Neuroscience for Architecture: Quantification of Human Responsiveness in Static and Responsive Built Environments

NYU TANDON SCHOOL OF ENGINEERING

BI LAB — THE FUTURE BUILDING INFORMATICS AND VISUALIZATION LAB

Graduate Students: **Zhengbo Zou,** PhD student, CUE, NYU, Ahmed Radwan, Grad. student, CUE, NYU; **Helen Joo**, MA, NYU Psychology; **Hyunjin Oh**, MA, NYU Psychology
Research Advisor: **Prof. Semiha Ergan**, Prof., CUE, NYU

Motivation & Problem Statement

❖ People spend more than 90% of their time indoors, making it crucial to analyze and assess the impact of the built environment on their responsiveness and performance.

❖ Problem:
  - Lack of empirical evidence of the influence that the built environment has on humans psychological, physical, and emotional states.
  - Lack of systematic quantification of the interrelations between neuroscience and the built environment.
  - Few research studies have explored architectural design characteristics (e.g., way-finding cues) and their effect on the emotional and psychological responses of human beings.
  - Lack of a holistic approach to quantify the combined impact of architectural design features on human experience. Existing research focuses on evaluating the impact of individual design features (e.g., color, size) on human experience.

Objective & Research Approach

❖ Objective:
  1. Quantification of the impact of architectural design features on human physiological states.
  2. Identification of the main architecture design features that influence human experience.

❖ Research Approach:
  1. Identifying architectural features - triangulation approach: (literature review – ethnographic studies – crowdsourcing)

  2. Quantifying design impact in virtual and real environments using Virtual Reality and Body Area Sensor Networks (e.g., Eye-tracking glasses, EEG headset, GSR).

