vSLRcam

Taking Pictures in Virtual Environments

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Background

- Collaboration project of University of Magdeburg & Police University of Applied Science Saxony-Anhalt, Germany
- **Goal**: Developing a serious game for virtual crime scene investigation

➲ OpenCrimeScene

Authoring, Training, & Documenting of Crime Scene Investigation

Crime Scene Investigation

- Training part of OpenCrimeScene
- Initial tasks
  - Securing the crime scene
  - Labeling traces and
  - **Taking pictures**

What do we need?

A realistic camera model which can be parameterized and is ready for interactive use.

☹ Previous approaches were either too slow or too restricted

☞ Simulate SLR camera components

☞ Simulate component‘s interdependencies

☞ Generate realistic lens effects

☞ GPU-based technique using OpenGL Shader

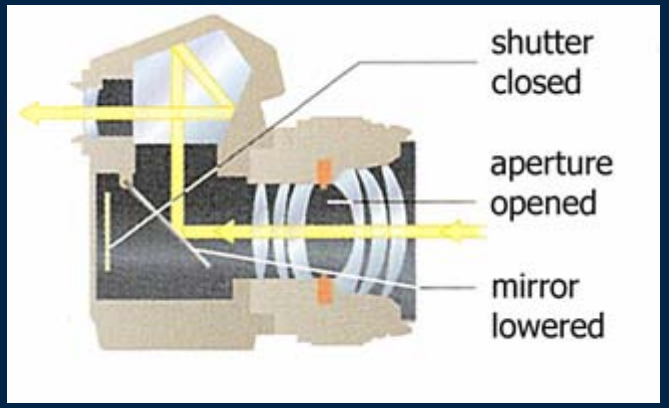
SLR Camera Components

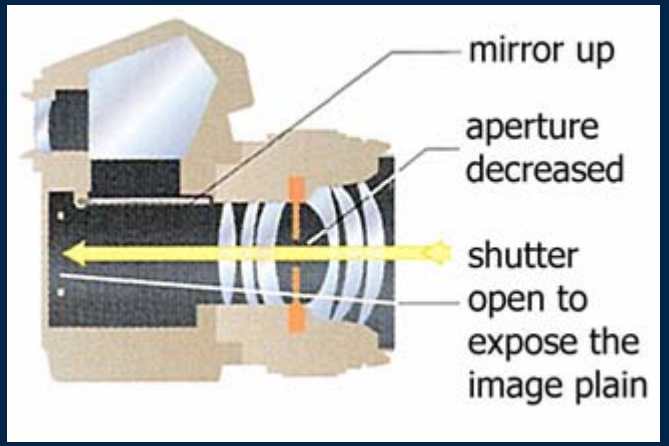
- Camera lens

- Aperture

- Shutter and shutter speed

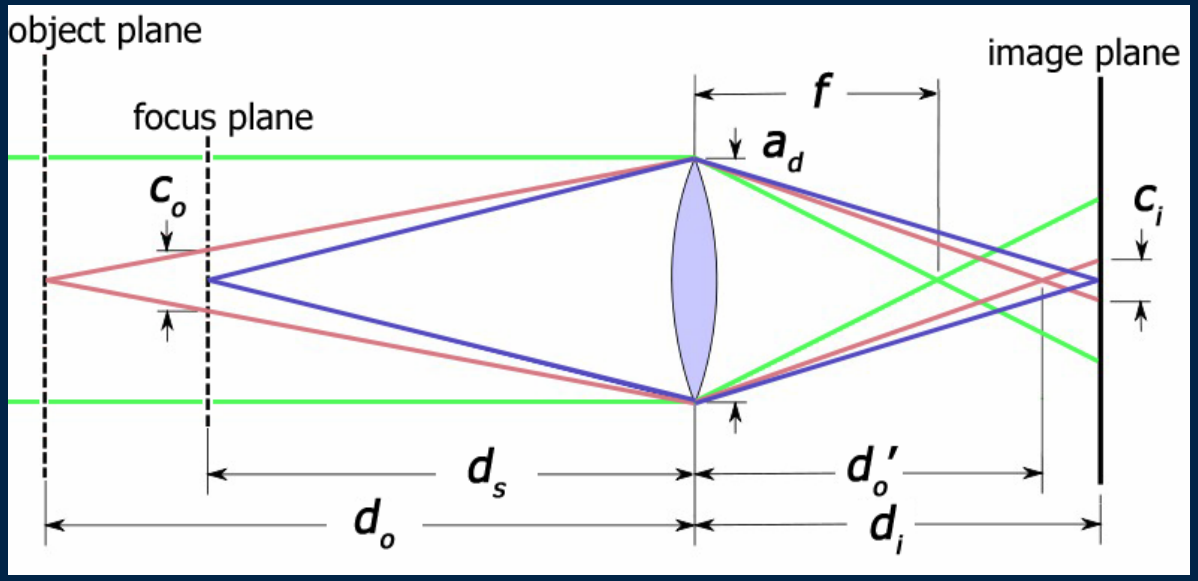
- Film type





Basic Considerations

- User-defined parameters
  - Focal length f, focus distance d_s, aperture size a_d, shutter speed t, film format i_d & film speed i_s
- Derive other parameters

