GENERATIVE-AI (UCS748) PROJECT WRITE-UP

Submitted by: Hemang Sen (102216064 ; 4Q26), Parijaat Gaur (102216104 ; 4Q27)

PROBLEM DEFINITION

Students availing hostel mess services do not have a frictionless method to judge their foods' recipes and by extension, their nutritional composition. Ideally one would ask the mess workers or authorities for the weekly menus, cooking methods, ingredient procurement/brands, and the ingredient-volumes per dish. But due to communication gaps or inherently loose standardization, this information is not transparently available to the average student. This hampers students' choice of attending breakfast/lunch/dinner, selecting optimal portion sizes (food wastage), and causes inaccurate monitoring of nutritional intake. To account for availability and reliability of information for generating nutritional vectors, there ought to be confidence tagging.

Additionally, many students unconsciously favor taste over health and get habituated into ordering takeout because there is a lack of perpetual exposure to media romanticizing precise and personalized health benefits for certain foods. Upon inevitably skipping meals, they cannot approximate their per item and per meal nutritional deficits, leaving them too underinformed to seek other available alternative foods as compensation.

Many nutrition tracking systems abstract away ground truth metrics for simplicity thus hiding potentially misleading uncertainties, and are too rigid/tedious in that they require daily hyper-monitoring and micro-management. Our goal is to appeal to students of all levels of casualness, giving them information and positive nudges without the loss of agency.

PROPOSED SOLUTION

Tamatar-Bhai – an application that is personable, transparent, and empowers dietary decision making for college students. The prototype currently helps with:

- Annotated food visuals for every meal combination for every day.
- Amusing Bhai-style commentary alongside robust information notifications, reports, and plots.
- Accounting for nutritional impact of missed meals or takeout, and suggesting alternative food items.
- Calculating and storing nutritional information/vector for every menu item, transparently accounting for all unknowns/uncertainties with textual acknowledgement.

From our course syllabus of Generative AI (UCS748), the following topics are covered:
Fine-Tuning LLMs, Conditional Text Generation, Multi-modal generation (Image Captioning), Prompt Engineering (CoT/ToT).

JUSTIFICATION FOR GENERATIVE AI

- Student engagement depends strongly on the humorous/personable commentary, which works best with LLMs as opposed to rule-based systems. Stylizing text into formal vs 'bhai-mode' is possible where students don't read raw numbers; GenAI presents priority information relatedly.
- Meal previews need semantically tying image and textual caption and nutritional card (image generation; multi-modal generation).
- Recipe extrapolation/prediction by LLMs (conditional text generation) where mess committee doesn't provide appropriate information or recipe parsing fails.
- Weekly Report Summarization requiring CoT Reasoning (eg: low X due to Y meals).

METHODOLOGY

1. Menu to Recipe to Nutrition Pipeline (NLP + Rule-based):
   Parsing dish names (handling Hinglish); mapping dish to recipe (known from mess committee else approximated by LLM) to ingredients to nutrition (from DB such as USDA/FSSAI using fuzzy matching and manual overrides); calculation of ± confidence ranges in nutrition metrics (based on info source, recency, recipe variances (oil, portion size, etc.).
2. Text Styling Module:
   Fine-tune GPT-2 or LLAMA on constructed Hinglish Slang Corpus for 'bhai' style; Conditional generation by switching between bhai-style and formal-style using prompt templates.
3. Multi-Modal Preview Cards (Text and Image Generation):
   Menu to Image Prompt Generator (Stable-Diffusion or Fine-tuned LoRA); Collates Image, dual-persona captions (GPT-2), and nutritional information into visual card.
4. Switch-up Diff Engine (Dish A versus B):
   Subtracts nutritional vectors of scheduled menu dish and replacement dish (special menu or takeout food); MCP pass to LLM for commentary.
5. Weekly Reports:
   Aggregated nutrition stats with RDA comparisons; Visual plots (matplotlib); LLM narrations.
6. Evaluation & Ablation:
   a. Text outputs evaluated with BLEU/ROUGE and peer surveys for persona effectiveness.
   b. Image outputs evaluated with FID and human ratings for realism.
   c. Ablation study compares baseline vs fine-tuned Hinglish models and with vs without uncertainty-aware narration.

EXPECTED OUTCOMES

Lightweight application having three tabs:

- "Daily Preview"
  - Student selects day + meal
  - System fetches nutrition profile, generated dual persona (bhai-style/formal-style) caption, cached/generated plate image.
  - Preview card displayed.
- "Weekly Report"
  - Nutrition data is aggregated for all meals in selected time-frame by backend.
  - Report and Summarization in dual-persona style.
- "Switch-up Diff"
  - Input or detection of mess menu change or additional/replacement food item.
  - Student selects a particular dish A vs dish B comparison.
  - LLM generates comparison and outputs inline in dual-persona.