LightGuider: Guiding Interactive Lighting Design using Suggestions, Provenance, and Quality Visualization

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https://www.computer.org/csdl/journal/tg/5555/01/08807288/1cG6djufx96

Lighting design

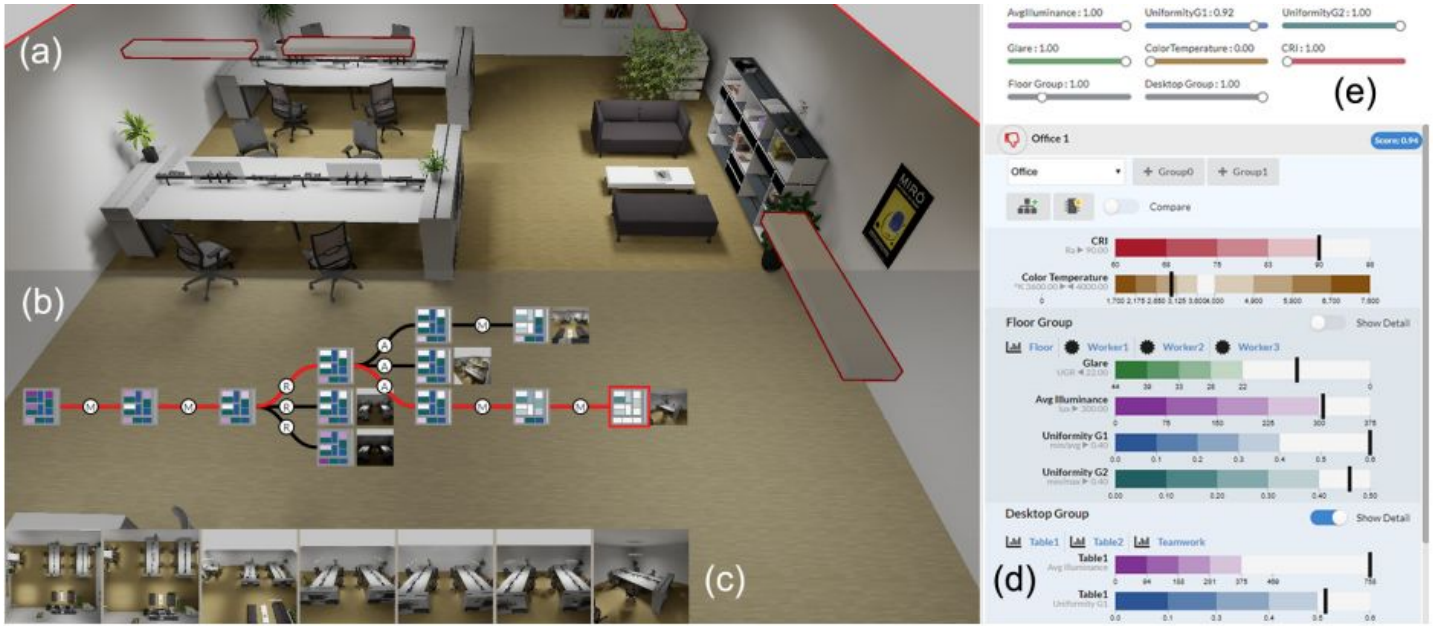
The process of placing light such that the emitting light fulfills technical and aesthetic requirements.

Lighting design is complex

- Must satisfy design constraints
- Must look good
- Simulating lighting is computationally expensive
  - Select, place, and align lights → run simulation
  - Check if illumination constraints are satisfied
  - Repeat until all constraints are fulfilled and design looks good
- Designers generally converge on solutions: single local optimum

