HEALTHY EAT

Submitted in partial fulfillment of the requirements
of the course **Innovative Product Development (IPD) IV**

Year 3, Sem VI Computer Engineering

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CERTIFICATE

This is to certify that the project entitled **"Healthy Eat"** is a bonafide work of **"Jayesh Kavedia, Jigar Shah, Junaid Girkar and Kanaad Deshpande" (60004190053, 60004190055, 60004190057, 60004190058)** submitted as a project work for the course **Innovative Product Development (IPD) IV, Year 3, Semester VI, B.Tech Computer Engineering**

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IPD Project Report Approval for BTech Semester VI

This project report entitled (***Healthy Eat***) by (***Jayesh Kavedia, Jigar Shah, Junaid Girkar and Kanaad Deshpande***) is approved for the Innovative Product Development (IPD) IV examination **of Year 3, semester VI, B.Tech Computer Engineering**

Examiners

1.----------

2.----------

Date:

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Declaration

I/We declare that this written submission represents my/our ideas in my/our own words and where others' ideas or words have been included, I/We have adequately cited and referenced the original sources. I/We also declare that I/We have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my/our submission. I/We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

Many people have a daily question of what to prepare today for meal, this document provides a solution to this question with the help of a recommender system based on the users choice and keeping his ailments in consideration. The platform is a mobile application where the user can get recommendations of recipes as per the data entered by him/her. We researched and took into consideration the existing apps and have tried to overcome their shortcomings and drawbacks. Data from API is filtered and analyzed and then provided to the user. Through this project a platform where food can be prepared by anyone depending on his choice, taste, physical work, ailments etc is created which would help a large amount of food makers.

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List of Abbreviations

Sr. No.	Abbreviation	Expanded form
i	GUI	Graphical User Interface
ii	REST	Representational State Transfer
iii	API	Application Programming Interface
iv	DB	Database
v	KNN	K-Nearest neighbors
vi	JSON	JavaScript Object Notation
vii	ANN	Approximate Nearest Neighbors

1. INTRODUCTION

Unhealthy eating is a major public health burden that may be reduced in part by helping people select healthier dietary choices. However, picking appropriate food to eat implies complex decision-making processes, including being aware of healthy options and choosing among them. With people growing increasingly familiar with interacting with machines in their everyday life, one solution to overcome this issue and help people to make healthier choices is to develop health-aware food recommender systems. One of the most important challenges for such a system is to deliver accurate and personalized recommendations to their users. Although most of the popular recipes found on Internet are unhealthy as defined by the United Kingdom Food Standard Agency (FSA), significant effort has been put recently into optimizing food recommendation algorithms and try to reconcile users' preferences with healthy recipe recommendation. By analyzing people's eating behavior, authors in found that the fat and calorific content of a recipe were the best rating predictors for people interested in eating healthy. However, this information is not always available, and research has shown how hard it is for people to infer the healthiness of a recipe simply from its picture, even when the recipe has been categorized as healthy. Based on these findings, it becomes important to build systems that not only recommend healthy and personalized recipes, but that also precisely display how healthy these recipes are. In this paper, we describe our app that would recommend healthy and customized recipe's for the whole family while considering any dietary restrictions. While there are many recommender systems and apps that target individuals, there are very few that consider groups.

2. SURVEY

2.1 Field survey

We conducted a survey of about 40 families (173 people) and the outcome was: only 5 people used recipe apps! There were lots of cases of people having diabetes. These people had to regularly check their sugar level. Out of the 173 people only 17 people were found to use health tracking apps. The survey was conducted among various different kind of families residing in different region and the result obtained was only 5 people used recipe app and that too not on a regular basis out of the 40 families surveyed 35 families were in favour of developing such an app, and agreed to the requirement of such an app.

For the 5th semester, we have begun circulating survey forms. Here we are collecting data to get a general idea of the variety of tastes, diseases, likes, dislikes and various general factors that affect eating habits – age, height, weight, number of hours one puts into physical exercise (daily), can one cook, if yes, does he prepare healthy food or can he just flip burgers and potato wedges; if not, are there family members who cook for him/her, what general locality do they reside in (for people living in central India will hardly eat fish food!), and so on. The survey is going to continue for some time, until we are satisfied that we have collected a dataset that is large enough.

2.2 Literature survey

We read 5 research papers related to recipe apps, examined their implementation and the different technologies they decided to use along with the pros and cons of each.

1. Foodorials[2] - A cooking recipe app, which provides users with tasty recipes with real time searches which are easy to understand and easier to implement.
2. Food Recipe Finder Mobile Applications Based on Similarity of Materials[3] – a smart way to find out how users can make best use of materials available and can help the app remember what the users use the most.
3. A Cooking Recipe Recommendation System with Visual Recognition of Food Ingredients[4] – A unique idea which revolves around the concept of a recommendation system which runs on a consumer's smartphone as a part of an interactive mobile application.
4. Machine Learning[5]: We are going to use machine learning (using Python) in the recommendation system, to give the users mouth-watering recipes for meal-times and snack-times so that our users never have to tire themselves out deciding what they can eat. All of this shall be possible by unleashing the power of Python in the realm of machine learning. As rightly said by "Thia Kai Xin, Python is the swiss army knife of Machine Learning."

