Engineering Art

SDMAY23-04

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SDMAY23-04

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Project Overview: Engineering Art

Create an interactive art exhibit displaying the potential of a future in engineering

The Design Process
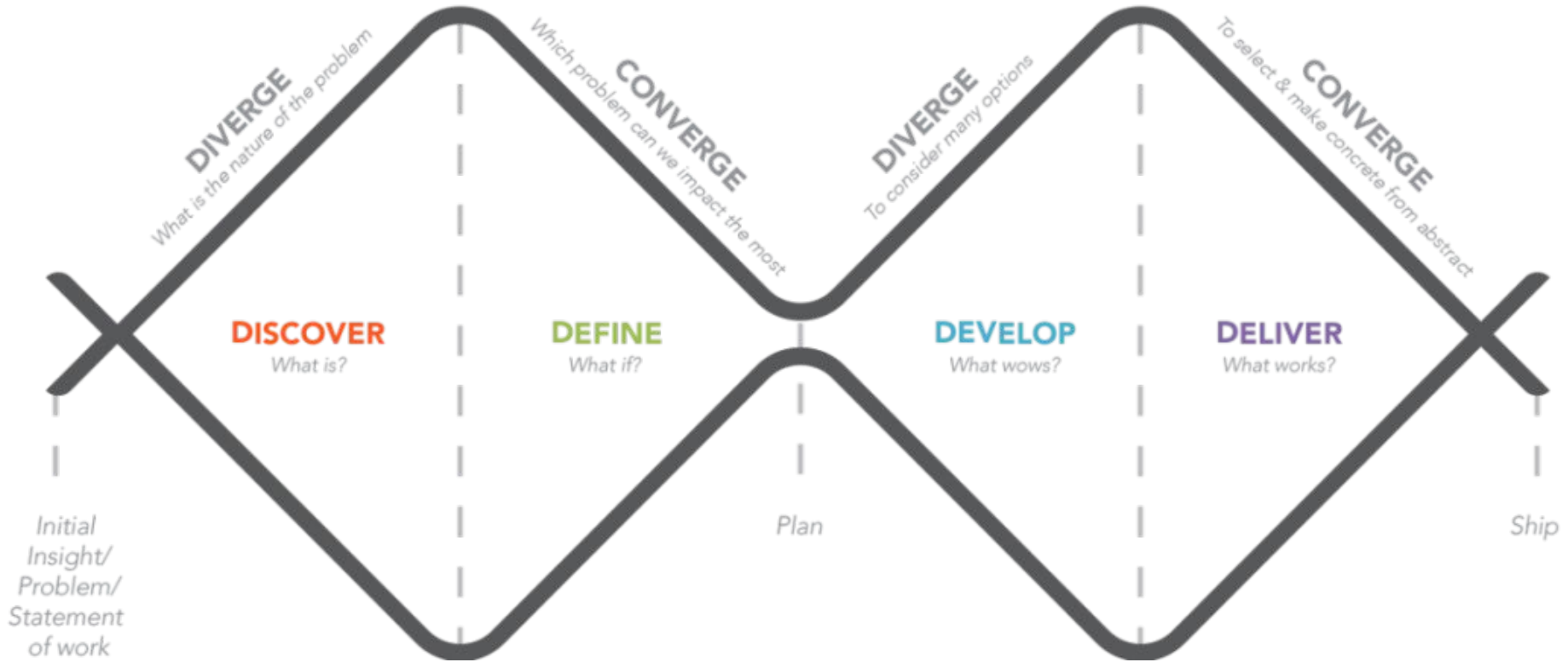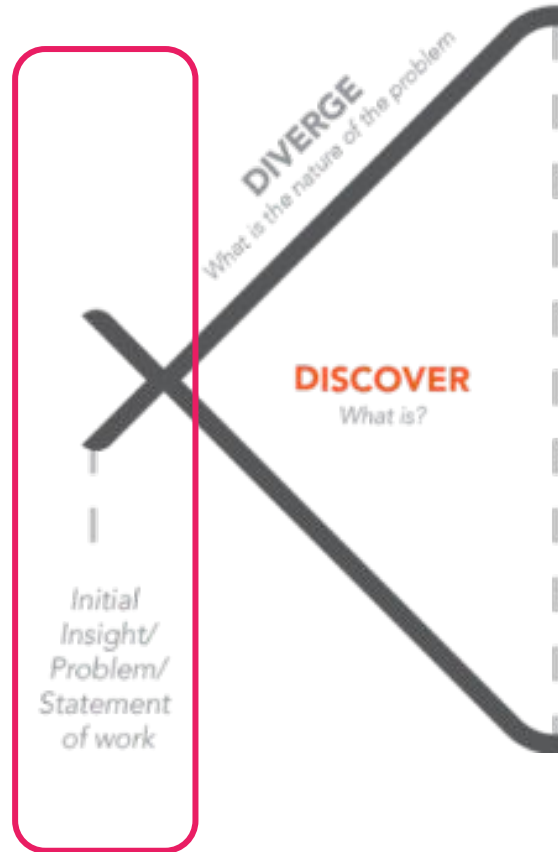
Design Thinking 'Double Diamond' Process Model

DIVERGE — What is the nature of the problem

CONVERGE — Which problem can we impact the most

DIVERGE — To consider many options

CONVERGE — To select & make concrete from abstract

DISCOVER — What is?

DEFINE — What if?

DEVELOP — What wows?

DELIVER — What works?

