27 faces

27faces.com

FRUCT-14 2013, Finland, 11-15 November
Application for Video Analysis Based on Machine Learning and Computer Vision Algorithms

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Why analyze the audience?

Applications:
- Visitors calculation systems
- Video surveillance
- Automatic systems of accident prevention
- Digital signage
Audience Analysis System

A block diagram of the proposed application for video analysis.
Face Detection

Viola-Jones Object Detection Algorithm:

- Integral image representation
- Learning classification functions using AdaBoost
- Combining classifiers in a cascade structure

Face Tracking

**Lucas-Kanade Method:**

It assumes that the flow is essentially constant in a local neighbourhood of the pixel under consideration, and solves the basic optical flow equations for all the pixels in that neighbourhood, by the least squares criterion.

Face Tracking

3 Tracking Problems:

1. Detected face window scaling and offset calculation during motion

2. Face overlapping with other objects

3. Face crossing
Lucas-Kanade Modification

**Lucas-Kanade-1**

Tracked object offset is estimated as an average value of key pixels offsets. Face window scaling factor is defined as key pixels scaling factors averaging.

**Lucas-Kanade-2**

Median filtration of key pixels offsets and scaling factors is added.
Lucas-Kanade Modification

Lucas-Kanade-3 detects overlapping and crossing by dividing the window into square regions and labelling each key pixel to the corresponding region. If a pixel moves out of its region, as it is showed in fig., then such pixel is removed from further consideration being suspected as an overlapped one.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Displacement of a point in an incorrect area
Face Tracking Test Video
Face tracking algorithms comparison

![Comparison of face tracking algorithms](chart.png)

- Lucas-Kanade-1
- Lucas-Kanade-2
- Lucas-Kanade-3

FRUCT-14 2013, Finland, 11-15 November
Gender Classification

General Scheme

Input Image $A_{Y \times Y}^{RGB}$

Color Space Transform
$RGB \rightarrow HSV$

Scaling
$Y \times Y \rightarrow N \times N$

Feature Set Calculation
$$\{A_{HSV}^{N \times N}F_i\} = \left\{\sum_{N}^{N} \sum_{N}^{N} A_{HSV}^{N \times N} \times C_{i}^{HSV}\right\}$$

SVM classifier
$$f(AF) = \text{sgn} \left( \sum_{i=1}^{m} y_i \alpha_i k(X_i, AF) + b \right)$$

$$k(z_1, z_2) = C \exp \left( -\frac{||z_1 - z_2||^2}{\sigma^2} \right)$$

Decision (male / female)
Gender Classification

Visual example:

- male
- female
## Gender Classification

### The Proposed Training and Testing Database Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>The total number of images</td>
<td>8,654</td>
</tr>
<tr>
<td>The total number of male faces</td>
<td>5,250</td>
</tr>
<tr>
<td>The total number of female faces</td>
<td>5,250</td>
</tr>
<tr>
<td>Minimum image resolution</td>
<td>640×480</td>
</tr>
<tr>
<td>Color space format</td>
<td>RGB</td>
</tr>
<tr>
<td>Face position</td>
<td>Frontal</td>
</tr>
<tr>
<td>Lighting conditions, background</td>
<td>No restrictions</td>
</tr>
<tr>
<td>People’s age</td>
<td>From 18 to 65 years old</td>
</tr>
</tbody>
</table>
Gender Classification

ROC-curves of tested gender recognition algorithms
## Gender Classification

### Comparative Analysis of Tested Algorithms Performance

<table>
<thead>
<tr>
<th>Parameter</th>
<th>AF-SVM (M=5000)</th>
<th>AF-SVM (M=400)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>True</td>
<td>False</td>
</tr>
<tr>
<td>Recognition rate</td>
<td>90.6</td>
<td>9.4</td>
</tr>
<tr>
<td>Classified as “male”, %</td>
<td>91</td>
<td>9</td>
</tr>
<tr>
<td>Classified as “female”, %</td>
<td>90.8</td>
<td>9.2</td>
</tr>
<tr>
<td>Total classification rate, %</td>
<td>79.6</td>
<td>20.4</td>
</tr>
</tbody>
</table>
Age Classification