2.3 Outcome of survey

After carefully examining the survey, the following points were concluded:

a. Very few people from the survey actually knew that such an app existed (users are oblivious to existence of such apps).
b. We noted a dependence on one person in the family to cook food (in most cases it was the mother!). Such users might not feel the need to consult to an app on a regular basis as they might be aware of all the constraints that are to be looked upon while cooking.
c. Lack of time among people to invest in healthy eating habits.
d. Cooking apps are not that popular among the users irrespective of age, gender or any other unbiased parameters that one might think of.
e. Middle aged and old aged people don't find the idea of cooking apps quite compelling.

*Please note that this survey is the survey conducted in semester 4.

3. NEED OF THE PRODUCT

3.1 Explain in detail why the product is needed?

Every now and then there is a discussion at home: what do we make for lunch, dinner and breakfast? The answer is simple. Instead of tiring their poor brains out, they leave this decision to our app! Another question that often arises when a person in a family has an ailment is that, his or her diet has to be maintained properly and everyone has to eat depending on what they need or what they don't need in their diet. Instead of Googling every time or searching on YouTube and requiring an internet connection which is very time consuming and boring an app would offer great convenience, if recipes and nutritional values according to the needs of family are provided under one roof, then it could be quite beneficial for everyone. The motto of our app is, "O ye of little faith, thou shalt never go hungry!"

3.2 If an extension of existing, then explain drawbacks of the existing

We have Google for everything we wish to 'search'. YouTube has become quite popular too. However, searching every time is quite time-consuming and also requires a proper internet connectivity. There are apps related to recipes and for diet planning but none of them are under one roof. An additional agony is that all these apps are for individuals and none of them takes care about the family as a whole.

4. PROBLEM FORMULATION

4.1 Problem formulation

It's an everyday issue in households on what to cook for the day. Normal recipe apps do not take care of individual health issues that are quite common for big families, a problem for which a solution is long overdue. We promise to work the kinks out by making this application.

4.2 Product objectives

We are trying to create a food recipe app for an entire family that takes individual health issues into consideration. It will be perspicacious enough to recommend dishes based on users previously searches.

4.3 Applications of the product

It will be used by almost all sorts of people as it will consider different cuisines and it will help to remove the daily question of “what do we make for lunch today?”. It would also help “fitness freaks” by giving them a proper diet, taking into consideration the nutritional values of the food.

4.4 Novelty

We will have a recommender system that recommends dishes based on previous selections. Another new feature would be that our app will take into consideration health concerns in the family and will make the necessary dietary changes.

4.5 Scope of the project

The project can be fully completed with the end result of a fully functional mobile application that solves a family’s eating-related problems.

5. PROPOSED DESIGN

5.1 The walkthrough

The first page being a prompt for the user to sign-up or login which, after success, would redirect the user to the main interface. The app would have an app-bar on the left, which will contain navigation links to different pages such as “home” which will redirect to the homepage, “browse” to browse different recipes, “stats” which will be an interactive page that shall display a user’s cooking history, a user’s cooking strategies, and so on. The main homepage shall have several sections like, “see what you cooked yesterday!” and “recommendations curated specially for you” and “recipe of the day” and so on. Each title shall lead to a new page. Another feature of the design would be the search system that enables the user to filter through several different choices like “vegetarian vs non-vegetarians”.

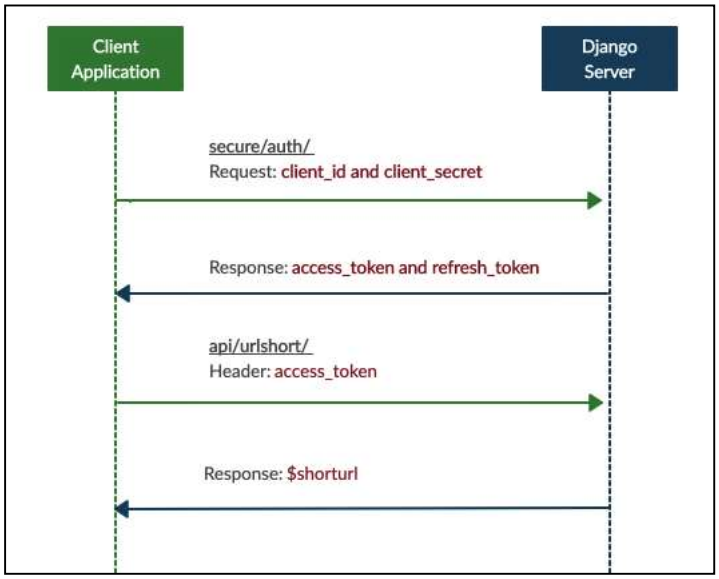
5.2 The tech stack

The mobile frontend will be Flutter with a Django backend. The Django backend is a requirement so as to use the recommender system and the Flutter app will ensure that the app will work on both Android and iOS. The database used will be PostgreSQL. We shall implement the machine learning algorithms using Python’s excellent libraries like Pandas, Numpy, Tensorflow. We shall also be using Python’s just-in-time compiler, Numba, that shall help us speed up our applications function. We shall also be implementing a lot of caching in our application.

6. IMPLEMENTATION

6.1 Database design

Our application has several requirements, some involving a schema and others falling under the schema-less category. For example users shall be loaded into a schema with multiple foreign keys, connectivity to other users and so on. In other cases, where we merely load a recipe into the database. Hence, we are using the PostgreSQL database which is very popular for its scalability, efficiency, and speed. We have here a diagram of our user-authentication database that we have implemented.



User Authentication

Our app shall work on a central recipe model, which takes into account nutrition and the vitamins present in a particular food. Some connected database tables include the allergies and eating constraints that might affect a person (we believe that allergy and eating constraint are a nicer way of referring to diseases). Some other aesthetics to make the app more user friendly include stats, wish list, user browsing history, etc.

