Project Title:
Malaysian Hawker Food Recognition with Portion-Based Calorie Estimation

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1. Introduction

Digital image processing has emerged as a pivotal tool in addressing public health challenges, particularly in dietary monitoring and nutrition management. In Malaysia, where hawker food culture is integral to daily life, the prevalence of obesity and related non-communicable diseases, such as diabetes, has risen significantly due to high-calorie intake from dishes like nasi lemak and roti canai. This project leverages image processing techniques to develop a system for recognizing Malaysian hawker foods and estimating their caloric content based on portion sizes. The approach draws from established methods in food image analysis, integrating classical techniques for robustness and deep learning for accuracy. The project utilizes a subset of the Malaysia Food 11 dataset from Kaggle, selecting 7 classes of authentic Malaysian hawker foods with approximately 7,000 images. The selected classes are nasi lemak, roti canai, satay, laksa, popiah, kaya toast, and mixed rice. Items such as hamburger, fish and chips, fried rice, and fried noodles were excluded to focus specifically on local hawker cuisine. The system aims to provide a practical prototype for health applications. Recent advancements in hybrid models have demonstrated enhanced performance in similar contexts, as evidenced by studies on food datasets for personalized interventions (Karabay et al., 2023).

The initiative aligns with global trends toward automated dietary assessment, promoting healthier eating habits in a culturally relevant manner. The dataset emphasizes authentic Malaysian hawker dishes, capturing real-world variations in presentation, lighting, and composition, which are essential for testing the system's robustness. Based on a study conducted by Karabay et al. (2025), advanced deep learning models can effectively recognize food items in complex meal scenes, which supports our approach of combining classical image processing with convolutional neural networks. Through this project, classical methods like HSV color space transformations, morphological operations including dilation, erosion, and hole filling, GLCM texture analysis for extracting mean, standard deviation, and smoothness features, and Chan-Vese active contours are combined with modern deep learning using a custom convolutional neural network to handle the complexity of hawker food images, ensuring accurate identification and portion-based calorie estimation using shape compactness and color density analysis. This not only supports individual health tracking but also contributes to broader public awareness of nutritional content in everyday meals, fostering a balance between cultural enjoyment and wellness. The system provides a desktop GUI prototype built in MATLAB that allows users to load food images for immediate analysis, displaying segmentation results, food classification, and estimated calorie content based on detected portion size.

2. Problem Statement & Objectives

Malaysia faces a growing obesity epidemic, with over 50% of adults classified as overweight or obese according to national health surveys, largely attributed to calorie-dense hawker meals consumed frequently in urban areas like Ipoh. Traditional dietary tracking methods rely on manual logging, which is prone to errors and underestimation of portions, leading to ineffective management of calorie intake. Existing food recognition systems often overlook Malaysian cuisines, lacking datasets tailored to local dishes and failing to account for portion variability due to diverse serving sizes and presentation styles. This gap hinders the development of accessible tools for nutrition monitoring, exacerbating health issues like diabetes. The project addresses these challenges through image processing, enabling automated recognition and calorie estimation from food images.

Furthermore, the absence of integrated systems that combine cultural specificity with precise portion analysis limits the effectiveness of health interventions in diverse populations. By focusing on hawker foods, which are affordable and ubiquitous yet nutritionally variable, the project seeks to bridge this divide, offering a tool that empowers users to make informed choices without sacrificing culinary traditions. The lack of such systems also overlooks the potential for technology to support tourism and education, where visitors could learn about local foods while monitoring intake.

The following are the objectives of this project:

1. To develop a food recognition system using classical image processing techniques for pre-processing and segmentation, with dual classification options using either Support Vector Machine (SVM) or Convolutional Neural Network (CNN).
2. To implement a graphical user interface prototype that integrates the system for immediate dietary feedback, supporting public health initiatives in Malaysia.
3. To evaluate the system's performance on a subset of the Malaysia Food 11 dataset comprising 7 Malaysian hawker food classes, and measure calorie estimation accuracy.

3. Project Scope

The project focuses on recognizing and analyzing seven key Malaysian hawker food classes from the Malaysia Food 11 dataset: nasi lemak, roti canai, satay, laksa, popiah, kaya toast, and mixed rice. It encompasses image pre-processing, classification, segmentation, portion estimation, and calorie calculation using MATLAB tools. Classical methods include histogram enhancement, noise filtering, HSV thresholding, morphological operations, k-means clustering, region descriptors, GLCM texture analysis, and Chan-Vese active contours. The system provides dual classification options using either Support Vector Machine (SVM) or Convolutional Neural Network (CNN). The system processes single-plate RGB images from real-world scenarios, excluding multi-plate or non-food images. Calorie estimates rely on the Malaysian Food Composition Database (MyFCD) for base values, adjusted by portion ratios using shape compactness and color density analysis. A GUI has been developed for demonstration, but deployment to mobile apps is beyond scope. Testing involves accuracy metrics on dataset subsets. Limitations include handling only static images, not videos, and assuming standard plate compositions without extreme occlusions or unusual presentations.

