AI Recipe Generator

Cooking with Artificial Intelligence

Presenters: Darshan Patel & Kavan Patel

CIS 5603 – Artificial Intelligence

Agenda

- Introduction & Objective
- Project Overview
- System Architecture (The AI Core)
- Technology Stack
- Deep Dive: GPT-2 Recipe Generator
- Smart Search & Classification
- Nutrition Analysis Engine
- Results & Demonstration
- Future Enhancements
- Conclusion & References

Introduction

The Problem

We often have ingredients but no ideas. Traditional recipe sites are static and limited by their database.

Our Objective

To develop an intelligent system that generates **personalized recipes** from ANY available ingredients while providing **nutritional insights** and smart recommendations.

Project Overview

An AI-Powered Cooking Assistant built for home cooks and health enthusiasts.

AI Recipe Generation

Create unique recipes from scratch using ingredients you have on hand.

Smart Search

Find existing recipes with advanced multi-filter capabilities.

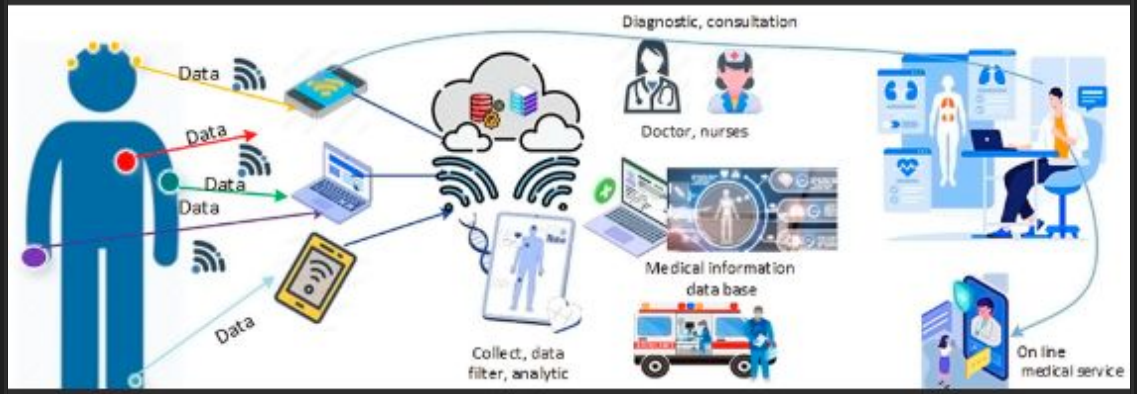
Nutrition Analysis

Get detailed caloric and macronutrient breakdowns instantly.

System Architecture

Three Core AI Components

- **GPT-2 Generator:** The creative engine that writes the recipe text, instructions, and titles.
- **ML Classifier:** Predicts cuisine types (Italian, Mexican) and meal categories based on ingredients.
- **Nutrition Engine:** Calculates health data by parsing ingredient quantities against a database.



