Image Based Recipe Recommendation System

INDRAPRASTHA INSTITUTE *of* INFORMATION TECHNOLOGY
DELHI

Group - 20

Akhil Mahajan (MT20107)

Shradha Sabhlok (MT20069)

Nitish Jha (MT20090)

PROJECT STATEMENT

"Extracting similar images and recipes to an input image of a food item"

MOTIVATION

1. When we want the recipe of a food item, the name of which is unknown to us, in that case, we might find it impossible.
2. In such a case, if we can identify food item using its picture and get same or similar food recipes, our problem is solved.
3. This project aims to solve the above problem with reasonable accuracy and time efficiency using ML models.
4. Enormous growth in Food Image data is the backbone of this project.
5. The methods of search using text based content are not efficient because mostly a lot of information cannot be expressed textually.

Literature Survey

1. **Comparative study and optimization of feature-extraction techniques for CBIR**
    This paper has implemented CBIR by using Average RGB, Color Moments, Co-occurrence, Local Color Histogram, Global Color Histogram, Geometric Moments as feature extraction techniques and Euclidean distance to find the similarity between images. It tries to optimize the above process resulting in much better accuracy

2. **An effective web content-based image retrieval algorithm by using SIFT feature**
    This paper proposes an image retrieval algorithm based on SIFT feature. SIFT algorithm is used for feature extraction and then Euclidean distance is used for feature matching.

3. **An integrated approach to content based image retrieval**
    The author has implemented CBIR system by using Color Moment (CM) and LBP for feature extraction and Euclidean distance to compare database images and query image.

Dataset Exploration

- **Food Ingredients and Recipes Dataset with Images** :

  This dataset has been scraped from website named Epicurious and consists of 15 folders representing various dishes and contains 3445 images.

  It also has a csv file which has 5 columns namely:

  - ❖ **Title**: Represents the Title of the Food Dish.
  - ❖ **Ingredients**: Contains the ingredients as they were scraped from the website.
  - ❖ **Instructions**: Has the recipe instructions to be followed to recreate the dish.
  - ❖ **Image_Name**: Has the name of the image as stored in the Food Images zipped folder.
  - ❖ **Cleaned_Ingredients**: Contains the ingredients after being processed and cleaned.

Dataset Visualization

Class : Soup

Class : Cookie

Class: Burger

Class : Cake

Class : Brownie

Class : Drinks

Class: Ice Cream

Class : Pasta

Class : Pizza

Class : Salad

Proposed System

1. **Data Preprocessing** : All the images in the food image database and the query image is reshaped to the size 224*169.

2. **Feature Extraction** : Features are extracted using feature extraction techniques like KAZE, SIFT, SURF and HOG.

3. **Ensembling Features** : Here, all Features obtained from above feature extraction techniques are combined/stacked.

4. **Feature matching** : Feature matching is performed between the query image and the images of the predicted class using cosine similarity.

5. **Class Prediction** : Various classifiers are used to predict which class the query image belongs to.

6. **Image and Recipe Retrieval** : First 5 images and their recipes are retrieved based on the least distances or maximum similarities.

7. **Web App** : A user friendly Web App has been made using HTML and the server is hosted using Flask. User can upload the clicked image and relevant dishes and their recipes are displayed in a website.
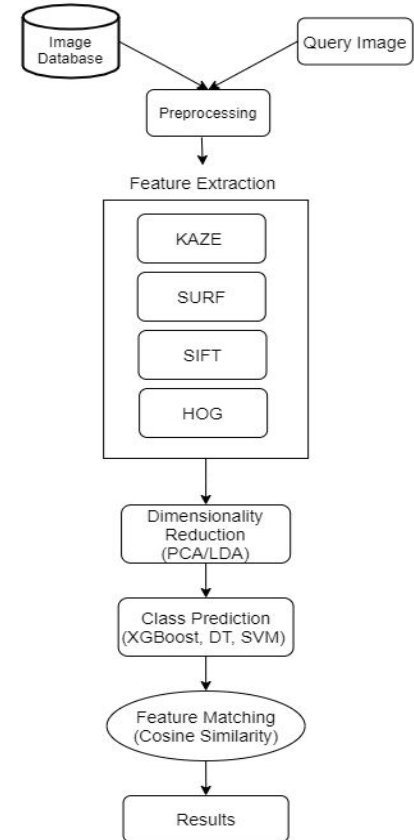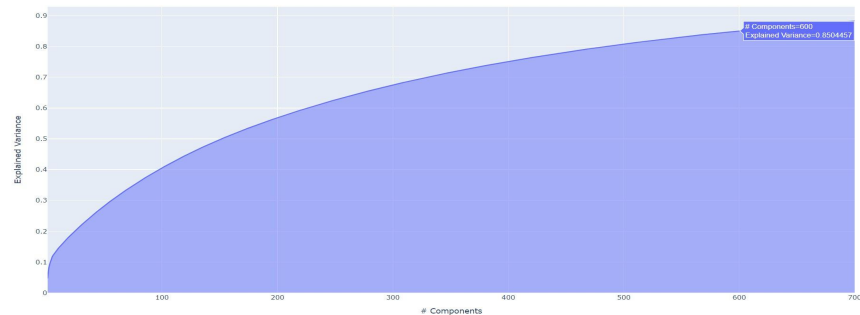
Preprocessing