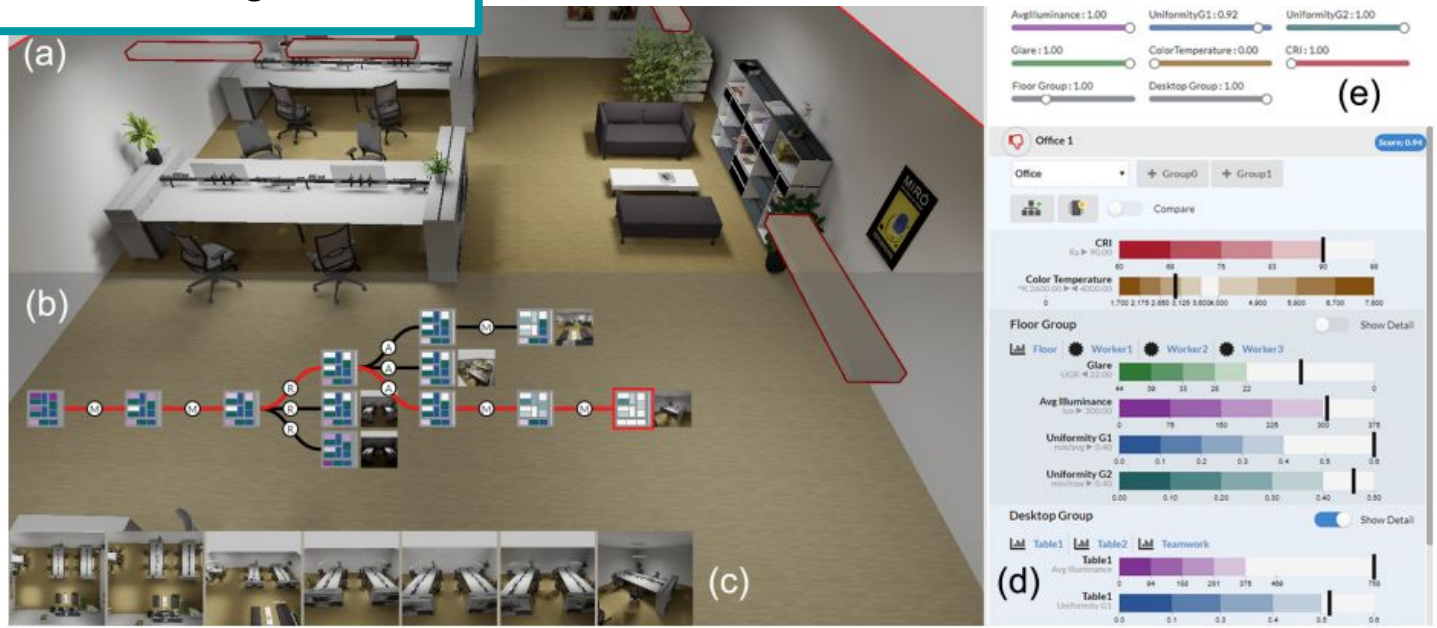
LightGuider

Simulates potential next modeling steps and shows how well current designs meet specified quality criteria.



