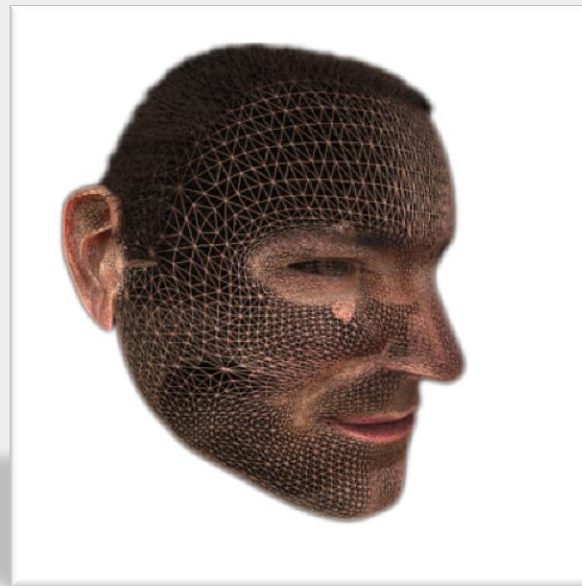


AUTOMATIC IMAGE-BASED 3D HEAD MODELING

with a Parameterized Model Based on a Hierarchical Tree of Facial Features



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CONTENT

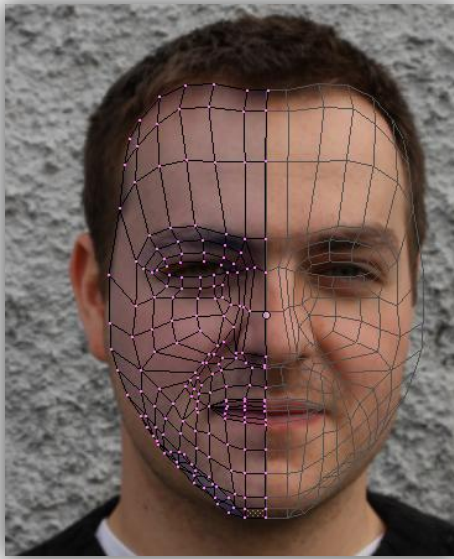
- Introduction
- Motivation
- Solution
 - Program structure
 - Parameterized model based on a hierarchical tree of facial features
 - 3D head reconstruction
 - Rendering
- Conclusion

THE MAIN GOALS

- Design and implement an application for 3D head model reconstruction from input images
- Real-time 3D head model rendering
- Model Export

MOTIVATION

- Problem definition
- Human head modeling



MOTIVATION

- Problem definition



SOLUTION

- Human head modeling algorithm
- Automation

PROGRAM STRUCTURE

Input images



3D head model reconstruction

Rendered 3D head model and texture



Export to Collada format

Exported model in Collada format

.dae

.jpg

3D HEAD MODEL RECONSTRUCTION

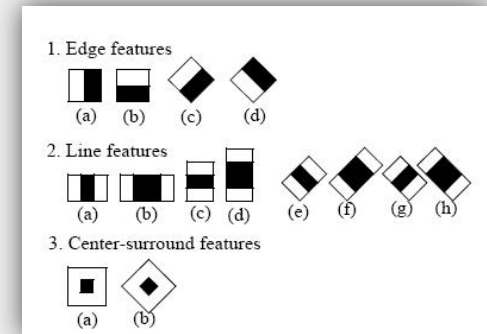
- Parameterized head model creation
[Ahlberg 2001]
- Parameters detection and parametrized model adjusting
[Mihálik, Kasár, 2007]
[In Kyu Park, Hui Zhang, Vladimir Vezhnevets, 2004]
- Texture synthesis and mapping

PARAMETERS DETECTION

- Haar cascade classifiers with an Extended Set of Haar-like Features

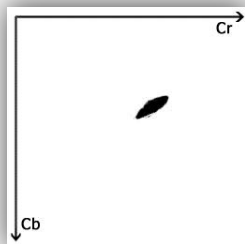
[Paul Viola, Michael Jones]

[Rainer Lienhart, Jochen Maydt]



- Skin tone based image segmentation

[Prem Kuchi, Prasad Gabbur, P. Subbanna Bhat, Sumam David S.]



