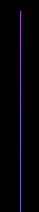


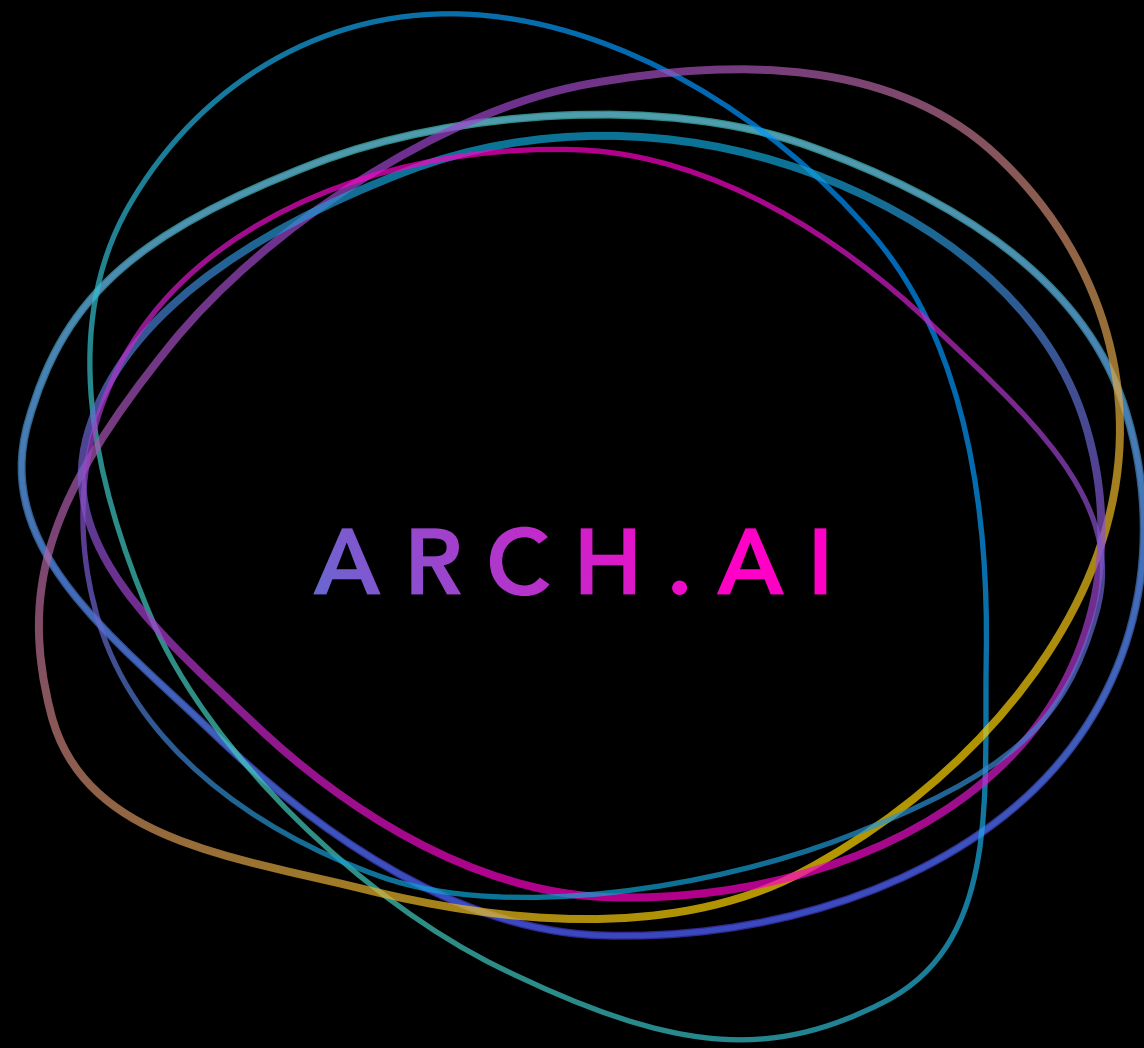
ARCH.AI

HUMAN-AI INTERACTION



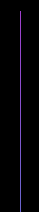
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SASHANK MACHARLA