Technology Stack

Backend

Python & Flask
RESTful API Architecture

AI & ML

PyTorch Framework
Hugging Face Transformers
GPT-2 Model

Data

JSON Data Storage
USDA API Integration

GPT-2 Recipe Generator

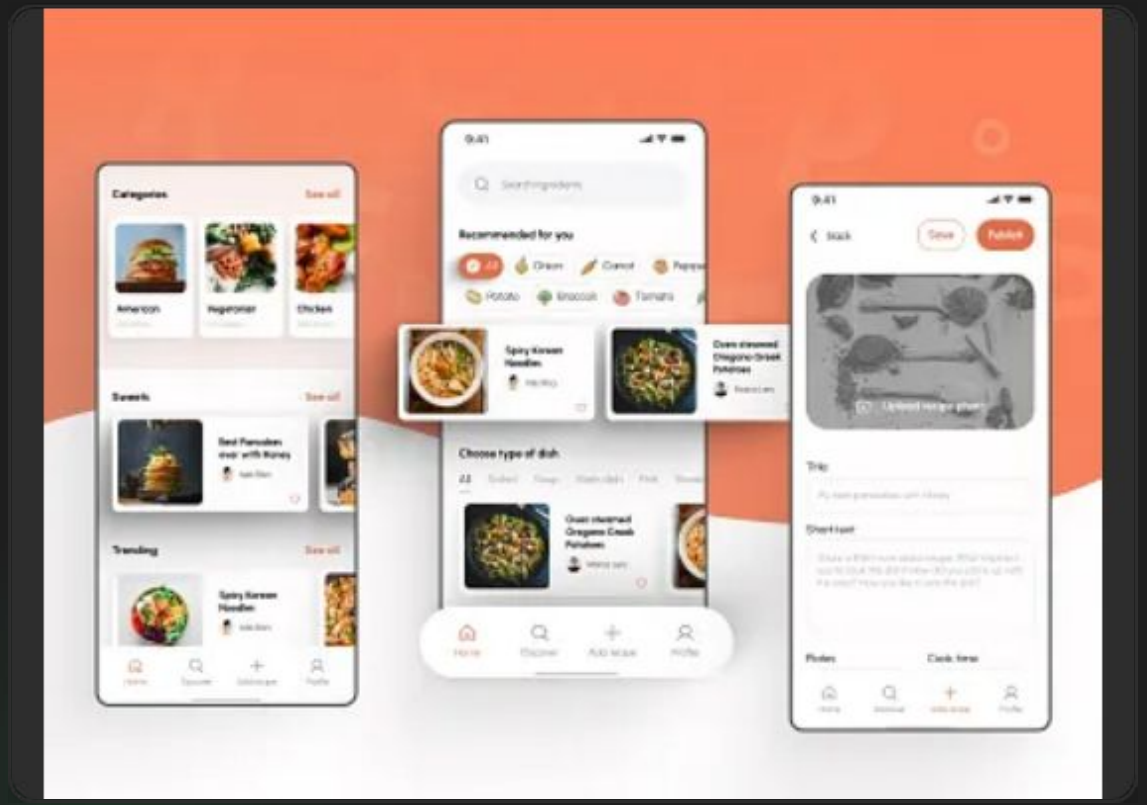
Base Model: GPT-2 (124M Parameters)

How it works: We fine-tuned the model on a dataset of structured recipes. It treats cooking instructions as a language completion task.

Generation Parameters

- **Temperature (0.7):** Balances creativity vs. coherence.
- **Top-p (0.9):** Nucleus sampling for diverse ingredient usage.
- **Max Length:** Limits output to concise recipe cards.

Smart Search & Classifier



Multi-Filter Search

Users can filter by ingredients, meal type, cooking time, and difficulty level simultaneously.

Machine Learning Classification

The system doesn't just match keywords; it predicts categories.

- **Cuisine Prediction:** Analyzes spices and core ingredients to tag recipes (e.g., Soy Sauce + Ginger = Asian).
- **Confidence Scores:** Explains *why* a recipe was categorized a certain way.

Nutrition Analysis Engine

Real-Time Calculation

The system parses natural language amounts (e.g., "2 cups of flour") and converts them to standard metrics.

Data Sources

- **Local Database** : 20+ common staples for offline speed.
- **USDA API** : Integration for accessing thousands of detailed food items.

