being clustered. We choose the cluster that contains the vector we appended (deficiency vector) since it'll have various ingredients that can cover the deficits and in turn be used to make some food product.

METHODOLOGY



Three primary components, namely deficiency detection, ingredient identification, and food product ranking form the base of the algorithm. Each component provides an intermediary output which feeds into the next component to finally list a set of ranked food product and their recipes for the users to consume.

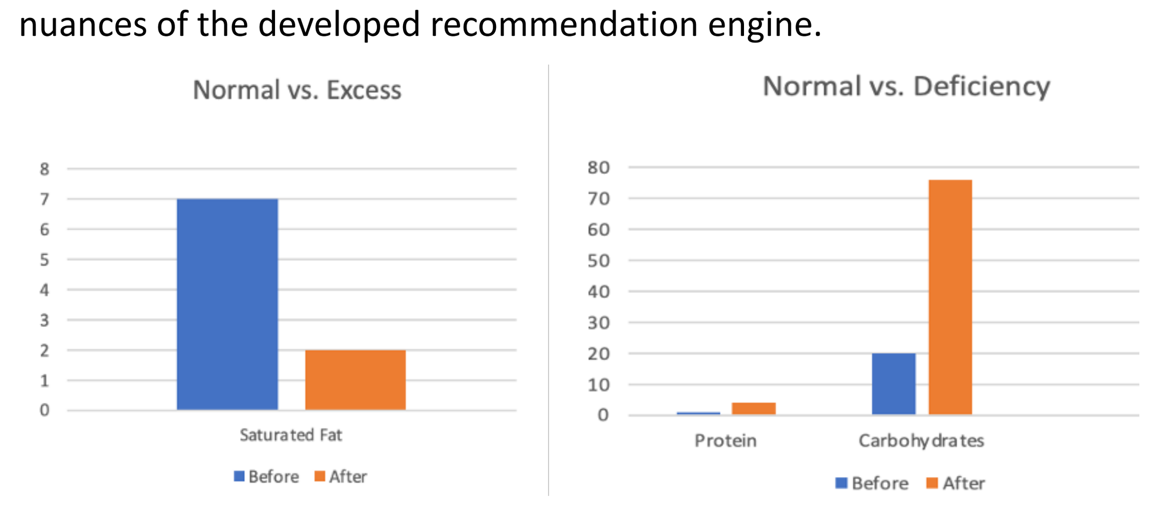
Deficiency detection: The user's consumption and biological profile are the primary input in this component. The input is a set of nutritional values that depict the general consumption pattern of the said user. It consists of 25 unique nutritional values i.e.., Protein, Ash, Fat, Dietary-Fibre, Carbohydrate, Energy, Thiamine, Riboflavin, Niacin, Pantac, Vitamin B6, Vitamin B7, Vitamin B9, Vitamin C, Aluminium, Calcium, Copper, Iron, Magnesium, Manganese, Nickel, Phosphor, Potassium, Sodium, and Zinc. The user's age range and gender are also received in this stage. These values are compared against the recommended standard values for the age range and gender. The shortcomings of any nutrient are calculated by finding the arithmetic difference between the two sets (user's input and the standard values). The shortcoming depicts the nutritional deficiency/overload in the user's standard consumption scenario. This deficiency/overload set is then adjusted to derive the required nutrition by performic arithmetic addition with the recommended standard values for the given age range and gender. This final set represents the nutritional requirements of the user for a particular consumption by the user. This result acts as the input to the next component i.e.., ingredient identification.

Ingredient identification: The second major component in the solution, ingredient identification uses the nutritional requirements of the user as input. It refers to a dataset that contains 299 food ingredients with each ingredient depicted by a set of values with nutrient information similar to the user's input. The principal aim of this component is to identify a subset of the ingredients from the dataset which fulfil the user's nutritional requirements. This is achieved by using a clustering algorithm called K-Means which is an unsupervised method to quantize vectors by partitioning x observations into y clusters where each observation is in a cluster with minimal spatial distance to the points that behave like the mean of each cluster. Traditional K-Means produce clusters with uneven sizes but as per the solution design, the cluster centres are rearranged to guarantee a number of ingredients returned each time that is most similar to the user's nutritional requirement. This component outputs a set of ingredients that contain the necessary nutrients which can be used to identify whole food products that can be presented to the user with their recipe and basic nutritional information.

Food product ranking: The final component before the results are provided to the user is the food product ranking process. The input to this component is a set of food products with their nutritional information. The web is scraped for each of the nutrients that the user's nutritional information set contains. These food products are ranked by finding the Euclidian distance between each of the food products and the nutritional requirement of the user. Euclidian distance is calculated as the distance between the two sets when represented as a point mapped on a 25 dimension map. The food products are ranked in the order of the sets that are closest to the user's nutritional requirements in this spatial mapping. The web is then scraped for recipes for each of these food products and presented to the user.

