Arabic Calligraphy Font Identification

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Preprocessing Module

The preprocessing module is divided into 3 steps. First step is converting colored image to grayscale image. Second step is using Otsu thresholding then converting the grayscale image to binary image. Third and last step is converting all binary image to white text and black background.

Feature Extraction

We have used local phase quantization as our feature extraction. Local phase quantization is a blur insensitive texture descriptor which was founded on Fourier phase spectrum. At each pixel, the local phase information is calculated by 3-by-3 neighborhoods using STFT Gaussian Window.

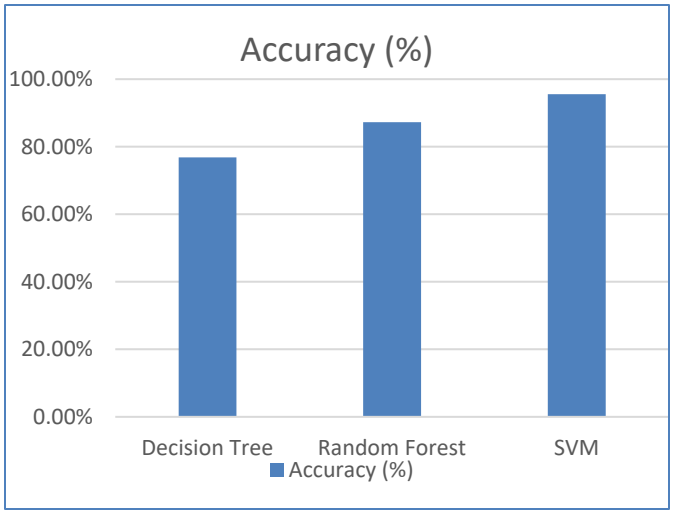
$$F(u,x) = \sum_{y \in N_x} f(x-y) e^{-j2\pi u^T y} = w_u^T \ fx$$

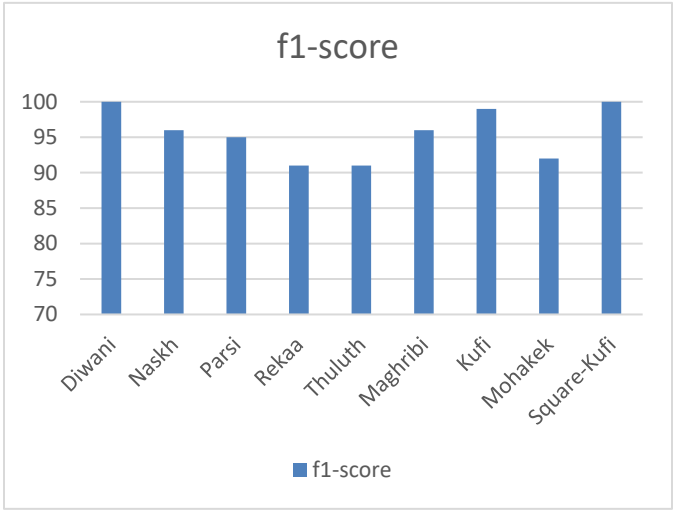
Model Selection

To choose the best classifier with LPQ features, we have divided training data into 80% training data and 20% validating data. We have tried DT, RF and SVM using polynomial as kernel.

Performance Analysis Module

Their accuracies are 76.85%, 87.24%, 95.55% respectively. We used K-Fold (K=5) Cross Validation.





Other Approaches

We have implemented 4 different research papers.

1. A Statistical Global Feature Extraction Method for Optical Font Recognition with Decision Tree Classifier:

   Preprocessing Module:

   1) Binarization using Otsu Thresholding.
   2) Laplacian filter to get an edge image.

   Postprocessing Module:

   - Edge Direct Matrix 1,2 (EDM_1, EDM_2)

   Feature Extraction Module:

   1) Edges Direction: $Max(EDM_1(x,y))$
   2) Homogeneity (θ): $EDM_1(x,y)/\sum EDM_1(x,y)$
   3) Weight: $EDM_1(2,2)/\sum(Iedge(x,y) = Black)$
   4) Pixel Regularity (θ): $EDM_1(x,y)/EDM_1(2,2)$
   5) Edge Regularity (θ_*): $EDM_2(x,y)/EDM_2(x,y)$

   θ represents 0, 45, 90, 135 and θ_* represents 0, 45, 90, 135, 180, 225, 270, 315 degrees.

2. GLCM (Co-occurrence Matrix) with Decision Tree Classifier:

    Preprocessing Module:

        1) Binarization using Otsu Thresholding.
        2) Laplacian filter to get an edge image.

    Feature Extraction Module:

        1) Contrast.
        2) Homogeneity.
        3) Dissimilarity.
        4) ASM.
        5) Energy.
        6) Correlation.

