COMP8780 Information and Human Centred Computing Project

Face Detection & Tracking using RGBD Camera

Presentation: Changjiang Dong (u4879096)
Supervisor: Xuming He
Outline

- Introduction
- Face Detection using RGB-Depth Camera
- Face Tracking by Segmentation
- Conclusion & Future Work
Introduction

1. Motivation for Research
2. Contributions of My Work
3. Visual Advantage of RGB-Depth Camera
4. Software Development Tools
   - Microsoft Visual Studio 2010
   - OpenCV
   - OpenNI
Face Detection using RGB-D Camera

1. Framework of Proposed Method

![Block diagram of face detection classification]

Figure 1: Block diagram of face detection classification
Face Detection using RGB-D Camera

2. Images Pre-processing and Searching Windows

1) Get the initial results in the preprocessing

2) Obtain the ROI with face and non-face in depth image

Figure 2: The detection results of Viola-Jones face detection using Kinect

Figure 3 Example image divided into 25 blocks (5*5)
Face Detection using RGB-D Camera

3. Training Dataset & Get Classifier

1) Dataset: 350 depth images
2) Get the ROI of depth images
3) Calculate depth variance of faces

Figure 4. Variance of face & non-face ROI

Figure 5 The ROI of depth image are extracted and a histogram of variance is constructed for the region.
# Face Detection using RGB-D Camera

## 3. Training Dataset & Get Classifier

4) Classifier: Value of thresholds parameters \( Thrl \) and \( Thrh \):

<table>
<thead>
<tr>
<th></th>
<th>Face detection</th>
<th>Non-face detection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thrl</strong></td>
<td>1.02</td>
<td>0</td>
</tr>
<tr>
<td><strong>Thrh</strong></td>
<td>1.81</td>
<td>76.18</td>
</tr>
<tr>
<td><strong>Mean of variance</strong></td>
<td>1.42</td>
<td>38.09</td>
</tr>
</tbody>
</table>

Table 1. Detection variance obtained on the training set using algorithms.
Face Detection using RGB-D Camera

4. Evaluation

Figure 6. Face detection multi-people database 2 containing gray, depth and color images.
Face Detection using RGB-D Camera

4. Evaluation

- 1) Dataset: color and depth images (positive and negative samples)
- 2) Method: Viola Jones Method in OpenCV **V.S.** Kinect Depth Method

<table>
<thead>
<tr>
<th>Index</th>
<th>Description</th>
<th>Missed</th>
<th>Misclassified</th>
<th>Total</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Viola-Jones</td>
<td>9</td>
<td>44</td>
<td>200</td>
<td>73.50%</td>
</tr>
<tr>
<td>2</td>
<td>Kinect-Depth</td>
<td>9</td>
<td>10</td>
<td>200</td>
<td>90.50%</td>
</tr>
</tbody>
</table>

Table 2  Face detection classification accuracy rates.
Face Tracking by Segmentation

1. Framework of Proposed Method

1) Preprocessing: remove the boundary black area

2) Calculation: get the depth value of head, body & background

3) Segmentation: get the mask of human face

Figure 7: Block diagram of face detection classification
Face Tracking by Segmentation

2. Preprocessing

1) Pixel localization for finding removing candidates

2) Calculate mean value of nearest region which contains detected pixel candidates

3) Use new value to fill the black pixel

Figure 8. Preprocessing of depth image
Face Tracking by Segmentation

3. Segmentation

1) The region A is face area
2) B, C are background area
3) D is the body area

Figure 9 Choose area for segmentation.
Face Tracking by Segmentation

3. Segmentation

- **Input:**
  1) $\mu_1$: threshold of face and body
  2) $\mu_2$: threshold of human and background
  3) $\sigma$: variance

- **Output:**
  The result of segmentation depth image

![Segmentation by depth value.](image)
Face Tracking by Segmentation

3. Segmentation

(a) original image  
(b) depth image  
(c) removing black pixels  
(d) mask of human  
(e) mask of face  
(f) result of segmentation

Figure 11 Results of our region segmentation algorithm
Face Tracking by Segmentation

4. Evaluation

- Segmentation Results in video sequence:

Figure 12. Segmentation results.
Face Tracking by Segmentation

5. Experimental Analysis

- Dataset: sequences is 640x480 at 30 FPS.
- Distance: minimum of 60cm from the camera and up to 5m
- Color image shows the edge of human face/head and depth images show face is labeled by rectangle.

Figure 13. Tracking examples of single face.
5. Experimental Analysis

Figure 14. Tracking examples of multi-faces
Conclusions and Future Work

- Face Detection:
  Combined with other method to enhance accuracy

- Face Tracking:
  Improve the preprocessing algorithm to get more accurate edge of face
Thank you!

Q&A