6.2 Use cases

User Authentication and Registration is a vital part of the app as the recommender system would need to be unique for every user. It also protects the data of all of our users and as we firmly believe that we should be intransigent about privacy.

The nutrition table shall store the nutritional values of a particular food item, while the vitamins table stores different vitamin content of a particular food. The vitamins are stored differently because they can be categorised in an ordinal manner. The allergies and eating constraints are included so that the app can decide to simply not show the items to a user who is suffering from a particular allergy, or constraint – disease. The stats and wish list are simply aesthetics as mentioned before and shall be incorporated as soon as the main product has been created.

6.3 GUI design

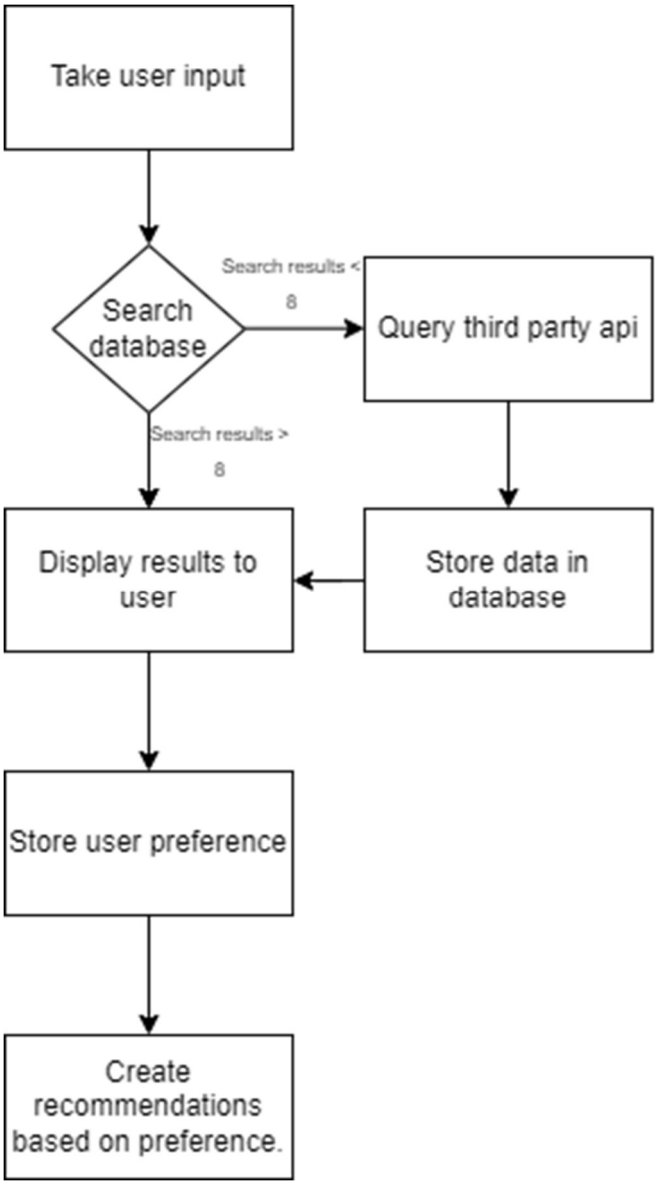
On starting the application the user either needs to perform a login or registration. If the user performs a registration he will be redirected to fill the profile details and either join a family code or generate a code for family. The home screen of the app contains sections for top recipes, user

recommendations and various healthy recipes where the data will be provided by the backend via the REST Architecture. The profile page allows the user to update profile details as when necessary. There is separate recipe page to search for recipes with a variety of filters available and then clicking on particular recipe list card will redirect to detail view of recipe where the user can also add the recipe to wishlist for saving it for future reference and can like the recipe to put it in the most liked recipes.

6.4 Modules implementation

The backend used for the authentication is the Django Rest Framework with Token authentication. The frontend is a native mobile flutter app. We have hosted the API on Azure Virtual Machine. The database used for the implementation is PostgreSQL because of its speed and scalability.

The Recommendation System: The recommendation system involves using of label encoded data wrapped in a sparse matrix in the dataset. This helps in predicting the recipe label after the preprocessing occurs using the K Nearest Neighbors brute-force algorithm instead of using the KD tree algorithm. This is because as the data scales, KD trees are unable to handle sparse matrices. KD trees also become very slow for higher dimensional datasets. Hence the brute force method blended in with the approximate nearest neighbors (ANN) helps predict the recipes to recommend to the user. The recommendation is based on recommending recipe labels similar to the ones in the user's search history. It can be seen that recommendations based on past searches help a user navigate to similar recipes and thus increase the chances of the user finding relevant results. This recommendation system uses a collaborative filtering approach. Here we have taken into account the implicit property of the data available as we have an option to wishlist a searched recipe that the user likes.