Initial Insight/ Problem/ Statement of work

Plan

Ship

Image from: https://www.redspark.io/double-diamond-o-que-e-e-como-usar/

Initial Brainstorming

Initial Brainstorming

DIVERGE

What is the nature of the problem

DISCOVER

What is?

Initial
Insight/
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Statement
of work

Initial Brainstorming: 21st Century Engineering Challenges

![NAE Grand Challenges for Engineering: Advance Personalized Learning, Enhance Virtual Reality, Engineer Better Medicines, Restore and Improve Urban Infrastructure, Provide Access to Clean Water, Manage the Nitrogen Cycle, Develop Carbon Sequestration Methods, Prevent Nuclear Terror, Make Solar Energy Economical, Reverse Engineer the Brain, Advance Health Informatics, Secure Cyberspace, Provide Energy from Fusion, Engineer the Tools of Scientific Discovery](image)
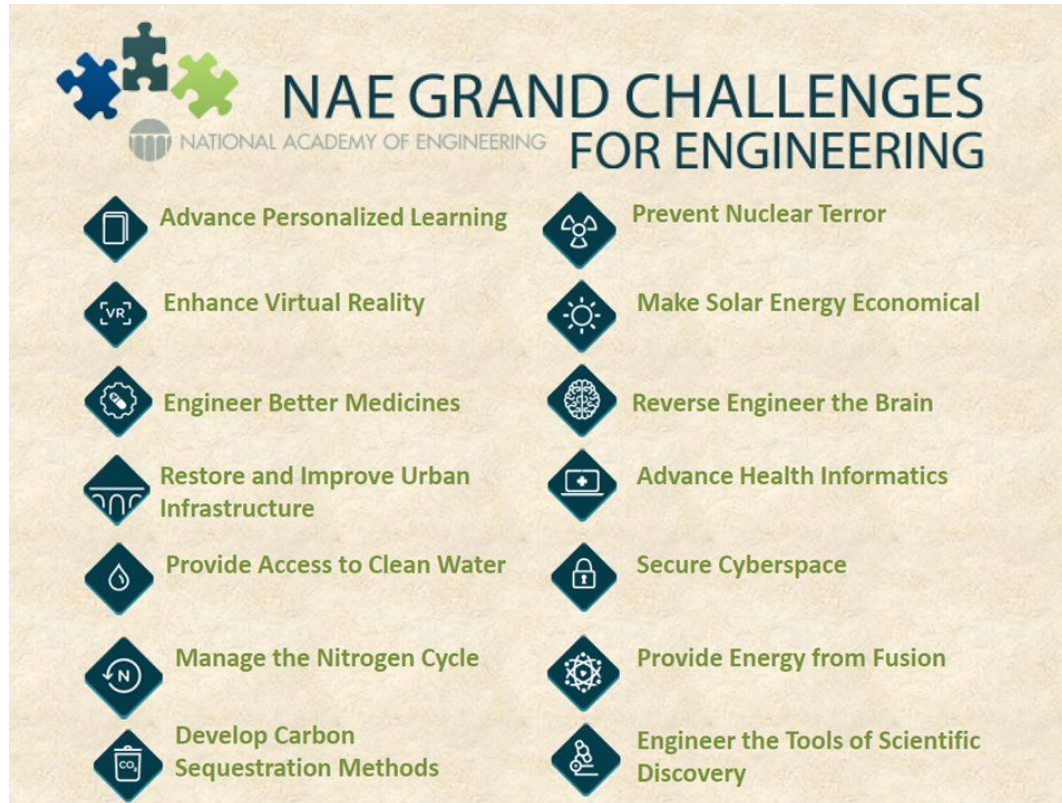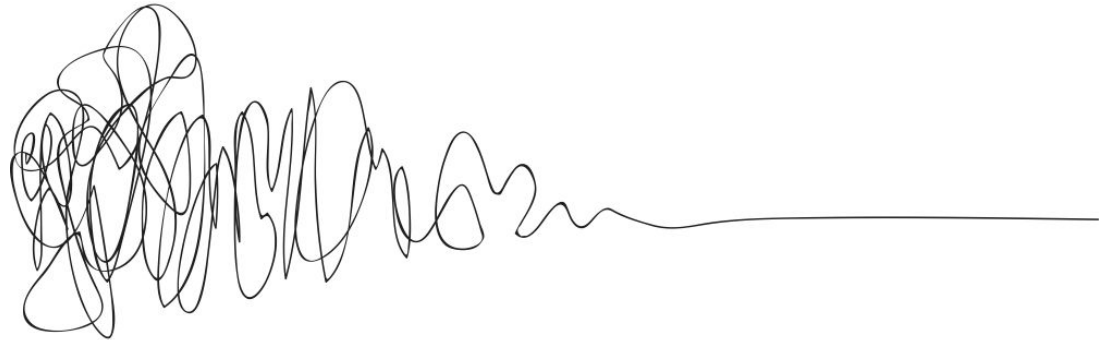
Image From

