EMFUTECH 2025

APRIL 2025

MINDMAX: EEG and VR for detecting emotional disorders

MIRAI INNOVATION

Presented By
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Mental Health

“Distress Tolerance (DT) is a transdiagnostic risk and maintenance factor implicated in a wide range of mental disorders.” The role of fear of anxiety and intolerance of uncertainty in worry: An experimental manipulation

30%

Mexican young adults experience anxiety or depression. (INPRFM, 2023)

1 of 3

young Mexicans (15-24 years) reported high levels of psychological distress

2nd

suicide is the 2nd leading cause of death for ages 15-29 (Mexico’s Ministry of Health)

20%

Young Mexicans with severe distress look for help. (WHO, 2020)

#Physical discomfort #Frustration #NegativeEmotions #Uncertainty #Anxiety

State of Art

VR headset with VR games designed to assess several with the use of EEG and AI vision.

Lucy

MIND GARDIAN

App/Video game that detects cognitive decline in elderly through AI.

THYMIA

Neuropsychology, AI analyze micro expressions & speech patterns to make mental health assessments.

MINDO

EEG headband with smartphone app for neurofeedback

VR assessment

Virtual reality (VR) is a potentially powerful technology for enhancing assessment in mental health. (Bell, 2022)

Panoramix:

EEG combined with VRET technology for mental health treatment. (Ma, Weizhi , 2024)

Market Overview

The Power of EMERGING TECHNOLOGIES TO MAKE mental care diagnosis more accessible

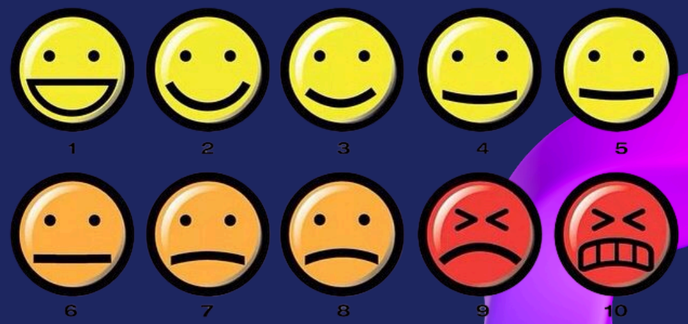
Mental Health

The global digital mental health market is projected to reach $26.5 billion by 2027 (CAGR: 23.5%)

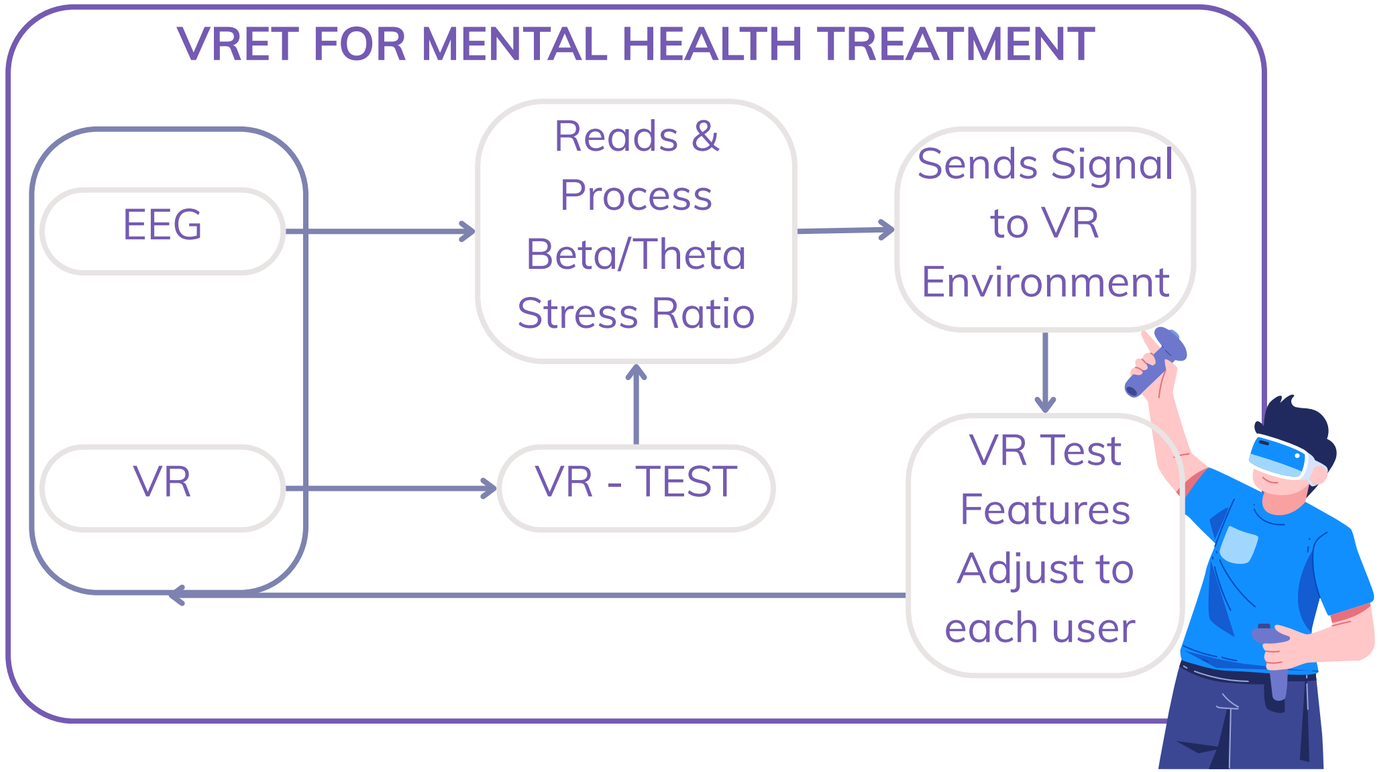
Company	Focus Area	Key Product/Service
AppliedVR	Chronic pain, anxiety	FDA-cleared VRET solutions
Oxford VR	Phobias, psychosis	Automated VR cognitive therapy
Neurable	EEG + VR neurofeedback	Brain-computer interfaces for mental health
MindMaze	Stroke rehab, PTSD	VR + EEG neurorehabilitation
Pear Therapeutics	Digital therapeutics	VR/AR prescription treatments. (defunct, but influential)

#Physical discomfort #Frustration #NegativeEmotions #Uncertainty #Anxiety

SOLUTION:



VRET as mental healthcare treatment to reduce the gap between Traditional psychological evaluations, time-consuming and influenced by bias.

