

Title of Proposal: Evaluation of the usability of a web based sketching interface for the iterative design of architectural daylighting

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Department: Computer Science

Is this proposal related to a sponsored project? Yes

If yes, please indicate:

Existing Award: (Fund # A12016), NSF,

Immersive Architectural Daylighting Design Experience

All investigators, including faculty supervisors, on this project must complete the self-study course on protection of human research subjects.

Certification: I/We have completed the course:

Max Espinoza (CS PhD Student) 10/05/15

Barbara M Cutler 7/2/08, refresher 11/2/11

Objective: Our goal in this study is to evaluate the effectiveness and usability of our web based sketching interface for the creation of closed architectural geometries and daylighting analysis.

Methods: Users in our study will begin by visiting a provided URL serviced by a password protected lab machine. Users will be required to register by providing a username of their choice and a password. During registration users will be given a brief explanation of their participation in our user study. There will also be an option to opt out of the user study, but still use our web interface. This opt out option will be clearly displayed when registering for our web application. We will not use designs or feedback of users who have opted out of the study. A sample screenshot of the registration process is shown below. After a successful login users will then be taken the main page of our application. The application is split into two parts. On the left hand side are the tools required to make sketches and generate 3D models. On the right hand side is a feedback panel with question that can be answered at any point of the study. These questions are not required to be answered in order to use the web interface. Users can choose to answer some questions, but leave others blank. Participants can stop at any point in time and continue by logging into the web interface with their username and password.

The questions asked are attached at the end of this document. (Along with sample screenshots)

Effects on Subjects: See benefits and risks.

Benefits to Participants: The participants will gain first-hand experience with a new online sketching environment for the generation of 3D models, and an understanding

of the iterative design process of creating architectural spaces. The results of the study will lead to the use, development, and improvement of algorithms that interpret architectural sketches. In addition user's feedback will lead to improvements in our daylighting visualizations.

Minimization of Possible Risks: There is no risk of physical harm in our web interface study. The only tool required to participate in this study is a computer and web browser. We have considered the issue of computer security. Users will be provided two kinds of digital information: design files and feedback. Design files are created automatically as the participants use our interface. These files save user's sketches in a format that is unique to our interface. To protect users we have a login system that requires a unique username and password pair. Users will be able to revisit the website to review/edit design files and feedback. The application is designed to store information created by users on a PostgreSQL database serviced by the Computer Science Department, of which only investigators have direct access to. The machine hosting this webpage will be using an up to date Apache server and hypertext transfer protocol secure (HTTPS) for maximal security. We will also hash user's password, such that nowhere on the system will user's passwords be stored in plain text. Users are not required to download anything on their computers to participate in this study, nor will they be required to make security exceptions on firewalls or anti-virus protection software. Our webpage is only dependent on users having a web browser (Firefox or Chrome) to participate.

The answers to some questions may contain personally identifiable information. For example participants are asked to identify what room they are creating a sketch of, moreover users are asked how often they visit this room. All the questions in our survey are optional, including those questions which may contain personally identifiable information.