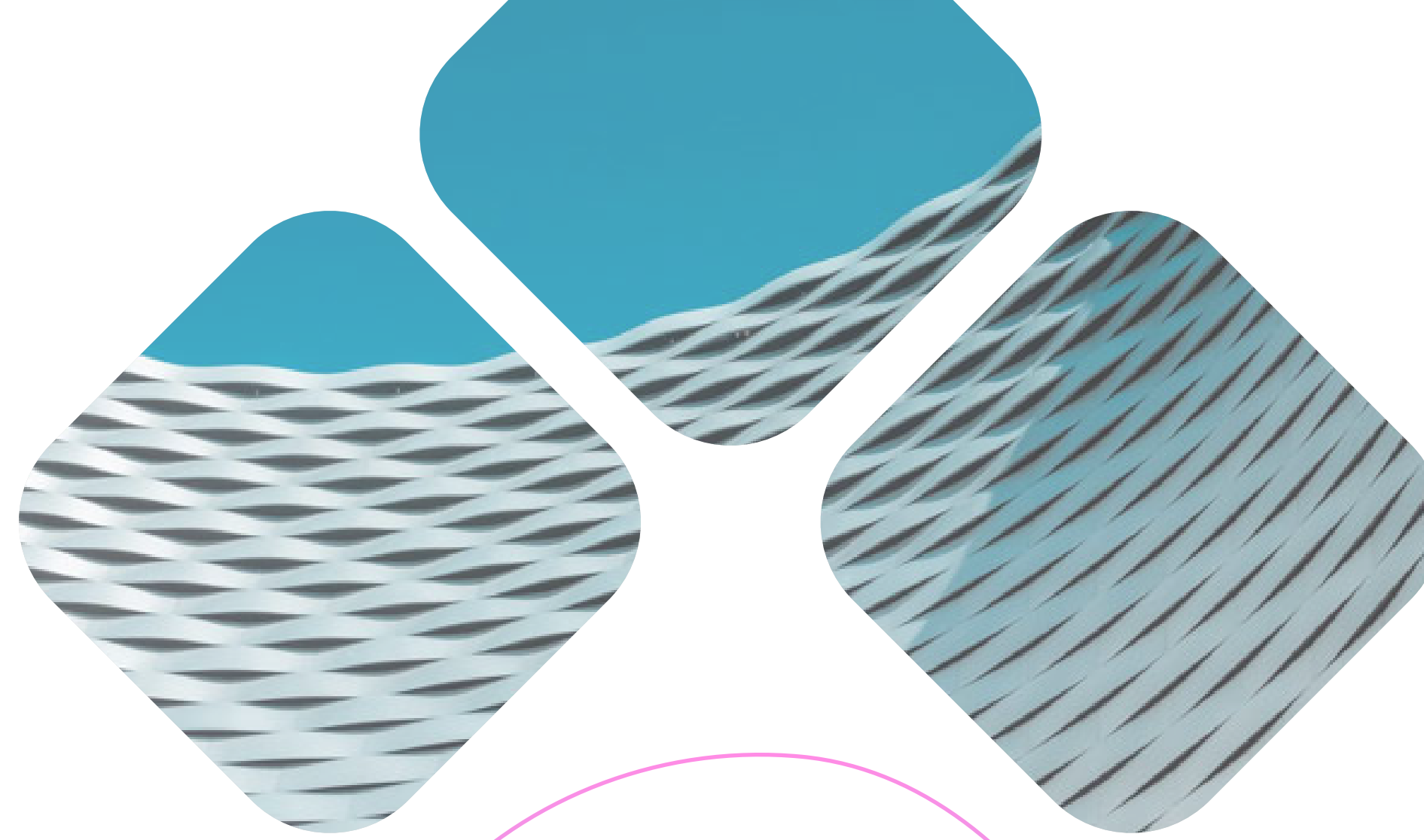
ARCH.AI

HUMAN-AI INTERACTION



12.07

SASHANK MACHARLA



**AGENDA**

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**PROBLEM  
INTRODUCTION**

**RESEARCH &  
ANALYSIS**

**DESIGN  
DEVELOPMENT**

**VALIDATION &  
FURTHER WORK**

# PROBLEM INTRODUCTION



## Barriers in Architectural Design ideation

When designing a building, there are too many interrelated variables, styles, choices and consequences to keep in mind for the architect. This usually is said to come only with experience, and it results in a large time and effort delays in the design process in architecture.

## Barriers in Architectural Design ideation

1

*Limited access to large teams and diversity*

2

*Lack of awareness of suitable materials*

3

*Energy costs, sustainability at scale*

4

*Safety*

## PROJECT OVERVIEW

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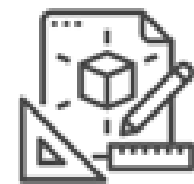
This project is an attempt to fill in the gaps in architectural ideation by using AI to generate design ideas that fulfill custom parameters, and are consistent with a selected architectural design style. This AI system also conforms to the human - AI Interaction factors that were discussed throughout the course. The project can be divided into 4 major phases as below:

1



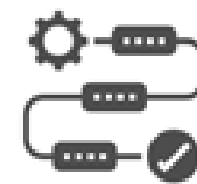
Research

2



Design

3



Iteration

4



Validation





## EXISTING WORK

Application of AI systems in architecture has been done before, and while most of it is in the realm of construction and management, there are a few explorations done, particularly in the field of data science, towards generative design and AI in architectural design process.

