

Neural Network

Team 8

| Name | Sec | BN | Code |
|-------------------------|-----|----|---------|
| Abdelrahman Hamdy Ahmed | 1 | 36 | 9202833 |
| Ziad Sherif Muhammed | 1 | 27 | 9202586 |
| Zeyad Tarek Khairy | 1 | 28 | 9202588 |
| Eslam Ashraf Ibrahim | 1 | 13 | 9202256 |

Submitted to Dr/ AbdelMoniem Bayoumi

Submitted to Eng/ Mohammed Shawky

Work Division

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|--------------------------|---|
| Abdelrahman Hamdy | <ol style="list-style-type: none">1. Preprocessing2. Model Selection |
| Ziad Sherif | <ol style="list-style-type: none">1. Feature Extraction2. Performance Analysis |
| Zeyad Tarek | <ol style="list-style-type: none">1. Feature Extraction2. Model Selection |
| Eslam Ashraf | <ol style="list-style-type: none">1. Preprocessing2. Performance Analysis |

Project Pipeline

1. Read images.
2. Preprocessing.
3. Get features.
4. Split Training and Test Data.
5. Training model.
6. Calculate accuracy.
7. Calculate performance analysis.

Preprocessing Module

1. Apply gamma correction to adjust lighting.
2. Segmentations
 - a. Convert image to YCbCr color space.
 - b. Skin masking.
 - c. Convert image to grayscale.
3. Convert original image to gray scale.
4. Dilation.
5. Draw left & right borders.
6. Region Filling using Contours.
7. Erosion.
8. Masking eroded the image with the original one.
9. Crop image to fit the hand exactly.

Model Selection

1. Fitting training data and labeling into **SVM model**.
2. Dumping model
3. Getting classified data

Feature Extraction Module

1. Enter each image on Histogram of Oriented Gradients (HOG).
 - a. Resizing
 - b. Gradient Computation
 - c. Cell Division
 - d. Orientation Binning
 - e. Histogram Calculations
 - f. Block Normalization
 - g. Feature Vector
2. Append array of features of each image in a list.

Performance Analysis Module

1. Calculate Confusion Matrix.
2. Get Unique Classes.
3. Creating Heatmap.
4. Displaying plot.

Other Developed Modules

Models Training

1. K-Nearest Neighbors
2. Logistic Regression
3. Gradient Boosting Classifier
4. Naïve Bayes
5. Random Forest
6. Decision Tree
7. Special Vehicle Rating

Feature Extraction

1. Local Binary Pattern (LBP)
2. Sift Algorithm
3. Conex Hull

Enhancement and Future Work

1. **Dataset Augmentation:** Increase the size and diversity of the training dataset by applying data augmentation techniques such as rotation, scaling, translation, and adding noise. This can help improve the model's generalization and robustness.
2. **Hyperparameter Tuning:** Optimize the hyperparameters of the neural network, such as learning rate, batch size, optimizer, activation functions, and regularization techniques. Utilize techniques like grid search or Bayesian optimization to find the best combination of hyperparameters.
3. **Real-Time Gesture Recognition:** Extend the project to real-time hand gesture recognition by integrating the trained model with a video stream. Consider using techniques like object tracking, background subtraction, or motion detection to isolate and analyze hand movements in real-time.
4. **User Interface and Interaction:** Build a user-friendly interface to visualize and interact with the hand gesture recognition system. This can involve integrating the system into applications, games, or interactive experiences.
5. **Ensemble Learning:** Combine multiple neural network models (e.g., by averaging predictions or using more advanced techniques like stacking or boosting) to improve overall performance and increase robustness.