Product Classification & Verification

Computer Vision 2024 Project [SC]
Team: SC_40

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Data Preparation

- The function reading_images() reads images from specified folders, resizing them, and preparing them for further processing. (Distinguishes between training and validation sets for both classify-cation and recognition tasks.)

- The extract_sift_features() function extracts SIFT descriptors from images using OpenCV's cv2.SIFT_create() function.

- The create_vocabulary() function utilizes MiniBatchKMeans from sklearn.cluster to create a BoW (Bag-of-Words) vocabulary from the extracted SIFT descriptors.

- Creating Triplets using create_trainging_triplets() & create_validation_triplets() to prepare the data for Siamese Network by combining anchor, positive, and negative images.

Model Training

Support Vector Machine (SVM):
- Data Preparation: Extracts histograms of BoW features for both training and validation sets.
- SVM Initialization and Training: Initializes an SVM classifier (Kernel Linear) from sklearn.svm.SVC and trains it using the training data.

Random Forest Classifier:
- Random Forest Initialization and Training: Initializes a Random Forest classifier from sklearn.ensemble.RandomForestClassifier and trains it using the training data.

AlexNet Architecture using Keras:
- Model Definition: Defines an AlexNet architecture using Keras' Sequential API with Convolutional, MaxPooling, Flatten, Dense, and Dropout layers.
- Model Compilation and Training: Compiles the model with specified loss function (categorical_crossentropy), optimizer(Adam), and metrics(accuracy). Then trains the model using the training data.

Siamese Network:
- Use a pre-trained convolutional neural network (like Xception) as the base encoder which generates the embeddings of anchor, positive and negative images.
- Loss Function is the to train the network $\mathcal{L} = max(d(a, p) - d(a, n) + margin, 0)$

- SVM and Random Forest Evaluation: Evaluates the SVM and Random Forest classifiers' accuracy on the validation set using accuracy_score from sklearn.metrics.
- AlexNet Model Evaluation: Evaluates the trained AlexNet model's accuracy on the validation set using model.evaluate() from Keras.

SVM Accuracy on Validation Set: 85%
Random Foreston Accuracy on Validation Set: 82%
AlexNet Accuracy on Validation Set: 88%
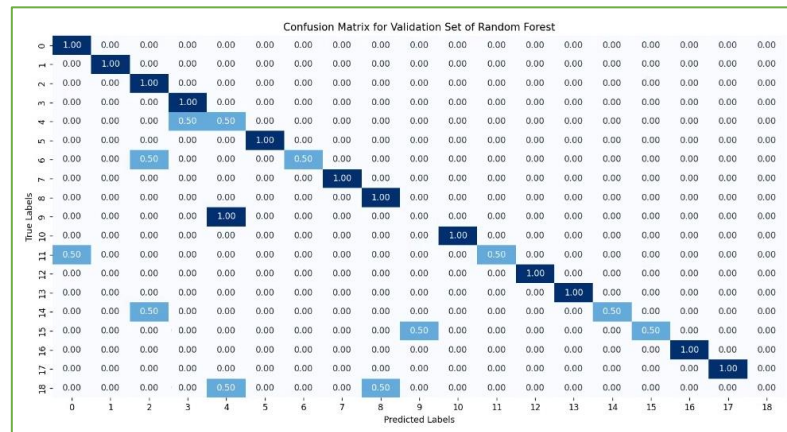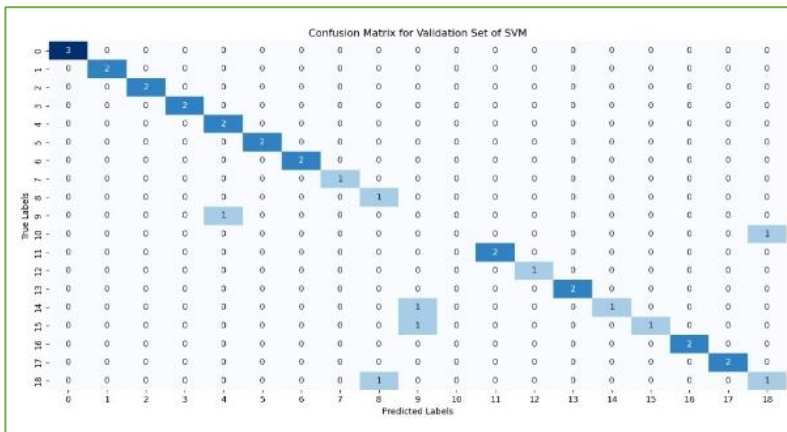
- Evaluate Siamese Model using validation triplets to compute accuracy and determine a threshold for distance between embeddings to classify similar/dissimilar images.
Siamese Accuracy on Validation Set: 95%