### **Towards a generative system for intelligent design support**

*JH Frazer et al, Talks about genetic algorithms for early stage design tasks*

### **Framework for integrating AI with architectural analysis**

*K Merrick et al, Uses flow based design process with variational dequantization*

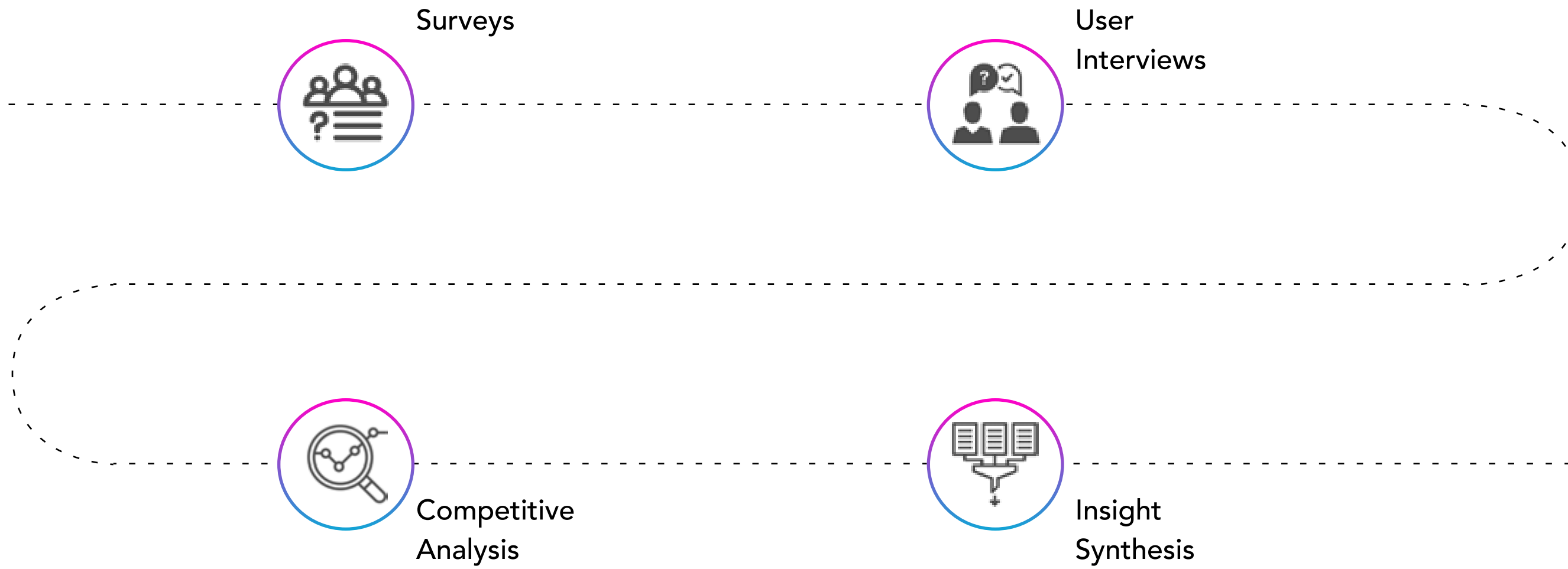
### **Deep design: Integration of topology optimization & design**

*MX Tang et al, talks about user interaction model based on grammar design systems.*

### **Simulation based decision support in architectural design**

*J Basilakis et al, talks about why most tools have not yet trickled down into the architecture community*

# RESEARCH METHODOLOGY





## SURVEYS

The survey was sent out to understand the common issues different users face when ideating during architectural design and what they thought could benefit their own process the most. The big findings were as below

*66% of users wished their tools would play a more active role in the design process*

*80% of users felt more than 50% of their work was manual and can be automated*

*42% of users said they would like to work with an intelligent design tool to brainstorm initial ideas*

**Survey responses**  
*The survey was sent to architect friends and associates who shared it in their own networks*

53

**Participants shortlisted for interviews**  
*Based upon their responses and availability, 8 participants were shortlisted for user interviews*

