TED UNIVERSITY

CMPE 491

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CHEF BONO: Virtual Kitchen Assistant

Project Specification Report

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1)Introduction

Artificial intelligence is becoming an increasingly important part of daily life, transforming the way people manage routine tasks. The kitchen, where technology can elevate the cooking experience, is a promising area of innovation. CHEF BONO: Virtual Kitchen Assistant aims to add intelligence, convenience, and, best of all, personalization to cooking by providing users with an interactive and supportive virtual assistant.

The project's primary motivation is to make cooking easier and more enjoyable for users of all skill levels. More than just a recipe provider, CHEF BONO acts as a real-time assistant, combining artificial intelligence, computer vision, and modern web technologies to contribute to the future of smart kitchens.

Through this initiative, the project aims to promote healthier lifestyles, reduce stress in the cooking process, and demonstrate how AI and image processing technologies can effectively and efficiently meet daily human needs.

2) Description

1. Core Problem and Solution Summary

The passive nature of traditional recipes can make cooking challenging. Following recipes, especially for individuals with special dietary needs (such as gluten intolerance or diabetes), can lead to critical errors in measuring and controlling ingredients. Chef Bono is an artificial intelligence assistant that monitors users' kitchen activities in real time, understands voice commands, and provides personalized feedback at every step of the process if asked.

2. Core Functionalities

Chef Bono serves as an active partner in the kitchen:

- **Step Tracking and Feedback**: At the user's request, it can analyze the size of the cut onions by visually monitoring them and confirm whether the user has performed the operation correctly by answering the user's question (e.g. "are the onions the right size?").
- **Cooking Control**: When the user starts cooking, it automatically sets a timer to prevent undercooking or overcooking, and notifies the user when the time is right. It can also analyze the cooking temperature.
- **Flexible Adjustment:** By listening to the user's ingredient requests, the recipe steps can be adjusted as the user wishes (for example, not adding chili powder, adding extra sugar, etc)
- **Recipe Retrieval:** It brings up the recipe you want and lists the preparation steps.
- **Cleanup Reminder**: Reminds the user to clear away leftovers and wipe down the counter when the meal is ready.
- **Special Nutrition Focus:** A strong feature of the project is its capability to support medical and special dietary requirements, going beyond standard recipes:

Medical Diets:

- **Gluten Intolerance (Celiac)**: It can offer completely gluten-free recipes and warns against cross-contamination (a substance containing even a small amount of gluten coming into contact with a completely gluten-free food and rendering it unusable).
- **Diabetes:** Focusing on guidelines for portion control and low-glycemic index recipes.

Lifestyle Diets:

- **Maternal and Infant Nutrition:** It offers recipes suitable for pregnancy and baby food recipes for babies transitioning to solid foods.
- **Fitness and Active Lifestyle Nutrition**: It offers recipes specifically focused on macro balance (carb, protein, fat ratios), pre/post workout meals, and recipes that support muscle gain or fat loss for regular gym goers and active individuals

3. Technologies Used

• Gemini API (image and text processing)

• Kokoro (TTS) or other api based TTS

• Python (General Flow, backend & frontend)

• Cookbooks.com and MediaWiki/Wikibooks (Recipes and ingredients)

• SpeechRecognition python library (STT)

•SQL lite (recipe storage)

After we finish the project, If possible, we are aiming to replace some non-opensource models with our models through some of the following technologies:

 # Core Computer Vision Libraries

opencv-python>=4.8.0

numpy>=1.24.0

pillow>=9.5.0

 # Deep Learning Frameworks

tensorflow>=2.13.0

torch>=2.0.0

torchvision>=0.15.0

 # Object Detection Models

ultralytics>=8.0.0 *# YOLOv8*

mediapipe>=0.10.0 *# Hand and pose detection*

 # Scientific Computing

scipy>=1.10.0

scikit-learn>=1.3.0

pandas>=2.0.0

matplotlib>=3.7.0

 # Image Processing and Analysis

scikit-image>=0.20.0

imageio>=2.30.0

 # Audio Processing (for future sound analysis)

librosa>=0.10.0

soundfile>=0.12.0

Hardware:

• Laptop (built in microphone, speaker)

• Camera

3) Constraints

The project is affected by several technical, economic and ethical constraints:

1. Technical Constraints

- The system depends on external APIs (Gemini, TheMealDB, MediaWiki/Wikibooks), all of which have request limits and usage restrictions.
- Since there is no access to GPU resources, training custom models (e.g., YOLO or PyTorch based networks) is not feasible during this phase, only pretrained models can be used.
- Recipe data from Wikibooks is inconsistent and stored in wikitext/HTML formats, requiring additional parsing and normalization before being converted into a structured JSON format.
- The application requires a stable internet connection because external APIs must be accessed during recipe retrieval or image analysis.

2. Economic Constraints

- Some external services (especially Gemini) have limited free-tier usage, making it necessary to reduce unnecessary API calls and store processed recipe data locally using Python's built-in SQL database (e.g., SQLite) instead of relying on external or paid database services.
- Budget limitations prevent the use of paid cloud servers or high-performance computing resources.

3. Ethical & Legal Constraints

- Recipe data sourced from Wikibooks is licensed under CC BY-SA 4.0, which requires proper attribution and sharing derivative content under the same license.

- All stored records must include source and license information to comply with attribution requirements.
- No personal user data is collected; the system must avoid generating outputs that could mislead users regarding safety or food preparation.

4) Professional and Ethical Issues

1. Privacy and Data Protection

Chef Bono uses a camera and microphone, which may capture personal or sensitive user data. A strict privacy control and compliance with data protection laws is required.

It should include encryption in case we decide to transfer data with radio signals from camera to laptop.

2. Consent

Users must be informed that Chef Bono uses video and audio input. Consent should be explicit, clear, and revocable.

3. Accuracy and Reliability

Chef Bono shouldn’t be overconfident and carefully examine user feedback.

4. Licensing

All recipes, datasets, and external resources must respect licensing terms. No copyrighted content should be redistributed without permission.

5. Environmental and Social Impact

Chef Bono should encourage sustainable cooking, reduce waste, and avoid unhealthy cooking patterns.

5)References

[1] Google AI. “Gemini API Quotas and Limits.”

Available: https://ai.google.dev/gemini-api/docs/quotas-limits

[2] MediaWiki. “API Etiquette and Usage Limits.”

Available: https://www.mediawiki.org/wiki/API:Etiquette

API Licensing: https://www.mediawiki.org/wiki/API%3ALicensing

Wikimedia Commons Licensing: https://commons.wikimedia.org/wiki/Commons%3ALicensing

[3] Creative Commons. “CC BY-SA 4.0 License.”

Available: https://creativecommons.org/licenses/by-sa/4.0/

[4] Python Software Foundation. “sqlite3 — DB-API 2.0 interface for SQLite databases.” Available: https://docs.python.org/3/library/sqlite3.html