### Project Proposal

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**Project Title**: Personalized Nutrition Recommendation System - MoodBite

### Project Overview (What?)

MoodBite is a web-based app designed to provide tailored meal recommendations based on the user's emotional well-being and nutrition goals. By collecting user-specific data such as mood, emotional goals, dietary preferences, allergens, and nutritional needs, the app generates personalized daily menus, nutritional analyses, and snack recommendations.

**How MoodBite Works:**

* **User registration and Profile creation:** Users register with their email and during profile setup, they provide essential information such as weight, height, sex, and age.
* **Users answer a series of questions reflecting on their current state, including:**
* How are you feeling right now?
* What are your emotional goals (e.g., feel energized, calm down, or treat myself)?
* What is your activity level (sedentary, moderate, high)?
* What are your dietary restrictions (e.g., vegan, gluten-free) and goals (e.g., high-protein, low-carb)?
* **Data Analysis and Recommendations:** The app processes user input through a machine learning model trained on nutritional data, recipes, and product prices.
* It generates a **personalized daily menu**, including breakfast, lunch, dinner.
* Provides a detailed **nutritional analysis** (calories, macro and micronutrients).
* Suggests **snacks or additional foods** to fulfill any remaining nutritional gaps.
* **Shopping Assistance:** To address the business risk of losing users due to socio-economic factors, particularly concerns about the cost of recipes, the app incorporates a **cost-awareness feature** to minimize barriers to entry and enhances user retention by offering personalized solutions. For each daily menu, the app:
* Generates an **estimated cost** of the required ingredients based on grocery price data from Trader Joe's or similar sources.
* Provides **alternative options** for recipes to fit different budget ranges, ensuring inclusivity for users across various economic backgrounds.
* **User Engagement:** Users will be able rate recipes, provide feedback on suggestions, and track their nutritional progress. Gamified features encourage consistent use, such as streaks or badges for meeting goals.

### Project Justification (Why?)

We’ve all experienced how challenging it can be to maintain a healthy balanced diet while juggling a busy lifestyle, tight budgets, and personal health goals. Whether it’s struggling to find time to plan meals, searching for recipes that fit specific dietary restrictions, or trying to eat well without overspending, the process can be overwhelming and discouraging.

Research supports that cooking at home is not only more cost-effective but also leads to healthier eating habits. According to Adam Drewnowski, director of the [University of Washington’s Center for Public Health Nutrition](https://sph.washington.edu/news-events/news/cooking-home-tonight-its-most-likely-cheaper-and-healthier-uw-study-finds), “By cooking more often at home, you have a better diet at no significant cost increase, while if you go out more, you have a less healthy diet at a higher cost” (American Journal of Preventive Medicine). Yet, many people struggle with meal planning, navigating dietary restrictions, and finding recipes that fit their budget, especially when time is limited.

Our solution bridges this gap by combining multiple health domains such as nutrition, mental health, dietary restrictions, and making meal planning and cooking personalized. The app doesn’t just recommend recipes; it addresses individual needs like accommodating allergies, specific emotional states, or personal health objectives. By estimating the cost of meals and offering budget-friendly alternatives, it ensures inclusivity for users from all socio-economic backgrounds. This app stands out from traditional diet planning tools due to offering highly customizable experiences that leverage machine learning and data manipulation.

### Business Model

**How does it generate value?**

MoodBite generates value through a combination of user-centric features, partnerships, and monetization strategies:

1. **Freemium Model:**

* Basic features such as meal recommendations and nutritional analysis are free.
* Premium features include advanced insights, personalized coaching, grocery shopping integrations, and access to exclusive recipes.

1. **Affiliate Marketing and Partnerships:**

* The app partners with grocery chains like Trader Joe’s or Whole Foods to link recipes directly to their inventory.
* Users can add ingredients to a shopping cart, and the app earns affiliate revenue from grocery delivery services.

1. **Data Insights for Businesses:** Aggregated and anonymized data insights on user preferences, dietary trends, and purchasing behaviors can be sold to food companies and retailers to help optimize their offerings.
2. **Advertisements:** Brands can advertise relevant products, such as health foods, kitchen tools, or meal prep kits, directly to users.
3. **Potential API licensing**

**How does it attract and keep customers?**

* Collaboration with health and wellness brands for targeted advertisements.
* Collaborate with fitness trainers, dieticians, and nutritionists to promote the app and gain user trust.
* Provide dietician and nutritionist consultation for premium subscription

**Potential Risks and Mitigation Strategies**

By addressing following risks and leveraging datasets and predictive models strategically, the app not only mitigates potential challenges but also strengthens its value proposition, creating a sustainable and competitive business.

