Neural Networks

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Handwriting Based Gender Classification Project

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May 202Table of contents

- **Project Pipeline**
- **Preprocessing Module**
- **Feature Extraction Module**
- **Model Selection/Training Module**
- **Performance Analysis Module**
- **Work Load Distribution**

2

Project Pipeline: this project has main four modules, preprocessing, feature extraction, model (selection & traning) and performance analysis. we will talk about each module in detail below.

Preprocessing Module: Our preprocessing was as following

- Resize Image to constant size (1240,800) to make the preprocessing easier.
- Converting RGB image to GrayScale.
- Converting GrayScale image to Binary Image using Yen thresholding, many thresholding algorithms were tested and Yen gave the best results.
- Removing large black areas caused by shadows using Morphological processes.
- Perform Morphological opening with kernel of size (3,50) to extract lines.
- Find contours on the opened image then cropping it from the original image and extract the lines images.

Feature Extraction Module: We extracted three different features from each line image that we gave best results according to many papers and they were COLD, LBP, HOG.

- COLD: Cloud of Line Distribution is a very useful feature that is used to define curvature in the text. The steps of algorithm is as follows:
  - Extract contours from line image, where each contour defines a letter.
  - Get the polygonal approximation of each contour.
  - For each two successive points extracted from the polygonal approximation calculate R and Theta where R is the distance between the two points and Theta is the angle of the line drawn between them.
  - Convert R and Theta from Polar domain to Spatial domain
  - Calculate 2d Histogram of 10x10 bins and return a feature vector of length 100
- Local Binary Patterns (LBP): is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighbourhood of each pixel and considers the result as a binary number. Due to its discriminative power and computational simplicity, LBP texture operator has become a popular approach in various applications. It can be seen as a unifying approach to the traditionally divergent statistical and structural models of texture analysis.

- Histogram of Oriented Gradients (HOG): is a feature descriptor like the Canny Edge Detector, SIFT (Scale Invariant and Feature Transform) . It is used in computer vision and image processing for the purpose of object detection. The technique counts occurrences of gradient orientation in the localised portion of an image. This method is quite similar to Edge Orientation Histograms and Scale Invariant aFeature Transformation (SIFT). The HOG descriptor focuses on the structure or the shape of an object. It is better than any edge descriptor as it uses magnitude as well as angle of the gradient to compute the features.

Model Selection/Training Module: we used in model selection 3 algorithmsalgorithms

- KNN
- SVM
- RandomForest

: The (random forest) algorithm establishes the outcome based on the predictions of the decision trees. It predicts by taking the average or mean of the output from various trees. Increasing the number of trees increases the precision of the outcome.

we first read the extracted features file and extract the features and the output of the images and the images names split them as follows

For SVM & KNN:

- 1.60% for training data
- 2.20% for cross validation data
- 3.20% for test data

While for random forest

1.60% for training data

2.40% for test data where 20% is also test data

we train the data then use cross validation data to choose the following parameters:

1.c (regularisation parameter) for SVM

2.k (number of points) for KNN

3.n_estimators for RandomForest

the we test the data with the chosenchosen parametersparameters for both the lines and the full image

Performance Analysis Module: For the Model Selection part:

- KNN trains and validate the data in 16.64 sec
  •SVM trains and validate the data in 72.79 sec
  •Random Forest trains and validate the data in 8.35 sec
- KNN accuracy for lines is 68.575 %
  SVM accuracy for lines is 72.625 %
  •Random Forest accuracy for lines is 73.79%

Enhancements and Future work

By increasing number of features the accuracy increased without being overfitted,by increasing the number of training set and testing set the more accurate it will be and also for random forest by increasing the

cross validation the more it takes time to get accurate n_estimate the more accuracy

Work Load Distribution

Ahmed ayman & Ammar Mohamed in feature extraction and PreProcessing

Mohamed Ahmed & Mahmoud Amr in Modeling and Classification

Work Load Distribution

- Ahmed Ayman: search papers, (LBP & HOG) features implementation.
- Ammar Mohamed Sobhi:
- Mohamed Ahmed Fathy:
- Mahmoud Amr Nabil: