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|  | Proposal |
|  |  |
|  | Natalia Palej |

A00279259  
Software Design with Artificial Intelligence for Cloud Computing  
Year 4

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# Project Title

**Recipe Vision**: AI-Powered Food Recognition and Recipe Generation App

# Aims and Objectives

## Aims

Develop user-friendly application that identifies (raw) food products and quantities using image recognition and provides recipe suggestions. That way we can reduce food waste and save on household expenses.

## Objectives

* Build an AI-powered application using YOLO for object detection
* Integrate Groq API for recipe generation
* Create simple Flask-based interface for functionality demonstration

# Background

## Problem

Food waste is major issue worldwide. Just within EU, over 59 million tonnes of food go to waste each year. At the same time, millions struggle to afford quality meals regularly [[1]](#_References).

## Solution

By utilizing Artificial Intelligence, the app addresses this challenge by recognizing leftover ingredients that we may not know how to combine. It will not only help reduce food waste, but also promote creative meal options and reduce household expenses.

## Context

AI is evolving in object recognition to support sustainable solutions. One of those solutions is managing household’s food inventory and waste. AI enables precise object detection, making it feasible to build a robust image recognition system. Companies like Samsung have introduced AI for food list management in their Family Hub Fridge-Freezer [[2][3]](#_References), although these solutions are not accessible for everybody. Recipe Vision aims to be cost-effective alternative for broader audience.

# Research Question

How can AI-based image recognition technology help reduce food waste by suggesting recipes based on identified ingredients?

# Proposed Methodology

## Technologies

|  |  |
| --- | --- |
| **Programming Language** | Python |
| **Image Recognition** | Framework: PyTorch Model: YOLOv8 and Custom Model |
| **Web Framework** | Flask |
| **Recipe Generation** | Groq API |
| **Development Environment** | Virtual Ubuntu  College PC for resource-intensive task (eg. training custom model) |

YOLO which will be built on PyTorch, will be used to train and test object detection models. Flask will be used to process user image uploads, run inference and display recipe outputs. Groq will be used to send AI API request to generate recipes based on the identified products.

YOLOv8 was chosen over YOLOv5 due to its improved performance metrics, such as higher precision and recall and more user-friendly integration with PyTorch. YOLOv8 also supports advanced features like anchor-free detection, which enhances the detection of irregularly shaped or overlapping objects, making it ideal for recognizing food items.

## Steps

|  |  |
| --- | --- |
| **Steps** | **Purpose** |
| Dataset Preparation | Collect and annotate raw food images, ensuring diversity, but limiting to most-common products for:   * Vegetables * Fruits * Meat * Dairy Products |
| Training the Model | Train YOLO on annotated datasets using college resources, optimizing accuracy |
| Integration | Combine detection results with Groq AI to generate recipes (where at least one is healthy option), ensuring seamless communication between components |
| Testing | Test the application, ensuring it works as expected |
| Front-End Development | Develop simple, user-friendly front-end that will allow for image upload and will display recipe outputs |

# Expected Outcome

## Functional Deliverables

The application will filter detected objects based on a minimum confidence threshold of 80%, ensuring that only items above this threshold are displayed. The 80% confidence threshold was selected based on a balance between reducing false positives and maintaining sufficient recall. The frontend will allow users to manually add any missing items, generate recipe suggestions via AI API integration and provide user-friendly interface to display the outputs.

## Impact

Reduced food waste through better management of leftovers from fridge and/or press.

# Milestones

**October 2024:** Requirements analysis, project proposal and project plan is done

**November 2024:** Gathering dataset is completed

**December 2024:** Complete annotation and validation of 50% of the dataset

**January 2025:** Complete annotation for the rest of dataset. Model is being trained

**February 2025:** System is integrated

**March 2025:** Backed and API development is finished

**April 2025:** Frontend development, testing, refinement and finalising outstanding documentation is completed

# Resources and Budget

## Resources

* Datasets of food images
* College PC for training the model

## Budget

* No cost due to open-source and free tools like PyTorch, YOLO, Groq and open-source datasets

# Risks

## Technical

* Annotating huge food dataset for training
* Handling misclassification of food products

## Non-Technical

* Dependency on external API (Groq)
* Hardware requirements for training custom model

## Mitigation Strategy

* Reduce data annotation to key, most common classes
* Implement data augmentation techniques to improve model
* If Groq API becomes unavailable, alternative API will be used (eg. ChatGPT)

# Conclusion

Recipe Vision aims to tackle food waste through an innovative application combining object detection through image recognition technology and AI-based recipe generation. It utilizes various technologies to create functional and user-friendly application, that can have significant social and environmental benefit.

# References

1. European Commission, "About Food Waste," Food Safety, 2023. [Online]. Available: <https://food.ec.europa.eu/food-safety/food-waste_en>. [Accessed: Nov. 2024].

2. The Verge, "Samsung’s Family Hub: AI-Powered Food List Management," Aug. 31, 2024. [Online]. Available: <https://www.theverge.com/2024/8/31/24231740/samsung-food-plus-vision-ai-food-list-management-ifa-2024>. [Accessed: Nov. 2024].

3. API4.ai, "How AI-Powered APIs Are Improving Waste Management with Image Recognition," 2023. [Online]. Available: <https://api4.ai/blog/how-ai-powered-apis-are-improving-waste-management-with-image-recognition>. [Accessed: Nov. 2024].