Nude Detection in Video using Bag-of-Visual-Features

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Introduction (1/2)

• There is a vast amount of multimedia data nowadays

• Filtering improper multimedia material by its visual content is needed
• Skin detectors
  • Precise skin detection is not a trivial task
  • Generic geometrical model X Various body poses
    – BoVF representation...
      • ...has great success in object recognition tasks and...
      • ...is robust to several variations and occlusion
Goals

• A method for detection nudity in videos
  • Bag-of-Visual-Features
  • Voting scheme
Related Work

• Color, texture and geometric constraints
• Gaussian Mixtures Models
• Expectation-Maximization
• Support Vectors Machines (linear and non-linear)
• Different color models (YIQ, YUV, and HSV)
• Bag-of-Visual-Features (First time!)
Representing Images as BoVF

1) Point selection
2) Point description
3) Vocabulary discovery
4) Cluster association
5) Histogram computation
Detecting Nudity from Videos

Our approach

- Frames Extraction
- HueSIFT Description
- PCA Transformation
- BoVF Construction
- SVM Classification
- Voting Scheme
- Video Classification
Experimental Results (1/4)

- Database
  - 179 segments
  - Nude sequences
    - From 43 to 308 frames long
  - Non-nude sequences
    - From 50 to 278 frames long
  - http://www.npdi.dcc.ufmg.br/nudeDetection
Experimental Results (2/4)

• Experimental Setup
  • Frames selection:
    • samples rates
      • 1/15, 1/30
  • BoVF creation
    • 10,000 random HueSIFT points
  • Vocabulary size: 60, 120 and 180
  • Linear SVM classifier
    • $10^{-5} \leq C \leq 10^5$
    • 30 5-folds cross-validation runs
Table I: Comparing recognition rates for keyframe and voting based classification.

<table>
<thead>
<tr>
<th>Voc. Size</th>
<th>Keyframe (%)</th>
<th>Voting (%)</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>76.4 ± 0.2</td>
<td>77.1 ± 0.4</td>
<td>0.7</td>
</tr>
<tr>
<td>120</td>
<td>80.2 ± 0.3</td>
<td>80.9 ± 0.4</td>
<td>0.7</td>
</tr>
<tr>
<td>180</td>
<td>83.9 ± 0.2</td>
<td>88.4 ± 0.6</td>
<td>4.5</td>
</tr>
</tbody>
</table>

(a) 1/30 frames

<table>
<thead>
<tr>
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<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>79.1 ± 0.1</td>
<td>80.5 ± 0.4</td>
<td>1.4</td>
</tr>
<tr>
<td>120</td>
<td>83.7 ± 0.2</td>
<td>87.3 ± 0.4</td>
<td>3.6</td>
</tr>
<tr>
<td>180</td>
<td>85.9 ± 0.1</td>
<td>93.2 ± 0.4</td>
<td>7.3</td>
</tr>
</tbody>
</table>

(b) 1/15 frames
Table II: False-negative rates for keyframe and voting based classification.

<table>
<thead>
<tr>
<th>Voc. Size</th>
<th>Keyframe (%)</th>
<th>Voting (%)</th>
<th>Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>12.2 ± 0.2</td>
<td>10.4 ± 0.3</td>
<td>1.8</td>
</tr>
<tr>
<td>120</td>
<td>11.0 ± 0.2</td>
<td>9.1 ± 0.2</td>
<td>1.9</td>
</tr>
<tr>
<td>180</td>
<td>8.0 ± 0.2</td>
<td>4.2 ± 0.3</td>
<td>3.3</td>
</tr>
</tbody>
</table>

(a) 1/30 frames

<table>
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<th>Voting (%)</th>
<th>Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>10.7 ± 0.1</td>
<td>10.7 ± 0.3</td>
<td>0.0</td>
</tr>
<tr>
<td>120</td>
<td>10.0 ± 0.1</td>
<td>8.5 ± 0.2</td>
<td>1.5</td>
</tr>
<tr>
<td>180</td>
<td>7.5 ± 0.1</td>
<td>4.2 ± 0.2</td>
<td>3.3</td>
</tr>
</tbody>
</table>

(b) 1/15 frames
The FIRST usage of BoVF for nude detection in VIDEOS.

A voting scheme to extend the technique for videos

A test database:
  • Collected
  • Segmented
  • Annotated
  • made available
Conclusion (2/2)

- 93.2% of correct classification
- Identified misclassification causes:
  - Background colors near to skin tones
  - Presence of large skin areas
  - Illumination variations
Future Work

• To validate the proposed scheme using:
  • A large database
  • Low-resolution videos
• To study the vocabulary formation process in BoVF
• To modify the method to distinguish among more than two classes
Acknowledgements
Thanks you for your attention!!!
Questions? Ideas?