Preprocessing and Descriptor Features for Facial Micro-Expression Recognition

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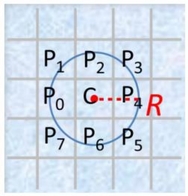
Motivation

Detecting and identifying micro-expressions lasting ≈¼ second would aid psychological studies, negotiations, interrogations, and more by giving a better understanding of underlying "true" reactions.

LBP – Local Binary Patterns

1. Compare center pixel value of each image sub-block to its (8) neighboring pixel values
2. Store 1 if center > neighbor, 0 otherwise → obtain 8-digit binary result
3. Compute histogram for frequency of each binary number over image sub-blocks

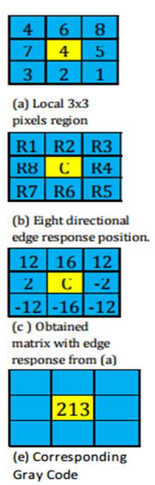


Gray value			Thresholded			Weights		
6	5	2	1	0	0	2	4	8
7	6	1	1		0	1		16
9	8	7	1	1	1	128	64	32

Pattern = 11110001
LBP = 1 + 16 + 32 + 64 + 128 = 241

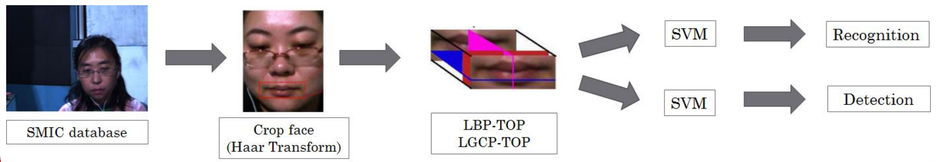
LGCP – Local Gray Code Patterns

1. Convolve 8 neighboring pixels with 8 Robinson Compass Masks to obtain 8 directional edge responses
2. Use directional edge responses to obtain gray code value
3. Compute histogram of gray code values – reduce dimensionality by discarding unused bins (256 → 15)
4. Perform weighting on bins with bin frequency



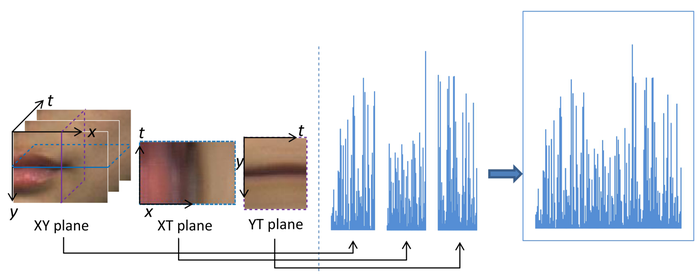
Process

1. Identify and crop faces
2. Convert face images to descriptor representations:
   A. Local Binary Pattern
   B. Local Gray Pattern
3. Use the descriptors to train a SVM system to detect and classify micro-expressions.



TOP – Three Orthogonal Planes

1. Used to compute descriptors for video sequence
2. Compute LBP or LGCP in XY-, XT-, and YT- planes
3. Captures spatial (XY) and spatial-temporal (XT, YT) changes

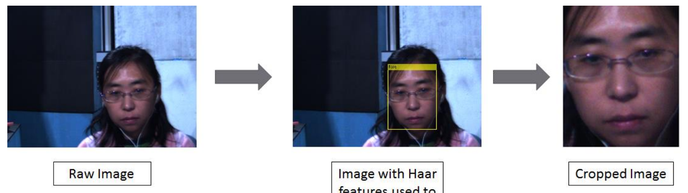


Acknowledgements

1. EE368 teaching staff
2. Xiaobai Li at University of Oulu for use of SMIC database and prior work

Cropping

1. Images were cropped using Haar features to identify a bounding box for the face
2. Face was then cropped and resized



Results

Our face isolation gives roughly equivalent results compared to the preprocessed database. Our LBP experiments are more rigorous than previous ones. LGCP is at least 10x faster than LBP, though not yet as accurate. Further steps include adjusting LGCP parameters and experimenting with more machine learning techniques.

Descriptor Used	Detection Accuracy	Recognition Accuracy
LBPTOP	68.9%	48.6%
LBPTOP – Li et. al	70.3%	52.2%
LGCPTOP	57.0%	38.4%