CVR - Final Project
Object Detection and Pose Estimation

Team Lenna
Goals

- Camera Calibration
- Model and Reference Generation
- Tracking and Pose estimation
Goals

Camera Calibration

Model and Reference Generation

Tracking and Pose estimation

- quick and reliable
- on the fly
- using openCV calib3d
Goals

- manual generation of one reference image and corresponding 3D model
- manual generation of multiple references and one 3D model
- automatic generation of a 3D model and arbitrary number of reference images
Goals

- Camera Calibration
- Model and Reference Generation
- Tracking and Pose estimation

- feature detection on reference and sample
- feature matching
- pose estimation via 2D-3D correspondences
- extension by multiple reference images
Achievements

- Camera Calibration
  - quick and reliable
  - on the fly
  - using openCV calib3d

- Model and Reference Generation

- Tracking and Pose estimation
Intrinsics and Distortion Calibration

```
<Camera_Matrix type_id="opencv-matrix">
  <rows>3</rows>
  <cols>3</cols>
  <dt>d</dt>
  <data>
    5.3252115366679107e+02 0. 3.19500000000000e+02 0.
    5.3252115366679107e+02 2.39500000000000e+02 0. 0. 1.
  </data></Camera_Matrix>

<Distortion_Coefficients type_id="opencv-matrix">
  <rows>5</rows>
  <cols>1</cols>
  <dt>d</dt>
  <data>
    9.8724926081221021e-02 -1.8842461784055184e-01 0. 0.
    -8.4766064340681832e-02
  </data></Distortion_Coefficients>
```
Achievements

- Camera Calibration

Model and Reference Generation

- Manual generation of one reference image and corresponding 3D model
- Manual generation of multiple references and one 3D model

Tracking and Pose estimation
Reference Image Generation

- using Blender

- Problem: matching performs poorly, due to different scene illumination

  using manually captured reference images from webcam
Achievements

- Manual generation of one reference image and corresponding 3D model
- Manual generation of multiple references and one 3D model
- Automatic generation of a 3D model and arbitrary number of reference images

Camera Calibration

Model and Reference Generation

Tracking and Pose estimation
Automatic Model Generation

- using marker board for pose estimation
- rectification for epipolar line depth estimation
- depth estimation via triangulation
Achievements

- Camera Calibration
- Model and Reference Generation
- Tracking and Pose estimation

- feature detection on reference and sample
- feature matching
- pose estimation via 2D-3D correspondences (ePnP)
- extension by multiple reference images
Achievements

- AR is a possible use of the estimated pose
- explored different approaches to display and use AR

```cpp
cv::projectPoints(pts, rVec, tra, camera, dist, pts2);
```
Achievements

- AR is a possible use of the estimated pose
- explored different approaches to display and use AR

glEnable(GL_TEXTURE_2D);
glBindTexture(GL_TEXTURE_2D, imageTex);
glBegin(GL_QUADS);
    glTexCoord2d(0,0,0,0);
    glVertex3f(-0.32, 0, 0.24);
    ... 
glEnd();
glDisable(GL_TEXTURE_2D);

glColor3f(0,0,0);
gLineWidth(4);
gBegin(GL_LINE_LOOP);
    glVertex3f(0,-0.8,0);
    glVertex3f(-0.32, 0, 0.24);
    ... 
glEnd();
[ movie ]