OiT: A UX design project for better decision making in generative design

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OiT: A UX design project for better decision making in generative design

BY

Yunsheng Zhou

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Fine Arts in Visual Communication Design

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May 10, 2021
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May 10th 2021
Abstract

New technology, such as AI and Machine learning, grows fast and plays a crucial role in improving efficiency and reducing the repeated working load in our daily lives. In the Architecture and Engineering area, AI is widely used in generative design. Generative design is a design exploration process. The software explores all the possible permutations of a solution, quickly generating design alternatives. However, the problem is that the intelligence systems can generate thousands of solutions that difficult for users to distill. This situation even reduces the efficiency of the working flow. The project's approach is to help users make better decision-making and find the best solution to get benefits from new technology. To solve the problem, I designed the iPad-based application named OiT - One in Thousands. OiT is an application focusing on better support, result evaluating, and data visualization for generative design, the target audience is the structural engineering and industrial designer working in the architecture and engineering area. The goal is to help users clearly define the design made by AI, efficiently ranking and picking the design options to support them better. This project presented an interactive interface and a mockup video showing how it benefits users to make better design decisions.

Keywords

UI/UX design, data visualization, Generative Design, AI, Machine Learning
Context

Problem and solution
The problem happened in the generated design process in the Architecture and Engineering area. New technology, such as AI and Machine learning, was invented in the creative industry to improve working efficiency and reduce the repeated working load. Leveraging the power of AI and machine learning, generative design provides an iterative design process, which is widely used in the industrial design exploration phase. To better define where the problem is, I have the interview with expertise and conduct user interviews to understand the current workflow. The working scenario (Appendix A, page 9) when using the generative design is: user define certain constraints and design goals; then they input the metrics and requirements, the intelligence system will generate a certain number of outputs (usually thousands), users will select specific output from them. The problem in this scenario is that the intelligence system can generate thousands of extremely difficult outcomes for users to distill. As a result, users need to select from thousands of solutions, which takes much time and even reduces the working flow efficiency.

To solve the problem, I designed an iPad-based application data visualization dashboard that helps users with decision-making through objective and subjective sorting in thousands of the generated solutions. This project is presented in an interactive mockup showing how it benefits users to make better design decisions. The goal is to help users clearly define and select the design made by intelligence systems, efficiently rank and pick the design options to support them better. The target audience is the structural engineering and industrial designer working in the architecture & engineering area. OiT - One in Thousands, the application provides an entire scenario from generating design options to select options. The first step is uploading and analyzing the requirements through upload the PDF file or add metrics manually. After that, the system automatically analyzes the requirements PDF and extracts the core metrics. Then, users adjust and prioritize the requirements, design seeds can be generated based on the requirements (Appendix A, page 19). After thousands of the design options are generated by the system, users could check all the design seeds in the dashboard panel. Interactive data chart showing iteration results, data flow, and all design options. Through zoom in, move, lone press the chart, there are multiple ways for the user to interact with the chart to check details and filter the seeds they want (Appendix A, page 22). The first step for decision making is objective filtering. Next, users checked the details of each design seed, filtered out, and selected the options that fit the requirements range (Appendix A, page 25). This process helps users to narrow down the choices they need to make. To further select options within the available range that meet users' needs, subjective decision based on generative iteration is the next step. Based on user-selected seeds, the user could generate a new round of iteration to match subjective decisions better. The new round of iteration generates the new branch based on the users' preferred options (Appendix A, page 27). Finally, when the user eventually narrows down the selection to four or five seeds, they can check the selected options and compare the seeds to make further selections (Appendix A, page 28).

