Neural Network Classification of Photogenic Facial Expressions Based on Fiducial Points and Gabor Features

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Introduction

• Photogenic

The concept is normally associated:

- with the attractiveness of a person as a subject for photography
- with pictures to smiling and neutral faces
- Non-photogenic
 - The concept is normally associated:
 - Expression such as anger, fear, surprise, disgust or sadness



Introduction

 The goal is to generate a device that can automatically classify pictures of the people as Photogenic and Nonphotogenic









Image Acquisition

We use a subset from Conh-Kanade Facial Expression

Facial Localization

The faces are extracted using Kanade Face Detector.

Pre-Processing

Resizing
Gray-Scale Conversion



Fiducial Points Extractor



 The fiducial points (29) were manually labeled
 Using manual labels, it is possible to extract fiducial points using a trained Active
 Appearance Model



Mask Normalization

- The length of the line segment linking fiducial points which corresponds to the eyes inner corners becomes unitary
- The origin of the Cartesian Coordinates System is translated to the middle of the eyes line.

$$x' = x - x_c$$

$$y' = y - y_c$$

$$x' = x * \cos \theta - y * \sin \theta$$

$$y' = y * \cos \theta + x * \sin \theta$$



• Gabor Wavelets

The convolution of the face's image with the familiy of the Gabor filters produces salient local features, such as eyes, nose and mouth.

$$g(x,y) = (\frac{1}{2\pi\sigma_x\sigma_y})e^{[\frac{-1}{2}(\frac{x^2}{\sigma_x^2} + \frac{y^2}{\sigma_y^2}) + 2\pi(-1)^{1/2}W_x]}$$



Classification

- Multilayer Perceptron
- For each type of experiment, the neural networks were trained 10 times

• Experiments:

- Type 1- 58 Coordinates of the fiducial points
- Type 2 32 Coordinates (eyes and mouth)
- Type 3 Gabor Features
- Type 4 Gabor and Coordinates
- Type 5 Gabor, Coordinates and PCA



Image Dataset

Conh-Kanade database

Photogenic







Non-Photogenic





Image Dataset





Training
 Validating
 Testing



Ty	\mathbf{pe}	Input	Hidden	Output	Max	Mean	STD	Exec. time
1	_	58	29	2	75.50	74.60	0.65	$9.2 * 10^{-4}$
2	2	32	16	2	73.50	71.70	0.90	$6.6 * 10^{-4}$
3	3	80	40	2	68.50	64.60	2.21	$7.2 * 10^{-4}$
4	Į	138	69	2	72.00	69.00	1.29	$1.2 * 10^{-1}$
Ę	5	78	38	2	71.00	68.70	1.28	$1.4 * 10^{-1}$

Experiments:

Type 1-58 Coordinates of the fiducial points

Type 2 - 32 Coordinates (eyes and mouth)

Type 3 - Gabor Features

Type 4 - Gabor and Coordinates

Type 5 - Gabor, Coordinates and PCA



Classifier Fusion

- Combining classifiers for compensate for their individual weakness and to enhance their individual strengths
 - Classifiers:
 - 58 Coordinates of the fiducial points (type 1)
 - Gabor Features (type 3)
 - Combination rules:
 - Weighted sum rules (S)
 - Product (P)
 - Weighted (W)

Combination Rules	Average Recognition Rates (%)
S	77,30
Р	77,50
W	78,00



Phtogenic classifier with a lower learning rate

Classifier	Average Recognition Rates (%)
Gabor- NN	68,00
Coord-NN	81,00
Combination	82,00



Comparing Manual and Automatic Fiducial Point Extraction

- Automatically detect the fiducial points.
 The Active Appearance Model (AAM)
- The mean of the Euclidean distances was used to compare the automatic and manual points
 - individual points;
 - all points;
 - the Root Mean-Squared Error (RMSE)



 Mean and the standard deviation of the euclidean distances for each individuals point



 The mean and the standard deviation of all Euclidean distances were 4.88 and 4.20 pixels receptively.

 The Root Mean-Squared error was 4.55.



Conclusions

 Preliminary experimental results indicate the potencial of fiducial points to distinguish between photogenic/non-photogenic facial expressions.

 A combination of classifiers performed slightly better (just 1%) than the best classifier investigated



The End

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