Likelihood of Harm: None

Alternate Method Not Using Human Subjects: None

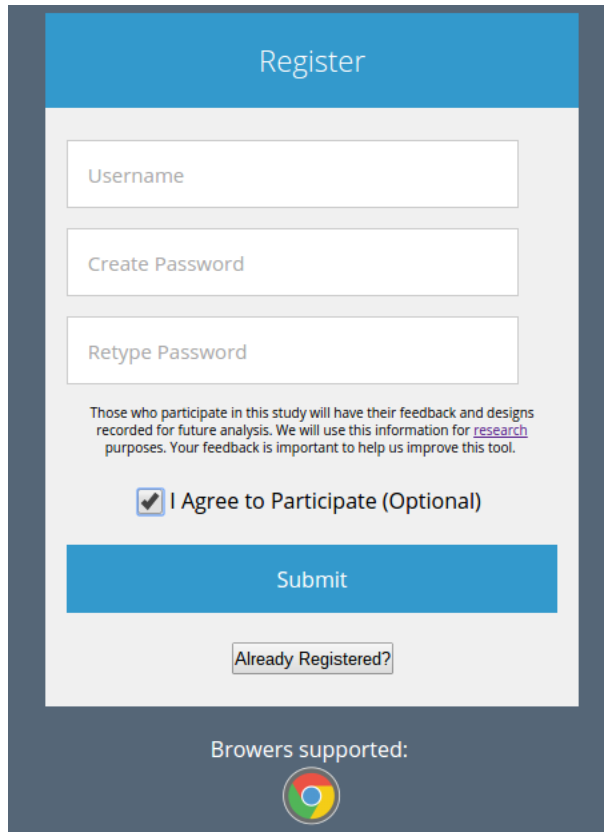
Qualifications of Researcher: Barbara Cutler has a PhD in Computer Science from Massachusetts Institute of Technology. Max Espinoza is a 3rd year PhD student in Computer Science at Rensselaer Polytechnic Institute studying computer graphics.

Recruiting of Subjects: We will ask for online volunteers to use our webpage and participate in this user study. We will advertise our web page to student volunteers (18 years or older) via posters, campus related social media, and direct contact with students attending related courses. We will obtain permission of the course instructors to advertise for the participation of their students, but participation in the study will be voluntary and will not impact their course grade. The faculty advisor for the study (Barbara Cutler) will not recruit students in her courses to participate. The names of the students who did or did not participate in the study will be confidential and will not be released to their instructors.

We are particularly interested in participants with experience in 3D modeling, architectural daylighting, general architecture, and visual arts. We are looking for users with formal education and experience in the above fields to provide us valuable feedback to improve our web interface's usability and functionality. This experience is not required for participation in the user study, but the subject's will have an opportunity to note prior experience in these related fields.

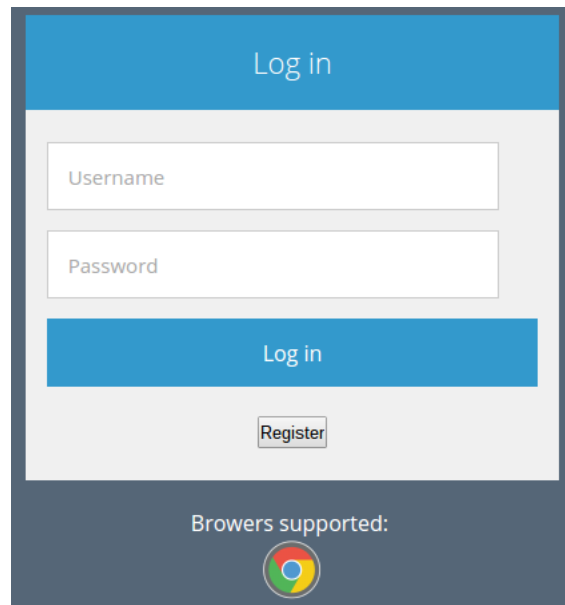
Confidentiality: Participants will register themselves with a username of their choice, when logging into the web interface for the first time. We do not require users to use any personally identified usernames and password pairs such as those provided by the RPI (RSC IDs). We work under the assumption that users follow standard practices for the creation and management of their login credential's. The participants can stop and continue where they left off at any point during this study using their unique usernames. Users will also provide a password, which we will hash using SHA-1 method. This hashed password is used to protect user's design file and feedback information. No where in our application will the user be asked for their real name. Participants will be identified by a randomly assigned ID number that is used only for this study. All recorded user information and design files will be labeled with this ID (and not the participant's username). All information and data relating to the user study will be protected to secure confidentiality. All electronic files will be stored on password protected computers in locked offices, which can be accessed only by the investigators of the user study. The correspondence between ID number and participant username will be recorded by Barbara Cutler and stored on a password protected computer, accessible only by her. This correspondence will be destroyed once analysis of the data is complete, within 1 year after participation in the study.

