Applied Machine Learning Systems ELEC0132 Assignment

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Abstract

Brief overview of the methodology/results presented.

I. Introduction

The perception of visual information is a key element of human communication, particularly those from the face. The features and characteristics of an individual's face can provide information of their identity, emotion, and intent, with potential applications in access and security, law enforcement, marketing, and banking. Researchers in the fields of computer vision have been developing technological breakthroughs in the implementation of face recognition using machine learning tools and techniques over the past decades. The image variations of real-world scenarios such as illumination, pose, expressions, and occlusions have required more complex methods in need of preprocessing techniques to prepare images for training and classification.

This assignment aims to train machine learning models and perform binary and multiclass classification on a large dataset of 5000 Portable Network Graphic (PNG) image files consisting of pre-processed subsets from the **CelebFaces Attributes Dataset (CelebA)**, a celebrity image dataset , and the **Cartoon Set**, an image dataset of random cartoons/avatarts , as well as a number of noisy images (mainly of natural backgrounds) to be detected and removed from the training data, which generally constitues 80% of the entire dataset. All images are labelled with hair colour, whether the subject is wearing glasses, is smilining, and is classified as human.

In order to train a suitable model for the required classification tasks, several preprocessing methods were taken into consideration to provide appropriate features for the process; for instance, facial landmarks were extracted via various detection methods, namely the Histogram of Gradients (HoG) Face Detector, Haar Cascade Face Detector, and the Deep Learning-based Face Detector, to train models using Support Vector Machines (SVM) using various Kernel functions or Multi-Layer Perceptor (MLP) models with the aid of backpropagation, based on the 68 x-y coordinates of the facial landmarks predicted. A comparative analysis of the performance of each method with respect to the labaled noisy images facilitated the selection of the most appropriate feature extraction method for the given dataset.

Prior to feature extraction, various preprocessing techniques were carried out on the images to improve both the performance and the processing power during the later stages of the extraction, training and classification procedures. Some of the techniques include colour space transformation, capable of significantly reducing processing complexity, gamma correction (power-law equalisation), a non-linear function used to normalise illumination by raising the input value to the power γ, and mean normalisation.

The original dataset was otherwise rescaled and augmented to avoid overfitting for alternative models more specifically used for visual recognition tasks, such as Convolutional Neural Networks (CNN), where the noisy images of the training and validation data are removed using the results of the optimum face detector method with the maximum accuracy.

II. Proposed algorithms

Algorithmic approach used to solve the problem.

Explain rationale behind choices, i.e. detail your *reasons for selecting a particular model*.

III. Implementation

Provide name and use of *external libraries* and explain how *model parameters* were selected.

Thorough discussion on the training convergence and stopping criterion (use learning curves graphs).

IV. Experimental result

Describe and discuss results, compare to other approaches in literature or variations of ML solutions.

Include *accuracy prediction scores on a separate test dataset, provided by the module organisers, but not used during training and validation*.

V. Conclusion

Summaries all findings and suggest direction for future improvement.

VI. Related Work

Summarise latest reserach on the topic, discussing merits/disadvantages of diff approaches.