LightGuider

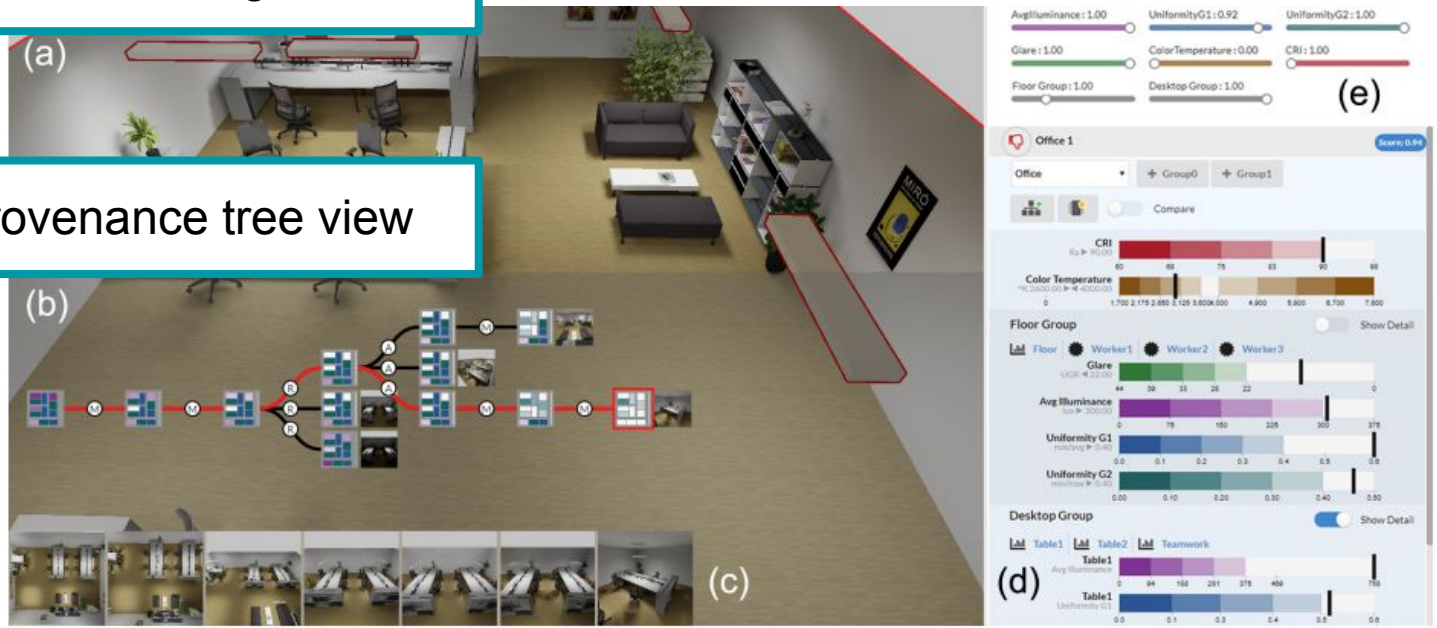
(a) 3D modelling view



LightGuider

(a) 3D modelling view

(b) Provenance tree view

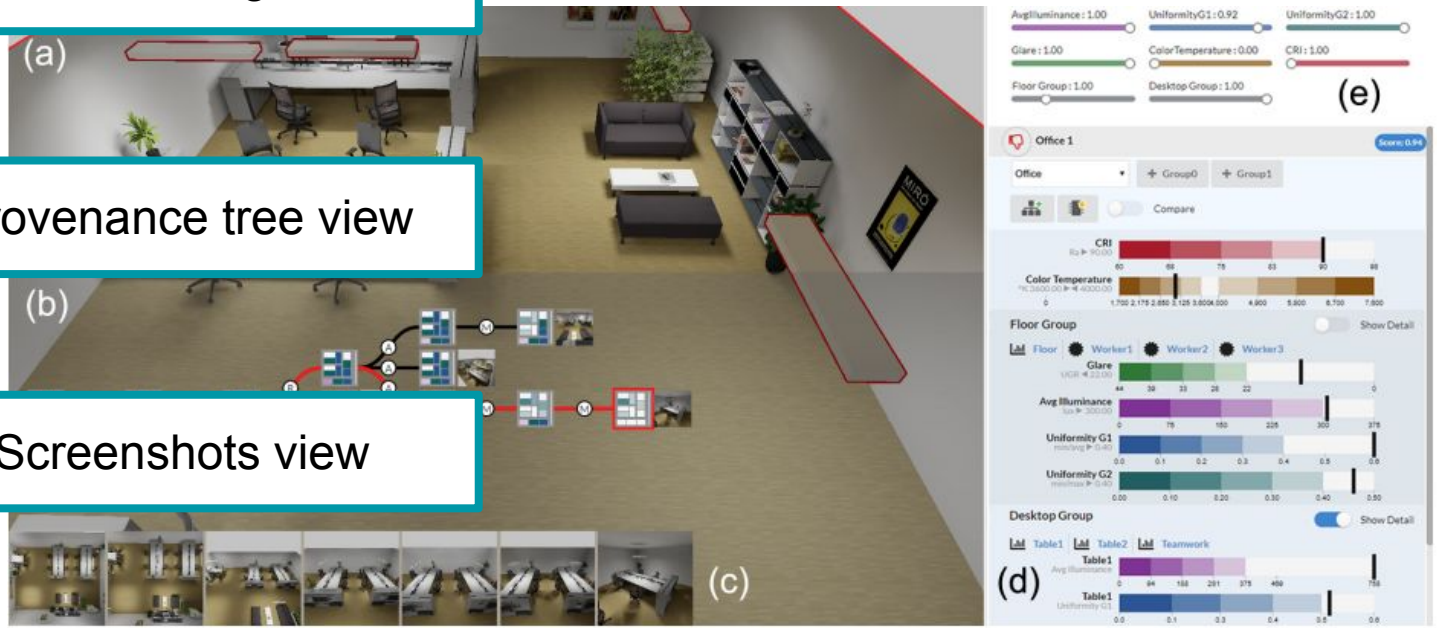


LightGuider

(a) 3D modelling view

(b) Provenance tree view

(c) Screenshots view



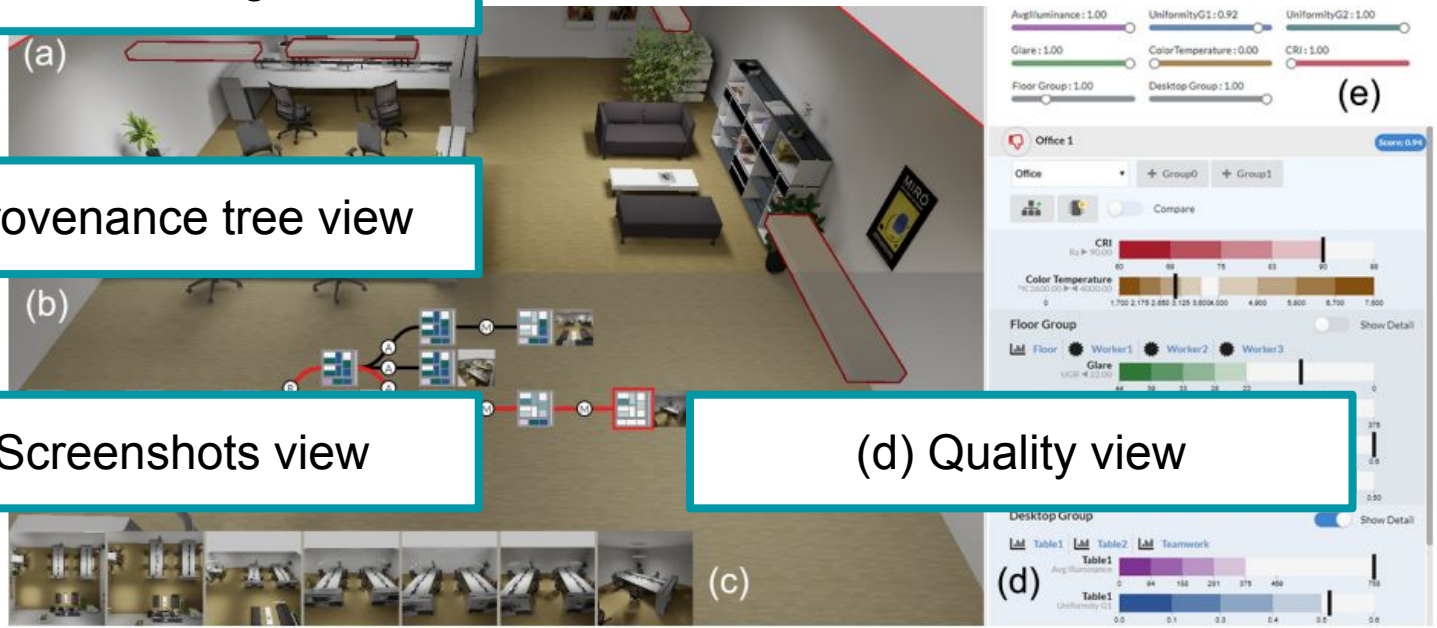
LightGuider

(a) 3D modelling view

(b) Provenance tree view

