Emotion Detection Through Facial Feature Analysis

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PCA and dimensionality

reduction via projection on

Eigenfaces

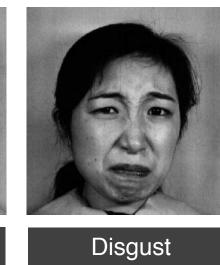
Fisher LDA for each

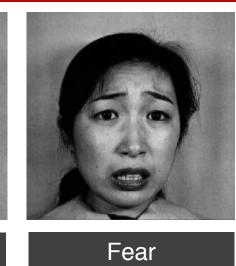
emotion (One vs All)

Motivation

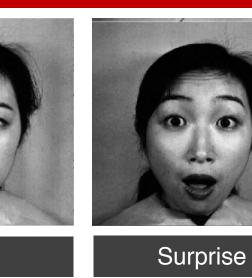












It has been proposed that humans experience 7 basic emotions, and exhibit them through universally recognizable facial expressions [1][2]. It is of interest then to develop effective and efficient computer algorithms that can recognize facial expressions for both data analysis and real-time tasks, finding applications in entertainment, criminal justice, healthcare and more.

Related Work

As emotion detection is significant for both human-human and human-computer interaction, there has been much work in face detection, face recognition, and expression recognition. Some of note are the use of Gabor wavelets with neural networks [3], the detection of Active Appearance Models and support vector machine (SVM) classification [4], local binary pattern extraction [5], and histogram-of-gradient (HOG) feature extraction [6].

Results

A dual-approach emotion detection algorithm is implemented in MATLAB using Fisherfaces and HOG+SVM, trained on 240 images from the CK+ dataset [4]. This allows for faster detection via projection on Fisherfaces for easier-to-detect emotions, or HOG extraction (leveraging the fact that there are unique inner facial feature manipulations to express emotions) and classification if further predictive measures are required. The algorithm works reasonably well on test images from the CK+ dataset, performing with same accuracy as HOG-only but with a speed improvement of 20%. The algorithm however has trouble with test samples from the JAFFE dataset [7] and some random test samples. This may be attributed to factors such as face-angling and nuanced/mixed expressions for non-dataset images. Future work should involve larger training sets, exploration of other feature identification techniques, and examination of more subtle/undefined facial expressions.

References

[1] Ekman, P. & Keltner, D. (1997). Universal facial expressions of emotion: An old controversy and new findings. In Segerstråle, U. C. & Molnár, P. (Eds.), Nonverbal communication: Where nature meets culture (pp. 27-46). Mahwah,

[2] Matsumoto, D. & Kupperbusch, C. Idiocentric and allocentric differences in emotional expression, experience, and the coherence between expression and experience. Asian Journal of Social Psychology (4), pp. 113-131 (2001). [3] Zhang, Z. Feature-based facial expression recognition: Sensitivity analysis and experiments with a multilayer perceptron. International Journal of Patten Recognition and Artificial Intelligence 13 (6):893-911 (1999) [4] Lucey, P., Cohn, J.F., Kanade, T., Saragih, J. Ambadar, Z. The Extended Cohn-Kanade Dataset (CK+): A complete dataset for action unit and emotion-specified expression. IEEE Computer Society Conference CVPRW (2010). [5] Shan C, Gong S, McOwan PW. Facial expression recognition based on local binary patterns: a comprehensive study. Image Vis Comput. ;27(6):803–816 (2009)

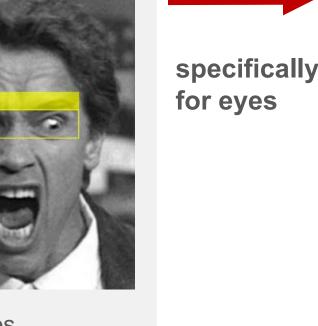
[6] Carcagnì P, Del Coco M, Leo M, Distante C. Facial expression recognition and histograms of oriented gradients: a

comprehensive study. SpringerPlus.;4:645. (2015) [7] Michael J. Lyons, Shigeru Akemastu, Miyuki Kamachi, Jiro Gyoba. Coding Facial Expressions with Gabor Wavelets, 3rd IEEE International Conference on Automatic Face and Gesture Recognition, pp. 200-205 (1998). Performed on test set of 32 images from CK+ Algorithm Acc. Runtime(s) 56% 7.40 Fisherface only HOG only 81% 9.87 Fisherface + HOG 7.91

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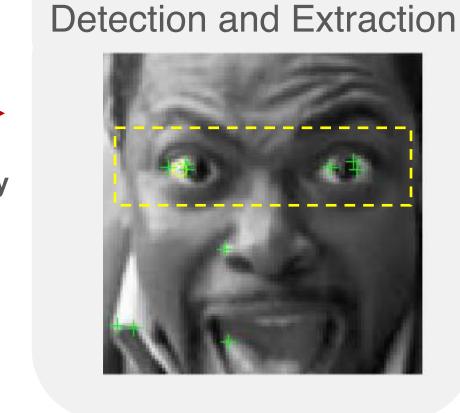
Implementation **TESTING** TRAINING Extract HOG If no Project onto Preprocess training predictions or Preprocess and features for Fisherfaces more than one images (CK+) crop test eyes and of the 5 images mouth and easier-topredict distinguish using SVM emotions Viola-Jones face detection + crop out **Emotion** prediction Harris Keypoint Haar feature detection for If Haar eyes and mouth regions

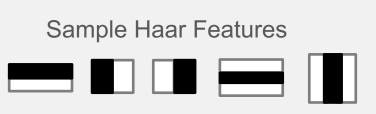


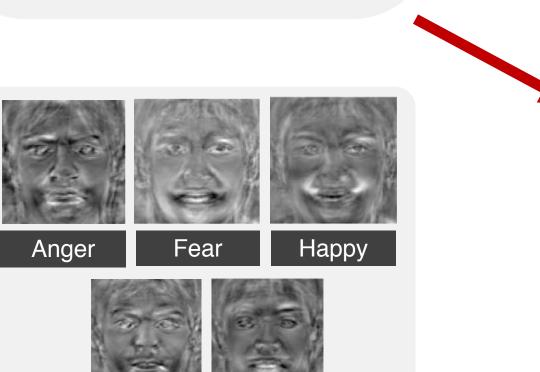


detection

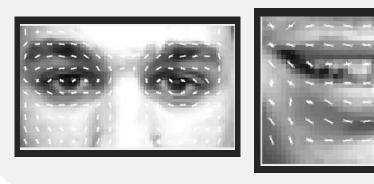
fails







Histogram of Gradient (HOG) Extraction on Eyes and Mouth Region



Train Multi-Class SVM