IMAGE CLASSIFICATION ON FOOD DATASET

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CONTENT

INTRODUCTION

This project aims to evaluate and compare the performance of traditional feature extraction methods with CNN’s in image classification tasks. By systematically analyzing the strengths and limitations of each approach, the study provides insights into their effectiveness and practical applications, contributing to the advancement of robust image classification systems.

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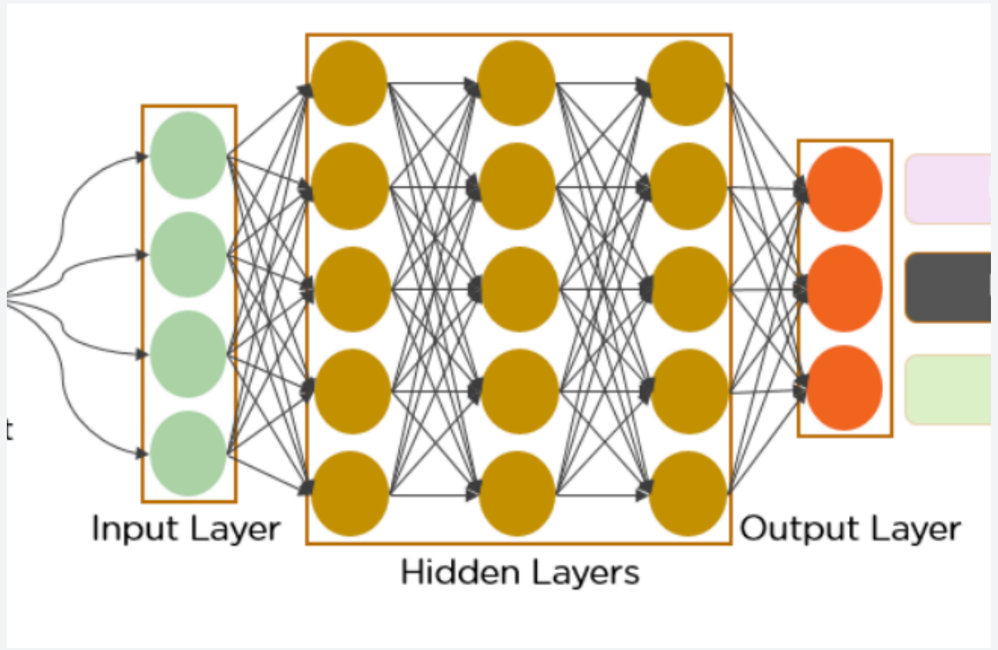
DATA PREPROCESSING

- Image Resizing
- Pixel Normalization
- Rotation and Flipping
- Scaling and Translation
- Brightness and Contrast Adjustments

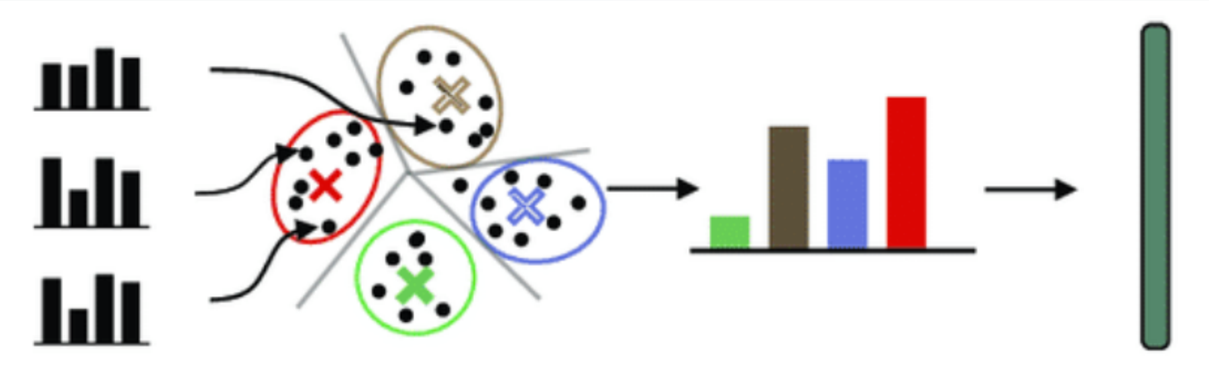
CNN

The CNN is trained on a labeled dataset of images. During training, the network adjusts its weights through backpropagation to minimize the classification error. Data augmentation techniques are applied on the fly during training to improve generalization. The performance of the CNN is evaluated on a separate test set to ensure its generalizability to unseen data.



