EVENT MINING DRIVEN CONTEXT-AWARE PERSONAL FOOD PREFERENCE MODELLING

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MOTIVATION

Promote healthy habits

Diseases
Cardiovascular diseases account for most non-communicable deaths, followed by cancers, respiratory diseases, and diabetes.

Unhealthy Diet
An unhealthy diet is one of the major causes of NCD deaths.

Technology: a solution
It is possible to guide users towards a healthier lifestyle by understanding their underlying taste profile and their daily lifestyles to provide healthier recommendations that still appeal to the user’s tastes.
A model which represents the food-related characteristics of an individual.

Preferential Personal Food Model
Models how the user’s taste preference profile changes in different contexts.

Biological Personal Food Model
Models how different food affect the body of the individual, chronic disease, sleep, overall health, ...

*Personal Food Model, ACM Multimedia 2020
## MULTIMODAL FOOD LOGGING

### Multiple logging modalities

<table>
<thead>
<tr>
<th>Food item</th>
<th>Nutritional values</th>
<th>Preference/Rating</th>
</tr>
</thead>
</table>

*Multimedia Food Logger, ACM Multimedia 2020*
CORE ASPECTS OF A FOOD EVENT
A STANDARD FOOD EVENT STRUCTURE
A STANDARD FOOD EVENT STRUCTURE

- **Informational Aspect**
  - Taste Info
  - Nutritional Info
  - Amount
  - Activity (Watching TV)
  - Sub-Dish Food Items (drink)
- **Structural Aspect**
  - Food Event
  - Temporal Aspect
    - Start Time
    - Duration
  - Spatial Aspect
    - Location
    - Ambiance
    - Weather
  - Experiential Aspect
    - Causal Aspect
      - Caused to Food Event
      - Caused from Food Event
    - Social
    - Sensory Experience
- **Sensory Experience**
  - Taste
  - Auditory
  - Sight
  - Smell
- **Biological Factors**
  - Blood Glucose
  - Sleep
  - HRV
  - Weight
  - Biological Factors
  - Environment
  - Biology

Streams that are easily available without asking the user for input:
- Green

Streams that are captured by manual user input:
- Yellow

The aspects of the event which are currently difficult to measure and quantized and is estimated:
- Orange

The aspects which are still not very well defined:
- Red
THE US4B TASTE SPACE

from taste molecules

https://cosylab.iiitd.edu.in/flavordb/
THE US4B TASTE SPACE

from taste molecules

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Event Mining for Food Preferences

Finding patterns in events
CAUSAL PREFERENTIAL MODEL

Architecture
Event Pattern Language

Specifying event patterns

<table>
<thead>
<tr>
<th>Relation</th>
<th>Illustration</th>
<th>Interpretation</th>
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<tbody>
<tr>
<td>(X &lt; Y)</td>
<td>(X \quad Y)</td>
<td>(X) takes place before (Y)</td>
</tr>
<tr>
<td>(Y &gt; X)</td>
<td>(Y \quad X)</td>
<td>(Y) takes place before (X)</td>
</tr>
<tr>
<td>(X \in Y)</td>
<td>(X \quad Y)</td>
<td>(X) is included in (Y)</td>
</tr>
<tr>
<td>(Y \in X)</td>
<td>(Y \quad X)</td>
<td>(Y) is included in (X)</td>
</tr>
<tr>
<td>(X \cap Y)</td>
<td>(X \quad Y)</td>
<td>(X) and (Y) overlap</td>
</tr>
<tr>
<td>(X \cup Y)</td>
<td>(X \quad Y)</td>
<td>(X) and (Y) are disjoint</td>
</tr>
<tr>
<td>(X \in Y)</td>
<td>(X \quad Y)</td>
<td>(X) is a subset of (Y)</td>
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<tr>
<td>(Y \in X)</td>
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<td>(X \subset Y)</td>
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<td>(X) is a proper subset of (Y)</td>
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- PollutionExposure → DifficultyBreathing
- High Humidity ⊥ SleepInterruptions
- Alcohol \(δ_{(3,4\text{ hrs})}\) SleepInterruptions
- Exercise \(=\) Run | Walk | Cycling | Swimming
USING SYNTHESISED DATA

To Illustrate The Context-Aware Preferential Personal Food Model

Ground Truth
We opted to utilize synthesized data for the experiments because we can use the ground truth of contextual factors’ impact on taste to validate the model.

Resembling Live Data
The synthesised data must somewhat resemble the original data statistically to ensure realism and keep problems engaging for data scientists.

Original Data Structure
Also, the synthesised data must formally and structurally resemble the original data so that any software written on top of it can be reused.
SYNTHETIC DATA GENERATION

Carefully Designed Markov-Chain Parameters set in the config file.
EXPERIMENTAL SETUP

Preference Model: **Contextual taste preference vector**
DATA DISTRIBUTION HISTOGRAM

- Synthetic data generation
EXPERIMENT

A. Contextual taste preferences
1. Identify changing taste preferences in different contextual situations
2. Demonstrate prediction improvement with contextual features

B. Longitudinal prediction model
Demonstrate improvement in contextual prediction performance over time
RESULTS

Contextual Taste Profile

- Changing user preferences in different contexts
- Context is defined by temperature and stress in these experiments
RESULTS

**Prediction:** Contextual vs Average taste vectors

- Nearest neighbor model for predicting meal items
- Compared performance for average vs contextual vectors using top-5 accuracy metric.
RESULTS

Longitudinal Performance: Cold Start Problem

- Initially, the average models outperform the contextual models.
- This can be explained by a lack of data in certain contextual situations.
- After collecting sufficient data, the contextual models consistently outperform the average models.
As discussed in the paper, many aspects of a food event are currently difficult to capture and the future research needs to fill the gap in food event capturing.

State of the art research in Personal Food Modeling has a lot to accomplish. Different biological and preferential factors need to be modeled in a practical manner.

Event mining research allows us to effectively leverage multiple data streams. Discovering behavioral patterns and identifying causal impact on our health is critical for effective health estimation and navigation.

The research community has a lot to achieve to create future contextual recommendation systems which promote effective behaviour change in our personal diet and lifestyle.
THANK YOU

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