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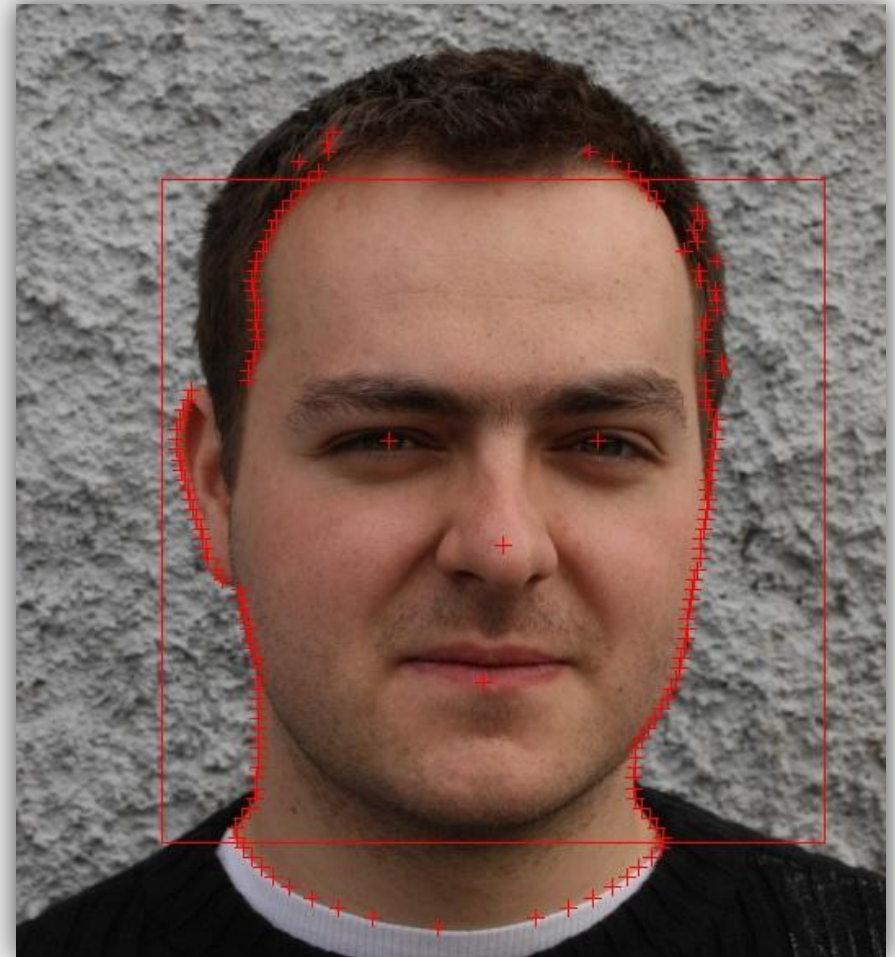


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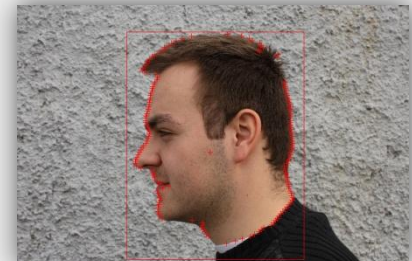
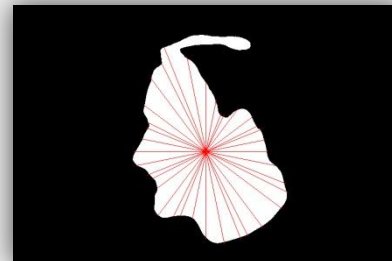
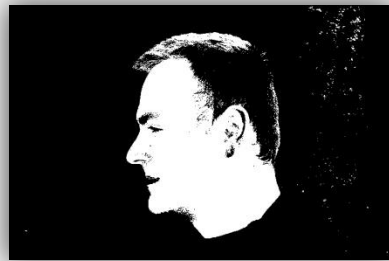
PARAMETERS DETECTION