8

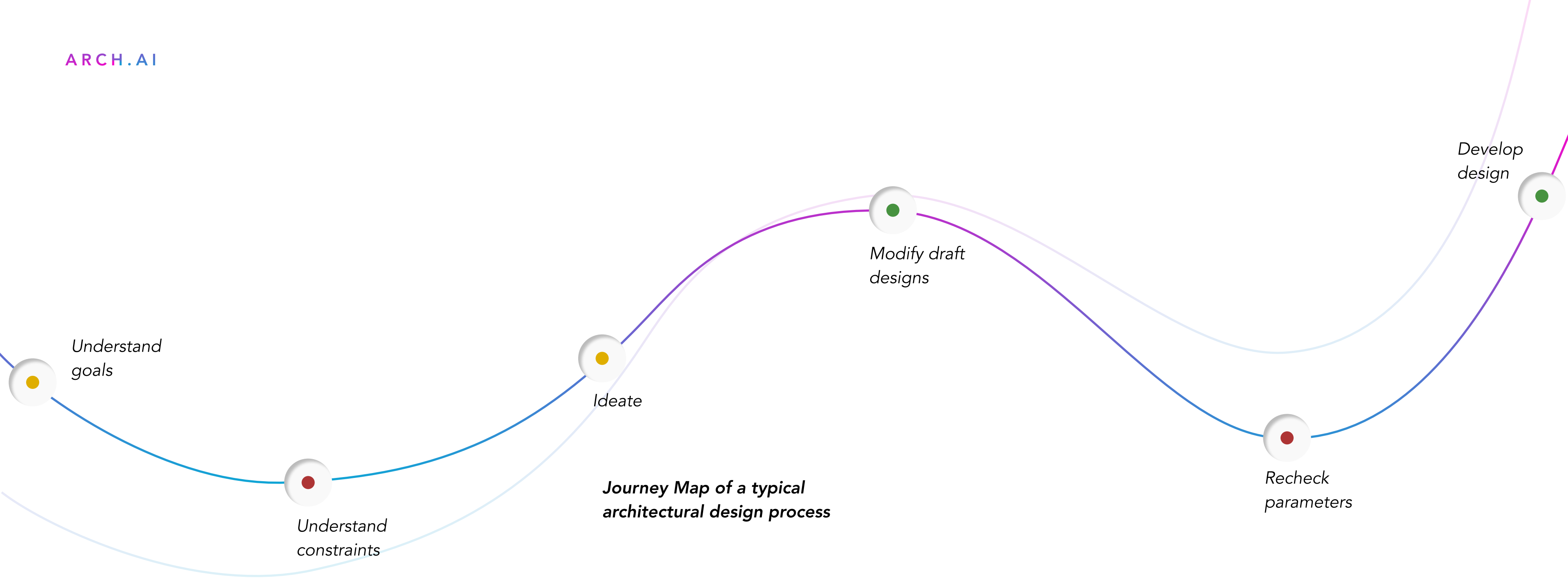
**User types**  
*The interview participants included 4 practising architects, 2 Students and 2 Educators, for use case diversity*

3

## COMPETITIVE ANALYSIS

To identify gaps and shortcomings in the products already in the market, I conducted a competitive analysis for the 3 most popular applications used in architectural design and ideation and filtered them through some of the features that users mentioned they used the most in the surveys.

	Revit Architecture	Climate Consultant	Rhinoceros
Design Suggestions	✓	✗	✗
Generative Design Assistance	✗	✗	✓ <i>(Supports Algorithmic design though grasshopper plugin)</i>
Design Style recognition/Analysis	✗	✗	✗



*Journey Map of a typical architectural design process*

## USER INTERVIEWS & SYNTHESIS

From the 22 participants who mentioned they were interested in using an intelligent application to help with their architectural design process, I chose 8 people for my interviews, spanning 3 different use cases in the architecture industry.