DATA FLOW DIAGRAM

7. EXPERIMENTATION & RESULTS

7.1 Datasets / Tables

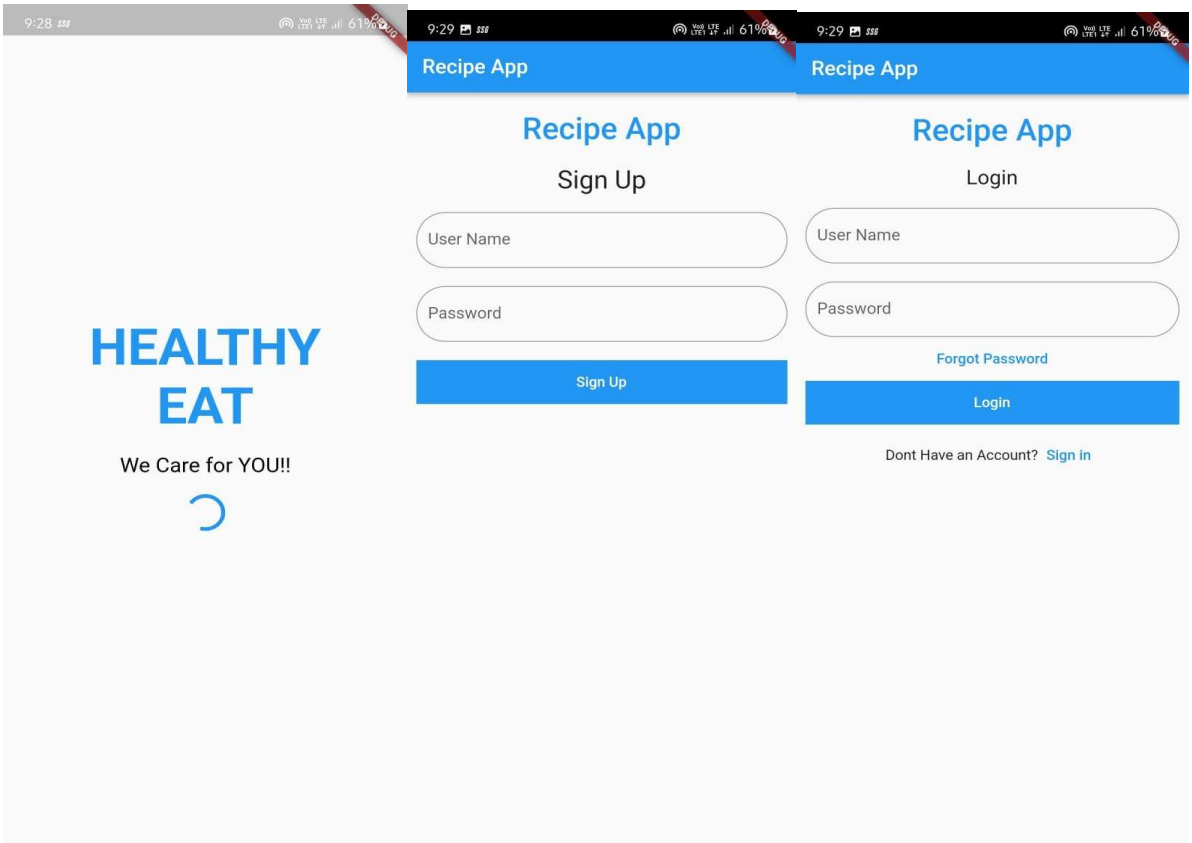
The following models exist in our database:

- A User Model.
- Recipe Model
- Nutrition Model
- Eating Constraints Model
- Vitamin Model
- Allergy Model
- Stats Model
- Wishlist Model
- User History Model

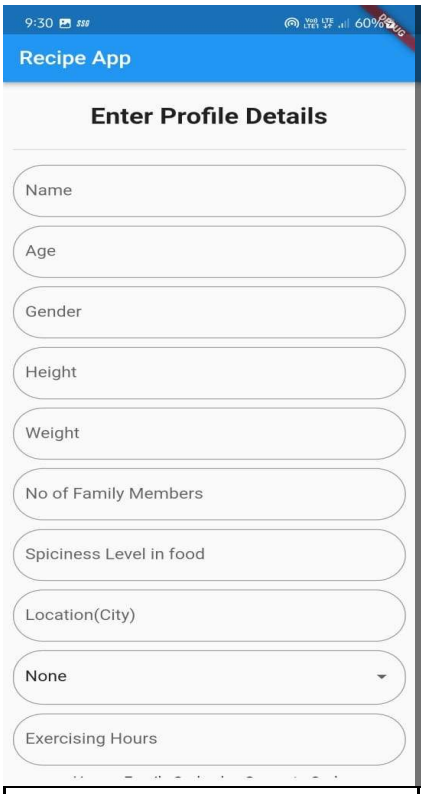
7.2 Test cases

The models pass all the API test cases. An external API, Edmam recipe and food API (https://developer.edamam.com/edamam-docs-recipe-api) has also been queried to get data to display in the application.