(c) Screenshots view

(d) Quality view



LightGuider

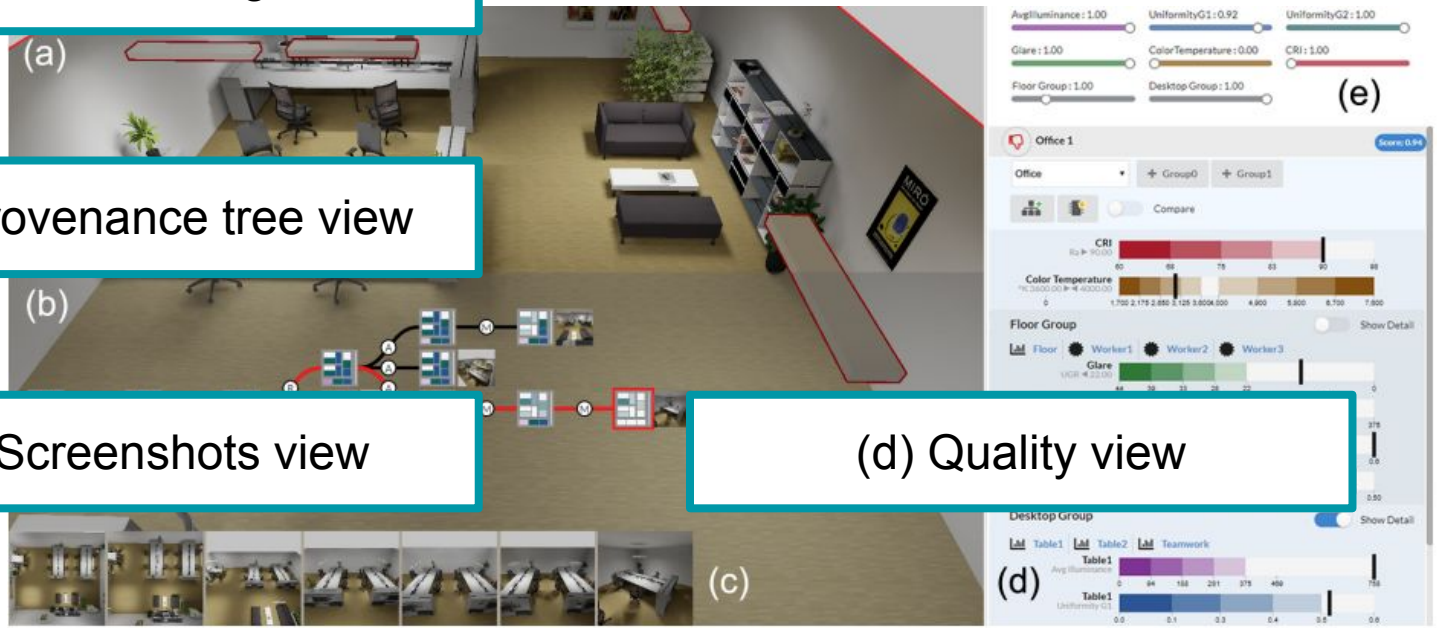
(a) 3D modelling view

(b) Provenance tree view

(c) Screenshots view

(d) Quality view

(e) Focus setting view

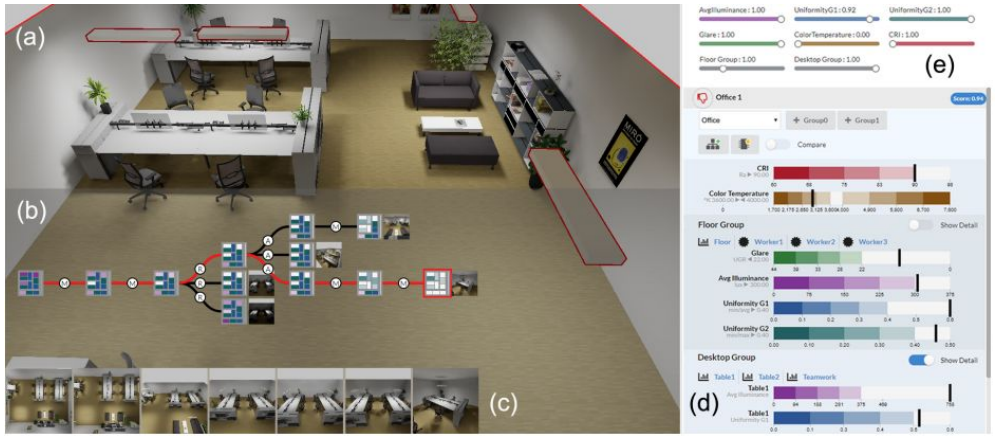


Video

https://vimeo.com/360154391

Components of LightGuider

- 3D modelling view
- Quality view
- Provenance tree view