## INSIGHTS & DESIGN POINTERS

---

01

Users need to quantify and organize design styles for scaled use

02

The application should manage conformity to design parameters

03

Users should be able to mix and match design styles across projects

04

Feedback for the AI needs to be intuitive and familiar

05

Simplicity is vital. Dont aim to do everything in one application

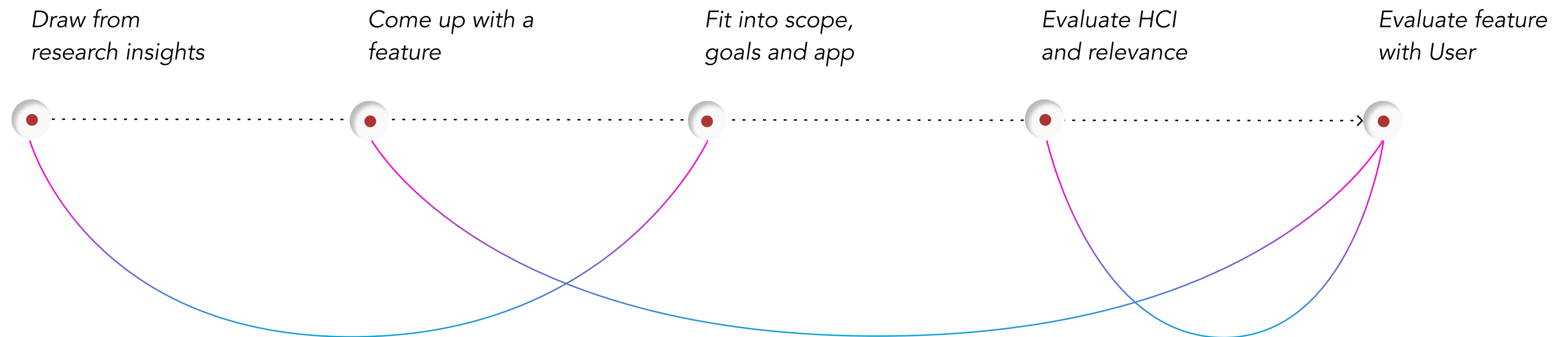
06

Enable the user to focus on creative work like design and style

**DESIGN & DEVELOPMENT**

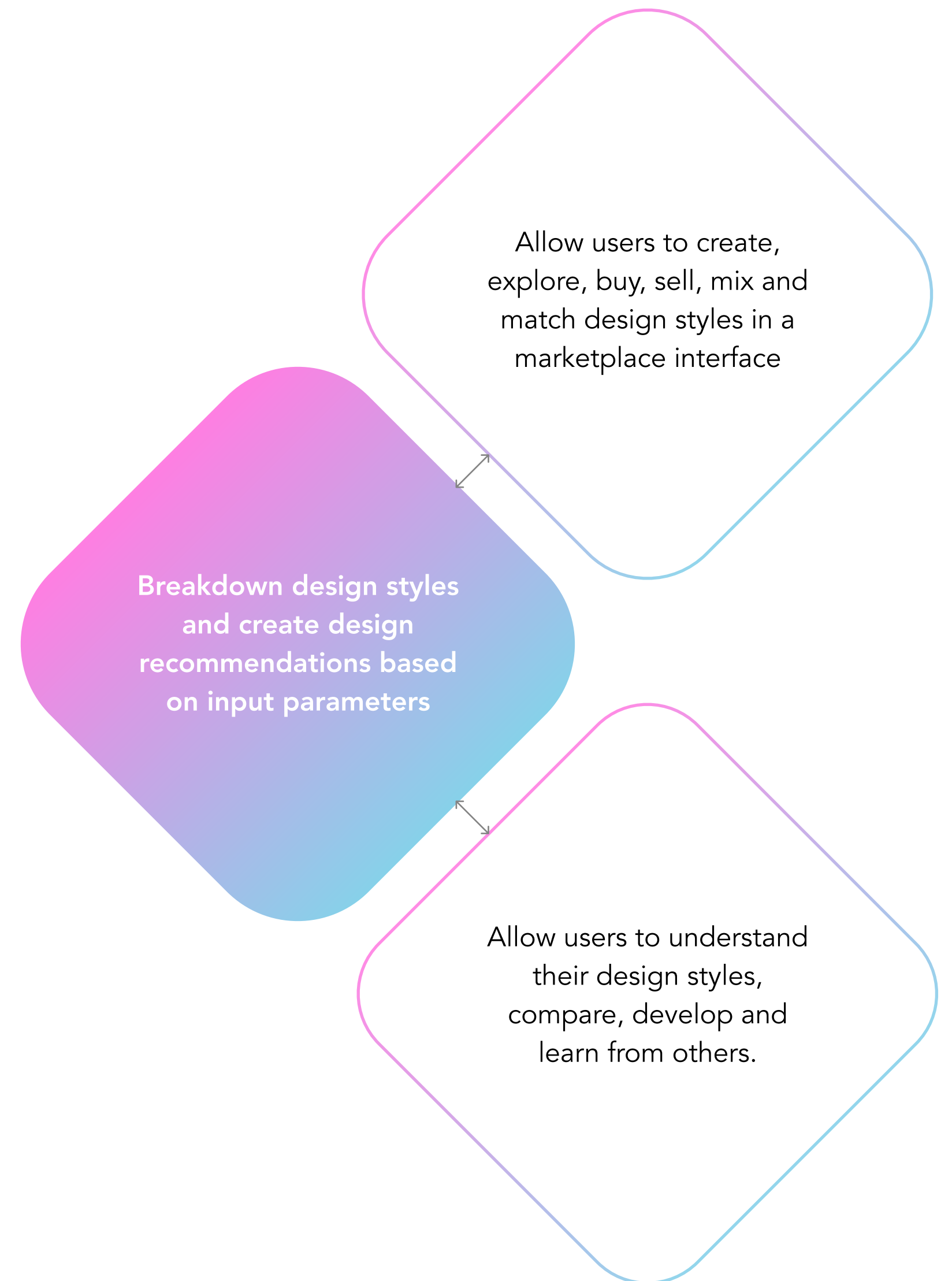
## DESIGN PROCESS

The design process of the app itself followed a loose structure as outlined below, but there was a lot of parallel work that involved multiple steps at the same time. The overall challenge was to come with with a relevant feature that both satisfied the HCI factors and fell within the scope of the app, while being relevant and useful to the users.