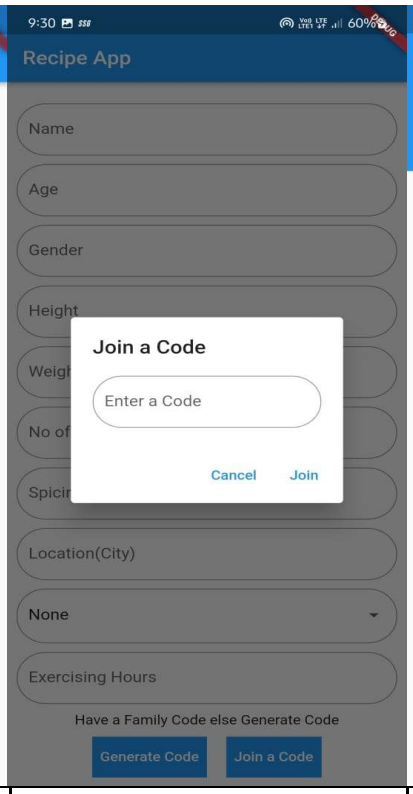
7.3 Results



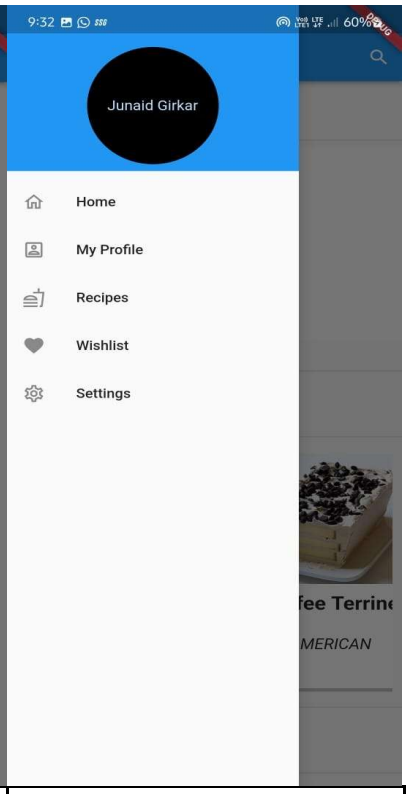
Splash Screen	Sign Up	Login



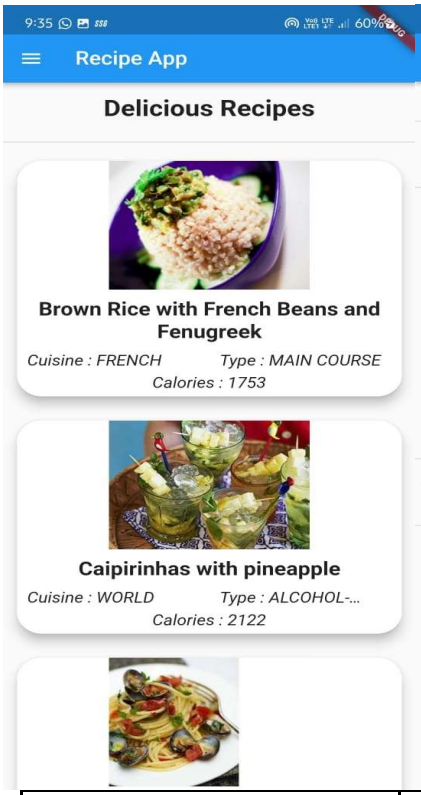
Entering Profile Details



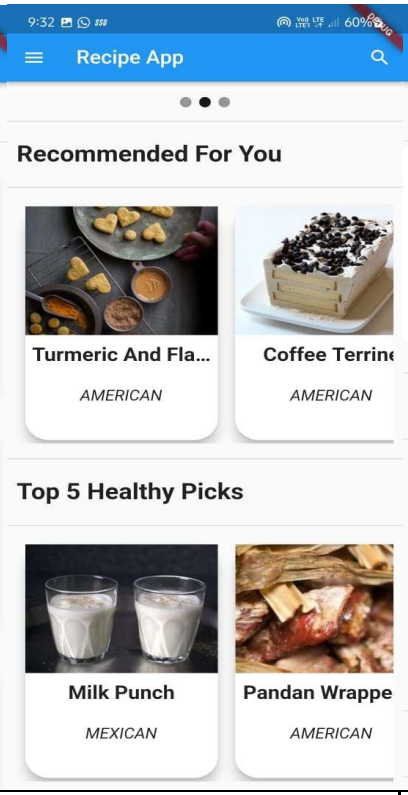
Join a family



NavBar



Home Page



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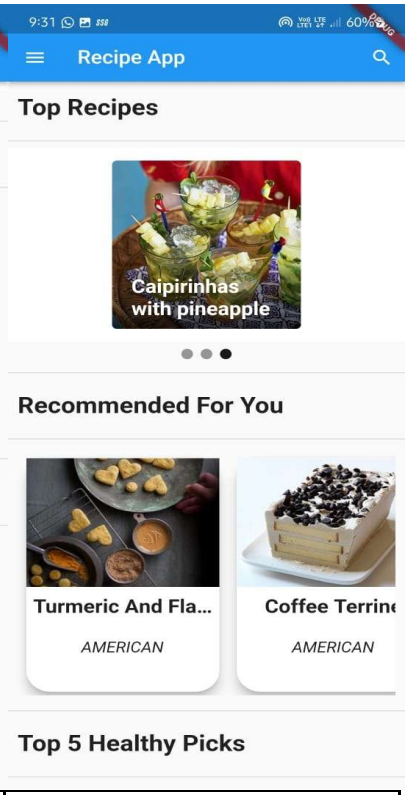