Initial Brainstorming

- 21st Century Engineering Challenges
- Whiteboarding
- Design Scribble

Noise / Uncertainty / Patterns / Insights   Clarity / Focus

Research & Synthesis   Concept / Prototype   Design
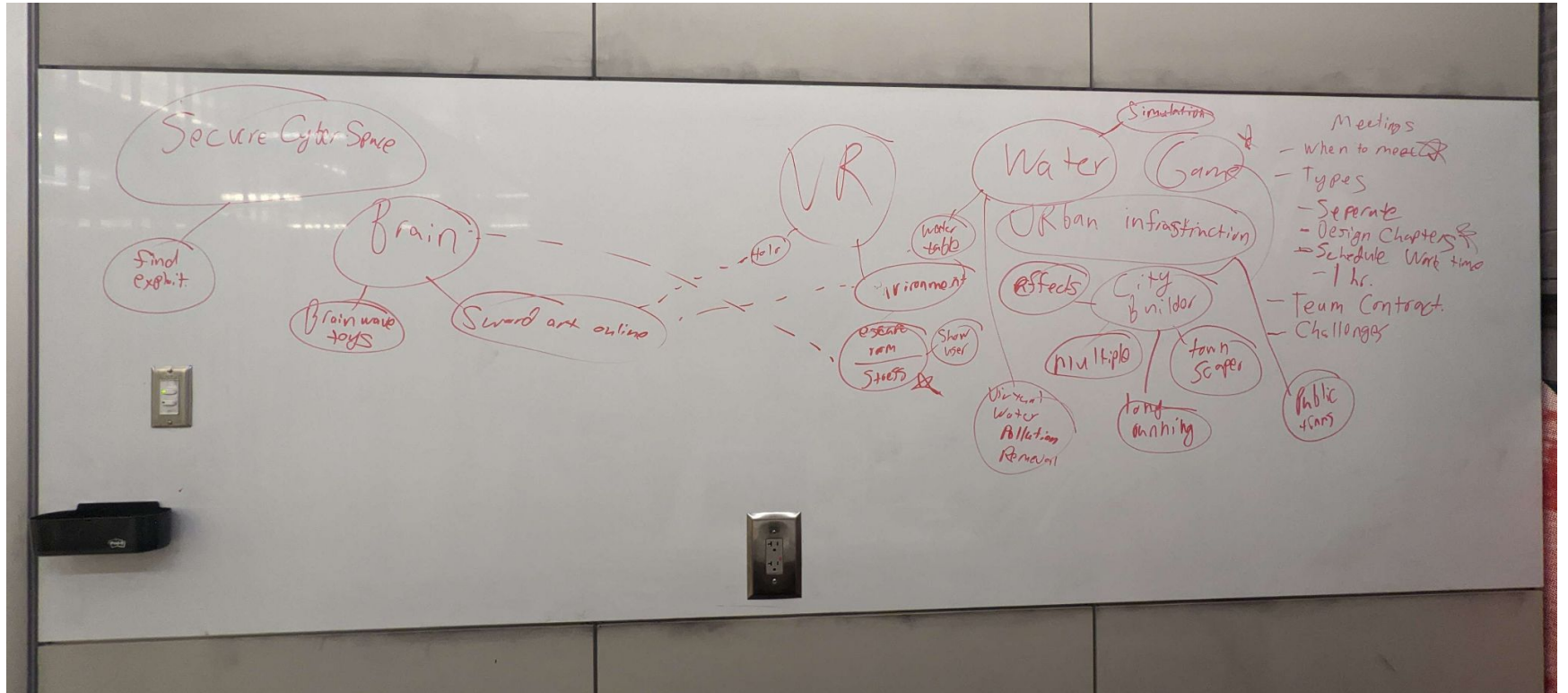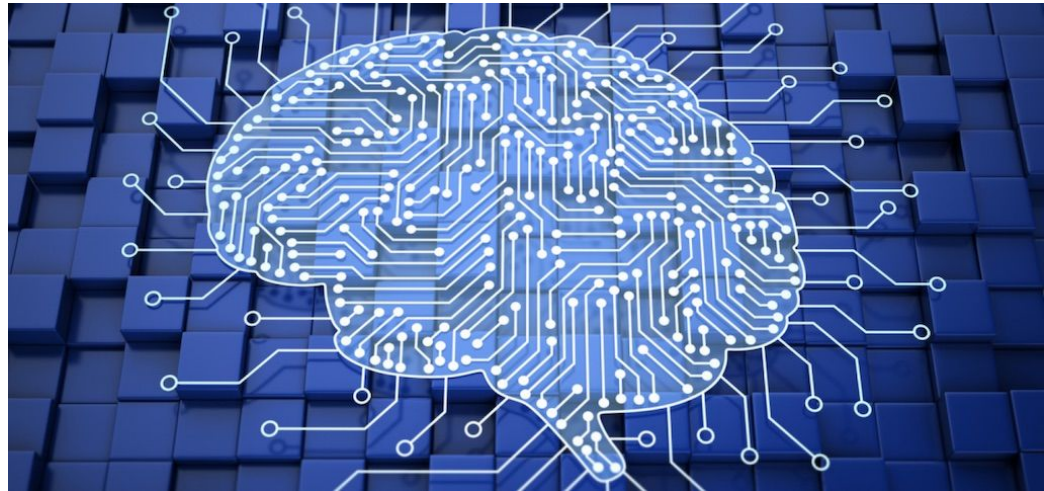
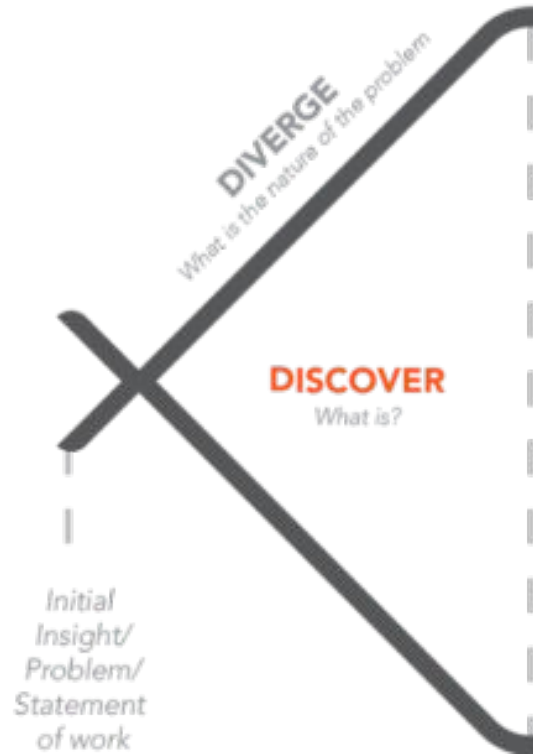Image taken from our initial brainstorming session