  - Displays design suggestions
- Focus setting view
- Screenshots view

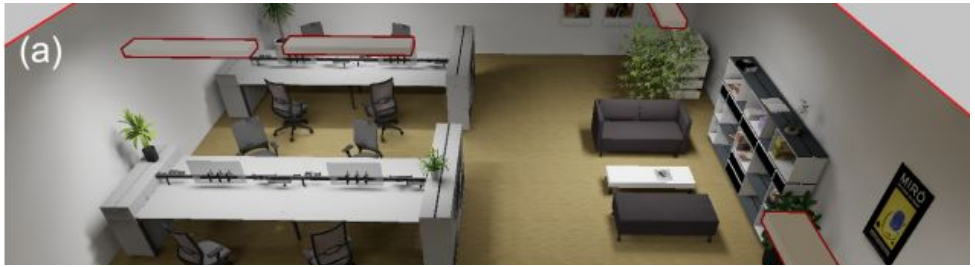


3D Modelling View

- LightGuider is built on top of a lighting design tool

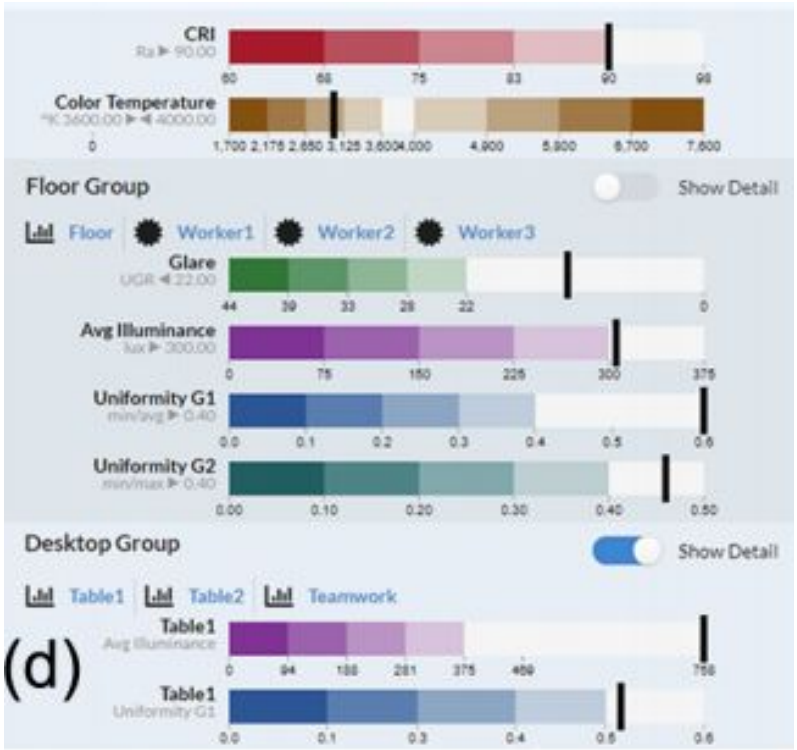
Specific to LightGuider:

- Camera animations towards poorly performing objects
- Displays colored outlines around selected objects