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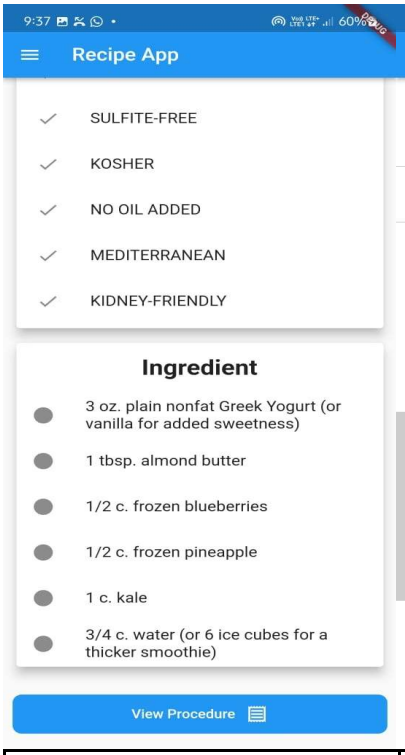
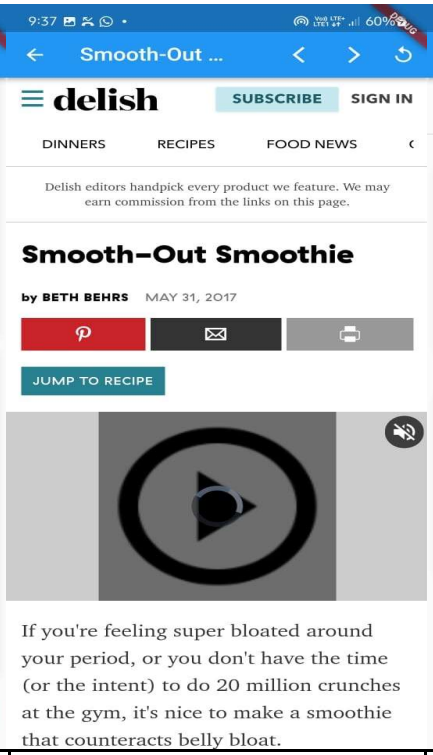
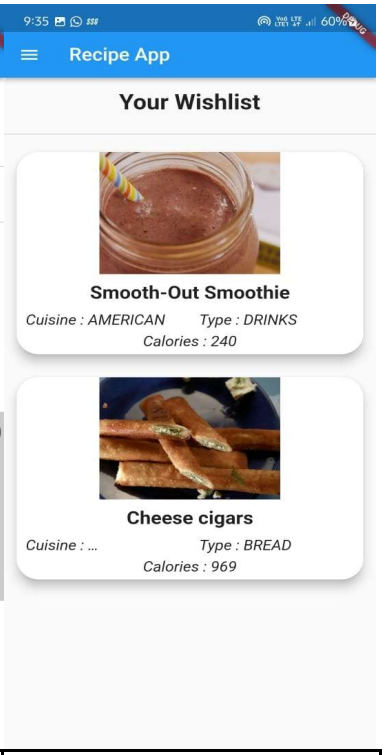


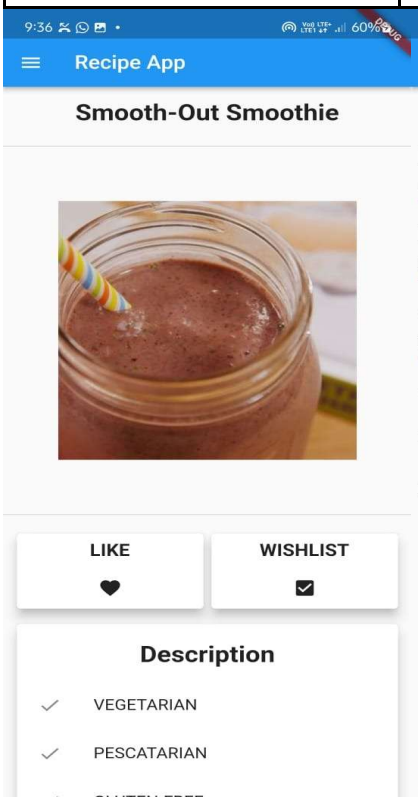
Recipe Detail View



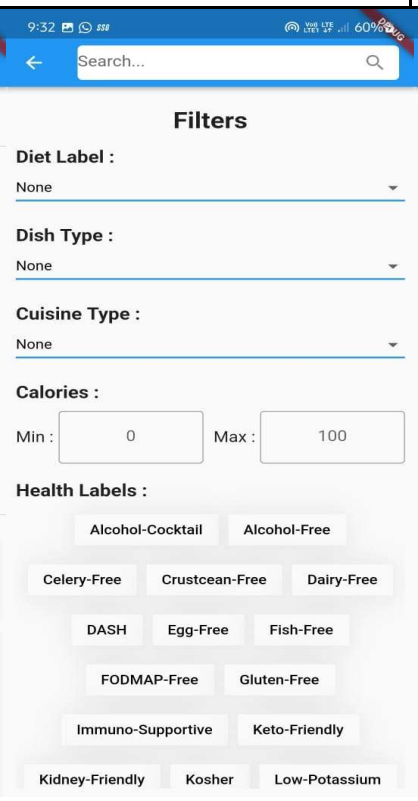
Recipe Instructions Page



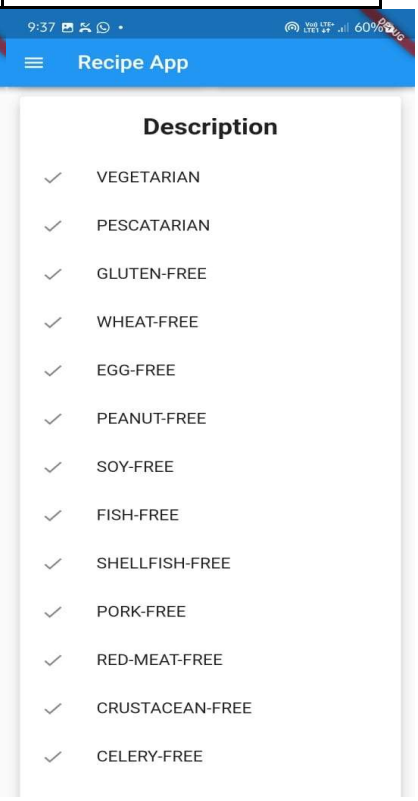
Wishlist



Recipe Detail View



Search Page



Recipe Details – Diet Labels

8. CONCLUSION

Thus, we successfully implemented our project after conducting an extensive survey of people's requirements and came up with an application that serves their purpose. This project is beneficial to all, from people wishing to learn to new recipes – to people who wish to use it for daily purpose. We have implemented recommendations in the application based on the user's past search history.