What is Reverse Engineering the Brain Challenge?

- Why you should reverse engineer the brain?
- What are the applications of this information?
- What is needed to reverse-engineer the brain?

Discover

Discover Phase

DIVERGE
What is the nature of the problem

DISCOVER
What is?

Initial
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Primary Research

- Interviews with experts in different related fields (Machine Learning, Virtual Reality, etc)
- Fields ranging from Engineering to Biology
- Museum visits
- Interactive displays on campus

Design Interactive Exhibit

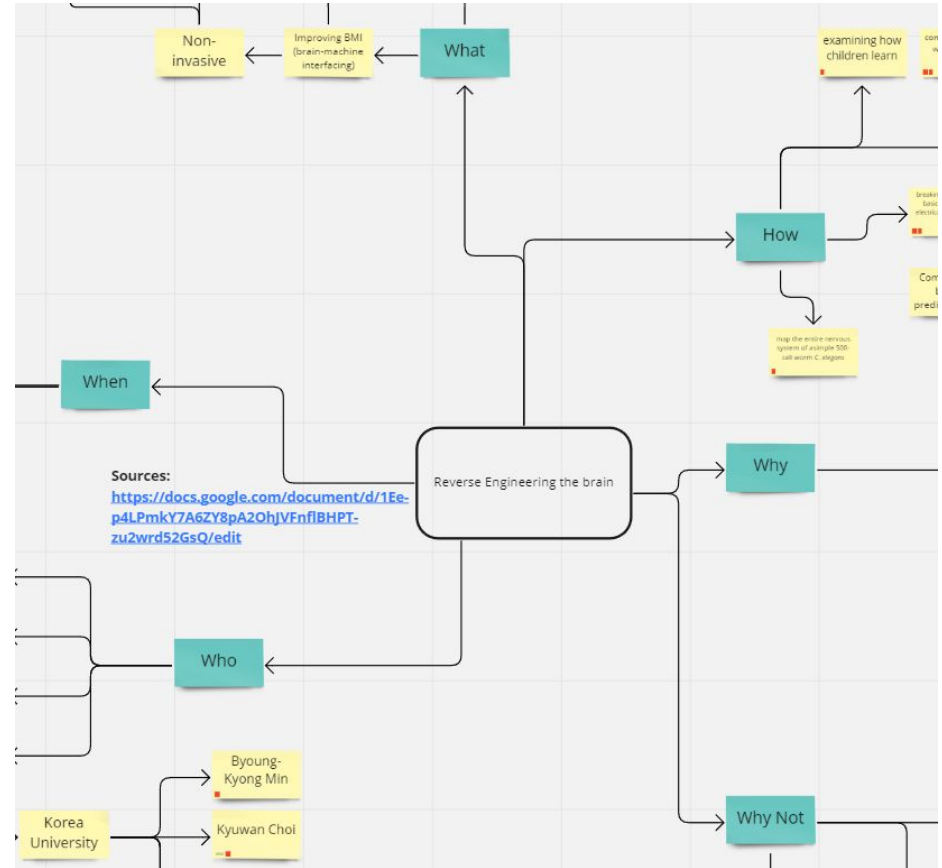# Coover Multimedia Wall

Farm House Museum

Muse 2

Image taken from:

Secondary Research

- Narrowed Down to a specific challenge
- Used Miro for mind map
- 6 "reporter" questions
- [Miro Link](#)

Define

Define Phase

CONVERGE
Which problem can we impact the most

DEFINE
What if?

Plan

Users- Personas

- Chrystal the curator – The person in charge of the building.
- Yvonne the youth – younger human that we want to have a lasting impact on.
- Adrianne the adult – Wants to gain knowledge, we need to provide in depth information for a wide range of understanding.
- Sally the student – an engineering student that wants the specific details of the workings of our exhibit, and wants to gain knowledge.
- Perry the Professor – The professor wants to see current engineering issues explained properly.

Requirements & Constraints

- Functional
  - The installation should be interactive
  - The installation should be safe to use
- User (Specifications)
  - An exhibit should be constructed to inform the public about reverse engineering the brain
- Aesthetic
  - The exhibit should be eye-catching, so someone will come to it without knowing what it is beforehand
- User Experience
  - The exhibit should appeal to all ages and levels of experience with engineering
  - The exhibit should be usable with minimal instruction or outside assistance
- Economic Constraints
  - $500 budget
- Environmental Constraints
  - Likely to have limited space for the exhibit

Reverse Engineering the Brain
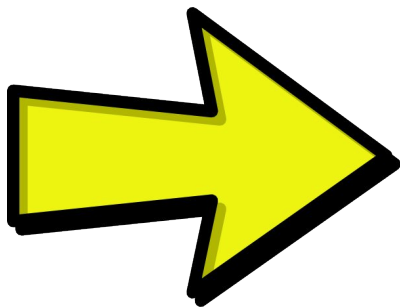
Narrow down...