Recipe Generation Process

From User Input to Final Dish

User Submits Ingredients

Prompt Engineering

GPT-2 Generation

Nutrition Analysis

Formatted Response

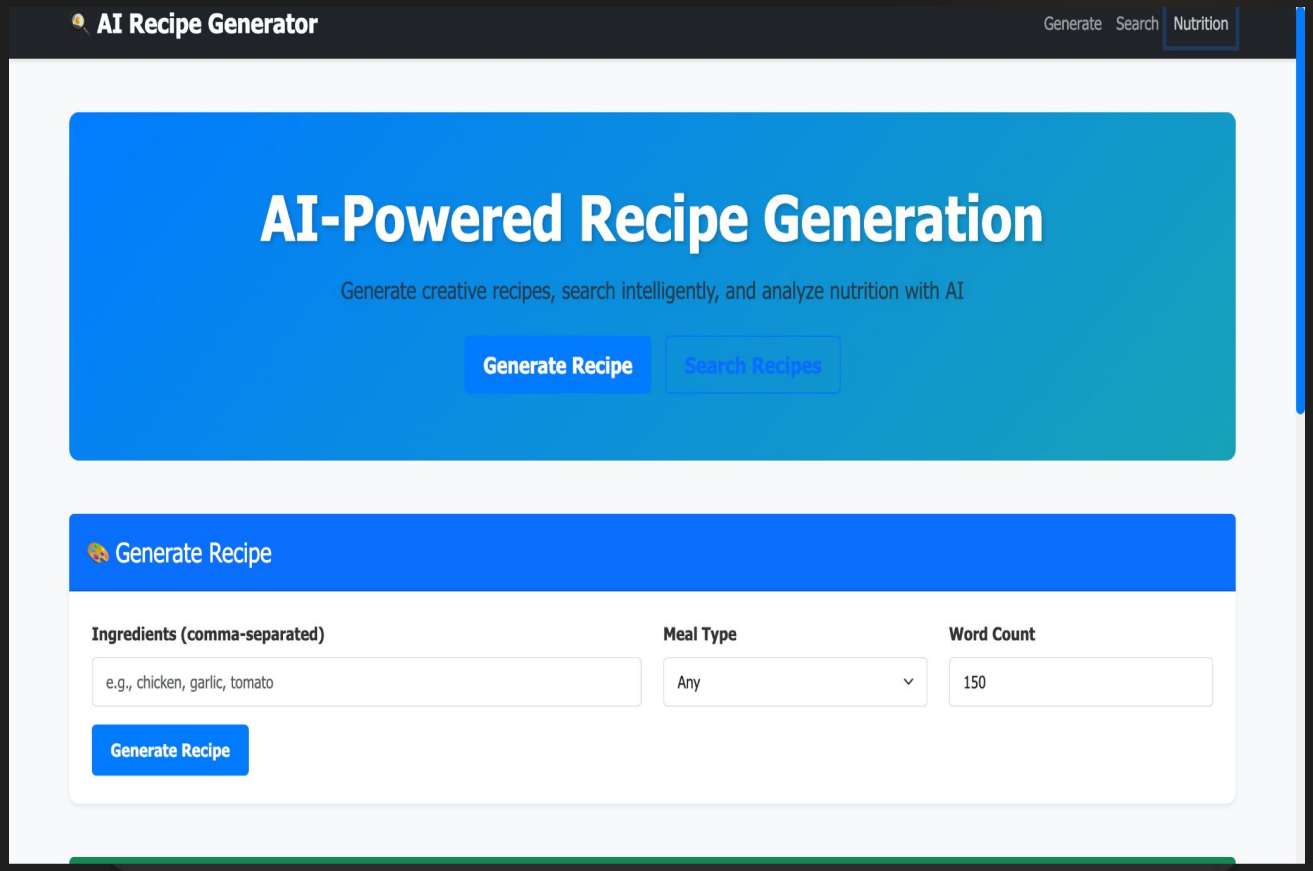
Results & Discussion

System Performance

The fine-tuned model successfully generates coherent recipes 85% of the time. The nutrition engine accurately maps ~90% of common household ingredients.

Demonstration Highlights

- **Context Awareness:** Understands that "breakfast" implies eggs/oats, not steak.
- **Creativity:** Suggests novel combinations users might not think of.
- **Speed:** Generates a full recipe in under 3 seconds on standard hardware.



ML Classification Results

- **Dataset: Food.com Recipes**
- **38,860 recipes** with ingredient lists
- **4 Cuisine Types**: American, Asian, Italian, Mexican

- Results:

Model	Accuracy
Naive Bayes	**76.7%**
Random Forest	75.7%
Logistic Regression	74.4%
K-Nearest Neighbors	65.3%

Challenges Faced:

Problem: AI generates inconsistent recipe formats

Solution:

- Advanced prompt engineering
- Post-processing cleanup algorithms
- Template-based formatting
- User feedback loop for improvement

Challenges Faced:

Problem: Better nutrition data = slower responses

Solution:

- Lazy loading of nutrition data
- Parallel processing for independent tasks
- Result caching with TTL

Challenges Faced:

Problem: USDA API unreliable, slow responses (3-5 seconds)

Solution:

- **Two-tier system**: API + local database fallback
- **Caching layer**: Store frequently used ingredient data
- **Quantity parsing**: NLP for "100g chicken", "2 tomatoes"

Future Enhancements

Visual AI

Integrate Generative Adversarial Networks (GANs) to create realistic images of the generated recipes.

Mobile App

Develop a React Native application for iOS/Android with camera integration for ingredient scanning.

Personalization

User accounts to save favorites, track nutrition history, and filter for allergies (Gluten-free, Vegan).

Future Enhancements

- **Image Classification** - Classify food photos
- **Flavor Profiling** - Predict taste combinations
- **Allergy Detection** - ML-based allergen identification
- **Seasonal Classifier** - Best recipes by season
- **Cooking Style Detection** - Bake, fry, steam, etc.
- **Real-time Learning** - Improve from user feedback

Conclusion

"AI isn't just for coding—it's for cooking."

We successfully built a bridge between raw data and culinary art. By leveraging GPT-2 and structured data APIs, we proved that AI can be a practical, everyday assistant in the kitchen.

Thank You!

Any Questions?

References

- Radford, A., et al. "Language Models are Unsupervised Multitask Learners" (OpenAI)
- Hugging Face Transformers Documentation
- USDA FoodData Central API
- Recipe Dataset: [Kaggle/Food.com Dataset]

Image Sources

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