Registration and Login Sample: When users visit our URL they will be directed to a registration page. Users who have already previously registered can navigate another page to sign in. Screenshots of the registration page are provided below. On this page users are only required to provide a username and password. In addition there is a brief prompt explaining what information is being recorded and an option to opt out of this study. All other kinds of user input beyond this point are optional.



The registration page has a blue header with the word "Register". Below it are three input fields: "Username", "Create Password", and "Retype Password". A paragraph of text explains that feedback and designs will be recorded for future analysis and used for research purposes. Below this is a checkbox labeled "I Agree to Participate (Optional)" which is checked. A large blue "Submit" button is at the bottom of the form area. Below the button is a link that says "Already Registered?". At the very bottom, it says "Browsers supported:" followed by the Chrome logo.

(a) This is the registration page for new user. Note the brief statement regarding participation in our user study.



The sign in page has a blue header with the words "Log in". Below it are two input fields: "Username" and "Password". A blue "Log in" button is positioned below the password field. Below the button is a link that says "Register". At the bottom of the page, it says "Browsers supported:" followed by the Chrome logo.

(b) Sign in prompt

Figure 1: Registration and Sign in pages

Sample User Specific Questions: These are sample questions we will ask on a per user basis. All of these questions are optional. Screenshots of where these questions are presented in our website are provided below.

The screenshot shows a web interface with a top navigation bar containing 'Load', 'Sketch', '3D', and 'Task' tabs. Below the navigation bar is a 'New Model' button. The main area is divided into two sections. The left section, titled 'PREVIOUS MODELS', lists four items: 'plucky ice gift', 'ambitious candle invention', 'tidy pearl strawberry', and 'plucky harp invitation'. The right section contains a series of questions and input fields. The first question is 'Are you affiliated with Rensselaer Polytechnic Institute?' with radio buttons for 'Yes' (selected) and 'No'. The second question is 'How are you affiliated with RPI?' with a dropdown menu showing 'Undergraduate'. The third question is 'Years of formal education in architecture?' with a text input field. The fourth question is 'Years of formal education in visual arts?' with a text input field. The fifth question is 'Years of job experience in architecture? (including internships)' with a text input field. The sixth question is 'Years of job experience in visual arts? (including internships)' with a text input field. The seventh question is 'Have you used any of the following modeling software?' with a list of checkboxes for 'SketchUp', 'AutoCAD', 'Rhino', and 'Maya'. The eighth question is 'Have you used any other *unlisted* modeling software?' with a text input field. At the bottom of the interface, the word 'Ready' is displayed.

Figure 2: This is the main page of our interface. Notice the questions users are encouraged to answer are located only the right hand side of the webpage.

1. Are you affiliated with Rensselaer Polytechnic Institute?
2. How are you affiliated with Rensselaer Polytechnic Institute?
3. Years of formal education in Architecture?
4. Years of formal education in Visual Arts?
5. Years of job experience in architecture? (including internships)
6. Years of job experience in Visual Arts? (including internships)
7. Have you used any of the following modeling software?
 - (a) SketchUp
 - (b) AutoCAD
 - (c) Rhino
 - (d) Maya

- (e) 3DS Max
 - (f) Cinema 4D
 - (g) Blender
 - (h) Revit
 - (i) Other
8. Years of experience with modeling software?
 9. Other relevant education / experience?
 10. Are you colorblind?
 11. Is it okay if we follow up with additional questions about specific models you created in our system?
 - (a) If so, please enter your email address
 12. What did you find fun or interesting in this sketching environment?
 13. What additional features should be added to system to allow greater flexibility in design?
 14. Describe some designs that you were not able to create due to system limitations?
 15. Was there anything you did not like about working in this sketching environment?
 16. Where there any UI elements that were hard to use or confusing at first?
 17. Describe your overall impression of the software for determining the interior vs exterior space in your designs?
 18. For the cases when the systems interpretation of the interior/ exterior of your design was incorrect where was the system wrong?
 19. Did you understand the results of the simulation, was there anything confusing or unclear?
 20. Did the system allow you to create and test daylighting performance with respect to over or under illumination?