**1. Socio-Economic Accessibility: (Planned to be incorporated into project)**

Risk: Users may perceive healthy eating as expensive or unattainable.

Mitigation: The app uses a predictive model trained on grocery price datasets (e.g., Trader Joe's) to estimate meal costs and provide budget-friendly alternatives. By offering cost-conscious options, the app ensures inclusivity and retains users across diverse financial backgrounds.

**2. User Retention and Engagement:**

Risk: Users might lose interest or feel overwhelmed by recommendations.

Mitigation: The app leverages machine learning to adapt suggestions based on user feedback, preferences, and behavior patterns. Dynamic content keeps users engaged by aligning recommendations with their evolving goals.

**3. Data Privacy Concerns:**

Risk: Users may hesitate to share sensitive health or dietary information.

Mitigation: The app employs strict data encryption protocols and anonymization techniques to protect user data. Clear communication about data usage builds trust.

**4. Competitive Market:**

Risk: Competing apps might offer similar features.

Mitigation: The app differentiates itself by integrating emotional and mood-based recommendations with cost estimation, a feature not commonly found in existing solutions.

**5. Predictive Model Accuracy:**

Risk: Poor prediction quality could lead to user dissatisfaction.

Mitigation: The predictive model is continuously refined with real-time data from user interactions and external datasets, ensuring accuracy and relevance.

### Implementation (How)

#### **Why Relational Database?**

A **relational database** (RDBMS) is used as the backbone of the system for several reasons:

1. **Structured Data Representation:** User data (e.g., profiles, preferences, and dietary restrictions), recipes, ingredients, nutritional information, and grocery prices are inherently structured and fit well into relational tables.
2. **Relationships Between Entities:** The system involves interconnected datasets, for example: a user linked to multiple preferences, recipes linked to ingredients, and recipes linked to costs. RDBMS excels at managing such relationships through foreign keys and joins.
3. **Data Integrity:** Features like constraints, primary keys, and foreign keys ensure data consistency and validity. For instance, every recipe must reference valid ingredients, and users cannot input invalid dietary labels.
4. **Query Efficiency:** SQL is optimized for complex queries such as fetching recipes based on user preferences and calculating nutrient summaries, making RDBMS highly efficient for the app’s needs.
5. **Scalability with Structured Data:** While NoSQL databases handle unstructured data well, the app primarily deals with structured datasets. As the user base grows, relational databases can handle scaling through partitioning, indexing, and replication.

**Data Sources:**

* **Recipes:** Spoonacular API, Edamam API, USDA FoodData Central, custom web scraping.
* **Nutritional Data:** USDA FoodData Central, Edamam API
* **Price Data:** Trader Joe’s or other retail chains (webscraped or API).

#### **Architecture and Technologies**

1. **Frontend:** Built using React.js for a dynamic and user-friendly interface.
2. **Backend:** Flask/Django for API endpoints development and implementation of algorithms to match user inputs with database records.
3. **Machine Learning Module:** The module interacts with the database to fetch and update data dynamically. For example: Linear regression model.
4. **Relational Database (RDBMS):** MySQL to store and manage user profiles, recipes, ingredients, grocery prices, and nutritional data. Facilitates complex queries like:

* "Find recipes that are gluten-free and meet 30% of daily protein requirements."
* "Calculate the total nutritional value of a day’s meal plan."

1. **Data Sources and Integration:**
   * **Datasets:** Nutritional information from sources like USDA’s FoodData Central, and grocery prices from Trader Joe’s.
   * **APIs:** Integration with third-party APIs like Edamam, Spoonacular for real-time recipe fetch and nutrition data updates.

#### **Phases of Implementation**

1. **Data Modeling:** Create an entity-relationship diagram (ERD) to capture relationships between core entities.
2. **Database Development:** Convert the ERD into a normalized schema and establish relationships in a DBMS like MySQL. Populate the database with initial datasets.
3. **Backend Development:** Implement GET/POST/PUT API endpoints to interact with database. Develop and implement an advanced matching algorithm using SQL queries and Python logic.
4. **Machine Learning Integration:**
5. **Frontend Development:** Build React components for user registration, profile management, and menu visualization. Add functionality for users to provide feedback on recommendations.
6. **Testing and Deployment:** Test for database performance, data integrity, and app responsiveness. Deploy using a containerized solution (e.g., Docker) for scalability.