- Images Resized to 224*169
- Below techniques applied for feature extraction:
  - HOG,
  - SIFT,
  - KAZE and
  - SURF
- Min-max Normalization is applied which is followed by PCA and LDA to reduce dimensions.
- PCA n-component value is deduced from variance components graphs.
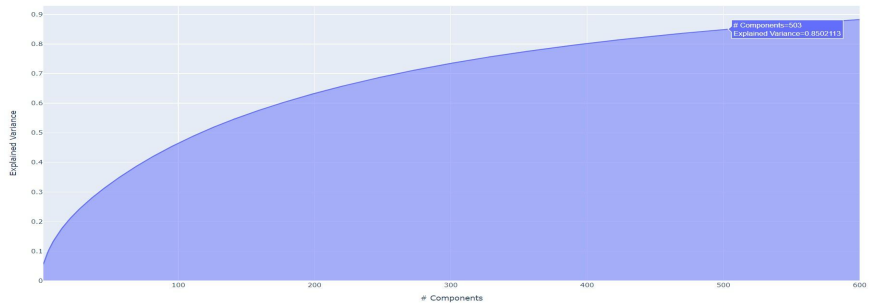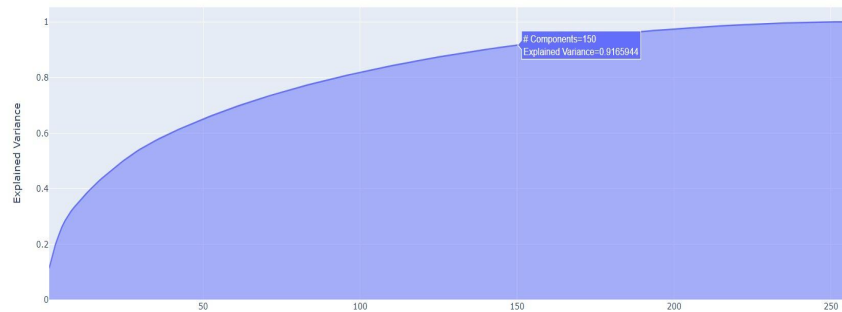
PCA Graphs
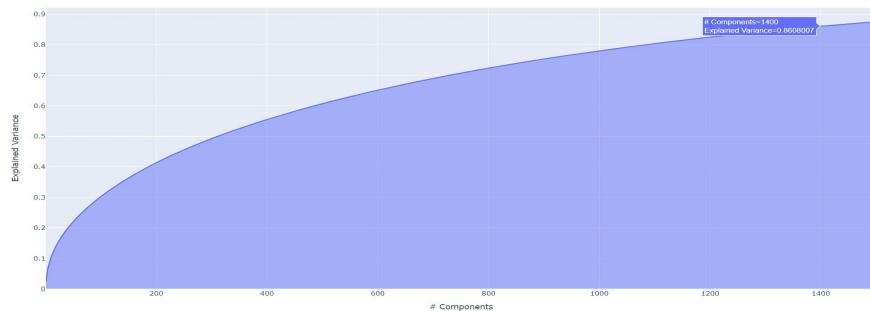
PCA_HOG - 1400 features

PCA_KAZE - 600 features

PCA_SIFT - 503 features

PCA_SURF - 150 features

Total Combined features - 2653

Model Performance

```
# Test train split
X_train, X_test, y_train, y_test = train_test_split(food_predict, labels, test_size=0.2)
print(y_train)
# Classifier
model1 = XGBClassifier()
model1.fit(X_train, y_train)
# Prediction
y_pred1 = model1.predict(X_test)
pickle.dump(model1, open("XGB_model", 'wb'))


# Print Classification Report
class_report = classification_report(y_test, y_pred1, output_dict=True)
print('Precision =', class_report['macro avg']['precision'])
print('Recall = ', class_report['macro avg']['recall'])
print('F1-score =', class_report['macro avg']['f1-score'])
print('Accuracy =', class_report['accuracy'])
```

Code Snippet

Results

Precision	98.40%
Recall	98.03%
F1-Score	98.15%
Accuracy	98.83%

```
Precision = 0.9840399788645403
Recall =  0.9803587380661316
F1-score = 0.9815364401836006
Accuracy = 0.988388969521045
```