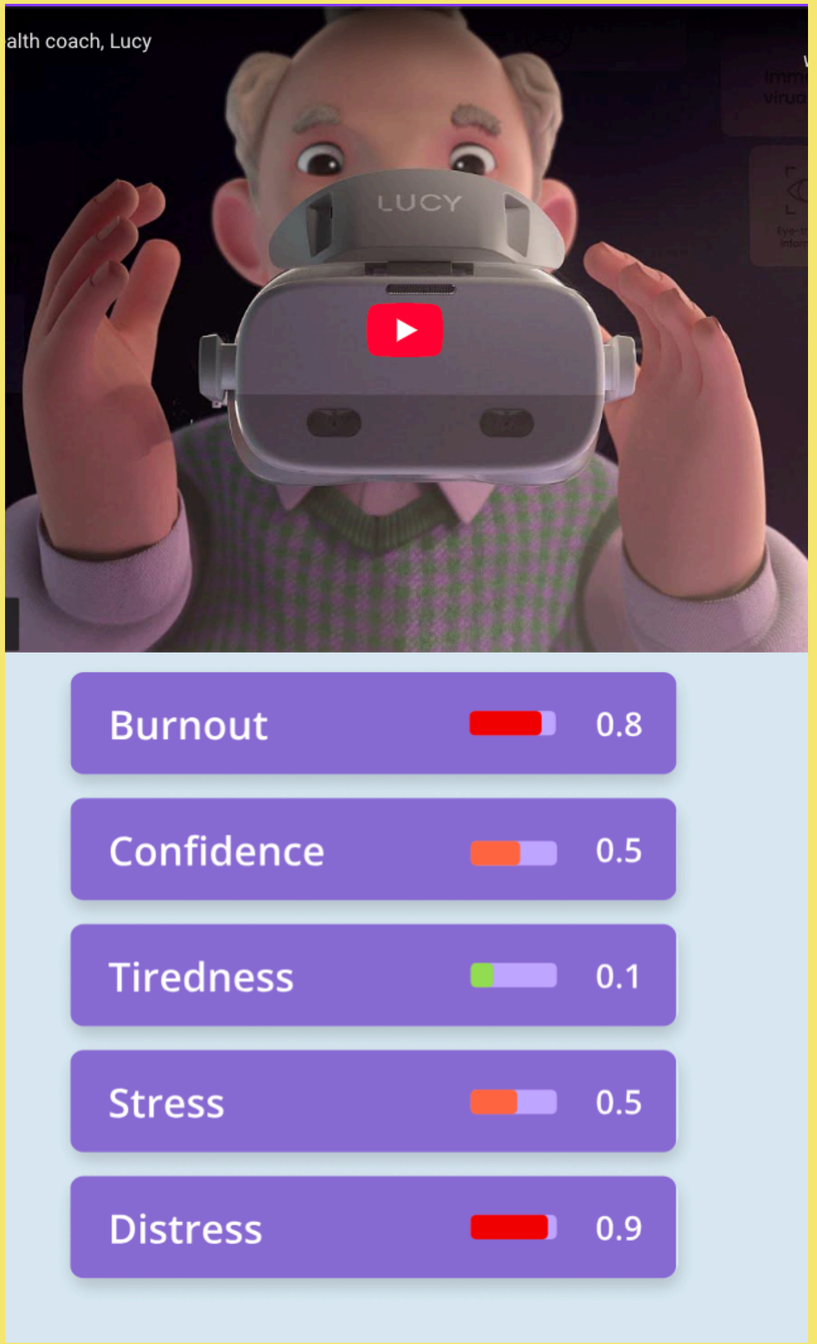


Behavioral analysis → Neural stress markers → Post-game adaptation.

OBJECTIVES

Design and implement a Virtual Reality (VR) environment that can evaluate emotional reactions associated with tolerance frustration, to analyze their emotional and neurological responses through the use of EEG technology.

VR Environment	EEG with AURA
• Develop a VR environment with interactive tests that can be used to evaluate **distress tolerance in a user.**	Use EEG to capture neural responses during VR interactions and process data analysis that can lead to an assessment for emotional regulation.



