

Flavour Enhanced Food Recommendation

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Abstract

We propose a mechanism to use the features of flavour to enhance the quality of food recommendations. An empirical method to determine the flavour of food is incorporated into a recommendation engine based on major gustatory nerves. Such a system has advantages of suggesting food items that the user is more likely to enjoy based upon matching with their flavour profile through use of the taste biological domain knowledge. This preliminary intends to spark more robust mechanisms by which flavour of food is taken into consideration as a major feature set into food recommendation systems. Our long term vision is to integrate this with health factors to recommend healthy and tasty food to users to enhance quality of life.

Evolution of Multimedia

- Audio: The most basic form of communication - almost every mammal uses auditory signals to communicate with its kind.
- Text: A symbolic form of communication - ranging from Egyptian hieroglyphs to modern writing systems
- Image: A still representation of an event, an object or a person
- Video: A collection of sequential images, often tied with audio
- Interactive: Amalgamation of the existing forms of media, that respond to user input

Features of Taste

Multimodal

Food perception is multimodal - visual information, tastes, smells, and tactile sensations.

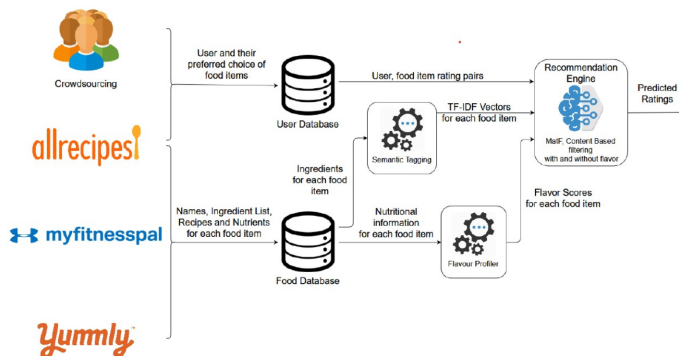
Feasible

People share food images, recipes, cooking videos onto the internet. Availability of large scale data and the processing power to handle it.

Ubiquitous

Like text and other visual media, food is universally accessible and available. Any application that utilizes taste will have a similar universal effect.

System Architecture



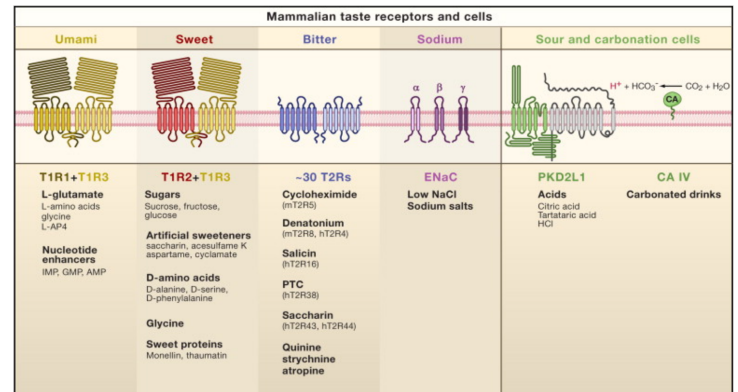
Flavour Profiler

- For a given dish, the flavour profiler assigns a score of 1-10 for each of the following tastes - Salt, Sweet, Rich, Bitter and Umami
- To develop the flavour profiler, we first identified the taste receptors associated with each taste
- We identified the nutrients/chemicals that activate the corresponding receptors
- Using the available nutrition and ingredient data for a given dish, scores are generated for each flavour

Flavour Score Samples

| Dish | Bitter | Rich | Salt | Sweet | Umami |
|--------------------|--------|------|-------|-------|-------|
| Curried bean salad | 0.961 | 0.7 | 2.63 | 2.47 | 2.534 |
| Aloo phujia | 2.149 | 2.3 | 3.116 | 0.27 | 9.271 |
| Palak paneer | 1.436 | 2.25 | 1.184 | 1.12 | 8.064 |
| Channa masala | 2.012 | 2.79 | 3.41 | 0.88 | 9.538 |
| Cilantro pesto | 0.604 | 4.45 | 0.904 | 0.57 | 2.198 |

Taste Receptors



Recommender System

- A database of users and dishes was constructed by retrieving data (consisting of recipes, user reviews, nutrition, etc.) from online sources such as Yummly, AllRecipes, Nutritionix
- Targeting the diet of the South Asian audience, dishes were also crowd-sourced from around 200 users, thereby accounting for the regional variety
- Two types of recommendation systems were explored - Collaborative Filtering (CF) and Content-Based Filtering (CB)
- The Matrix Factorization algorithm for CF does not take into account the features of the dish, instead only generating recommendations from reviews
- For CB Filtering, TF-IDF helped incorporate the features of the dish as input towards recommendation.
- The flavour scores generated are also used as attributes towards generating recommendations

Results of Online A/B Testing

| Method | RMSE |
|----------------------|------|
| Matrix Factorisation | 2.93 |
| TF-IDF | 2.11 |
| TF-IDF with flavour | 1.94 |

Taste Computing - Applications

- Health: Taste Computing could be useful for improving the adoption of healthy diets, as taste is the top driver for adoption of diets
- Culinary Arts: The process of food creation could be improved greatly with taste computing and the data associated with it
- Neuroscience: Taste Computing could provide us with an insight into how we sense our environments through chemical interactions

Future Work

- The quality of recommendations could be significantly improved with the incorporation of a cuisine element. The preparation techniques will also need to be considered during classification, as it varies from cuisine to cuisine.
- We initially were inspired by encouraging people to eat healthier through better recommendations. The limited scope of this work is on food flavour profiling, and we hope to bolster the work and accelerate the research field by more thorough integration of health factors into food recommendation at large.