Arabic Letters Classification

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Project Overview

This proposal outlines a project for CSCE4603 - Fundamentals of Computer Vision (Fall 2024), focused on Arabic letters classification using a combination of traditional computer vision techniques and deep learning. The project addresses challenges in Arabic handwriting recognition, including cursive writing styles and diverse character shapes.

1 Problem Statement

Arabic handwriting recognition presents unique challenges due to the script's cursive nature and varied character forms. Our project will employ both traditional computer vision techniques and deep learning methods to effectively classify Arabic letters and numbers.

2 Project Goals

- Develop a hybrid model combining traditional computer vision techniques (e.g., edge detection and feature extraction) with deep learning using a Convolutional Neural Network (CNN).
- Explore a combination of handcrafted features (e.g., SIFT, HOG) and deep learning-based feature extraction for enhanced classification accuracy.
- Benchmark the performance of this hybrid approach against state-of-the-art models, such as EfficientNet B7.

3 Approach Outline

3.1 Data

We will use the Arabic Handwritten Alphabets, Words, and Paragraphs dataset, chosen for its comprehensive coverage of Arabic characters. This dataset offers a manageable size that is suitable for training and testing with both traditional and deep learning methods.

3.2 Model and Techniques

- **Traditional Computer Vision Techniques**: We will preprocess images using methods such as Gaussian filtering to reduce noise, edge detection (Canny) to identify character boundaries, and contour detection.
- **Feature Extraction**: For feature extraction, we will utilize Histogram of Oriented Gradients (HOG) and Scale-Invariant Feature Transform (SIFT), providing these features to a machine learning classifier (e.g., Support Vector Machine or Random Forest).

- **Deep Learning**: We will implement a CNN-based model using EfficientNet B7 architecture with transfer learning to improve performance. The CNN will process preprocessed images, allowing us to compare results from traditional and deep learning-derived features.

3.3 Metrics

We will evaluate model performance with accuracy, precision, recall, and F1 score. Additionally, a confusion matrix and log loss will be used for a more detailed analysis of model predictions.

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