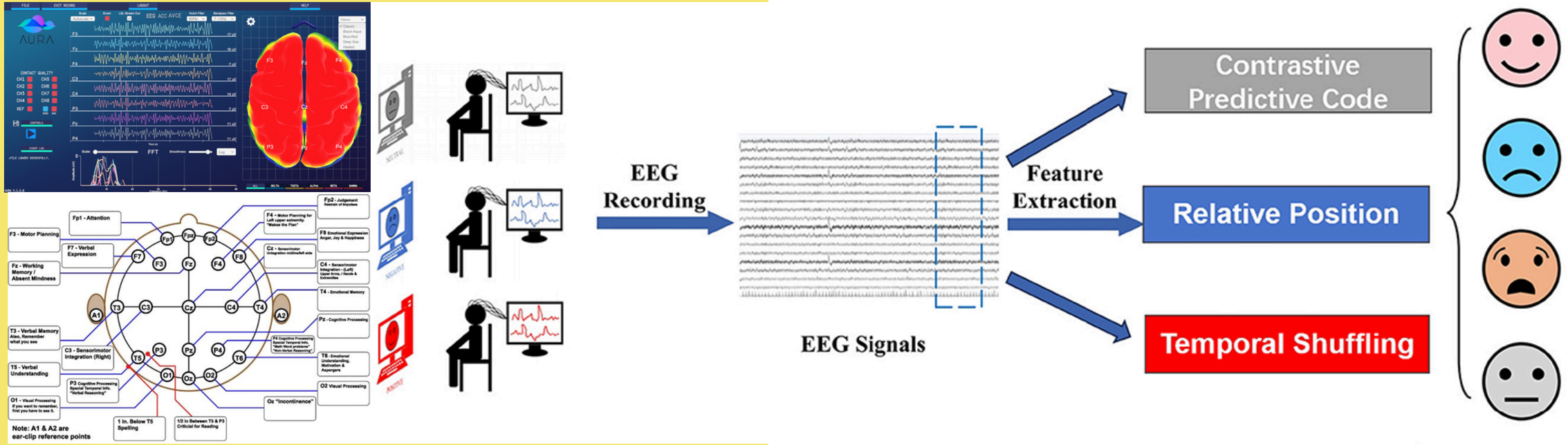
Why VR Environments for emotional assessment?

Effectiveness of Serious Games for Alleviating Depression: Systematic Review and Meta-analysis

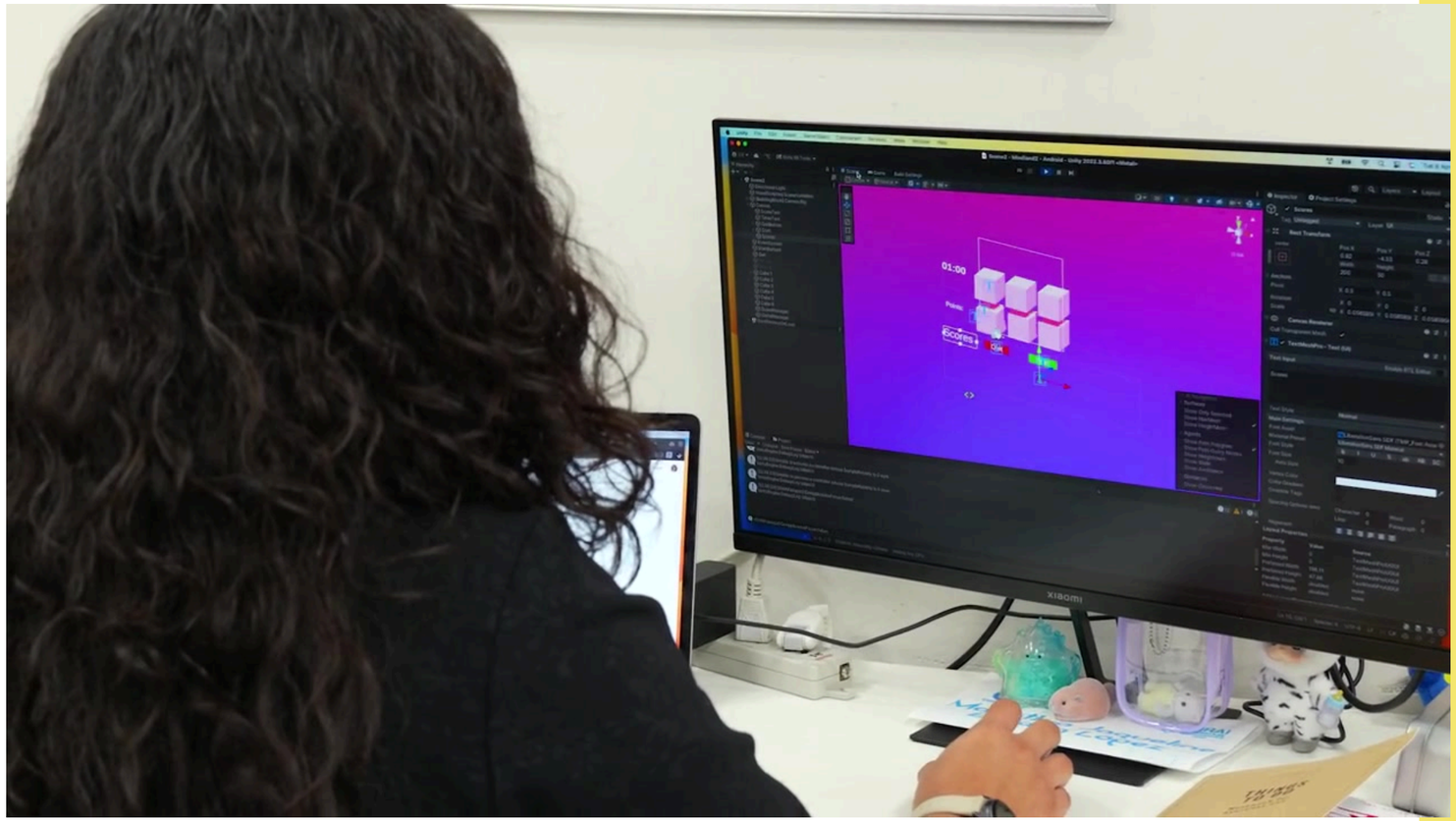
VR can simulate controlled environments with high immersion, presence, and interaction to induce intense emotions. Therefore, researchers can evaluate emotional experiences in a realistic context. ^

Why EEG for emotional assessment?