Improve AI

Define

Focused Problem Statement:

"Reverse engineering the brain is one of the National Academy of Engineers' 21st Century Challenges—a list of complex problems that are tightly intertwined with engineering and the future. Medical and technical personnel around the world are working towards solutions that will have applications in artificial intelligence, medical treatments, and prosthetics. The knowledge of this challenge is crucial to garnering public support and increased funding. Our goal is to inform and gain the interest of the general public and potential engineers through an interactive art exhibit that converts brain wave activity generated from listening to music into art."

High Level Design
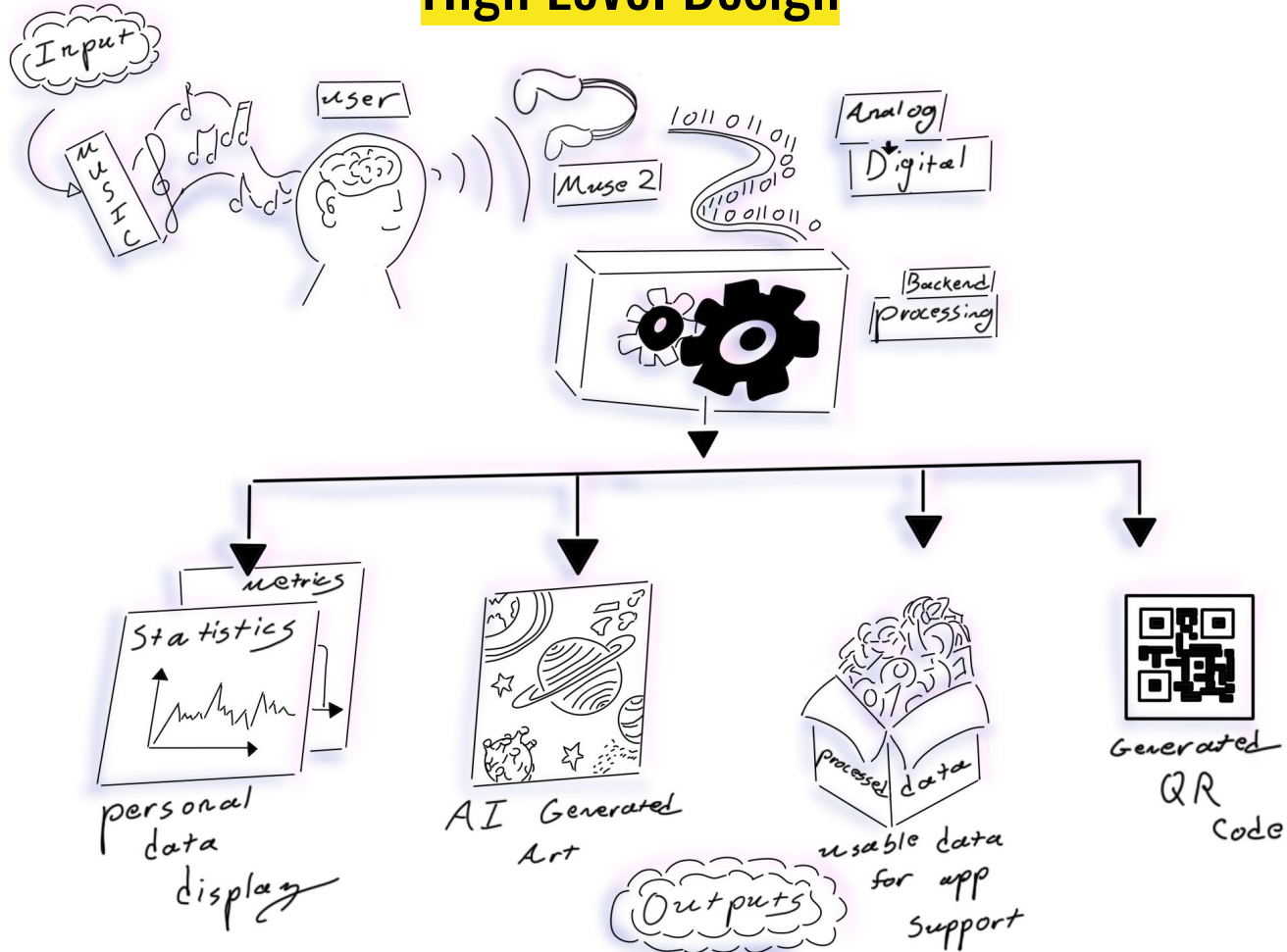
Device Backend
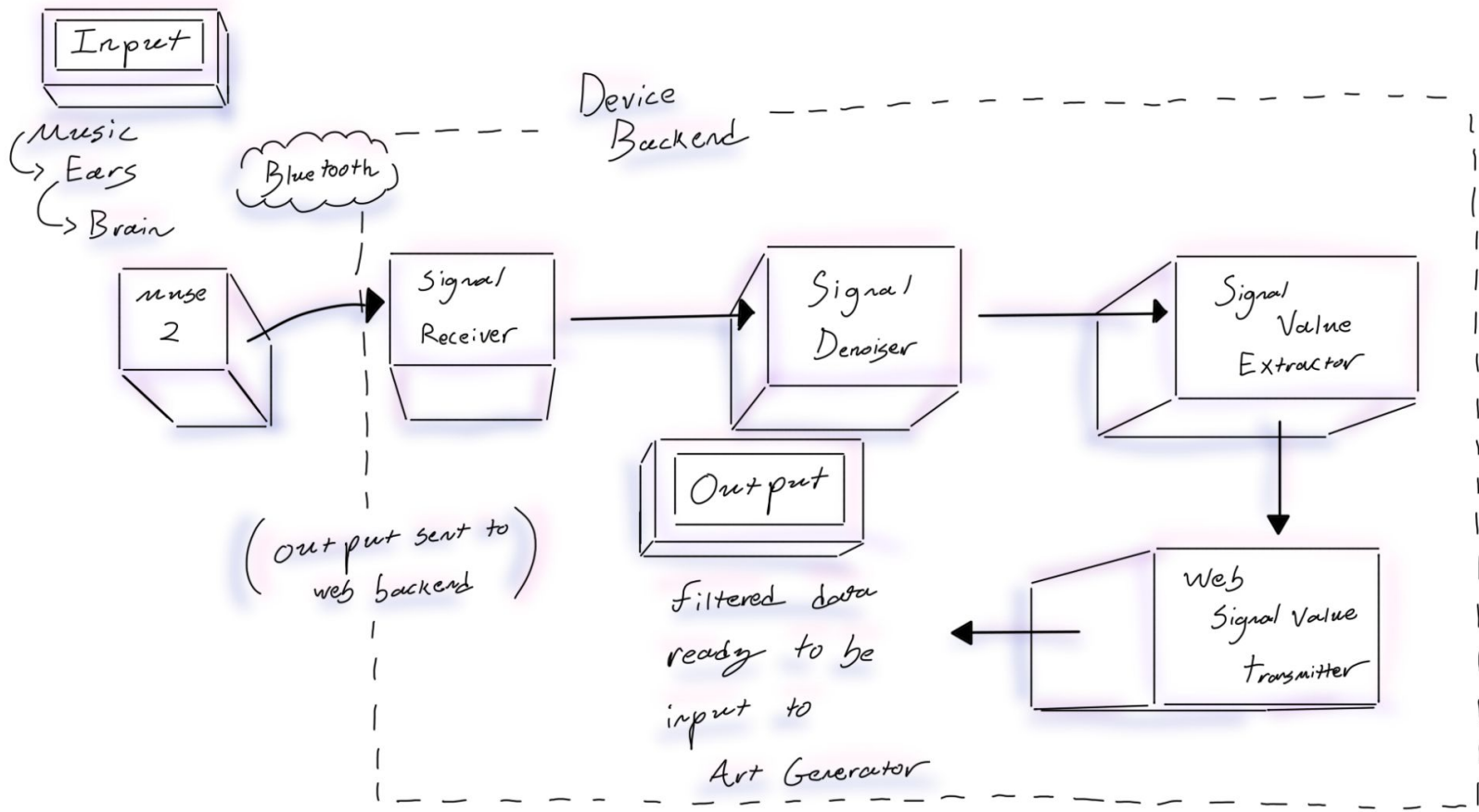
Web Backend

