Expand Training Set for Face Detection by GA Re-sampling

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Motivation

- The performance of all of the statistical methods highly depends on the training set, and they suffer from a common problem of collecting enough and informative data for training.
Include these samples in our training set?
How about these samples?
Contribution of this Paper

- Proposed a re-sampling method to generate more samples from existing ones by using genetic algorithm (GA) operations.
Framework of the Proposed Method

Initial Positive Training Set

Current generation

Train the SNoW Classifier

Negative Samples (Non-Faces)

Intermediate generation

Evaluating based on SNoW

Garbage Can

Bad samples

Good samples

GA Re-sampling (Crossover and mutation)

Can

Initial Positive Training Set

Current generation

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Garbage Can

Bad samples

Good samples

GA Re-sampling (Crossover and mutation)
Data Preparation

30,000 faces

6,000 faces

Translate
Rotate
Scale

Training set 15,000
Validation set 5,000
Test set 10,000

Transform
Face Encoding

Encoding \((20 \times 20)\)

FeatID = \(256(y \times w + x) + I(x, y)\)

\[0 \leq I(x, y) \leq 255\]

\((l_1)(l_2)(l_3) \cdots (l_i) \cdots (l_{400})(w_j)\)
Outline of GA

- Create an initial population
- Selection
- Crossover and mutate
- Evaluate
GA: Initialization

- Initial Population.
  generated by encoding all normalized face sample of $20 \times 20$ pixels.

population of genotypes
GA: Crossover

For face case in this paper, it is to exchange part of faces.
GA: Mutation

For face case in this paper, it is to transform parts of faces.
GA: Re-sampling

- Divide the initial population.
- Choose individuals based on “roulette selection” method.
- Crossover these selects with a probability of $P_c$.
- Mutate with a probability of $P_m$. 
GA: Roulette Selection of Samples

- Selection is a probability-based

Selected parents: 10001, 10111, 11001, 10001
Evaluation based on SNoW

- Evaluation function
  - The normalized scores of Sparse Network of Winnows (SNoW) classifier are exploited as the confidence of evaluation for each new sample generated by GA procedure.
  - If the output confidence is large enough, the sample is labeled as “good” and added into the new generation of positive samples, otherwise it is labeled as “bad” and thrown away into the garbage can.
Face samples generated by GAs
Experiments

- Comparing the solutions performance of the different generations

- The generalization performance
The ROC on the validation set of different generations
ROC curves for Adaboost based detectors on the CMU test set.
CAS-PEAL Face Database

- Contains 99,594 images of 1040 individuals (595 males and 445 females)
- Varying Pose, Expression, Accessory, and Lighting (PEAL)
Examples in CAS-PEAL Face Database
## Released CAS-PEAL-R1

Content of the released version of the CAS-PEAL face database

<table>
<thead>
<tr>
<th>Subset</th>
<th># Variations</th>
<th># Subjects</th>
<th># Images</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontal</td>
<td></td>
<td></td>
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<tr>
<td>Normal</td>
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<td>1040</td>
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<tr>
<td>Expression</td>
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<td>377</td>
<td>1,884</td>
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<td>Lighting</td>
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<td>2,450</td>
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<tr>
<td>Accessory</td>
<td>6</td>
<td>438</td>
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<td>Background</td>
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<td>650</td>
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<tr>
<td>Distance</td>
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<td>324</td>
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<tr>
<td>Aging</td>
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<td>66</td>
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<td>Pose</td>
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<tr>
<td>Total:</td>
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<td>30,900</td>
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</tbody>
</table>

2004-11-3
Release Strategy

- CAS-PEAL-R1 is almost free except very little cost and postage for research purpose only on a case-by-case basis after signing a release agreement with us.
- Please find me during the conference or write to me for a DVD package

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or Bo Cao (bcao@ict.ac.cn)  
http://www.jdl.ac.cn/peal/index.html
Thank you!

Questions?