## FEATURES

- Breakdown, quantify and explain any architectural design style
- Generate design recommendations from parameters
- Ideate designs in chosen design styles
- Search, adapt and mix popular and custom design styles
- Be explainable to the user
- Choose and sell design styles in a marketplace



## USE CASES & SCENARIOS

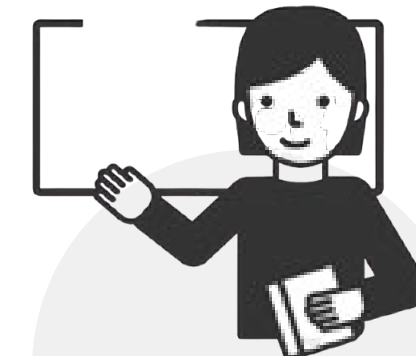
To explain the features and functionality of the application, I decided to walk the users through 3 different scenarios, each pertaining to a specific user and use case. These three would touch upon all the features and functionality of the app between them.



Architecture  
Student

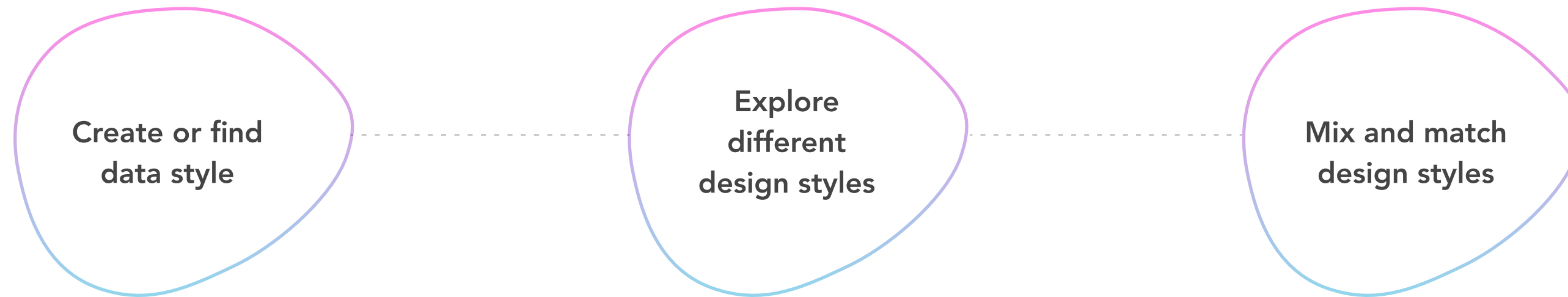


Architecture  
Professional



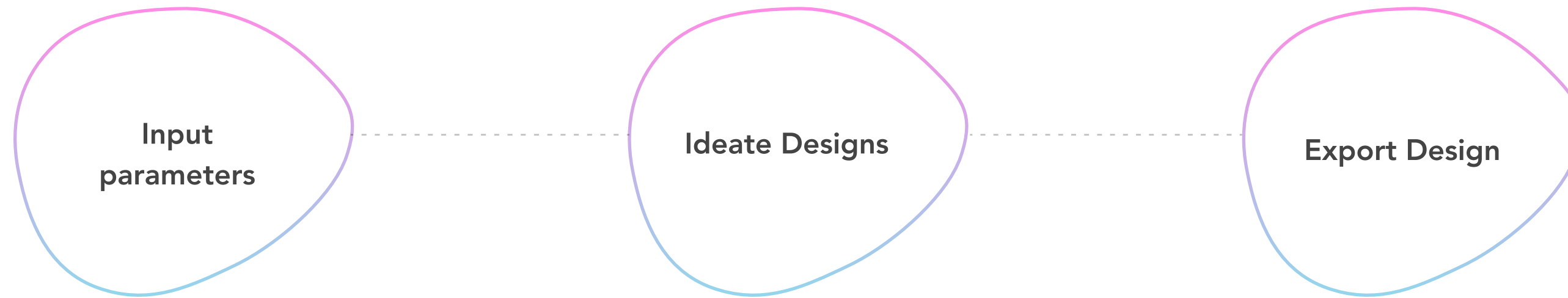
Architecture  
Researcher





**USE CASE 1:**  
**Architecture**  
**Student**

Students are in the process of developing their own individual designs style, and would greatly benefit from exploring other design styles, understanding them, and essentially playing with them to see how they work and what makes a good architectural design style.