4. Significance of Project

This project holds substantial value for public health and cultural preservation in Malaysia, where hawker food represents a UNESCO-listed intangible heritage yet contributes to rising obesity rates. By automating recognition and calorie estimation, it empowers individuals to make informed dietary choices, aligning with national initiatives like the Malaysian Healthy Plate program. The dual-mode approach innovates by combining classical image processing with an option for deep learning classification, improving accessibility in resource-limited settings. Similar systems have shown promise in dietary interventions, as seen in Central Asian contexts where datasets enable personalized nutrition, as demonstrated by Karabay et al. (2023). Moreover, recent work on large-scale food scene datasets by Karabay et al. (2025) demonstrates that region-specific food recognition systems are feasible and accurate even in complex real-world settings. Economically, it supports tourism by aiding visitors in identifying local foods while promoting balanced consumption. Academically, it advances image processing applications, demonstrating how segmentation enhances calorie accuracy in diverse cuisines, as shown in the research of Haque et al. (2022). Ultimately, the prototype could integrate into health apps, fostering preventive care and reducing healthcare burdens associated with diet-related diseases. Beyond immediate impacts, it encourages further research into culturally adapted technologies, potentially inspiring similar systems for other regional cuisines and contributing to global efforts in combating non-communicable diseases through innovative digital solutions.

5. Proposed Methodology

The methodology employs a dual-mode framework in MATLAB, emphasizing classical image processing with an option for deep learning classification. Images are loaded using standard reading functions. Pre-processing involves histogram stretching and bilateral filtering to handle noise and lighting variations in real-world photos. Food classification uses SVM with combined color and GLCM texture features, or optionally CNN for improved accuracy. Segmentation isolates food regions via HSV thresholding and morphological operations, refined by Chan-Vese active contours and k-means clustering for ingredient analysis. Portion estimation applies region descriptors including area, solidity, and extent to compute relative sizes, enhanced by color density analysis for complex dishes. Calorie calculation adjusts Malaysian Food Composition Database (MyFCD) base values by portion ratios. A GUI, built with App Designer, enables image loading and output display.

This structured process ensures efficient handling of diverse image conditions, starting from raw input to actionable nutritional insights. The integration of classical techniques provides a foundation for feature extraction and refinement, while the optional deep learning classifier enhances precision when available. Comparisons between SVM and CNN methods highlight how each approach performs on the dataset. The workflow incorporates data augmentation techniques during CNN training to enhance model generalization.

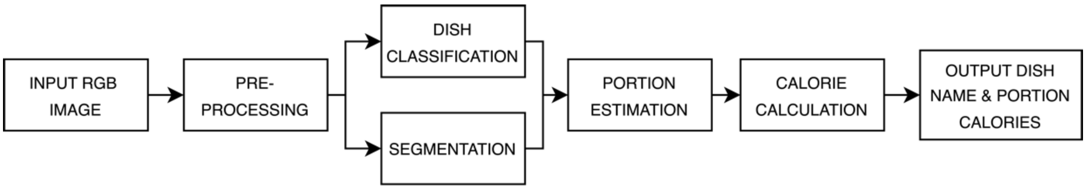

Figure 1: System Flowchart

The flowchart in Figure 1 illustrates the sequential workflow, beginning with image input and culminating in GUI output. It visually represents how pre-processing feeds into classification and segmentation, which merge for portion and calorie computations, ensuring a cohesive dual-mode pipeline tailored to Malaysian hawker food analysis. This diagram aids in understanding the modular design, allowing for iterative testing and refinement during development.

6. Performance Metrics

Performance will be assessed using standard metrics for classification, segmentation, and estimation. Classification accuracy, precision, recall, and F1-score evaluate dish recognition, targeting above 80% on test subsets. Segmentation quality will be assessed through visual inspection of mask boundaries and food coverage percentage. Calorie estimation employs Mean Absolute Error (MAE) against reference values from the Malaysian Food Composition Database (MyFCD), aiming for less than 15% deviation from standard serving sizes. Computational efficiency measures processing time per image, with goals of under three seconds on standard hardware. Cross-validation on the dataset ensures robustness, with comparisons between SVM and CNN classification methods to evaluate performance trade-offs. Additional qualitative assessments will involve visual inspections of segmented outputs and user feedback on GUI usability, providing a comprehensive evaluation of the system's practical viability.

References

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