3. A New Computational Method for Arabic Calligraphy Style Representation and Classification with Support Vector Machine:

    Preprocessing Module:

        1) Binarization using Otsu Thresholding.
        2) Laplacian filter to get an edge image.
        3) Skeleton image.
        4) Diacritics image.
        5) Text only image.

    Feature Extraction Module:

        1) Horizontal & Vertical Straight Lines (HVSL) from edge image.
        2) Text Orientation from edge and skeleton images.
        3) Long Vertical Lines (LVL) from skeleton image.
        4) Special diacritics from diacritics image.
        5) Word's Orientation (WOr) from text only image.
        6) Horizontal Profile Projection (HPP) from text only image.

    New way of classification:

        Each feature has its own classifier (SVM) then we sum all classifier after fitting the training data.

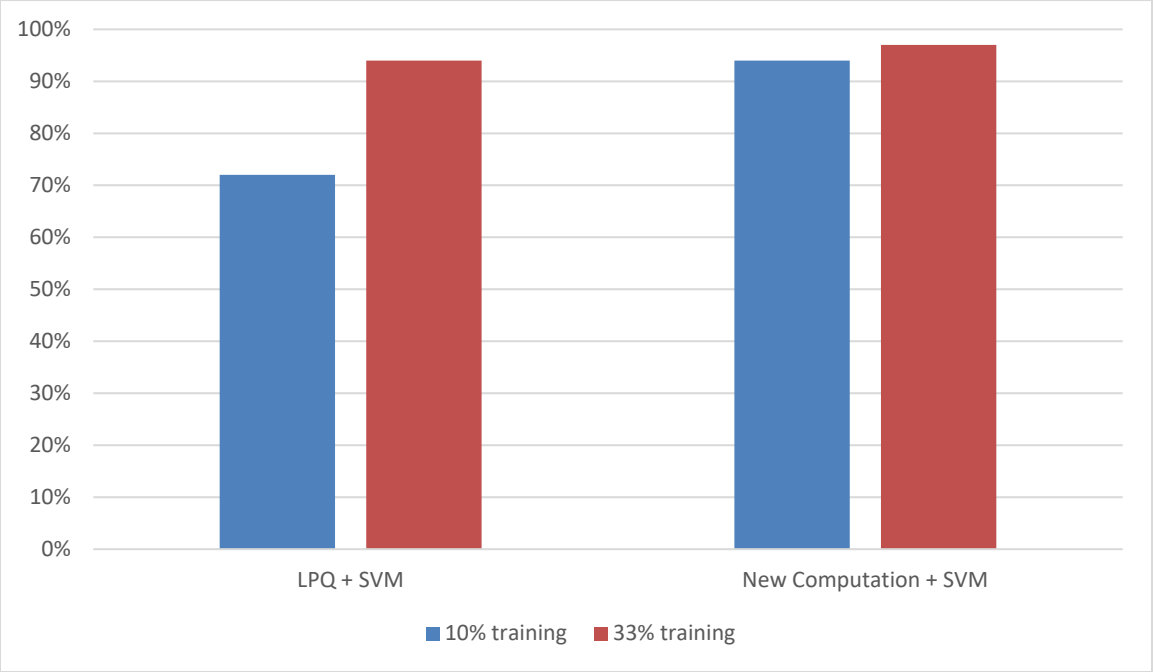
Comparison Between Approaches

Approach	EDMs + DT	GLCM + DT	New Computation + SVM	LPQ + SVM
Accuracy	78.34%	83.45%	69%	95.55%

We have found that EDMs + DT and GLCM preform not very well. We believe new computation + SVM and LPQ + SVM have good promises.

Enhancement and Future Work

We believe new computation + SVM will outperform LPQ + SVM because their features are much reasonable and the accuracy that we conducted haven't hyper tuned their parameters to the optimum. New computation also gives much more promises than ever. They have said that their proposed method outperforms LPQ + SVM and other neural network approaches. Even with 10% training data and 90% validating data.



Workload Distribution

Name	Distribution
Ahmed Ayman Elsayed	A Statistical Global Feature Extraction Method for Optical Font Recognition
Ahmed Hussein Abdelghany	Arabic Artistic Script Style Identification Using Texture Descriptors
Mohamed Mahmoud Ghallab	A New Computation Method for Arabic Calligraphy Style Representation Classification
Omar Tarek Elwakil	
Equally distributed	An efficient multiple-classifier system for Arabic calligraphy style recognition

References

1. An efficient multiple-classifier system for Arabic calligraphy style recognition.
2. A New Computational Method for Arabic Calligraphy Style Representation and Classification
3. Arabic Artistic Script Style Identification Using Texture Descriptors.
4. A Statistical Global Feature Extraction Method for Optical Font Recognition