Device Frontend

Input

web Backend
finished processing

previously collected user data

Raw
Data/
processing
Brain
waves

Screen
Saver

Signal
Visualizer

Android
App

Generated
QR code

Generated
Art

QR
Code
Visualizer

Art
Visualizer

Outputs

Visualizations of
- QR code
- personal Generated Art
- Signal in processing
- previously collected Data
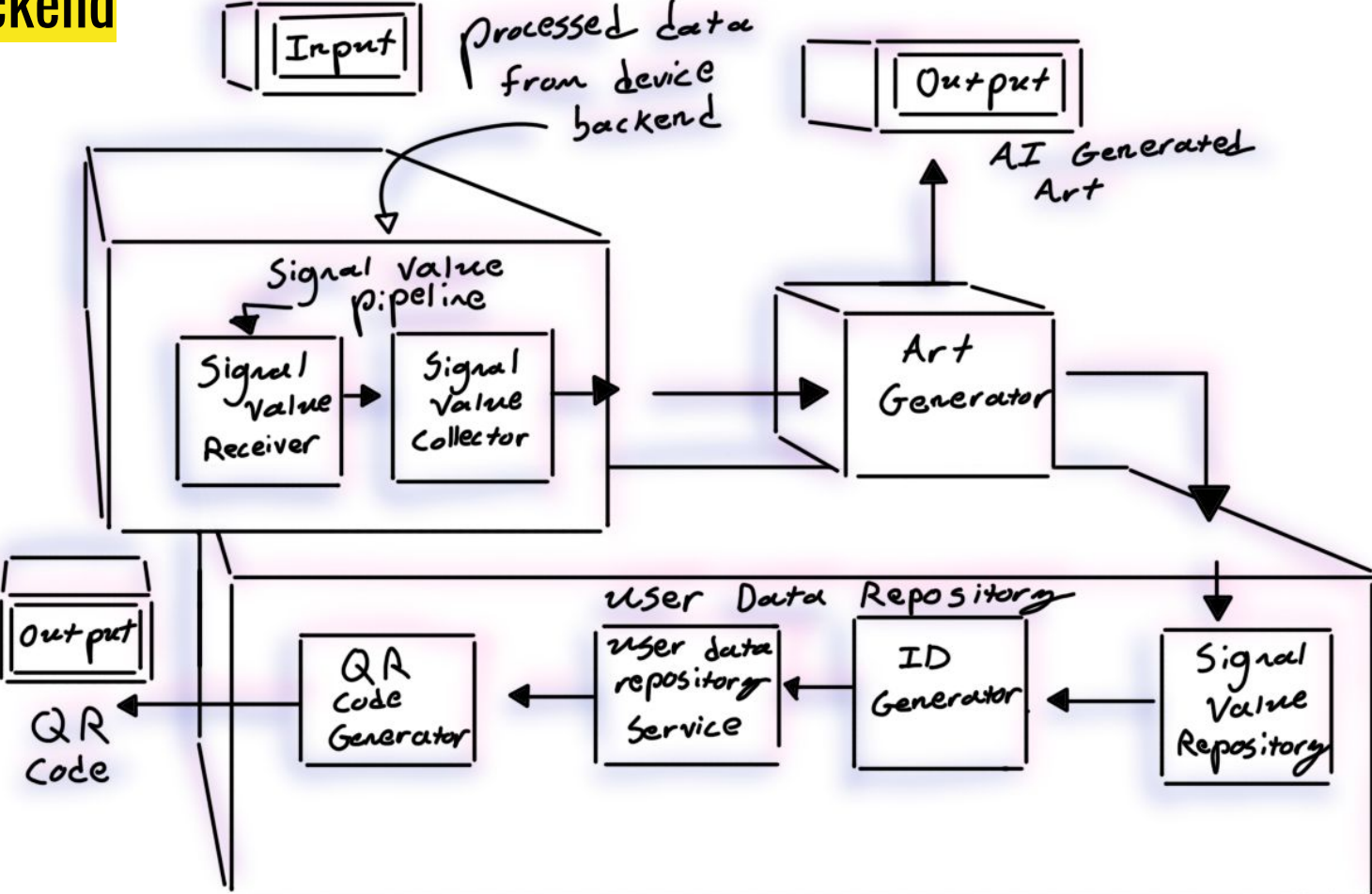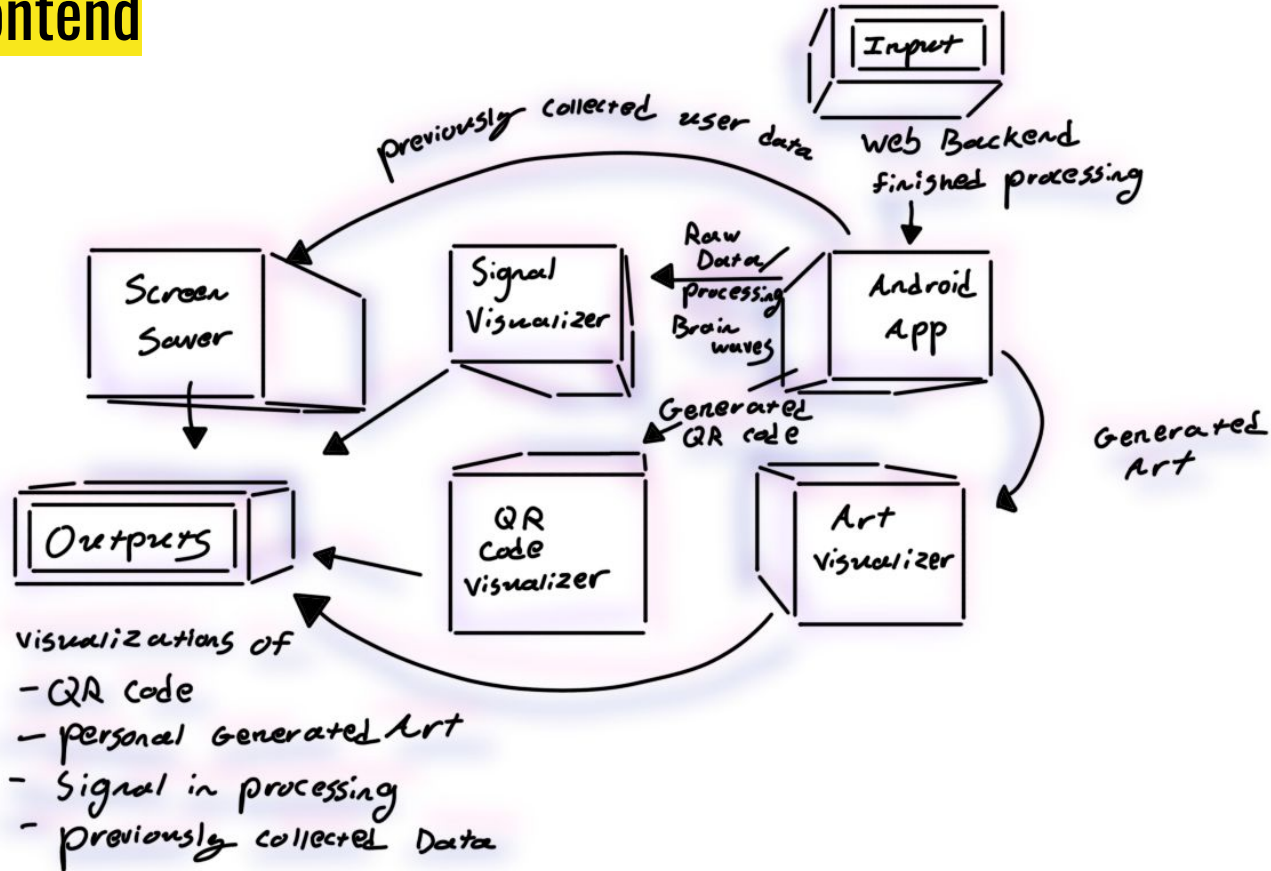
Web Frontend
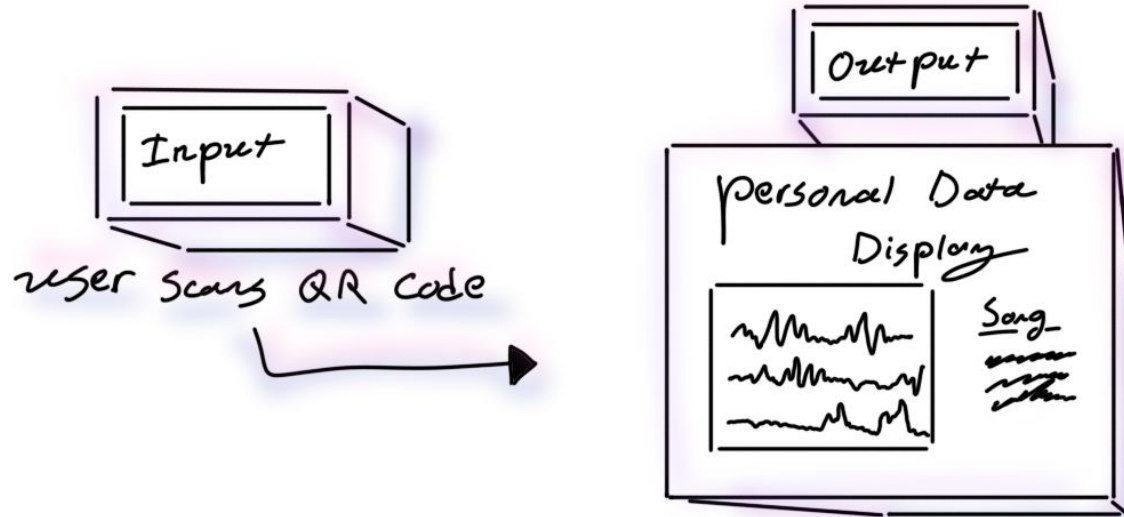
Develop

