FAKULTÄT FÜR !NFORMATIK
Faculty of Informatics

Diplomarbeitspräsentation

Projector-Based Textures for 3D-Printed Models

Tangible Molecular Visualization

Masterstudium:
Visual Computing

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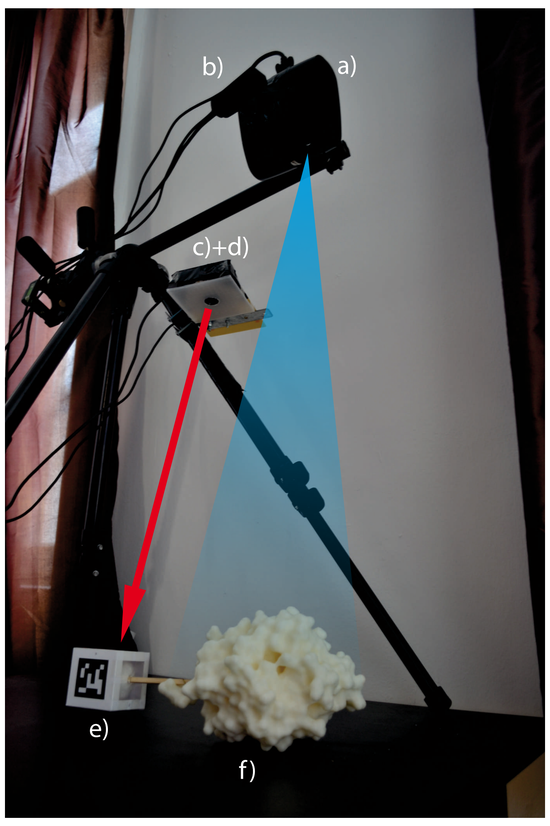
Problem Statement/Motivation

The now widely available 3D printing technology enables structural molecular biologists to easily produce tangible models of complex molecular structures, such as proteins. Those models, however, are static and often monochrome, therefore their information content cannot compete with existing screen-based visualization solutions.
Following the paradigm of spatial augmented reality, we present an approach to dynamically visualize molecular properties directly on the surface of 3D-printed tangible models using digital projections.

Contributions

- Assembly and calibration of a suitable hardware setup
- Development of an augmented reality software prototype
- Evaluation of the approach with domain experts

Hardware setup



a) digital projector

b) camera for projector calibration

c) infra-red tracking camera

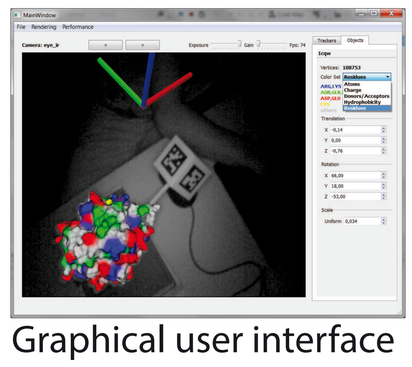
d) infra-red lighting

e) ArToolKitPlus marker cube

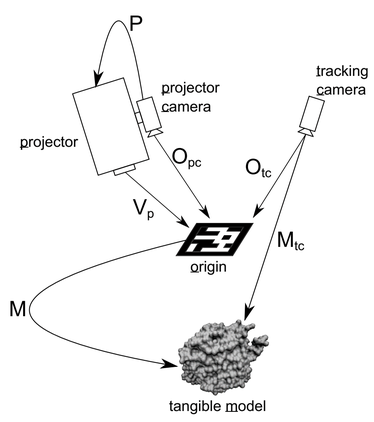
f) 3D-printed molecular model

Software

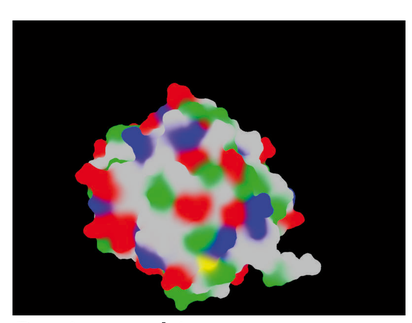
- Device management
- Real-time optical 6-dof tracking of the model
- Correct rendering of virtual model
  - Optical properties of projector/camera
  - Transformations between components
- Projector image + camera view for GUI



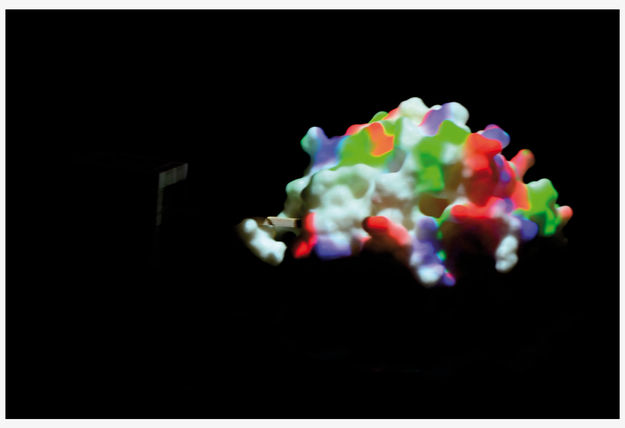
Graphical user interface

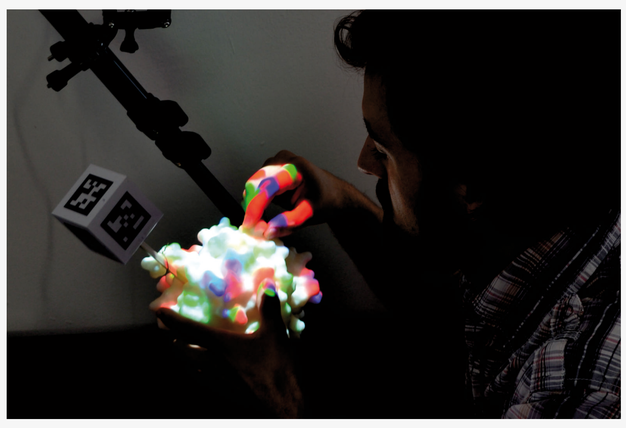


Geometric relations between system components


Projected image

Results

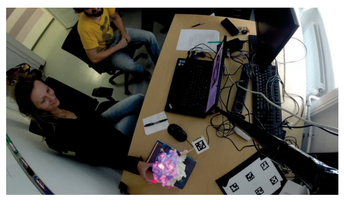


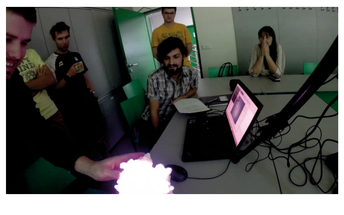


- The model is freely movable and rotatable
- Projection stays registered
- Color coded molecule properties can be changed at run-time
- Infra-red tracking works in dark environments → vivid colors

Evaluation

- Informal evaluation with domain experts
- Demonstration, free exploration and interview
- Two evaluation sessions, four domain experts





Findings:
- System is impressive and appealing
- Most effective for presentations, science fairs and museums
- Too complicated for everyday use by scientists
- Issues:
  - suboptimal tracking
  - printed model is rigid; surface only

<u>Promising applications:</u>
- Animations
  - trajectories of ligands
  - simulate flexibility of proteins
  - interactive stories
  - DNA binding sites
- Inter-molecular docking

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