SIFT-BOW

SIFT is applied to each image to detect keypoints and compute descriptors representing local image gradients around these keypoints. Then, the collected SIFT descriptors from the training set are clustered into a number of clusters using k-means clustering, forming a visual vocabulary where each cluster center represents a visual word. Then, for each image is represented as a histogram of visual words by assigning its SIFT descriptors to the nearest visual words in the in the Bag of Words (BoW) model. These histograms, representing the BoW features, are used as feature vectors for training the Support Vector Machine (SVM) classifier.



SVM

These histograms are utilized as feature vectors for training a Support Vector Machine (SVM) classifier, which is trained with an RBF kernel to handle non-linear separations. The performance of the SVM classifier is evaluated on a validation set, with metrics such as accuracy, precision, recall, and F1-score being calculated to fine-tune the classifier. Finally, the trained SVM classifier is tested on a separate test set, and the test accuracy, precision, recall, and F1-score are reported to assess the model's performance.

TUNING HYPERPARAMETERS OF SVM

Hyperparameters are found by grid search.

a) Hyperparameters

- Kernel: RBF, linear,
- C: 1, 10 ,100
- Gamma: Scale, 0.01, 0.1, 1

Best Hyperparameters are:

- Kernel: RBF
- C: 1
- Gamma: Scale

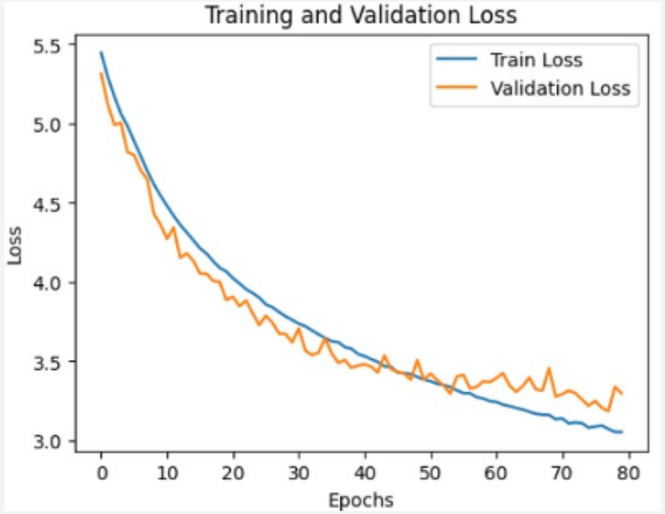
COMPARISON

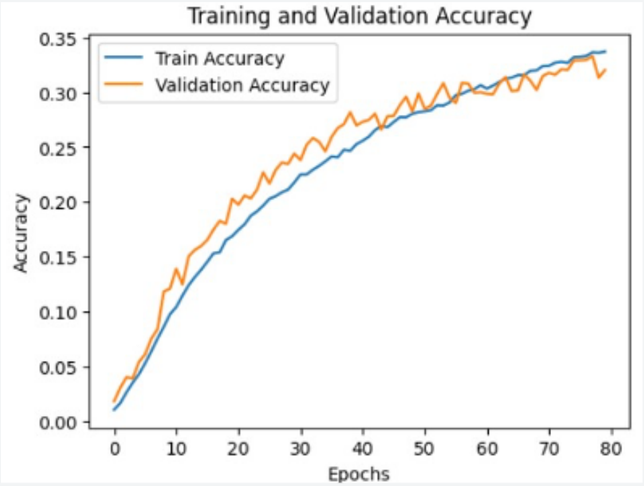
SVM:

- Test Accuracy: 0.060
- Test Precision: 0.061
- Test Recall: 0.060
- Test F1-score: 0.056

CNN:

- Test Accuracy: 0.390
- Test Precision: 0.430
- Test Recall: 0.390
- Test F1: 0.390





CONCLUSION

The results clearly show that the limitations of the traditional SIFT-BoW-SVM approach in handling the complexity and variabilityin the food image dataset. In contrast, CNNs show superior performance due to their ability to learn and generalize features directly from the data.