AN UNCONSTRAINED METHOD FOR LIP DETECTION IN COLOR IMAGES
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Motivation
• Increasing interest for lip detection which stems from its usefulness in a wide range of applications
• Efforts towards an unconstrained system for lip detection that does not impose certain restrictions on users
• We propose a simple, computationally efficient system that avoids time consuming preprocessing steps or parameter initialization

Method
Face Detection
• Viola – Jones real time face detector

Lip Segmentation
• Convert to the perceptually uniform L*a*b* colorspace to increase color contrast between lip and non-lip regions
• Perform two category nearest neighbor classification, using two color markers created from the extreme a* values and the corresponding b* values, to discard unwanted non-lip pixels
• Apply k-means clustering method with an automatically adaptive number of clusters which is defined according to a lip size criterion (1 - 4% of the face image)

Morphological Processing
• Morphological closing and connected component labeling
• Fit lip object using the best-fit ellipse
• Check whether the lip object constitutes the whole lips area or just the lower lip (if so find the corresponding upper lip object)

Keypoint extraction
• Upper and lower keypoints: Intersection of the ellipse’s minor axis with the lip object boundaries
• Use Harris corner detector to refine mouth corners located in dark areas, where chromatic information is not visible

Datasets
• Caltech Image Database: 421 images of 27 different people
• GTAV Face Database: 848 frontal & near frontal images of 44 different people

Results

<table>
<thead>
<tr>
<th>Database</th>
<th>Failed Detection</th>
<th>Perfect Detection</th>
<th>Acceptable Detection</th>
</tr>
</thead>
<tbody>
<tr>
<td>CID</td>
<td>3.8%</td>
<td>94.3%</td>
<td>96.2%</td>
</tr>
<tr>
<td>GTAV</td>
<td>2.5%</td>
<td>93.3%</td>
<td>97.5%</td>
</tr>
</tbody>
</table>

Advantages
• Independent from specific color values
• Does not require training or prior assumptions about the underlying feature distribution
• Able to deal with the high variability of lip shapes and color
• Robust in challenging cases such as non-uniform lighting, bearded speakers, low color contrast between lip and non-lip area, small face size
• Unaffected by the yaw, pitch and roll angle as long as the lip region is visible

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