Classification Report

Results for some Query Images

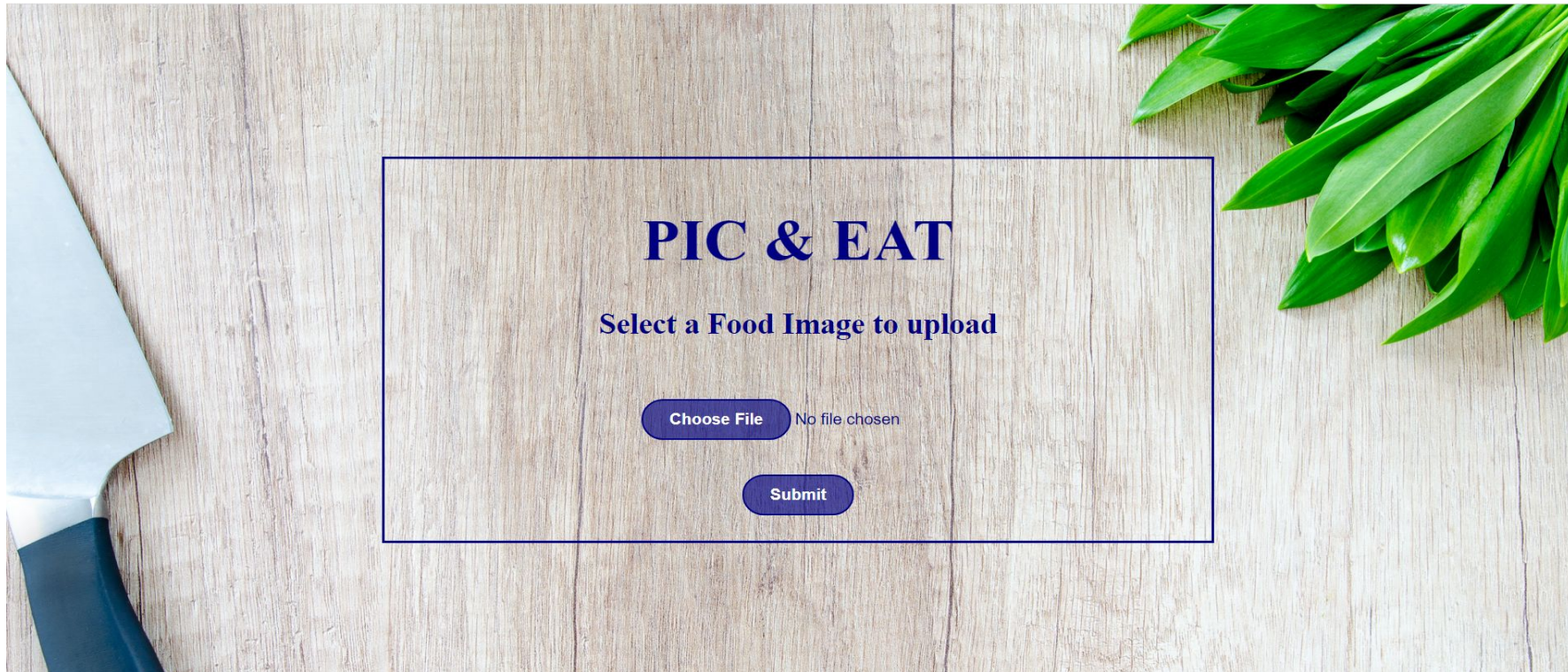

Query Image

Figure 1: Results for Query - 1

Query Image

Figure 2: Results for Query - 2

Website Glimpse

Home Page

Query Results

Cocoa Brownies

Preheat oven to 325°F. Line an 8x8x2" glass baking dish with foil, pressing firmly into pan and leaving a 2" overhang. Coat foil with nonstick spray; set baking dish aside. Melt butter in a small saucepan over medium heat. Let cool slightly. Whisk sugar, cocoa, and salt in a medium bowl to combine. Pour butter in a steady stream into dry ingredients, whisking constantly to blend. Whisk in vanilla. Add eggs one at a time, beating vigorously to blend after each addition. Add flour and stir until just combined (do not overmix). Scrape batter into prepared pan; smooth top. Bake until top begins to crack and a toothpick inserted into the center comes out with a few moist crumbs attached, 25-30 minutes. Transfer pan to a wire rack; let cool completely in pan. Using foil overhang, lift brownie out of pan; transfer to a cutting board. Cut into 16 squares.

Sourdough Rye Brownies

Place all the stage 1 ingredients in a 300ml (½ pint) jar or container with a lid, mix, cover and leave at warm room temperature for 4–6 hours. Place the stage 2 ingredients plus 125g (4 oz) of the starter in a large bowl, stir well with a whisk, cover and leave in a warm place for 1–2 hours or more time if it suits you. It won't rise much but you should see some bubbles as evidence of fermentation on the surface of the mix. In the hour before you plan to do the final mix and bake, melt the butter and chocolate in a small heatproof bowl over a pan of simmering water. Set aside to cool for 30 minutes. Line a 25cm (10 in) square tin with baking parchment. Preheat the oven to 160ºC/325ºF/gas mark 3. Add the melted chocolate and butter plus the remaining stage 3 ingredients into the bowl with the batter. Whisk until well combined. Pour into the lined tin and smooth the top with the back of a spoon so it is evenly distributed. Bake for 30-40 minutes until the top looks dry but it still has a slight wobble. It's difficult to overbake these. Sprinkle with additional sea salt, if liked, after they come out of the oven and leave to cool in the tin. When cool cut into squares to serve. The brownies can be stored in an airtight container for up to a week.

Thank You !