- Front face detection



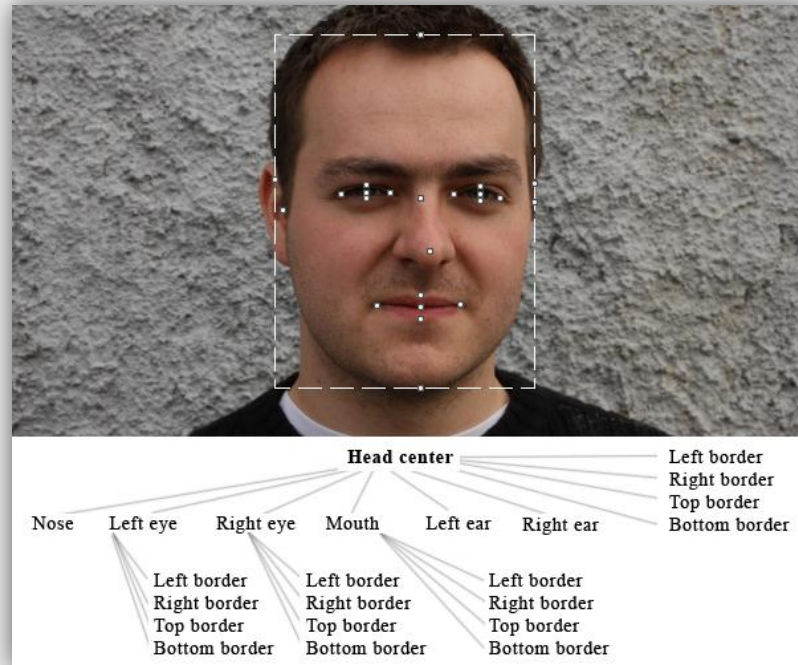
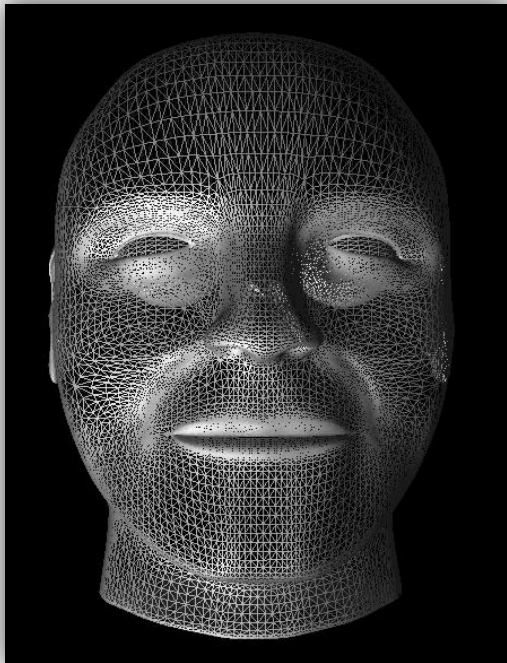
PARAMETERS DETECTION

- Profile face detection
 - Skin tone based image segmentation
 - Median filtration
 - Head center calculation by linear interpolation
 - Bounding box calculation
 - Face contour analysis



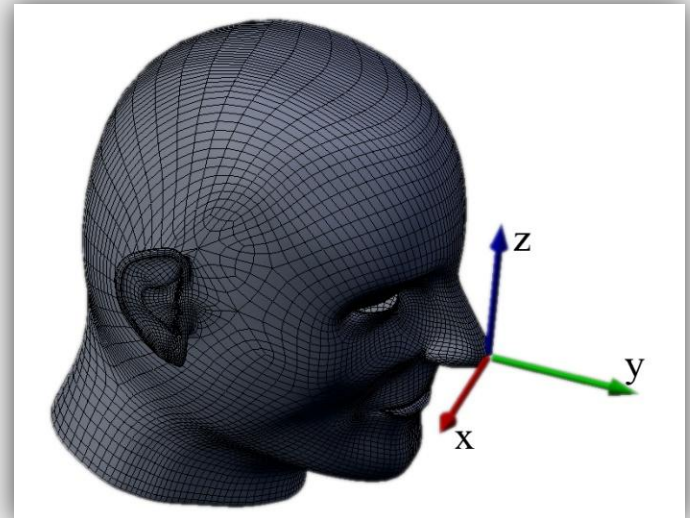
PARAMETERIZED MODEL

- Predefined head model (32672 triangles)
- Hierarchical structure of facial features



3D MODEL RECONSTRUCTION

- Model adjusting by hierarchical tree of facial features
- 3D head model reconstruction:
 1. Global vertices transformation
 2. Local vertices transformation
 3. Textures creation
 4. Textures mapping



LOCAL GEOMETRY TRANSFORMATIONS

- Geometry transformation according to facial features positions detected from input images
- Intensity of transformations is defined as vertex weights for each facial feature
- Final vertex position calculation by linear interpolation

$$Vertex_i = (1 - p).oldVertex_i + p.newVertex_i$$

3D MODEL RENDERING

- Real-time
- OpenGL
- Normal mapping, texture-space diffusion
[S. Green, 2004]