[Dealing with uncertainty: A high-density EEG investigation on how intolerance of uncertainty affects emotional predictions]



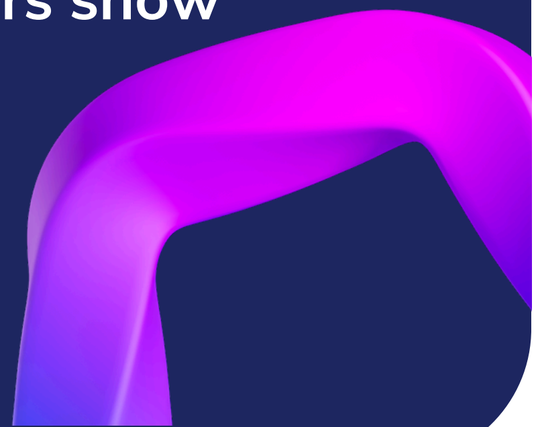
KEY INNOVATION



Dynamic adjustment of VR environments based on the user's **emotional reactions**, enabling personalized scenarios that challenge or improve frustration management for mental treatment.

DISTRESS TOLERANCE (DT)

Combining risk-taking (frontal EEG) + critical thinking (parietal EEG) can predict real-world cognitive flexibility. Studies show high-risk takers exhibit low P3 amplitudes (Knoch et al., 2006), while analytical thinkers show parietal gamma synchronization.



Prefrontal cortex Theta/Beta Correlation

Stress often correlates with increased frontal beta (12–30 Hz) and **reduced frontal theta** (4–8 Hz).

1. **Beta-to-Theta Ratio (BTR)**

   A common stress metric is the ratio of beta to theta power. Higher values indicate increased stress or cognitive load:

   $$\text{BTR} = \frac{P_{\text{Beta}}}{P_{\text{Theta}}}$$

   - Some studies use **absolute power** (raw PSD values) instead of relative power.
   - *Variation*: Use **log-transformed** values for normalization:

   $$\text{BTR}_{\log} = \log(\text{Beta Power}) - \log(\text{Theta Power})$$

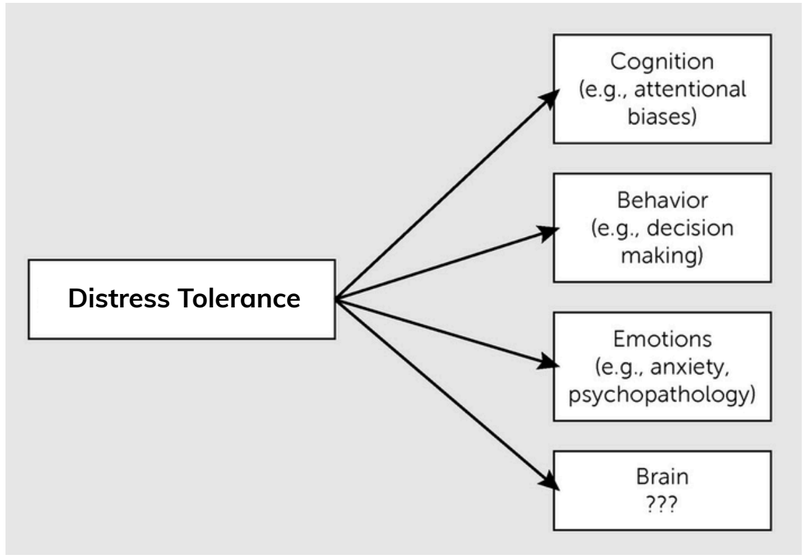
2. **Stress Index (SI)**

   A weighted combination of beta and theta power, sometimes including other bands (e.g., alpha):

   $$\text{SI} = k_1 \cdot P_{\text{Beta}} - k_2 \cdot P_{\text{Theta}} + C$$

   - k_1, k_2: Empirical weights (e.g., from regression models).
   - C: Baseline constant (calibrated per individual/study).

PROTOTYPE - TESTING
“PUSH YOUR LUCK”



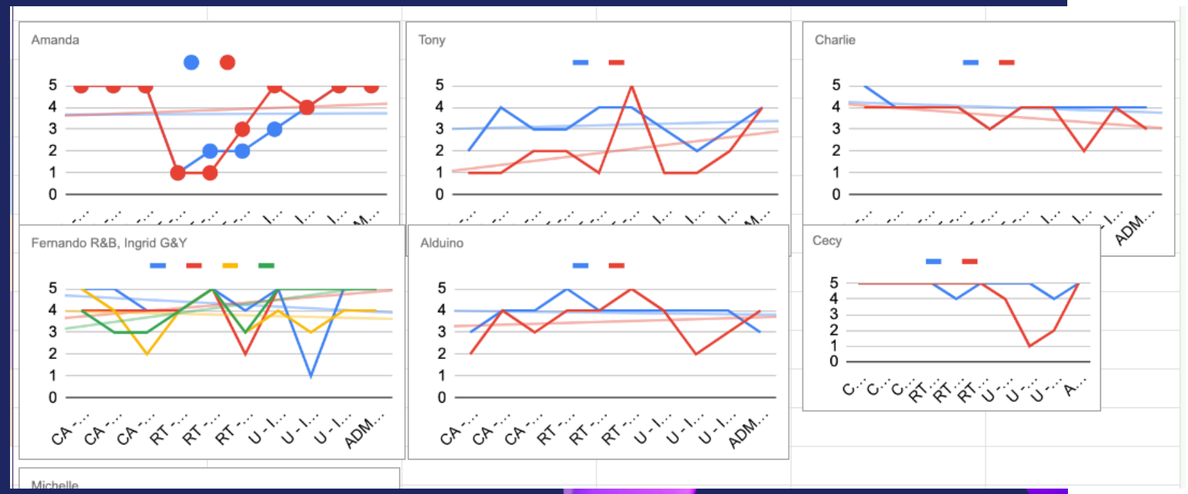
DECISION MAKING (TAKING RISK)

