iShirt

CS5245 Project

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Outline

- Introduction
  - Scenario
  - Special Effect

- Special Effect
  - Several Approaches
  - Square Corner Detection
  - Corner Coordinates Re-organization
  - 2D-warping & Anti-aliasing

- Conclusion
  - Techniques
  - Further Improvements
Introduction

- Scenario
- Special Effect
Scenario

- A parody of an Apple iPod ad
  - Releasing iShirt
  - Listening to mp3
  - Showing some photos
  - Playing a video
Special Effect

- Video Mapping
  on a non-flat surface
Special Effect

• Several Approaches
• Square Corners Detection
• Corner Coordinates Re-organization
• 2D-warping & Anti-aliasing
Several Approaches

- 3D Camera 😞
- 2D Sub-Image Mapping
  - Tracking points/patches
Several Approaches

- 2D Sub-Image Mapping

4-color pattern 😞  

1-color pattern 😊
Special Effect

- Several Approaches
- Square Corners Detection
- Corner Coordinates Re-organization
- 2D-warping & Anti-aliasing
Square Corner Detection

1. Extract Pattern from video
Square Corner Detection

2. Set a color threshold to differentiate black squares and background

3. Apply Scan-line Checking method to detect each square
Square Corner Detection

4. Use Color Filling algorithm to find the 4 corners of each square
Square Corner Detection

4. Use Color Filling algorithm to find the 4 corners of each square:

<table>
<thead>
<tr>
<th>Corner</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top-Left</td>
<td>-x-y is max</td>
</tr>
<tr>
<td>Top-Right</td>
<td>x-y is max</td>
</tr>
<tr>
<td>Bottom-Left</td>
<td>-x+y is max</td>
</tr>
<tr>
<td>Bottom-Right</td>
<td>x+y is max</td>
</tr>
</tbody>
</table>

Assumption: the pattern can not rotate more than 45 degrees.
Special Effect

- Several Approaches
- Square Corners Detection
- Corner Coordinates Re-organization
- 2D-warping & Anti-aliasing
Corner Coordinates Re-organization

- During experiment:
  - tracking of the corners rather than sorting.

- good results.
Corner Coordinates Re-organization

- During final work:
  - sorting:
    - better results than tracking.
Special Effect

- Several Approaches
- Square Corners Detection
- Corner Coordinates Re-organization
- 2D-warping & Anti-aliasing
2D Warping

- Assumption: approximate each cell on T-Shirt as a quadrilateral
2D Warping

- Approach: Inverse Mapping
  - 17*9 cells on the T-Shirt
  - Do inverse mapping for 153 cells on each frame
2D Warping

- Quadratic Bezier Parameterization
  - Forward mapping:
    \[ Q(u,v) = u \cdot v \cdot a_{00} + u \cdot (1-v) \cdot a_{01} + (1-u) \cdot v \cdot a_{10} + (1-u) \cdot (1-v) \cdot a_{11} \]
  - Inverse mapping:
    - Given \( Q(u,v) \), which is a vector of length 2 specifying the pixel coordinates in the frame, we can also compute the \((u, v)\) pair by solving the forward mapping equation.
2D Warping
Anti-aliasing

- Aliasing - *Jigsaw* effect
- Algorithm
  - Divide pixel into sub-pixels
  - Count sub-pixels
Conclusion

- Techniques
- Further Improvements
Techniques

• Image Masking
• Threshold
• Color Filling
• Bubble Sort
• 2D Warping
• Anti-aliasing (& Alpha-blending)
Further Improvements

• 2D ➔ 3D
  – Get the depth info
  – Add ambient light effect

• New Pattern
  – Handle overlaps
Thank you!