RESULTS

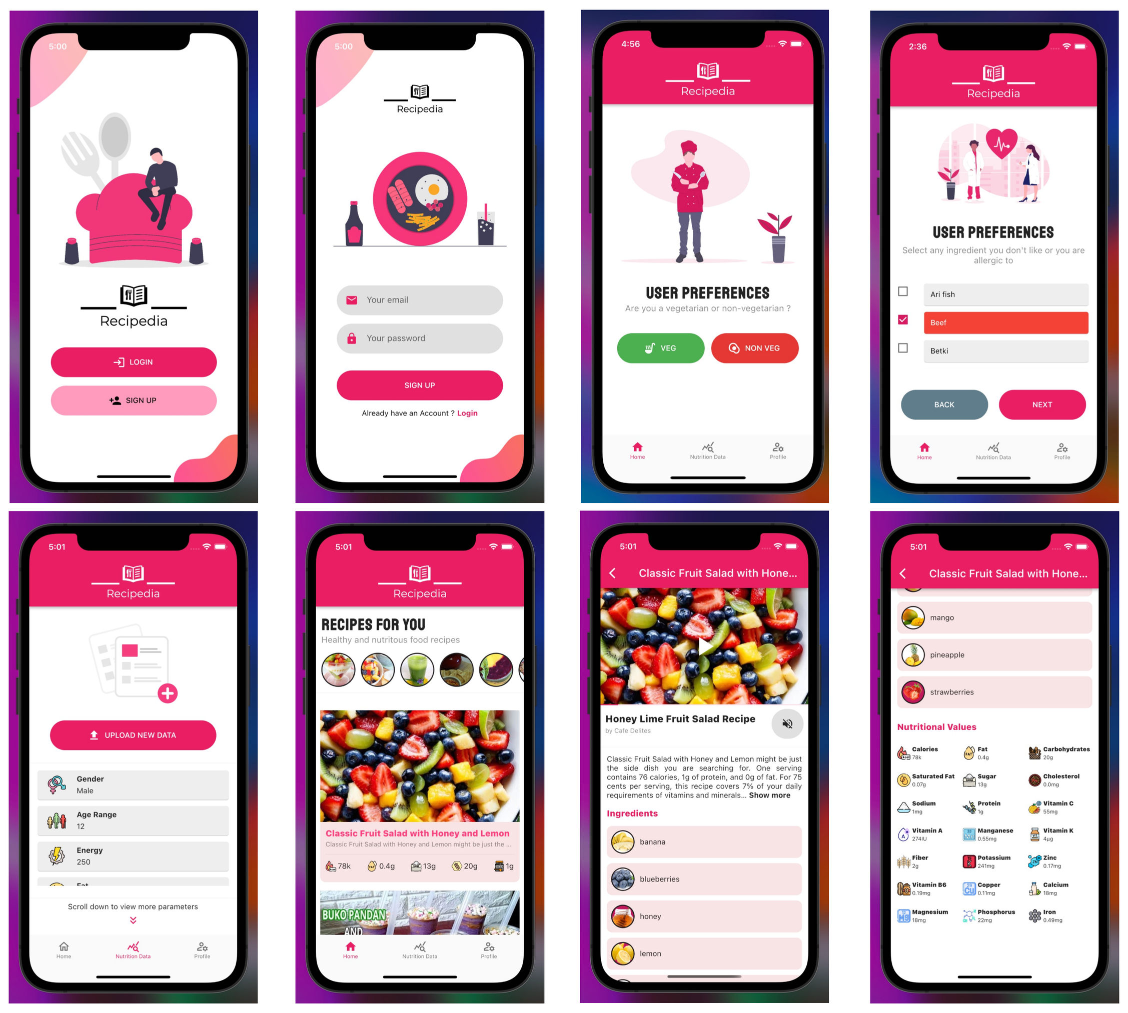
Given below are some visualizations that can better help understand the nuances of the developed recommendation engine.



Normal vs. Excess shows the levels of saturated fat the engine recommends for a user that consumes a healthy diet vs. a user that consumes a fatty diet. As it is clearly visible, users who have an excess intake of a particular nutrient are provided diets and recipes with ingredients which help in reducing their consumption to have a good and healthy overall diet.

Normal vs. Deficiency graph shows the levels of protein that the engine recommends for a user without a deficiency vs. a user with a deficiency in protein and carbohydrates. As it is clearly visible, users with a deficiency are provided diets and recipes with ingredients which help in improving their intake for a given deficiency.

Displayed below are screenshots from the easy-to-use application developed.



CONCLUSION

The result of this research is an algorithm which ingests a user's age, gender and nutritional profile to obtain a list of suitable ingredients for the user. The user's personal preferences are also considered for recipe recommendation and depending on the user's preferences certain ingredients are removed. The final list of ingredients are then fed into the Spoonacular API that gives various choices of final food products that can be made using the ingredients obtained from K-Means clustering. Another layer of personalization is added by ranking the choices suggested by the API on considering the user's nutritional profile. The YouTube API is used to scrape the web to find videos of recipes of the final recommended food products. These videos are then displayed to the user along with other relevant information through the flutter application with an elegant UI and user-friendly design that encompasses a smart and personalized recipe recommendation engine. Users can also search for generic recipes based on a specific deficiency to enhance their nutritional profile. This research might lead to a system that can greatly contribute to the cause by saving a considerable amount of time in choosing an appropriate recipe to fulfil all needs and help individuals evade life- threatening health conditions and malnourishment.