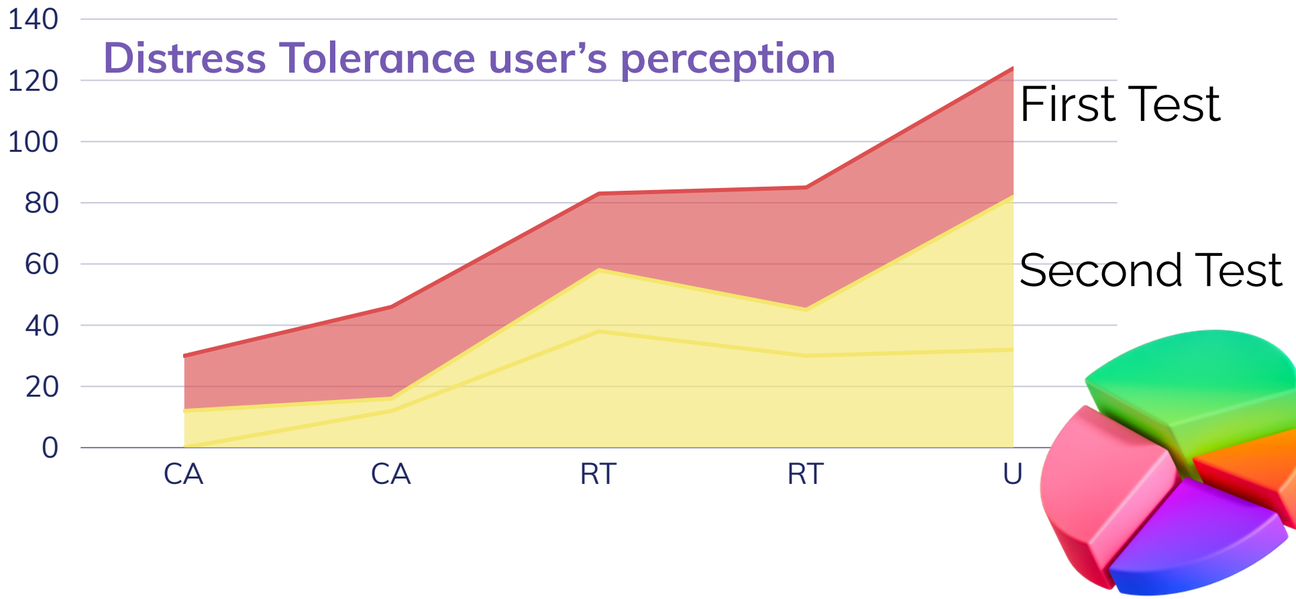
CRITICAL ANALYISIS

UNCERTAINITY

Quantitative Methods

TROVA - Perception with Likert Scale





VR - REACTO-QUEST

The Montreal Imaging Stress Task (MIST) has 3 test conditions (rest, control and experimental))

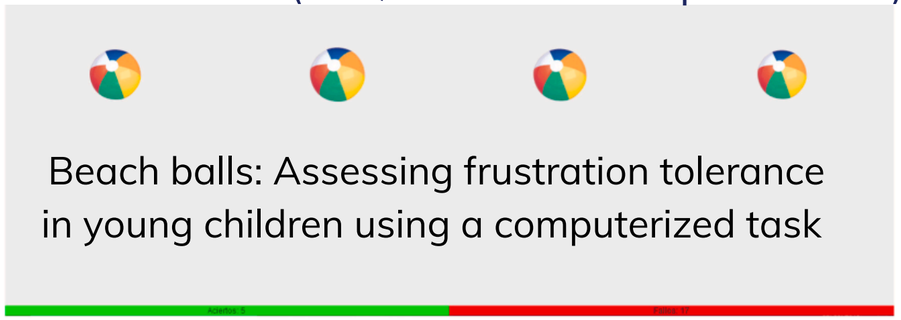
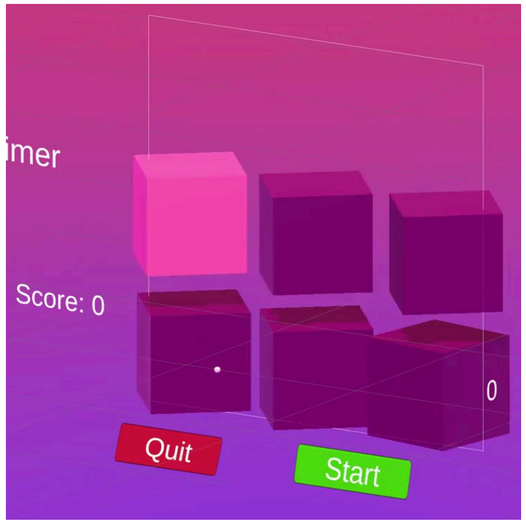
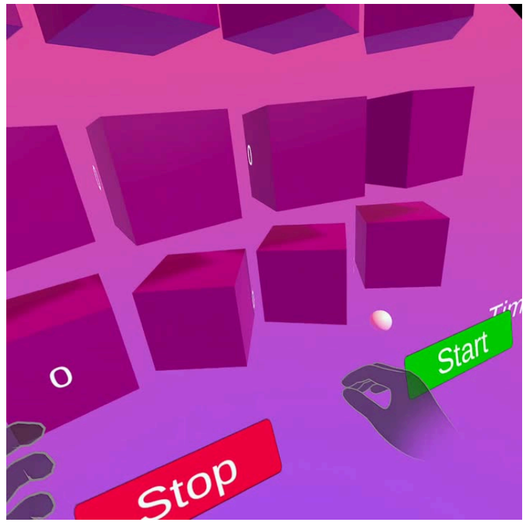