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Personalized Recipe Recommender System

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***Abstract*—People often ask themselves a question everyday: what do I prepare for today's meal. This application provides a solution to this question with the help of a recommendation system based on the users choice and taking into account his ailments, likes, dislikes, etc. The platform is a mobile application where the user can get recommendations of recipes as per the data entered by him/her.Data from an API is filtered, analyzed and then provided to the user. Through this project we offer a platform which helps one prepare food.**

***Index Terms*—food recommender system, healthy eating, dietary constraints, recipe, machine learning**

I. Introduction

Unhealthy eating is a major public health burden that may be reduced by helping people select healthier dietary options. However, picking appropriate foods to recommend involves complex decision making including but not limited to being aware of healthy options. With the ever-increasing population that is familiar with interacting with machines in their everyday life, one solution to overcome this issue and help people make healthier choices is to develop health-conscious food recommender systems. One of the most important challenges for such a system is to deliver accurate and personalized recommendations to users. As declared by the United Kingdom Food Standard Agency (FSA) most of the popular recipes found on the Internet are unhealthy. Significant effort has since been put into optimizing food recommendation algorithms and into reconciling them with user preferences for healthy recipe recommendations. By analyzing eating behaviors, authors have discovered that fat and calorific contents of recipes are the best rating predictors for classifying eating habits as "healthy" and "unhealthy". However, this information is not always available, and research has shown how difficult it is for people to infer the healthiness of a recipe simply from its picture, even when the recipe has been categorized as healthy. Based on these findings, it becomes important to build systems that not only recommend healthy and personalized recipes but also precisely display how healthy these recipes are. In this paper, we describe our app that would recommend healthy and customized recipes for an entire family while considering dietary restrictions. While there are many recommender systems and apps targeting individuals, there are very few that consider groups.

II. Model

To investigate our research questions, our first step was to collect a recipe dataset we could use to build our recommender system.

We have used the EDAMAM API from edamam.com as they have an arsenal of 2,300,000+ recipes, 900,000+ ingredients, 150+ nutrients and 40+ major diets/allergens. For each recipe, we collected: its recipe label, image link, list of ingredients and quantities, health labels, diet labels, the cuisine type, the dish type, and information about the nutritional value provided by the "digest" object of a query of the API.

III. Need for the product

Ever so often there is a discussion at home as to what one should prepare for lunch, dinner and breakfast. Another question that often arises when a person in a family has an ailment is that, his or her diet has to be maintained properly. Everyone has to eat depending on what they need or what they don't in their diet. Instead of Googling or searching on YouTube every time, which is very time consuming and boring - an app would offer great convenience, if recipes and nutritional values according to the needs of family are provided under one roof.

IV. Proposed Design

The first page is a prompt for the user to sign-up or login which, after success, redirects the user to the main interface. The app has an app-bar on the left, which contains navigation links to different pages such as "home" which redirects to the homepage which has , "browse" to browse different recipes, "stats" which will be an interactive page which has the "top recipes" category, and the "recommended for you" category and the "trending" category. Each title shall lead to a new page.

Another feature of the design would be the search system that enables the user to filter through several different choices like "vegetarian vs non-vegetarians".

V. Tech Stack

Flutter

Flutter is Google's Mobile SDK to build native iOS and Android apps from a single codebase. Everything in Flutter is made up of widgets. The user interface of the app comprises several simple widgets, each of them handling specific tasks. The application created using flutter can be thought as a tree of such Widgets. Flutter has a large number of widgets with various features. Managing state in an application is one of the most important processes in the life cycle of a Flutter application.

- Ephemeral - Lasts for a few seconds like the current state of an animation or a single page like current rating of a product. Flutter supports it through stateful widgets.
- App State - Lasts for the entire application like logged in user details. Flutter achieves this through its scoped model with support using stateless widgets.

Navigating between the screens makes the application interactive. Flutter has its own Navigation System: it uses Navigator.push() for navigating to a screen and Navigator.pop() to close a screen. The biggest advantage of using Flutter is that it is used to build cross platform apps.

Django Framework

Django is a Python-based web framework that allows you to quickly create efficient web applications. It is a battery included framework because Django provides several built-in features for everything such as the Django Admin Interface, default database – SQLlite3, etc. When you're building a website, you always need a similar set of components: a way to handle user authentication (signing up, signing in, signing out), a management panel for your website, forms, a way to upload files, etc. Django gives you ready-made components to use and that too for rapid development.

Django Rest Framework Django REST Framework is a wrapper over the default Django Framework, basically used to create APIs of various kinds. There are three stages before creating a API through REST framework, Converting a Model's data to JSON/XML format (Serialization), Rendering this data to the view, Creating a URL for mapping to the viewset.

PostgreSQL Database PostgreSQL is an advanced, enterprise-class open-source relational database that supports both SQL (relational) and JSON (non-relational) querying. It is a highly stable database management system, backed by more than 20 years of community development which has contributed to its high levels of resilience, integrity, and correctness.

