ECE 4438 Advanced Digital Image Processing

Assignment 1

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## MLP Using SIFT Feature Extraction Method Setup and Parameters

Using SIFT feature extraction method, 50 of the strongest points were picked out of a grayscale, histogram equalized images. The 50 points are then used to create the feature matrix and formatted to be accepted for the featureInputLayer. The input dataset was then separated into training and testing datasets, with the labels are attached to it.

Now that the dataset is fully formatted, the structure of the MLP can be created. The options for the MLP are chosen below:

options = trainingOptions('sgdm', ...

'MaxEpochs',300,...

'InitialLearnRate',2e-3, ...

'Verbose',false, ...

'Plots','training-progress');

Based on experimentation results, a learning rate of 2e-3 was a good spot for testing accuracy and as well optimizing the computational time to reach ~100% training accuracy. The number of epochs was chosen to guarantee that the model was able to reach ~100% training accuracy with the selected learning rate.

The layers were also chosen below based on experimentation results. Three fully connected (FC) layers with a batch normalization layer sandwiching each FC layer produced the best training accuracy result. Adding a relu layer before the final classification layer allowed the training accuracy to be above 50%, which is theorized to activate the final classification layer, but more testing needs to be done.

layers = [featureInputLayer(size(Data,2))

batchNormalizationLayer

fullyConnectedLayer(32)

batchNormalizationLayer

fullyConnectedLayer(8)

batchNormalizationLayer

fullyConnectedLayer(2)

batchNormalizationLayer

reluLayer

classificationLayer

];

## MLP Using SIFT Feature Extraction Training and Testing Results

In Figure 1, this graph shows the training accuracy and loss function of the model in Section 1.1. The model reliably reaches ~100% training accuracy in the number of Epochs allocated. The loss function also passes -2, which indicates that the model’s predictions, at least in the training data set, are accurate.

A graph with a blue line

Description automatically generated with medium confidence

Figure 1 MLP Training using SIFT Feature Extraction

The test accuracy using the SIFT model shows a significant decrease in accuracy compared to the high training accuracy. This is likely caused by introducing completely new images that the model doesn’t train on.

A screenshot of a test

Description automatically generated

Figure 2 Best Test Accuracy Using MLP with SIFT Feature Extraction

## 2.1 MLP Using Raw Images, Setup and Parameters

To set up the MLP to receive raw images as input,

layersRaw = [

imageInputLayer([524 524 3])...

batchNormalizationLayer ...

fullyConnectedLayer(32) ...

batchNormalizationLayer ...

fullyConnectedLayer(8) ...

batchNormalizationLayer ...

fullyConnectedLayer(2) ...

batchNormalizationLayer ...

reluLayer ...

classificationLayer];