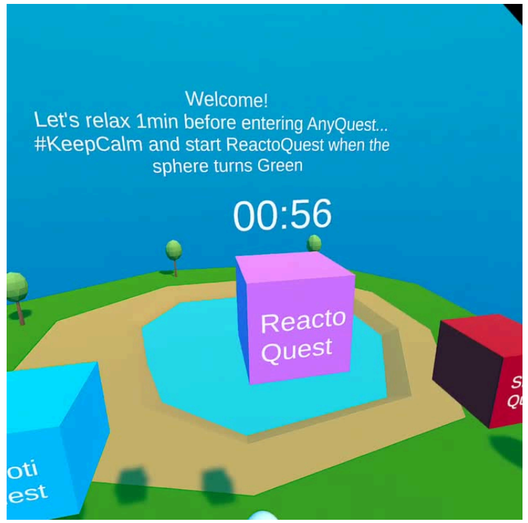
Fig. 1. Appearance of the task on screen. The upper bar shows response time and the lower bar shows hits (green) and errors (red). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Qualitative Methodology for DT (Distress Tolerance)

1. Reaction Time.
2. Response Variability.
3. Omission Errors.
4. UNCERTAINITY







RELAXING BASELINE

CRITICAL ANALYISIS

STRESS ENVIRONMENT

USER TESTING

Experimental procedure:

Positive and Negative Affect Schedule' (PANAS)