### Target Users and Use Cases (Who? When?)

**Primary Users:**

* Health-conscious individuals seeking personalized meal plans.
* Individuals with dietary restrictions or allergens.
* Mental health and nutrition connection awareness seekers
* Fitness enthusiasts
* Individuals with specific nutritional goals

**Secondary Users:**

* Nutritionists and dieticians for professional recommendations.
* Fitness trainers to guide clients' nutrition.

**Use Cases:**

* Daily Meal Planning: Generate tailored recipes and snack suggestions based on the user's emotional and health goals and dietary restrictions.
* Nutritional Analysis: Provide detailed breakdowns of caloric and macronutrient intake in a day.
* Shopping Assistance: Estimate the cost of daly menu based on local pricing data for groceries.

**Specific Scenario: Daily meal planning**

* A user logs into the app every morning to receive a daily menu recommendation based on their mood, dietary goals, and nutritional needs for the day.
* They input their current emotional state, energy levels, and any new dietary restrictions or goals (e.g., "cutting carbs" or "low sodium").
* The app suggests a balanced meal plan that meets their caloric, protein, and other nutrient needs for the day, along with estimated costs based on grocery price data.

#### **Specific Scenario: Weight Loss or Health-Tracking Plan**

* A user who is actively trying to lose weight or manage health conditions (e.g., diabetes, high blood pressure) uses the app to track their caloric intake and adjust their meal plans accordingly.
* The app generates a personalized meal plan based on the user’s goals, offering calorie-controlled recipes and healthy alternatives.

**Frequency of Use:** This use case is likely to occur every day, as users will rely on the app to plan their meals for a day and track their nutrition progress toward their health goals.

### Context and Scope (Where?)

**Deployment Environment**: Accessible via a web application.

**Scope of Deployment:** For the scope of the project, the initial focus will be on urban areas in the United States where data on grocery prices and dietary trends are readily available.

**Limitations:**

* The model's effectiveness depends on the availability and quality of training datasets.
* Integration with third-party APIs (e.g., Spoonacular) may incur costs and reliance on external services.

**Future Analysis and Feature Possibilities**

While the primary focus of the app will be on daily meal planning and nutritional management, there are several additional features planned for future releases. These features will enhance the app's functionality and expand its user base. Below are the future features and their anticipated use cases:

#### **1. Grocery Shopping Assistance**

**Scenario**:

* A user checks the app before going grocery shopping to view the shopping list generated from their daily meal plan.
* The app provides a detailed list of ingredients required for the meals, along with estimated prices from local grocery stores (e.g., Trader Joe's).
* If the total cost exceeds their budget, the app provides affordable alternatives for ingredients or recipes.

**Frequency of Use**: once a week before a regular grocery shopping trip

#### **2. Tracking Nutritional Progress and Goals**

**Scenario**:

* Users may access the app to review their progress in meeting their dietary goals (e.g., tracking protein intake or caloric consumption).
* The app generates a report on how well the user has adhered to their nutritional goals, highlighting areas where they have succeeded and areas needing improvement.
* If users are working with a nutritionist or have long-term health goals (e.g., weight loss or muscle gain), they can review this data to inform their next steps.

**Frequency of Use**: weekly or biweekly to assess long-term progress and adjust meal plans or nutritional goals.

#### **3. Social and Community Engagement**

**Scenario**:

* Users can share their favorite recipes or meals with friends or within the app’s community section.
* They may participate in challenges such as "healthy eating week" or "30-day diet challenge" where they can compare progress with others.

**Frequency of Use**: occasionally, by users who enjoy engaging with a like-minded community.

#### **4. Holiday or Special Event Meal Planning**

**Scenario**:

* A user plans a special meal for an event (e.g., Thanksgiving, birthday, or family gathering).
* The app offers suggestions for large meals, group-friendly recipes, and nutritional breakdowns to ensure that everyone is accommodated (e.g., vegan, gluten-free options).
* Users can also receive ingredient and price estimates to ensure the meal fits their budget.

**Frequency of Use**: occasionally, during major holidays or special events, with spikes in usage around festive seasons like Christmas, Thanksgiving, or other cultural celebrations.