Design process and details
When I was identifying problems and designing, the following process was followed. First, I conducted content analysis to locate the problem and better understand the background of the generative design, including domain research and market research (Appendix A, page 8). Overall, the problem happened in the options analysis process in the generative design, that users are difficult to make decisions in thousands of options. Next is cognitive walkthrough to better understanding the process for decision making and how other products help users explore their design options. The takeaway is: when we filter designs using objective design criteria, such as color, size, cost, we can sift through large number of designs to find some viable solutions, but our subjective needs remain ambiguous. Then, I conduct a competitive analysis to check how existing products help users explore more design
options (Appendix A, page 11). Existing products learn about user preferences by learning from their choices and recommending similarly styled designs to help users figure out what subjective needs they want. After that, aiming to define the product user, I conduct a semi-structured user interview with six expertise in the industry. Finally, define the target audience as the structural engineering and industrial designer (Appendix A, page 12). Also, as a result of the user result, the user journey of making the decisions in generative design is observed (Appendix A, page 13). Based on the design process, I discovered three main points to the project. First, users have clear objective metrics but ambiguous about subjective options. Second, in the selection process, without clear subjective criteria, users repeatedly wander through different design styles, leading to a loss of efficiency. Third, users typically have to filter through a dozen different criteria when screening through design metrics, checking each design solution individually to see if it is within range is very time-consuming.

To solve these problems, the OiT application was prototyped. There are three main steps in this application: upload the requirements, filter design seed by objective filtering and subjective iteration, and compare the selections to make the final decision (Appendix A, page 14). To solve the first point, the application workflow offers a combination of both objective and subjective selection. Users could select their preferred options and then run a new round of design iteration based on their preferred style. Users gradually specify the subjective options that they are looking for. The iterative process guides users' choices and clarifies their subjective needs. Also, in the visual design, I get the idea from different aspects to get the visual cue (Appendix A, page 40), then decide to focus on glassmorphism, indicating that the process of selection is the same feel from ambiguity to clarity. To solve the second challenge, the comparison function was established. After users walk through the objective filtering and clarify the subjective iteration, they could check all the selected design options and design tracks in the chart. By gathering all the preferred options in the chart, users could efficiently compare them without back and force. To solve the third challenge, the interaction of the data diagram and filtering tools was built. I created the interaction map indicating how users could use the gesture to interact with the 3D diagram in the interface (Appendix A, page 34). In the data chart, I also presented a 3D dimensional chart including three metrics on 2D images by the visual language of light and shadow (Appendix A, page 33). By using the multi-dimensional graph, multiple metrics could be displayed at the same time. Users could also filter the objective metrics through the filtering function (Appendix A, page 34). The objective sorting could be conducted efficiently and clearly in the chart by area filtering through the multi-dimensional data chart and filtering function.

To evaluate my design solution, I conducted usability testing with the six interviewees who were interviewed before and then collected the feedback from them. As a result, five of the six gave positive feedback to understand the design seeds better and make the decision (Appendix A, page 44). One of them was confused about grabbing the seed to select, which I have improved the design by adding the visual indication. And 100% of the testers are satisfied with the solution. Overall, the user feedback was collected through user testing to effectively understand whether the problems were solved during the user interview phase. The satisfaction of the solution was investigated through the questionnaire, which measured the feasibility of the solution in all aspects.

**Conclusion**

Through the research and design process, I successfully solved the problem that operators are extremely hard to pick up from thousands of generated objective solutions. The main three project goal is to help user clarify the subjective need in the generative design; improve the efficiency when users making decisions in different design track; reduce users' cognitive load in filtering a large number of design options. The OiT application achieved the goal and provides objective filtering and subjective decisions for operators to clarify the design seed they want and improve the efficiency through interactive data diagrams when user filtering and making decisions. As a result, this project has effectively helped improve the efficiency of the generative design workflow, significantly reducing the time needed to select solutions.
Appendix A

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1. Overview | Page 3-4  
2. Research  | Page 6-15 
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Overview
Intelligence system generated thousands of solutions that are difficult for users to distill.

I want a chair that supports 300 pounds, costs $500.