1MIN — RELAXING BASELINE

↓

1MIN — CRITICAL ANALYISIS

↓

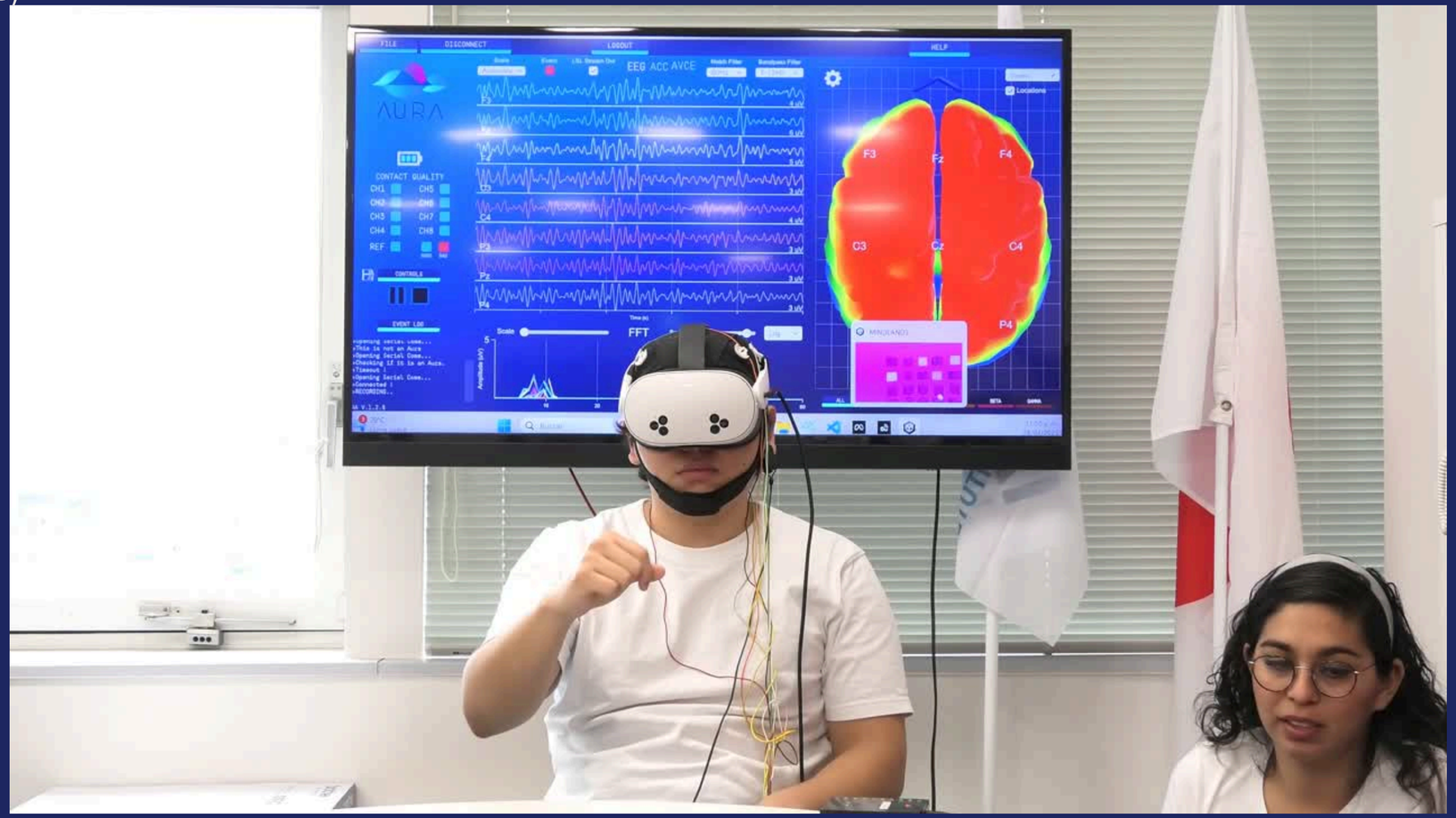
1MIN — RELAXING BASELINE

↓

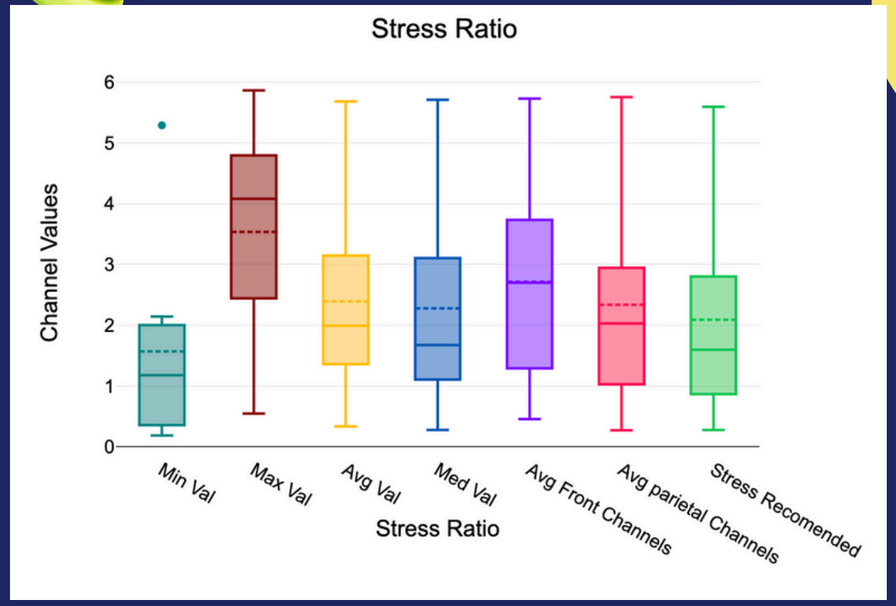
1MIN — CRITICAL ANALYISIS

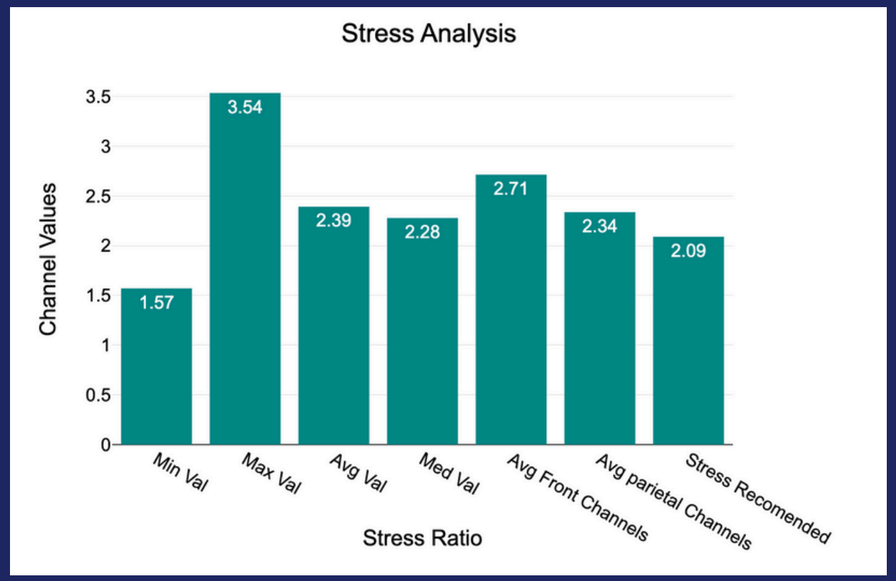
↓

1MIN — STRESS ENVIRONMENT



DATA ANALYSIS





State-of-Art:

Stress Ratio Theta/Beta	**Interpretación**
< 1.0	Relax or Low Stress
1.0 – 1.5	Cognitive Engagement
> 1.5	High Stress

Real Data:

Ratio Theta/Beta	**Interpretación**
< 1.5	Relax or Low Stress
1.5 – 2.5	Cognitive Engagement
> 2.5	High Stress

Alfa Frontal Asymmetry = log (F4_alpha / F3_alpha) (emotional indicator related to anxiety / depression)