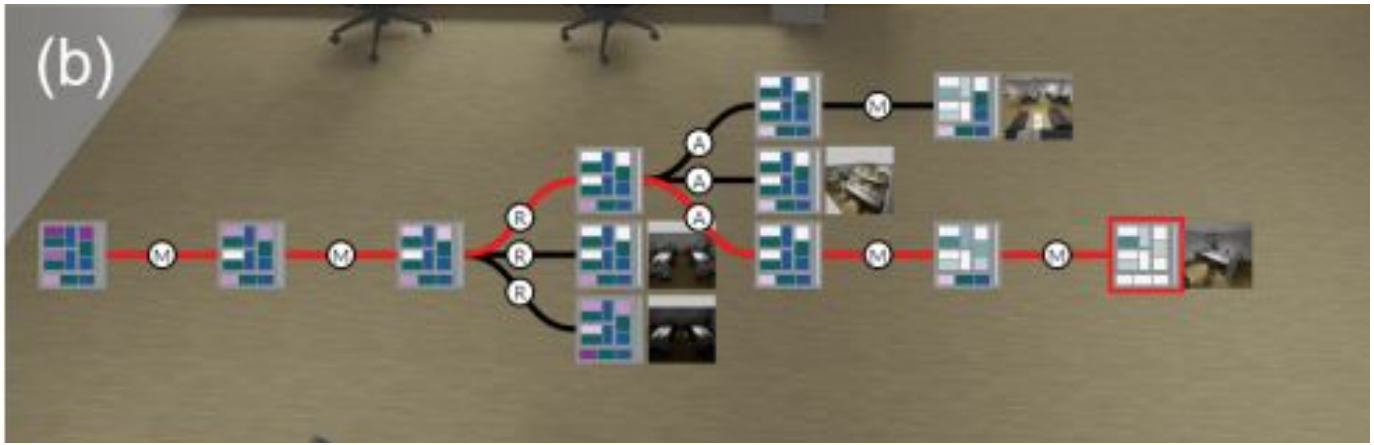
Quality View

- Shows all illumination constraints and current status
- Positions on aligned but not common scales
- Hue maps to different constraints
- Dark, saturated → solution is far off
- Light → solution is close
- Scales have equal brightness values on all levels



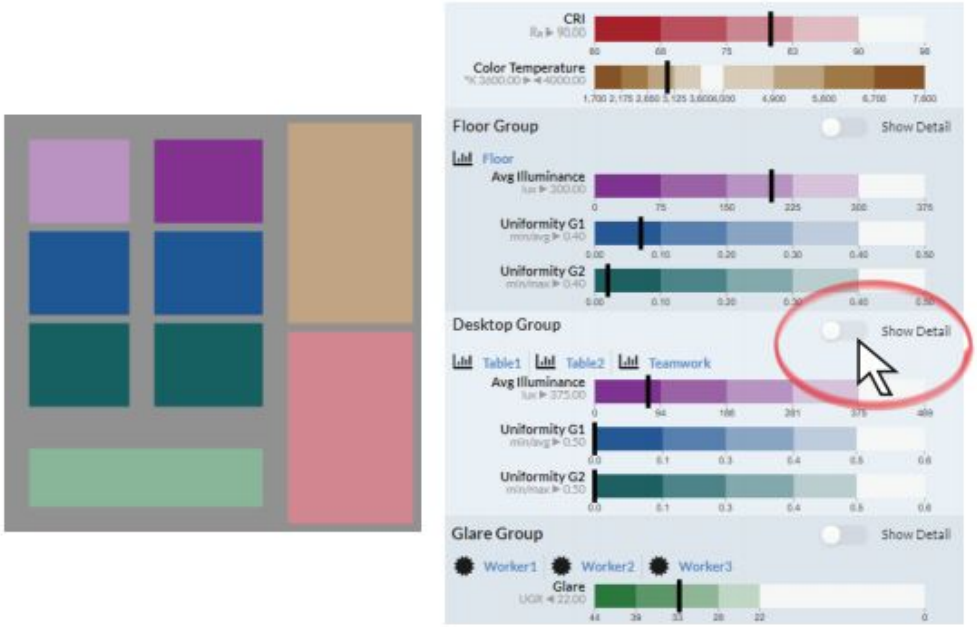
Provenance Tree View

- Node-link diagram that shows workflow history
- Letters indicate different actions
- Select a node to highlight path towards it



Provenance Tree View

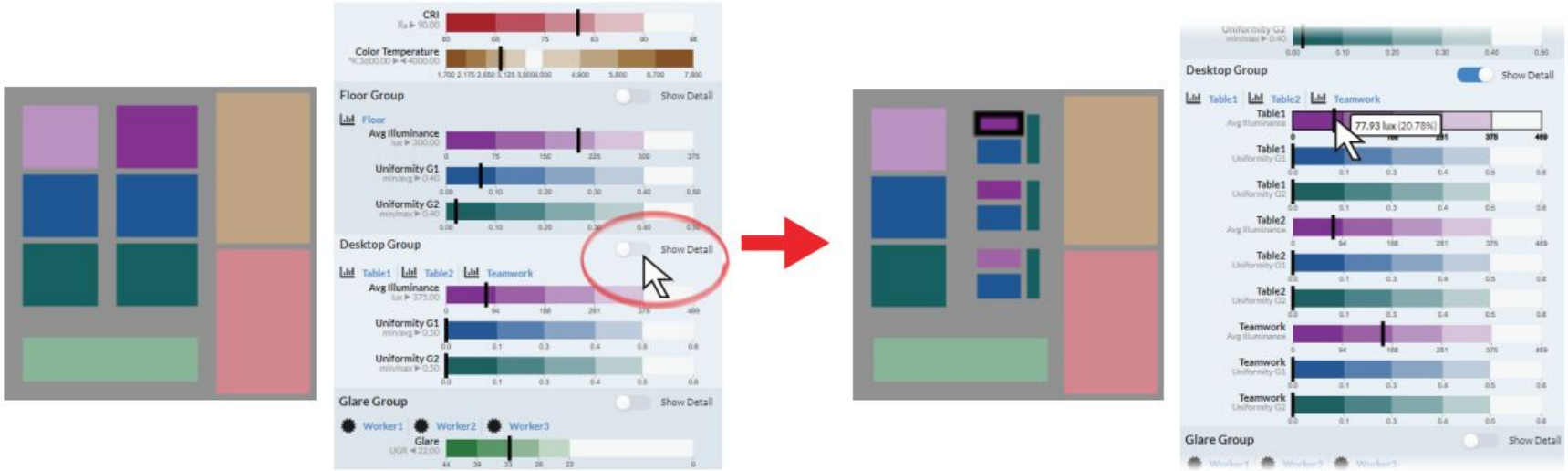
- Treemap in each node
- Each constraint associated with distinct color
  - Same as quality view