**USE CASE 2:**  
**Practising**  
**Architect**

Practising architects often need to generate a large number of ideas in a short time. Replicating a consistent visual style is vital to establish the practice's identity as well. This would be the flow in this use case -



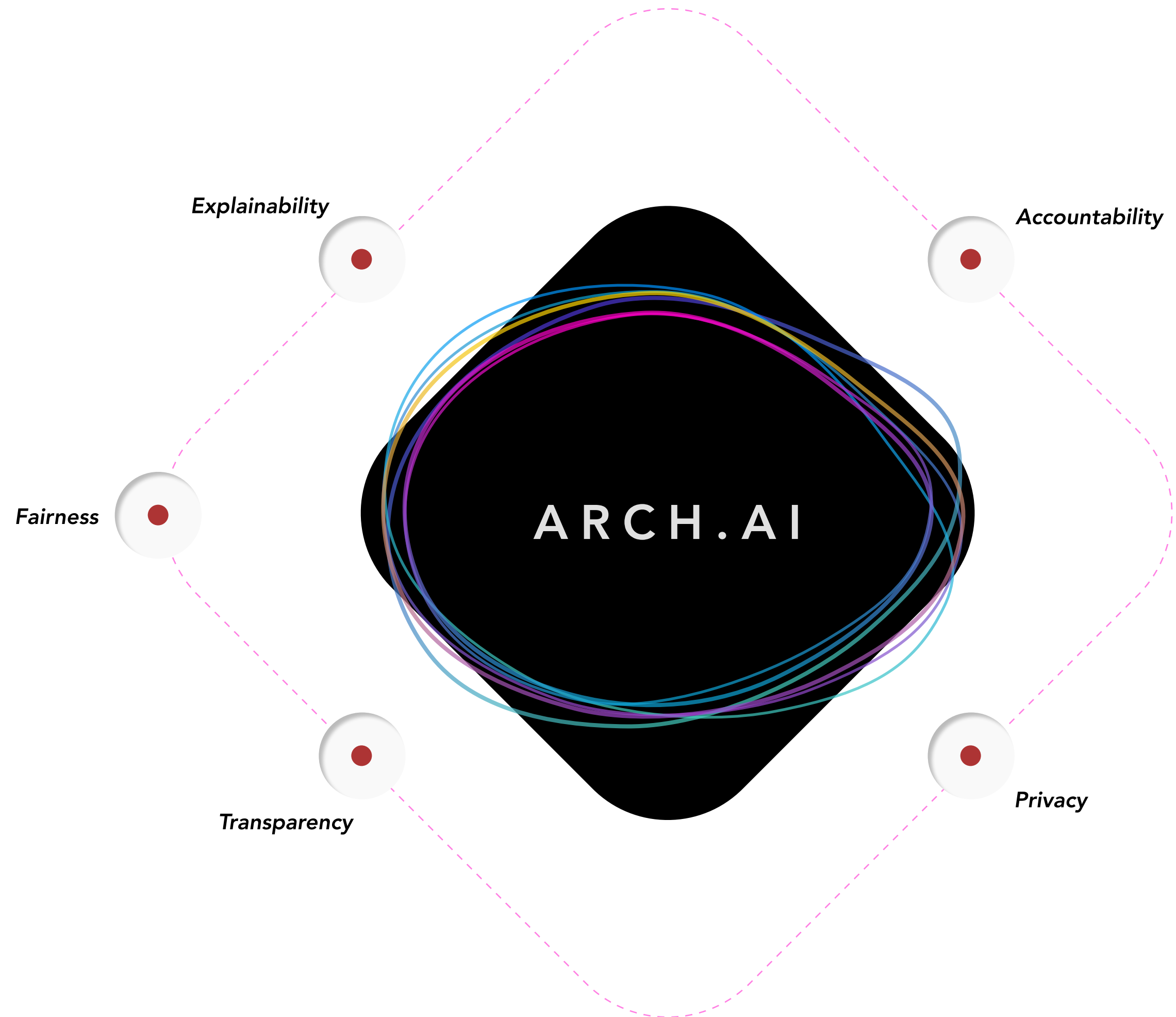
**USE CASE 3:**  
**Researchers /**  
**Instructors**

Researchers are driven by finding out what makes some design bad and some other design great. They require a very granular level of understanding into what makes good design work, and how this can be replicated across instances, and how it changes and evolves over time.

## HAI FACTORS

The application has to maintain the Human AI Interaction Standards to function effectively. These are the various HAI factors that have been addressed in the design of the app.

Inclusion of these factors is essential for the scaling and proper functioning of this application within the larger framework of AI driven systems in the industry.