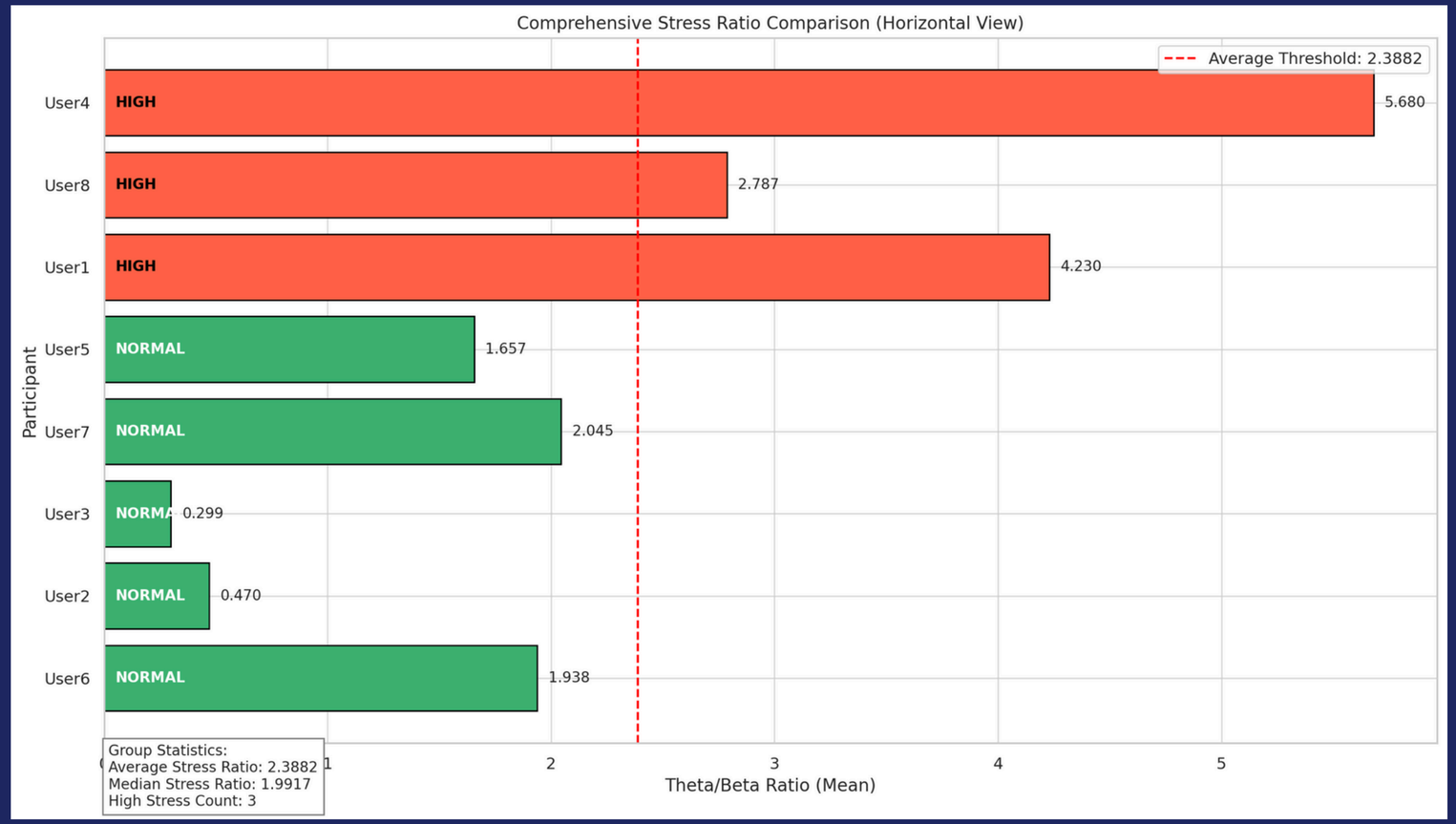
FIRST RESULTS

"HIGH" if the average ratio is above the threshold.

"NORMAL" if it is below threshold .

It analyzes whether the frontal (F3, Fz, F4) or parietal (P3, Pz, P4) channels have more stress.

Frustration occurs when an individual continues an action in the expectation of the gratification or desired goal but does not actually attain it (Dollard et al., 1939; Berkowitz, 1989; Anderson and Bushman, 2002)



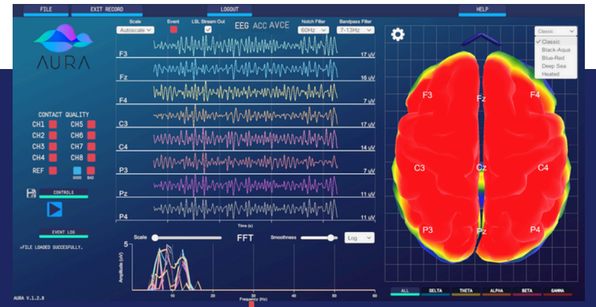
DEVELOPMENT PLAN

Week 1: 03/24-28 | **Week 2: 04/31-4** | **Week 3: 04/ 7-11** | **Week 4: 04/ 14-18** | **Week 5: 04/21-25** | **Week 6: 04/28-02**

Research & Data Collection — **AI & Deep Learning Development** — **Software & Hardware Design**

Define, design and develop VR Environments in Unity

VR integration and connection with EEG and AURA visualization.



Conduct participant testing and visualize EEG data.

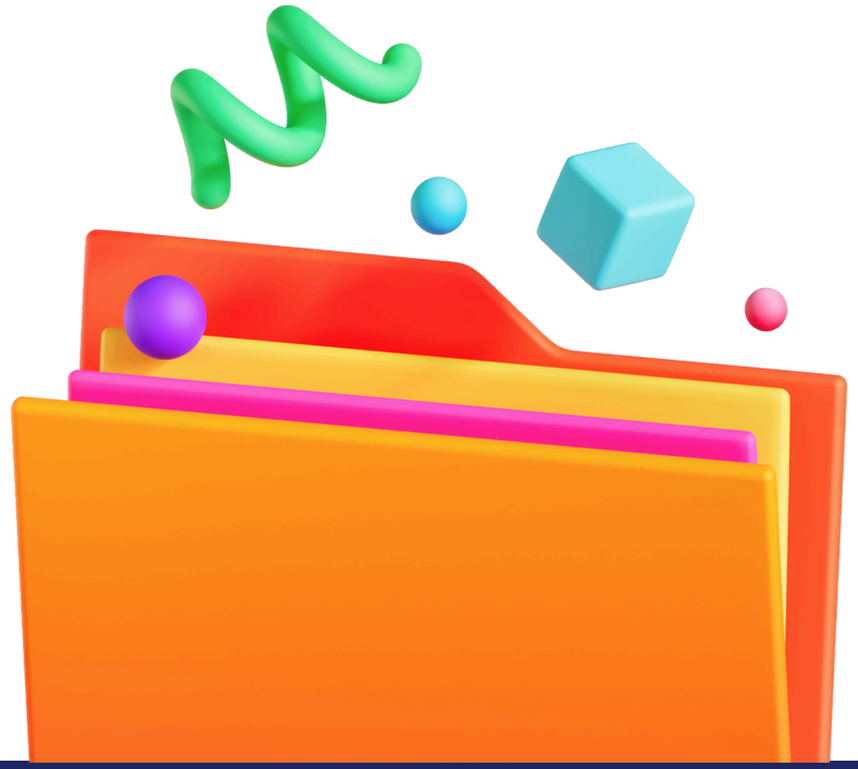
Process RAW data to analyze results.

Generate a final report
05/02 Presention Deadline

R&D — VR Env — VR Test — EEG Test — Data Processing — Data Analysis

MINDMAX:

Expected Deliverables



1. ✓ Unity VR frustration evaluation test.
2. ✓ EEG - Aura User testing results
3. ✓ Analyzed data & feedback-based on improvements.
4. ✓ Final report & presentation materials.
5. **Dynamic adjustment of VR environments** based on the user's **emotional reactions**, enabling personalized scenarios that challenge and improve frustration management.

References

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