I stage

Input Image Fragment

BC < 18

BC 18 - 45

BC > 45

II stage

Histogram Analysis

BC 0-10 / 10-20

BC 20 - 30

BC 30 - 40

BC 40 - 50

BC 50 - 60

BC > 60

Histogram Analysis

Decision
## Age Classification

### I Stage Image Database Parameters

<table>
<thead>
<tr>
<th>Class Label</th>
<th>&lt; 18</th>
<th>18-45</th>
<th>&gt;45</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database Capacity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training Images per Class</td>
<td>2000</td>
<td>2000</td>
<td>3000</td>
<td>7000</td>
</tr>
<tr>
<td>Testing Images per Class</td>
<td>226</td>
<td>400</td>
<td>531</td>
<td>1157</td>
</tr>
<tr>
<td>Total Number of Images Used</td>
<td>2226</td>
<td>2400</td>
<td>3531</td>
<td>8157</td>
</tr>
</tbody>
</table>
Age Classification

Binary Classifier’s ROC Curves
### Age Classification

#### Classification Results

<table>
<thead>
<tr>
<th>Ground Truth</th>
<th>Decision</th>
<th>&lt; 18</th>
<th>18-45</th>
<th>&gt;45</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 18</td>
<td></td>
<td>82%</td>
<td>14%</td>
<td>4%</td>
</tr>
<tr>
<td>18-45</td>
<td></td>
<td>22%</td>
<td>58%</td>
<td>20%</td>
</tr>
<tr>
<td>&gt;45</td>
<td></td>
<td>3%</td>
<td>5%</td>
<td>92%</td>
</tr>
</tbody>
</table>
Age Classification
Web-application 27faces.com
## Web-application 27faces.com

### Users

<table>
<thead>
<tr>
<th>ID</th>
<th>ФИО</th>
<th>Организация</th>
<th>Электронная почта</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Тестовый</td>
<td></td>
<td><a href="mailto:test@27faces.ru">test@27faces.ru</a></td>
</tr>
<tr>
<td>5</td>
<td>Владимир Павлов</td>
<td></td>
<td><a href="mailto:i@yajon.ru">i@yajon.ru</a></td>
</tr>
<tr>
<td>6</td>
<td>Имя</td>
<td></td>
<td><a href="mailto:bots@pavlov.tel">bots@pavlov.tel</a></td>
</tr>
<tr>
<td>14</td>
<td>Павлов Евгений</td>
<td>Test</td>
<td><a href="mailto:evgeny@pavlov.name">evgeny@pavlov.name</a></td>
</tr>
<tr>
<td>20</td>
<td>Га Алекс Ни</td>
<td>Дом</td>
<td><a href="mailto:angnn@mail.ru">angnn@mail.ru</a></td>
</tr>
</tbody>
</table>

*Записи с 1 до 5 из 5 записей*
Web-application 27faces.com

Tokens:

<table>
<thead>
<tr>
<th>Ключ (токен)</th>
<th>Действителен до</th>
</tr>
</thead>
<tbody>
<tr>
<td>d97c0fafa7d71489e91c4c18c2681db0</td>
<td>2014-07-14</td>
</tr>
</tbody>
</table>

Token auth-system
Conclusions

• The 27faces system provides collection and processing of information about the audience in real time.

• The 27faces system works in a cloud.

• A modern efficient classification algorithm allows to recognize viewer’s gender with more than 90% accuracy.
Welcome to 27faces.com

Online Audience Measurement for Digital Signage Networks

The popularity of digital signage networks is growing dramatically as they provide a unique opportunity to deliver live information to a huge audience with high accuracy and efficiency. However, the majority of Indoor-TV offers don't possess the functionality to interactively get customer feedback and thus are unable to measure the impact of advertising material on the audience.

Let us introduce you the 27faces, a product providing such functionality.

27faces allows measuring precisely the number of advertisement viewers and the level of their interest in video content demonstrated on digital displays or TV monitors. 27faces instantly performs audience segmentation with its further analysis.

Given all completeness of the audience size and segmentation information at specific time and location, advertisers will be able to evaluate the return on investment from their advertising campaigns, to choose the optimum time and place for advertisement demonstration, to measure the effectiveness of advertising content.
27
Faces

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