

Computer Science Project

Graph-Based Design

Problem Statement

Food waste is a major problem in supermarkets, where perishable goods often expire without being sold. Managing stock efficiently while ensuring that customers receive fresh products is a hard task. Traditional inventory systems rely on simple expiration tracking, but they often fail at reducing the waste as well as rotating the stock regularly.

Solution

Develop a graph-based image analysis system that can detect expired goods and relay how goods need to be placed in the supermarket.

Project Justification

It simplifies the large amount of products that need to be checked to only those that need to be changed. It also reduces waste in supermarkets because graphs model relationships and dependencies between food items.

Technical Algorithms to use

- KNN Graph
- Graph Clustering

Member Tasks

Member 1 (AO Cushe) 223220776

Suggests similar food items based on freshness and expiration date using K-NN graph.

Member 2 (P Mabeso)223039521

Classifies food items based on freshness levels using clustering techniques to group them.

Member 3 (MY Ntombela)222222816

Building user-friendly GUI for supermarket employees and managers to visualize food stock levels and make data informed decisions.

Member 4 (TD Selane)222045938

Tracks and updates food item freshness and expiry using its corresponding graph representation and date metadata.

How the Project should work

Steps	How the project should work
1	User uploads shelf image/s or they load a previous graph
2	GUI lets user crop/select regions to be shown
3	For each region: system turns the cropped region into a graph
4	System compares to existing product graphs
5	Suggests likely match (classification)
6	User is prompted to input product expiry and today date , as well as name and shelf Id for product.
7	The selected product image is converted into a graph (Nodes are the products ,edges are the relationships of products).
8	The system calculates how many days are left before the product expires and based on this, it assigns a freshness label(fresh,expired,expires soon(in 2 days) ,etc)
9	The system compares the current product graph with all previously stored product graphs using KNN to find visually similar products.
10	System groups products into clusters based on similarity and freshness score.
11	Display in GUI : cropped product image,graph of the image(these 2 can be left out to uncomplicate the task), Expiry status, Table of all products in inventory,as well as recommendations for which products to rotate
12	Repeat for each product on shelf/s

Tasks :

Graph-Based Core: TreeGraph models products as nodes with similarity edges, used for similarity detection (findSimilarProducts). TreeGraph stores products as nodes, with edges added via addEdge- **k-NN**: KNN calculates similarity using image features (rgbHistogram, avgGray`) and metadata.

Similarity Detection: KNN computes distances based on name, shelf ID, and image features (Features), integrated into TreeGraph.

Classification: FreshCalculator.getFreshnessLevel assigns freshness labels based on expiry dates.

UI: GuiHandler provides input fields, buttons, and dialogs for user interaction, with GraphVisualizer showing product relationships. It also performs the following:

- Image upload and cropping.
- Product input and management.
- Freshness table (showFreshnessGrid) with images.
- Rotation recommendations (showRotationRecommendations).