Design Specific Sample Questions: These are sample questions we will ask on a per design basis. Upon the creation of a design these questions will be available for users to answer. Again all of these questions are optional. Some of these questions ask users for possibly personally identifiable information, however participants are not required to answer these questions. We remind users that these questions are optional by labeling them as optional. Screenshots of where these questions are presented in our website are provided below.

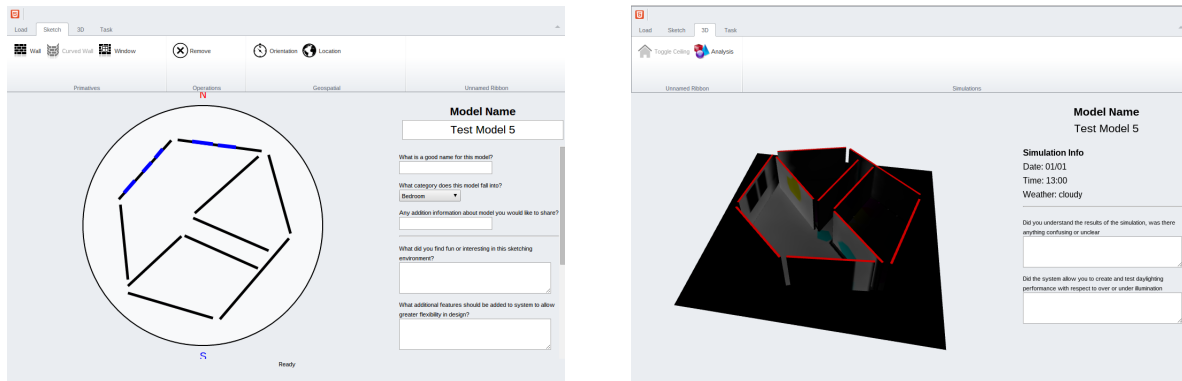


Figure 3: Left) This is sketching interface where users create designs. These designs are recorded for future analysis. Right) Users can view the daylighting of their 3D generated designs. Notice how throughout the application the feedback we are collecting is non-intrusive and located on the right hand side.

1. What category does this model fall into?
 - (a) Dorm
 - (b) Bedroom
 - (c) Living room
 - (d) Apartment / House
 - (e) Classroom
 - (f) Office
 - (g) Lobby
 - (h) Other
2. What dorm is this a model of? (Optional)
 - (a) BARH (Burdett Avenue Residence Hall)
 - (b) Barton Hall
 - (c) Beman Lane Undergraduate RAHP Apartments
 - (d) Blitman Residence Commons
 - (e) Bray Hall

- (f) Bryckwyck Floor Plans
 - (g) Cary Hall
 - (h) Colonie Apartments
 - (i) Commons
 - (j) Crockett Hall
 - (k) Davison Hall
 - (l) E-Complex
 - (m) Hall Hall
 - (n) Nason Hall
 - (o) North Hall
 - (p) Nugent Hall
 - (q) Quadrangle (The Quad)
 - (r) Sharp Hall
 - (s) Single RAHP
 - (t) Stacwyck Apartments
 - (u) Warren Hall
 - (v) Other
3. What floor number? (Optional)
 4. What room number? (Optional)
 5. When was the last time you visited this space? (Optional)
 - (a) Less than a week ago
 - (b) Less than a month ago
 - (c) Less then a year ago
 - (d) Less than 4 years ago
 - (e) More than 4 years ago
 6. How often did you visit this space?
 - (a) Once
 - (b) Occasionally
 - (c) Multiple times a week
 7. How confident are you in modeling this space? (scale of 1 to 5)
 8. Does the 3D generated model match your intentions?
 - (a) Matched my intentions exactly (no revision required)
 - (b) Did not match my intentions initially (revisions were required)
 - (c) Failed to match my intentions (even after revision)