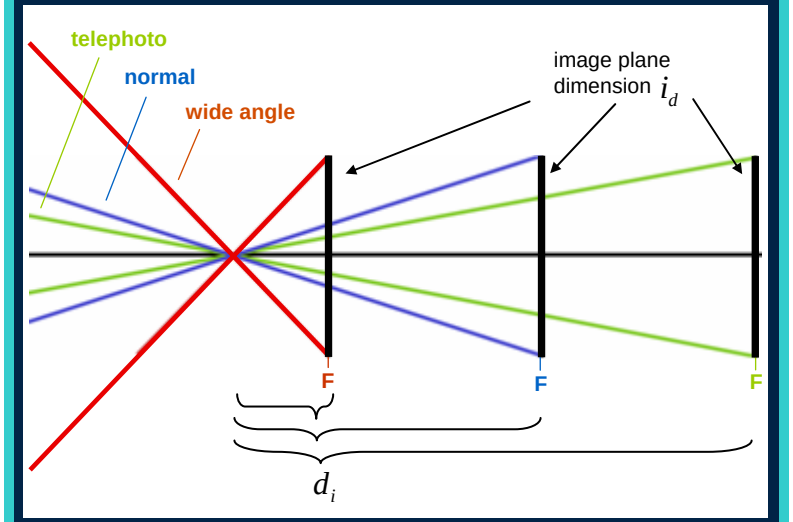


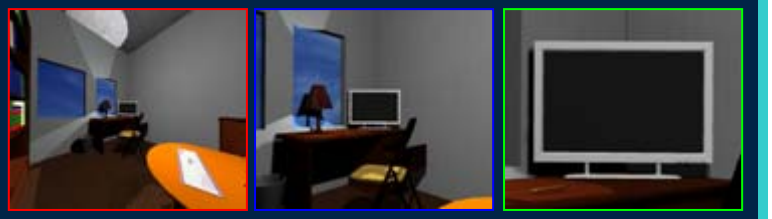
Simulating Lenses

- Angle of view
  - Result of camera lens‘ focal length f
- Determined by
  - Lens-image distance d_i
  - Image format dimension i_d

$$\alpha = 2 \cdot \arctan\left(\frac{i_d}{2 \cdot d_i}\right)$$

- Realization
  - Calculate α and apply it to OpenGL‘s viewing volume

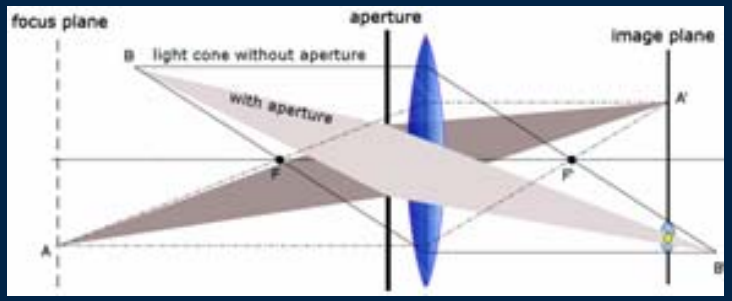


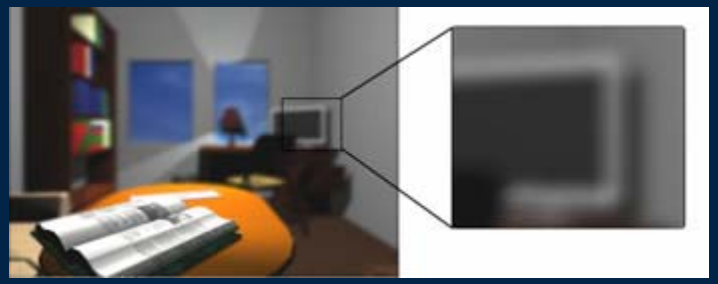


Simulating Depth of Field

- Certain area **in focus** surrounding the focus plane
- Projected object points represented by **circle of confusion**

- Calculate the circle of confusion for each image point
- Perform Poisson Disc Sampling to blur each image point





Simulating Motion Blur

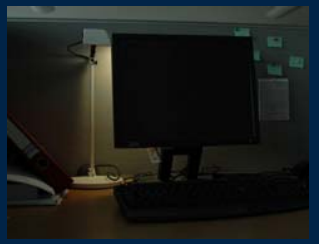
- During exposure
  - accumulation of illuminances
  - motion blur occurs if object or camera move
- Assume current frames are illuminances
  - ➲ Accumulate weighted frames
- Ensure rendering in real-time
- Ensure contribution of each frame to the final image
- Accumulate frames by

$$(1-\alpha)\cdot curFrame+\alpha\cdot accFrame$$

$$\alpha:[0,1]\rightarrow R$$

Simulating Exposure

- During exposure light falls onto film plane
  - ➲ Find balanced exposition
- Scene illuminance EV_s and aperture/shutter speed combination EV_c
- Calculate exposure values $EV_{delta} = EV_s - EV_c$
- Map exposure values to color values





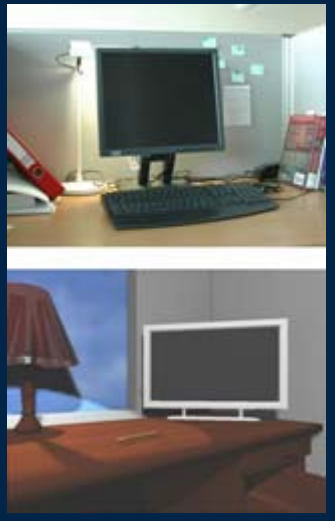
Results

- Realistic camera model for interactive use in virtual environments

a = 3,5f & t = 1/200s

a = 3,5f & t = 1/60s

a = 3,5f & t = 1/45s



a = 3,5f & t = 1/30s

a = 3,5f & t = 1/4s

Conclusion

- vSLRcam approximates an SLR camera‘s components & their interdependencies realistically
- Photo-realistic lens effects are achieved
- Lens effects can be rendered in real-time
- Camera components can be parameterized by a user
- The camera can well be applied to a virtual training environment like, e.g., OpenCrimeScene

Thank you!