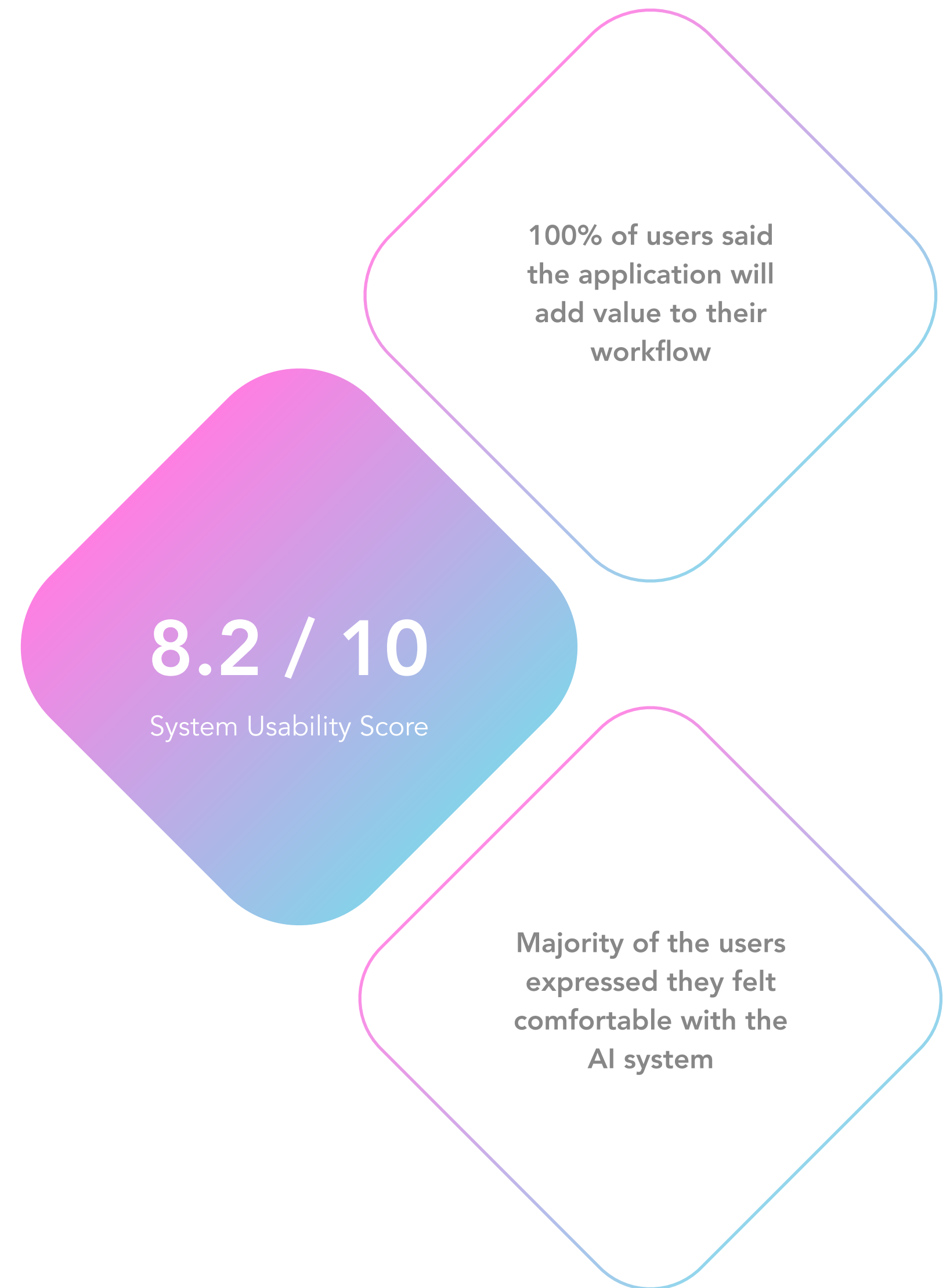




## EVALUATIVE RESEARCH

After the working prototype of the design has been done, I showed it to some of the same users I had interviewed to ask about their thoughts on the app.

Here are the findings from this usability test as part of the evaluative research



## FURTHER WORK

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This project for this class was limited in its scope and time availability. However, given more time, these are the further works that I would have undertaken to steer the design further and aid in the development of the application.

### **Validate usability with more users**

*Based upon their responses and availability, 8 participants were shortlisted for user interviews*

### **Incorporate adaptive learning into the app**

*Based upon their responses and availability, 8 participants were shortlisted for user interviews*

### **Gather more datasets on design styles**

*Based upon their responses and availability, 8 participants were shortlisted for user interviews*

### **Allow users to sketch inside the application**

*Based upon their responses and availability, 8 participants were shortlisted for user interviews*