Here are 1000+ options.
OiT - solution for better decision making

An iPad-based data visualization dashboard helps users with decision-making through objective and subjective sorting in thousands of the generated solutions.
Research
2.1 Domain research

What is generative design

Generative design is a design exploration process. Designers or engineers input design goals into the generative design software. The software explores all the possible permutations of a solution, quickly generating design alternatives. It tests and learns from each iteration what works and what doesn’t.
2.1 Market research

Generative design market

It grows fast and plays a crucial role in improving efficiency and reducing the repeated working load in our daily lives. AI funding projections paint a $46 billion spending spree by 2020. Personal gadgets, manufacturing, media streaming gadgets, smart cars, and home appliances use this high technology.
2.1 Problem research

Where is the problem in generative design?

Design exploration process when assisting with generative design

- Define goal
- Input requirements
- System generated design seeds (1000+)
- Analyze and pick generated options
- Tests and learns from generated options
- Select a few options to polish

Problem

Intelligence systems can generate thousands of solutions that difficult for users to distill.
Goal

Help users make decisions from thousands of generated design options.
2.2 PHASE I - cognitive walkthrough

When I'm looking for a suitable reference image...

**Step 1**
Define requirements
- e.g. "Poster with dark background"

**Step 2**
Collect images based on requirements
- Collected from: Pinterest, Behance

**Step 3**
Screen and clarify the style I am looking for
- Filtering based on: Requirements, beauty, sense, style...

**Step 4**
Check more images in the same style
- Image recommendation algorithm, ML, Advanced search

**Step 5**
Filter and rank to make the decision
- Filtering based on: Style, beauty, clarity, accessibility, continuity...

**Competitive analysis**
How do these platforms help users find the ideal images?

- **Pinterest**
  - Image classification/collection
  - Key word search
  - Recommendation based on preference
  - Image board based on user collection

- **Behance**
  - Design classification
  - Collection based on author
  - Advanced search
  - Recommendation

- **Dribbble**
  - Image classification
  - Advanced search
  - Recommendation based on selected image

- **Same.energy**
  - Filtering based on selected image
  - Recommendation based on collection
  - Advanced search
  - Image classification
2.3 PHASE II – about our user

When our users selecting the generated designs...

**Product development engineer**
- Age: 25-50
- Education: College BS/MS
- Work experience: >5 years
- Work environment: Office, factory
- Equipment: Computer, tablet
- Technology: Learn new technologies quickly

**Structure engineer**
- Age: 25-40
- Education: M.S. computer science
- Work experience: <5 years
- Work environment: Office
- Equipment: Computer, tablet
- Technology: Pioneer of new technologies
2.3 PHASE II – current workflow

When our users selecting the generated designs...

- **Objective**
  - Model characteristics, input parameter, requirement range, input data, requirements...

- **Subjective**
  - Experience-based intuitive decision
  - Subconscious mental processing
  - Affect-initiated decisions
  - Decisions based on personal or company values or ethics

**Iterate from the selected track**

- **Objective**
- **Subjective**

- **Filter**

**Iterate to find the best**

- Number of design alternatives: <= 10

**Filter out the track they want**

- Number of design alternatives: > 10

- Narrow down from 1000 to 10

**Filter**

- Focus on some of the options and iterated to check more related options
How OiT works to help make decisions?

1. **Upload the requirements**
   - Upload design documents → System keywords analyzing → Select Key metrics → Input/adjust requirements details → Click to start AI generating → System generated design seeds (1000+)

2. **Filter design seeds**
   - Filter the seeds based on the metric range → Browse several options in the top ranking → Check one branch of design → Review the detail/model of design seeds → Click like/dislike on the single solution → Generate another round of design iteration based on your likes

3. **Compare to make final decision**
   - Check the seeds liked (2-3 options) → Click compare button → Select key metrics → Ranked the metrics → Check the comparison results → Check details of comparison → Explore more
2.4 Research result – OiT workflow

How OiT works to help make decisions?