Develop Phase

Project Plan- Milestones

ELEMENT	MILESTONES		Q1																Q2					
			JAN				FEB				MAR				APR				MAY					
		2	9	16	23	30	6	13	20	27	6	13	20	27	3	10	17	24	1	8	15	22	29	
1	**Muse 2**	- Acquire device																						
		- Read data from device																						
2	**Tablet**	- Acquire device																						
		- Configure device for app																						
3	**Tablet app**	- Basic UI																						
		- Connect to Muse 2																						
		- Pull raw data from Muse 2																						
		- Denoise data																						
		- Connect to web backend																						
		- Exchange data with web backend																						
		- Guided experience																						
		- Polish UI and experience																						
4	**Web backend**	- Connect to tablet app																						
		- Exchange data with tablet app																						
		- Generate art																						
		- Store and retrieve results																						
5	**Web frontend**	- Display results																						

Project Plan Risk/Mitigation

Risk	Probability (estimate)	Risk mitigation plan (if needed)
Settings could be changed, making device unstable, possibly opening backdoors for malicious software.	0.4	Lock device to our app only (this is a built in feature of Android) so they aren't able to leave it without our screen lock password.
Process Injection security risk (ATT&CK T1055)	0.2	Strong input validation. Application should not connect to DB with root privileges.
If the project is to be held in a place for the public to experience it, the hardware may be stolen or broken	0.2	Have the project be accessible to the public only when it is being watched over and/or our team is there to host the project experience for users.

Deliver

Deliver Phase

CONVERGE
To select & make concrete from abstract

DELIVER
What works?

Ship
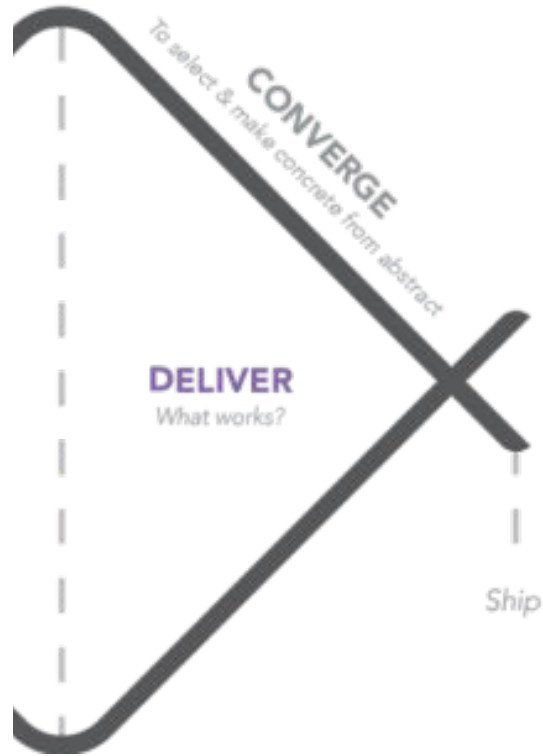
Testing Plan

AssertJ
Fluent assertions for java

System

Integration

Unit

JUnit 5

mockito

Icons from: https://junit.org/junit5/, https://assertj.github.io/doc/, https://site.mockito.org/

Conclusions

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