Final Project Proposal- ECE/CS 8690 2302 Computer Vision

Coffee Grains Size &Distribution Recognition Using OpenCV

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1. Project Background

I am actually a coffee enthusiast, drinking an average of more than 2 cups per day. Additionally, I have served as a barista in a coffee shop located at my undergraduate school. I have a group of friends who also love coffee, enjoying drinking, brewing, and researching it (yes, we even research coffee brewing and roasting).

One of the essential points of coffee brewing is grinding (the other most essential two are coffee bean itself and brewing water &method). For grinding, in another word, converting coffee beans into coffee grains. Barista use different grinders, blur types, and settings (grinders spin speed, blur gap spacing or so called "clicks") to create different grinding profiles. There are many profiles, but these profiles can be described quantitatively as the particle size &distribution.

When baristas obtain this quantified information, it can better help them understand brewing and even assist in achieving better coffee brewing results and flavor. At the same time, it can also appropriately curb the proliferation of subpar coffee grinders on the market that are expensive but cannot achieve a good particle size distribution. These is my motivation for this project.

2. Project Overview

The aim of this project is to develop a system that can automatically identify the particle size, distribution, and color value of ground coffee using OpenCV. The system will use image processing techniques to extract relevant features from coffee images and analyze them to determine particle size, distribution, and color value. The project will involve designing and implementing an algorithm for feature extraction, as well as developing a user interface to display the results.

3. Project Goals

The goals of this project are to:

a. Develop an algorithm for extracting relevant features from coffee images
b. Use the extracted features to determine particle size, distribution, and color value
c. Develop an interface to display the results
d. Validate the system's accuracy and performance through testing

4. Methodology

The project will be carried out in the following steps:

- Step 1: Image Acquisition: The first step will involve acquiring images of ground coffee using a camera or scanner. (Detail see Sec. Dataset)
- Step 2: Image Preprocessing: The images will be preprocessed to remove any noise or artifacts that could interfere with feature extraction. This will involve applying filters to remove noise, adjusting brightness and contrast, and converting the images to grayscale.
- Step 3: Feature Extraction: The next step will involve designing and implementing an algorithm for feature extraction. The algorithm will extract features such as shape, texture, and color from the coffee images. These features will be used to determine particle size, distribution, and color value.
- Step 4: Data Analysis: The extracted features will be analyzed to determine the particle size, distribution, and color value of the ground coffee. This will involve applying statistical and machine learning techniques to the feature data.
- Step 5: Interface: A interface will be developed to display the results of the analysis. The interface will allow the user to input coffee images and view the resulting particle size, distribution, and color value.
- Step 6: Testing and Validation: The system's accuracy and performance will be validated through testing. This will involve comparing the system's results to manual measurements of particle size, distribution, and color value.

5. Dataset

As stated above, we acquire images of ground coffee using a camera or scanner. For better stability and quality, a simpler approach will be taken to acquire coffee images. This could involve using a standard camera or smartphone camera to capture images of ground coffee samples in a controlled lighting environment. The coffee samples will be placed on a flat, uniform background to ensure consistency in the image background. Multiple images will be captured from different angles and orientations to ensure complete coverage of the coffee sample.

Since this project will be an OpenCV Project, we won't need too much images comparing to machine learning project. The estimated images number will be 5 different grinding settings × 3 different views.

6. Deliverables

The deliverables for this project will include:

a. Source code for the system
b. Test data and results
c. Final report documenting the project's methodology, results, and conclusions

7. Timeline

The project timeline will be as follows:

- Week 1: Image acquisition and preprocessing
- Week 2: Feature extraction algorithm design and implementation
- Week 3: Data analysis and results display
- Week 4: Testing and validation
- Week 5: Final report writing and submission

8. Conclusion

In conclusion, this project aims to develop a system for identifying ground coffee particle size, distribution, and color value using OpenCV. The system will involve image acquisition, preprocessing, feature extraction, data analysis, and results display. The project will be completed over a five-week timeline, and will result in a fully functional system that can accurately determine particle size, distribution, and color value of ground coffee.