“I love this four track, they all make sense, can I see more?”

“I love S108, can we explore more regard S5 and S108?”

“S204, S208 is also good.”

“Let’s selected from these three.”

1,125 Seeds
03 Design details
Design process

- Topic Research
- Concept Development
- Trends/Competitor
- Concept Solution
- Writing Abstract
- Visual & Interaction Ideation
- Design Iteration
- User Flow & Wireframe
- Interface Design
- Motion & Animation Design
- Writing Thesis
- Design Pitch
- Final Design & Presentation Deck
- Mockup Animation

03 Design details - timeline
OiT - solution for better decision making

1. Upload the requirements

- Upload design documents
- System keywords analyzing
- Select Key metrics
- Input/adjust requirements details
- Click to start AI generating
- System generated design seeds (1000+)
03 Design details – step 1

Requirements clarification

The system automatically analyzes requirements PDF and extracts the core metrics. Users adjust and prioritize the requirements, the design seeds can be generated based on the requirements.
03 Design details – step 1

Requirements clarification

1. Control handle
   Hover the mouse on the handle and drag to change the prioritize of the metrics.

2. Slider control
   Change to edit the number of the metrics in the range.

3. Upload new files
   Add and upload new PDF files to generate design metrics.

4. Input new metrics
   Manually input the design metrics and number range.

5. Number input box
   Manually input or edit the number in the box.
Objective filtering based on metrics

Filter design seeds

1. Filter the seeds based on the metric range
2. Zoom in to check region
3. Long press to check range data
4. Zoom in to check the seeds in the region
5. Switch to 3D diagram
6. Check seeds details

Check seeds details

- Circle the seeds that in a suitable range
- Selected these seeds
- Zoom out to back to region view
03 Design details – step 2

Objective filtering based on metrics

Interactive data chart showing iteration results, data flow, and all design options. Checked the details of each design seed. Filtered out and selected the seeds that fit the requirements range.
Objective filtering based on metrics – region page

1. **Toolbar**
   - Function bar of requirements, generated seeds, selected seeds

2. **Design ranking**
   - Scrolling display of the top five design solutions with the highest range

3. **Design seeds model view**
   - Show all design models, drop down window to expand pop-up

4. **Seeds region data chart**
   - Presenting the iteration, data flow, seed region, region ranking, seeds ranking

5. **Generate a new round of iteration**
   - Click to create a new round of iteration based on the selected/preferred design seeds
Objective filtering based on metrics – data diagram
Objective filtering based on metrics – seeds page

1. Objective filter by metrics
   Filtered out and selected the seeds that fit the requirements range

2. 3D seeds graph
   Showing the distribution of all seeds under the three dimensions of load, cost, MU

3. 2D & 3D toggle
   Switch the graph from 2D to 3D to check the distribution of seeds

4. Seeds ranking
   Display the corresponding data of the top seeds in the group. Scroll through the top three seeds

5. Heatmap
   Showcasing the seed areas with the best overall data in the region
Subjective decision based on generative iteration

1. Selected the seeds in the top rank
2. Connect selected regions
3. Generate another round of iteration
4. System generate options based on selection
5. Check & pick option in the new round
Subjective decision based on generative iteration

Based on user-selected seeds, generate a new round of iteration to a result that better matches subjective decisions.
Subjective decision based on generative iteration

1. **Objective filter by metrics**
   Filtered out and selected the seeds that fit the requirements range

2. **Selected seeds region**
   Highlighting the seeds/region that user had selected when browsing

3. **Iteration data flow**
   Showing the rationale options for a new design iteration with the data flow

4. **Iterations notification**
   Showing total number of iteration rounds, with emphasis on the latest iteration performed

5. **Scroll bar**
   Moving to the left to see the history of past iterations
03 Design details – step 4