(a) (b)

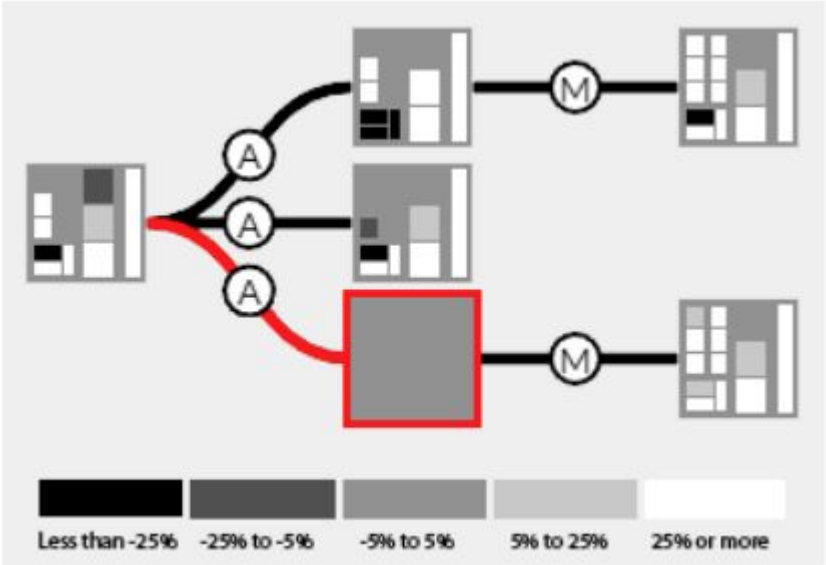
Provenance Tree View

- Can show more details on demand



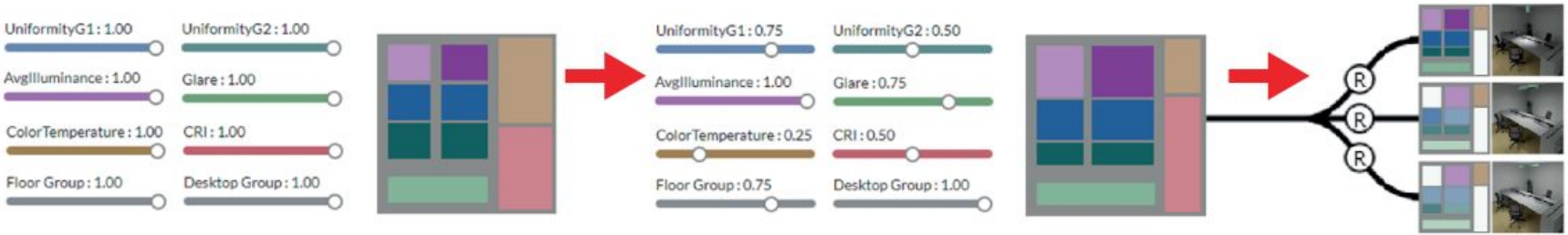
Provenance Tree View

- Can compare modelling states globally
- Grayscale
- Selected node acts as reference; all other nodes encode the difference to it
- Darker → worse
- Lighter → better



