Facial Expression Recognition

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Why Does Facial Expression Matter?

Facial Expressions are widely used in communication to gauge the conversational partner's attitude and reaction. It is a vital component to proper communication and is often our first indication of another's thoughts and mood. These are all important factors to consider when selecting phrases and tone and to gauge the progress of a conversation.

This can be an important feature and integral feature that could be integrated with other AI agents, such as chatbots, etc.

So What's The Research?

Robust facial expression classification using shape and appearance features

Summarized Methodology:

The methodology presented in this paper uses both PHOG(Pyramid of Histogram of Gradients) to isolate shape features of the facial data and LBP(Local Binary Patterns) to isolate appearance features of the facial data. After each of these features sets are isolated they are combined into a single feature vector which is then fed into a combo PCA(Principal Component Analysis)-LDA(Linear Discriminant Analysis) pipeline algorithm to reduce dimensionality. After this the data is then classified using an SVM model, which is trained to classify the expression on each of the images provided. All this takes place after some basic cleaning of the facial images, mostly normalization through resolution/orientation of the images themselves.

Using these methodologies allows the model to be trained on partial face data that focuses in on the elements of the face that most affect the determination of a facial expression. This includes the mouth corners, the eyebrows, and various other fine-motor control areas of the face.

Facial Expression Detection Techniques: Based on Viola and Jones Algorithm and Principal Component Analysis

Summarized Methodology:

The methodology presented in this paper breaks down each step taken upon the base image data, first each image processed by running it through an algorithm based on the Viola and Jones algorithm. This consists of first running the images through a feature detection algorithm, which is piped into a function to find the edges of these images and map those to a new set to account for lighting and various other components. This new set then goes through Skin Segmentation using a RGB-YCbCR model.

After the Pre-Processing is complete the features are pushed to a PCA(Principal Component Analysis) Model. From the results of this model the eigenvalues and agenvectors can be calculated. These are then used to make a prediction of what emotion is displayed by comparing the Euclidean distance of the space from the space of a neutral expression.

Simultaneous Facial Feature Tracking and Facial Expression Recognition

Summarized Methodology:

This paper focuses on the various different kinds and levels of facial recognition. It gives both a background on various techniques and then proposes a model that it claims to be effective at combining these techniques and classifying a multitude of the different levels of facial recognition.

The model that this paper proposes uses a Dynamic Bayesian Network(DBN) to track each of different face feature level simultaneously. It does so in a casual manner in order to provide better classification for each and all feature levels. After training this basic structure, the Bayesian Network can be expanded and from this expanded model we can extract predictions and classifications on given facial inputs.

On What Data?

I will be using the following two data sets:

- The CK+ Dataset
- The Japanese Female Facial Expression (JAFFE) Dataset

I picked these datasets because they were publicly available and easy to access and find.

Where did I find these datasets?

I found and downloaded local copies of these datasets at the following sites on Sept 11, 2024:

CK+

JAFFE

Replicating Which Method?

I should like to replicate the methods proposed by Agrawal, S., and P. Khatri.

First the data will be processed and reduced into a more viable feature space via the Viola and Jones algorithm, afterwards this feature space will be fed into both a RGB-YCbCR model for the purposes of Skin Segmentation. After this the feature space will go through a PCA model for classification.

I should think that this shall be a decent challenge, though I am not sure, as I am fairly new to Machine Learning as a topic in general.

Timeline of the Project

Preparation of Proposal: 2 Weeks

Research on Background: .5 Week

Research on Methods: 1 Week

Preparation of Data: .5 Week

Data Processing Methods Setup: 4 Weeks

Model Setup, Training and Testing: 3 Weeks

Clean-up and Reporting: 2 Weeks

The Breakdown of these tasks should keep my project on task and in a timely fashion. I chose this breakdown of time and tasks for a few reasons. I believe that the cleaning and processing of the data will be the more difficult aspect of the project. Isolating the face features and defining the various parameters to feed the model may prove to be a difficult task. I expect the training and building of the model to be comparatively simple, but time consuming. From there the only thing left will be to determine and clean up the results into a format suitable for reporting.

What Shall I Learn?

I think that the bulk of what I shall learn in the project shall come from the data processing and the model analysis/refining stage.

The data processing phase looks to be the more intricate part of this solution. This should be some great experience in cleaning and isolating pieces of images, as well as finding features in these pieces of data.

Building and training this model will also be an interesting task, especially when it comes time to test and refine it. There are many things I could learn from these steps that seem crucial to Machine Learning in general, even if it is just learning how to refine the knowledge and methods that I already know.

As such I expect to learn quite a few things from this project, including a deeper and more sophisticated look into data processing, especially in the visual spectrum, a better understanding of feature spaces, model building and model evaluations.

References

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