PostgreSQL is used as the primary data store or data warehouse for many webs, mobile and geospatial applications because of its ability to handle complex queries, and perform fast read-write operations and it is highly scalable.

VI. Implementation

Database Implementation

Our application has several requirements, some involving a schema and others falling under the schema-less category . For example users shall be loaded into a schema with multiple foreign keys, connectivity to other users and so on. In other cases, where we merely load a recipe into the database. Hence, we have used the PostgreSQL database – a SQL based relational database which is preferred for its faster read-write speeds and its scalability and flexibility over its main competitors.

Our app works on a central recipe model, which takes into account diet labels and the health labels, cuisine types, ingredients, dish type and nutrient information present in a particular recipe. A many-to-many relationship is established between the recipe model and the health labels, the recipe model and ingredients, and the recipe model and nutritional content. Some other aesthetics to make the app more user friendly include wish list, user browsing history, multiple family members mode etc.

Content-Based KNN Recommendation

Recommending recipes is a difficult task, especially when one considers the limited data available. Here we have built a content-based KNN recommender system which uses the underlying principle of cosine similarity that measures the sameness of two vectors of an inner product space. The parameters of our data are mostly binary - for example the value of 1, if a recipe is for vegetarians and 0 if he isn't. Label encoding of the recipe tag is necessary for effective training of the model based on categorical data. Calorific values are included in floating points in the dataset.

A brute force algorithm is used in the k-nearest neighbors approach. The model is trained using Python's scikit-learn package. This recommendation is purely content based and does not have any collaborative elements in it.

Filtering Options

The main purpose of the app is for it to fit to the needs of every user. So we have included a plethora of filtering options that can be done on the recipes so that the resulting output is perfectly suited for the user as per their requirements.

We have the option of filtering recipes by their minimum calorie count, maximum calorie count, user's preferred cuisine type (Indian, American, French, Italian, etc), dish type (Starters, Main Course, Dessert, etc), health labels (High-Protein, High-Fiber, High-Carbs, etc) and diet labels (Vegetarian, Gluten Free, Nut Free, Alcohol Free, Kosher, etc).

We have the option of filtering by the family health labels directly instead of manually selecting them. This would ensure that the recipes recommended would be suitable for each and every family member and this is our end goal.

Frontend Architecture

The front-end for the project is a Flutter mobile app that uses API calls to the backend for its data. The app starts with a typical Login screen, for a new user he will go to the Sign-Up screen, after entering the details he will be redirected to the Login Screen. On logging the user will fill the details on the Profile Filling screen. If the user has already a family member on the app he will be using Join a Code if he has no members he will be using Generate a Code for any other members to join in future. After filling details the Home Screen customized according to the user's profile will be displayed where Top Picks, Top Healthy Picks and Recommendations will be displayed on cards with recipe name and description. User can view all the recipes present by navigating to Recipes List View through the side bar. The List View too contains Recipe Cards with name and description about the Recipe. The user can find a dish by applying various filters like health label, diet label, dish type, calories etc via the search page. On clicking on any recipe card the user will be directed to the detailed view of the selected Recipe which contains all the health labels, ingredients and a link to the detailed procedure of making the dish. For integrating with the family all family members with the same joining code would be grouped together, and all recipes wishlisted by all the family members would be added to a common wishlist. There are Additional Screens which includes the Profile Screen and Settings.

The User Interface is made through Flutter Widgets and the following flutter packages : carousel slider for making a carousel, http for working with API's, flutter webview for integrating web page inside the application and inbuilt dart packages. The data from the backend is collected and displayed with the help of API endpoints. The User Interface of the App is as shown in figure.

Backend Architecture

The architecture of our application is based on REST APIs. The backend used for authentication is token authentication of the Django Rest Framework. The front end is a native mobile flutter app. We have hosted the API on Microsoft azure. The database used for the current implementation is PostgreSQL as it is fast yet highly scalable. We also have added the following API endpoints in our app.

GET /accounts/login
GET /accounts/signup
GET /accounts/forget-password
GET /api/[recipe-name]
GET /api/all
GET /api/home
GET /api/detail/[recipe-id]
GET /api/get-user-history
GET /api/get-family-info
POST /api/join-family/[family-id]

The first three endpoints are for user authentication. The first use is used for logging in, the second one for user registration and the third one is to be used in-case a user forgets their password and want to reset it. The remaining endpoints are for the main app functionalities. The fourth endpoint is used to query for a recipe by its name. The fifth endpoint returns all the recipes that are available in the database. The sixth one is for the home page where it returns three types of recipes - Top, Recommended and the latest recipes. The seventh one is for the detail view of each recipe. The eighth one returns a list of the recipes that were viewed by the user previously. The ninth one return details about the family of which the user is a part of and the tenth one is for the user to join a family using the family id code.

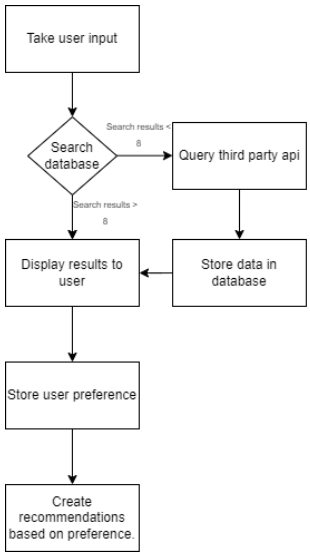

Fig. 1. User Flow Diagram

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