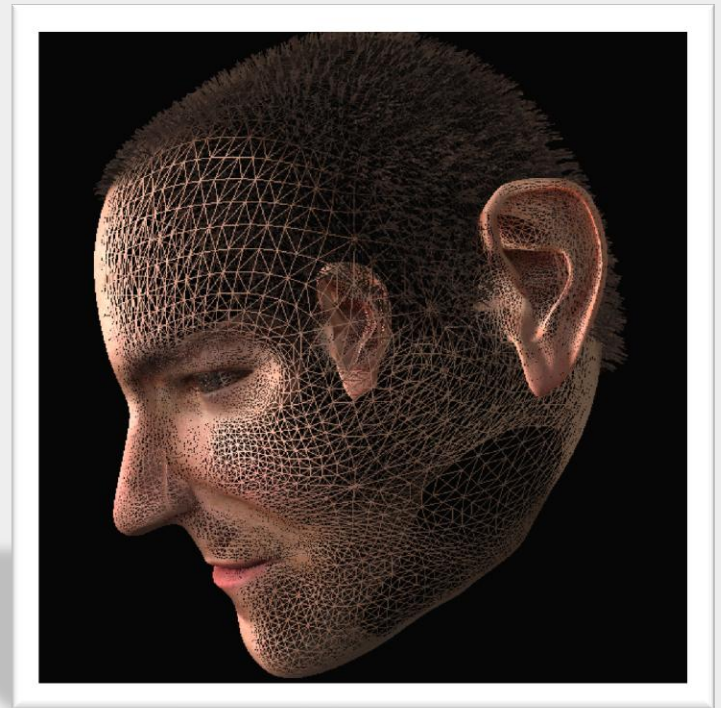
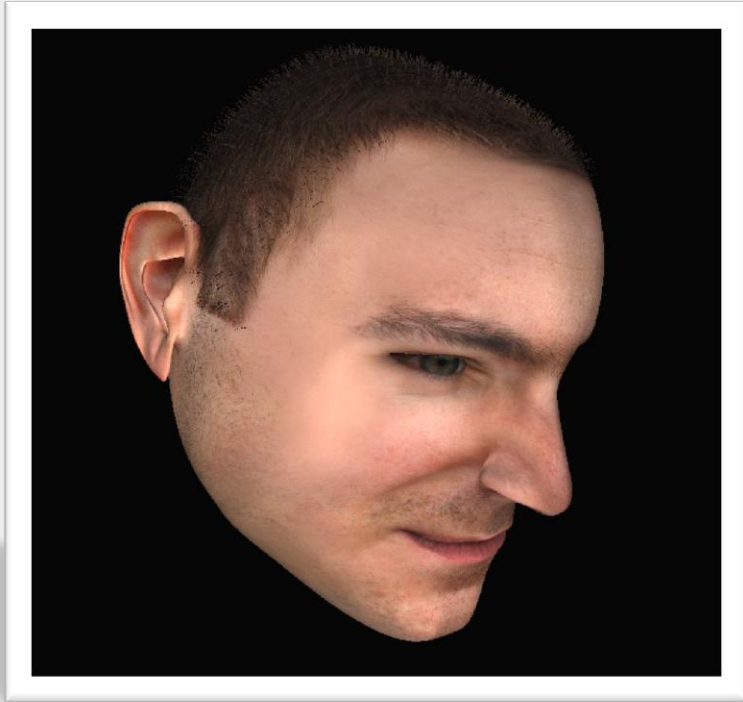
EXPORT TO COLLADA FORMAT

- Model parts export:
 - geometry, transformations
 - effects

[Arnaud, Barnes, 2006]

- Texture export

EXAMPLES



TEXTURES COMPARISON



APPLICATION

- Computer games
- Films
- Telecommunications
- Medicine(Plastic surgery)
- Security systems
- ...

CONCLUSION

- The system for automatic image-based 3D head modeling from 2D images was designed and implemented
- The novel technique for 3D head reconstruction with parameterized model based on hierarchical tree of facial features is proposed
- New method for detecting head parameters from image with use Haar Cascade Classifiers and skin-tone based segmentation is presented
- Collada Engine for rendering 3D models in real time was created

THANK YOU FOR YOUR ATTENTION.

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