Compare among the selected seeds

After users selected the seeds that they preferred based on objective filtering and new rounds in the iteration, they can check the selected options and compare the seeds to make further selections.
Design iteration - sketches
03 Design details - iteration

Design iteration – data page

- Basic dashboard page layout
- Information flow diagram mockup

Wireframe 1.2

- Basic dashboard page layout
- Iteration view (3D visual system) of the chart

Wireframe 3.1

- Glassmorphism visual style
- Glass bubble visual system enhance the group system
- Interactive pop-ups rather than flat layout

Final version
Design iteration – data visualization

- **Bar chart**: Only show the scale of two dimensions, more proportional needed for making decisions.

- **Satellites diagram**: Multiple dimensions, but circular distributed compositions are less readable.

- **Tree diagram (3D)**: 2D and 3D switched views provide a full range of dimensional comparisons, using tree diagrams to show the transfer and iteration of data.
Design iteration – data visualization
03 Design details - wireframe

Interaction map

- Click to close the window
- Click to back
- Automatically display the clicked-in group view for a group zoomed in more than 200%
- Click the seed check detail
- Click the seed check detail
- After selecting your people seeds, draw lines connect between them for the next round of iteration
- Three fingers to move chart
- Swipe right to bring up the ranking popup window
- Pull down to show more details
- Drag to check more people model view
- Click into the group
- Drag to check more people model view
- Pull down to show more details
- Drag to check more people model view
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- Three fingers to move chart
Interaction map

1. Homepage
   - Swipe right to bring up the ranking popup window
   - Three-finger to move chart
   - Swipe left to bring up the model popup window
   - Zoom in
   - Zoom out

2. Design seeds
   - Swipe to change region
   - Press to check details
   - Long press to select

3. Subjective iteration
   - Swipe to move chart
   - Swipe down to compare selected seeds
   - Swipe four fingers to add a round of iterations based on current selection
Wireframe

- Requirements page
- Metrics page
- Loading page
- Generated seeds page - ranking
- Generated seeds page
- Generated seeds page - seeds model
Wireframe

Generated seeds page

Region range data

Seeds in the region

Range selection

3D data chart - filter

Seed detail
03 Design details - wireframe

Wireframe

Range selection

3D data chart - filter

Seed detail

Generated seeds - seeds selected

Selected seeds page

Compare page
Interface design
Visual language

Bubble Glassmorphism

From ambiguity to clarity
Visual system

01. Color palette

02. Typography

- **Large Title**: Circular Std Bold 20pt #EDEDE9
- **Title 2**: Circular Std Medium 24pt #EDEDE9
- **Title 3**: Circular Std Medium 20pt #EDEDE9
- **Headline**: Circular Std Bold 17pt #EDEDE9
- **Headline**: Circular Std Bold 17pt #EDEDE9
- **Body**: Circular Std Book 16pt #EDEDE9
- **Caption**: Circular Std Book 14pt #EDEDE9

03. Iconography

04. Grid system
03 Design details - visual

Visual system – Logo design
04
Evaluation
**04 Evaluation**

**Evaluation through testing**

*Participants S.*

“Love the visual language of bubbles to communicate the grouping system.”

*Participants M.*

“I can clearly see that it has rankings for me to quickly understand which option is the best.”

*Participants L.*

“The objective and subjective filter process works well to help me clarify what kind of solution I want.”

Users have a better understanding of the design seeds and make the decision

Satisfaction of the new solution

---

Yunsheng Zhou – OiT Process Deck
Conclusion
Through the design process, I successfully solved the problem that operators are extremely hard to pick up from thousands of generated objective solutions. Through designing and prototyping the iPad-based solution, OiT application helps designers make a better decision in thousands of the generated options. OiT application provides both objectives filtering and subjective decision based on generative iteration for operators to clarify the design seed they want. In summary, this project innovational solved the problem. A new visual language was tried to communicate to the user how to make better choices.
Appendix B: Bibliography and References