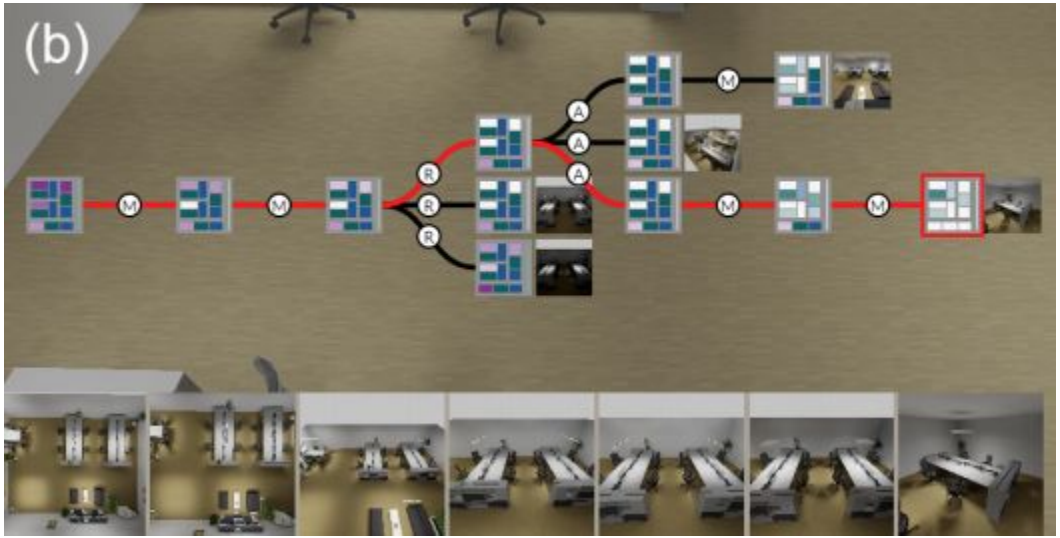
Focus Setting View

- Set weights for illumination constraints and user-defined groups
- Slider colors match the colors in the tree nodes
- More weight → larger corresponding area in tree node
- More weight → more important when generating design suggestions



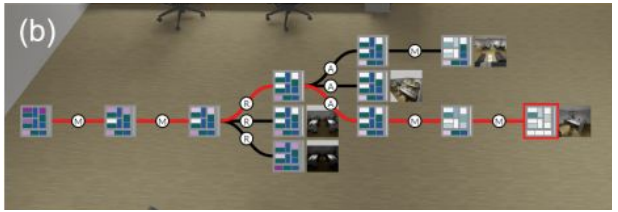
Screenshots View

- Shows thumbnails for linear path through tree to current state
- Thumbnails also shown at leaf nodes



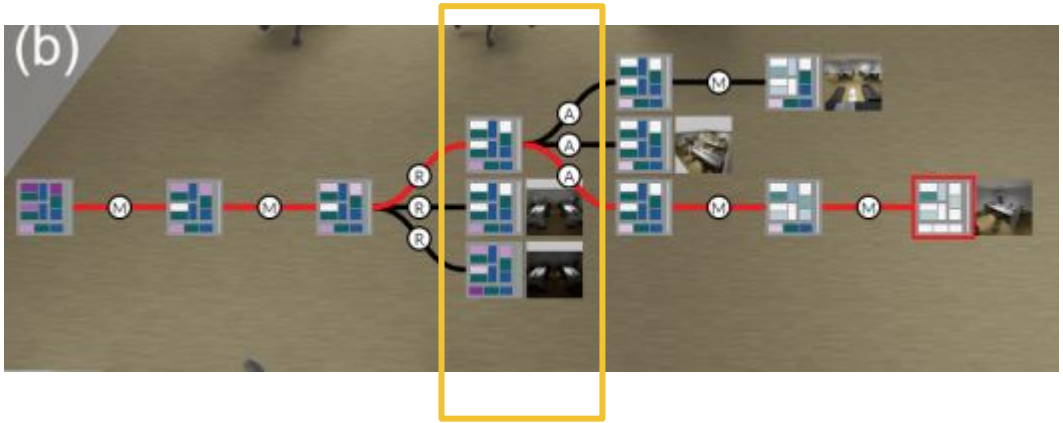
Provenance Tree View: Analysis

- Node-link diagram
  - Horizontal growth shows development through time
- Treemap summarizes modelling step
  - Color encodes constraint status
  - Area encodes constraint weight
  - Spatial position does not encode data
- Difficult to read hierarchy info from treemap, but not important in this scenario



Generating lighting design suggestions

- Can **add**, **remove**, **dim**, or **change** lights
- Can **change height** of one or all lights



Generating lighting design suggestions

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Process:

- Compute scores for all actions, accounting for weights assigned to illumination constraints
- Pick top 2 actions, simulate 3-5 randomized parameterizations for each
- Compute scores for random simulations, accounting for weights assigned to illumination constraints
- Show 3 highest-scoring solutions to user

Summary

- **What**
  - Workflow history (network), design quality (quantitative values)

- **Why**
  - Generate and verify satisfactory designs
  - Discover alternate design paths

- **How**
  - **Encode:** node-link diagram, treemap, horizontal scales
  - **Manipulate/facet:** update scene, select step to compare it to all other steps
  - **Reduce:** aggregate constraint statuses

Overall Critique

Strengths

- Justifies design choices for specific tasks
- Implements overview then details on demand
- Follows “eyes beat memory”
- Recognizes limitations in scalability
  - Hues
  - Nodes in provenance tree

Weaknesses and limitations

- Examples of scalability of provenance tree
- Justification for randomly generated suggestions
  - Came up in user study feedback
- Clarity of LightGuider’s 3D modelling view contribution

Thank you