VR setup

EEG

Eye-tracker

GSR

Facial Expressions
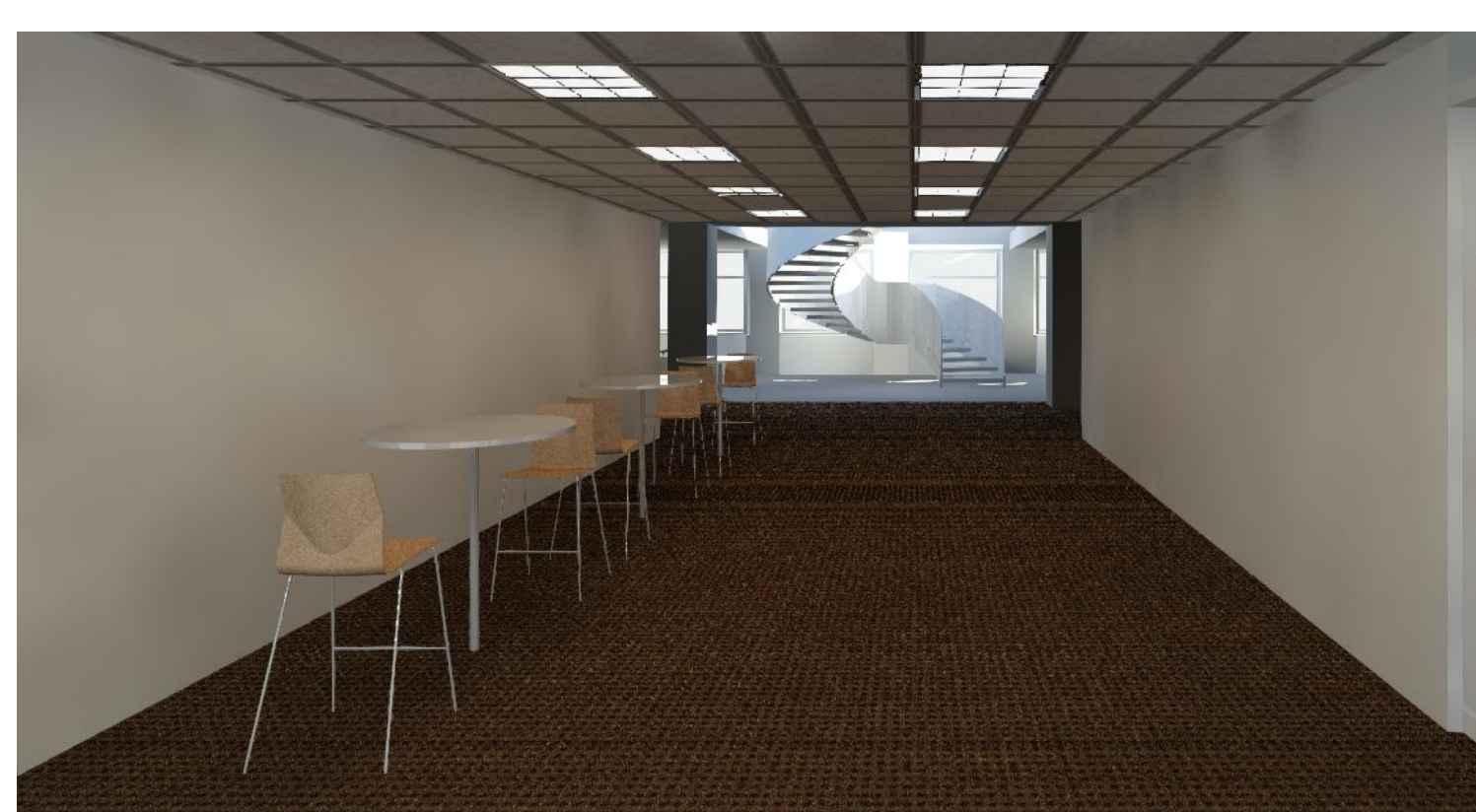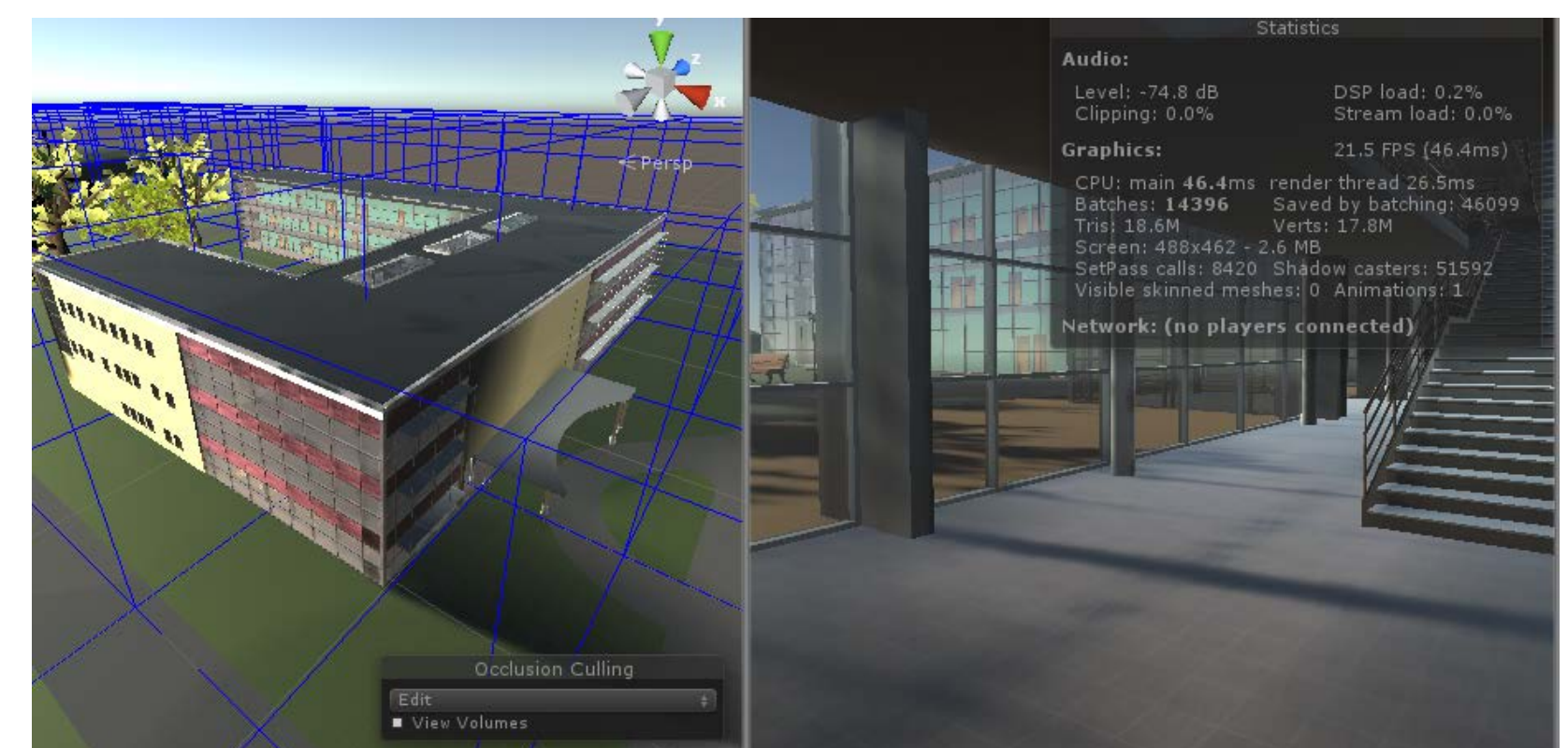
Sample of Architectural Design Feature Comparisons for Crowdsourcing
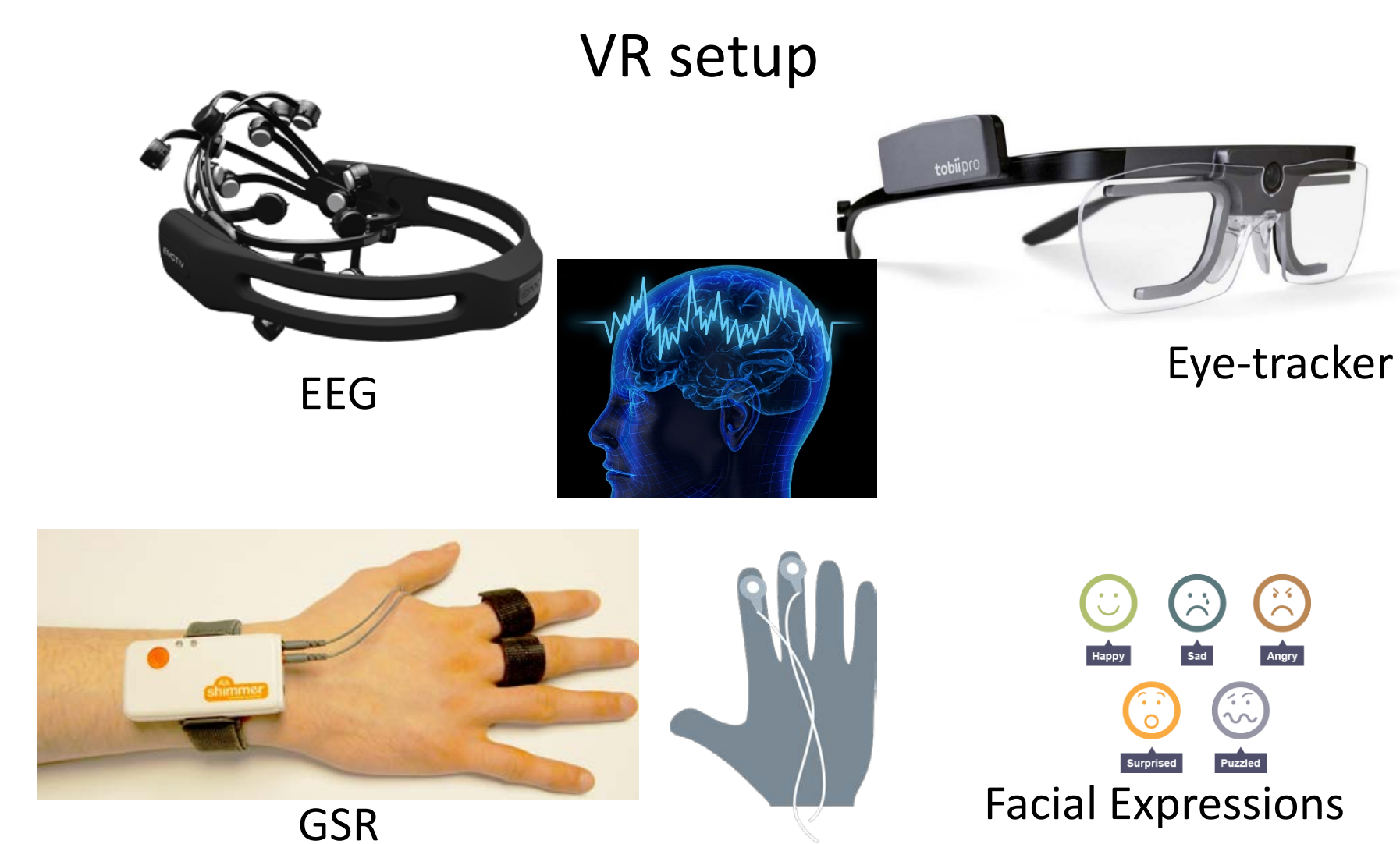
Initial Findings & Expected Contributions

❖ Initial Findings:
  For the crowdsourcing experiment: A set of **16 architectural design features** were identified (e.g. spatial alignment, presence of windows, ceiling height). Each feature is tied to one or more sensation, and in total **7 sensations** were identified (e.g. sense of spatial orientation, sense of stress and anxiety).

❖ Expected Contributions:
  Quantifying the impact of architectural design features on human experience, responsiveness, and performance in built environment.

❖ Publications
  Radwan, A. and Ergan, S. (2016). *Towards Quantifying the Impact of the Built Environment on Human Experience: Elements of Experimental Design.* Abstract submitted at ANFA 2016: CONNECTIONS – BRIDGESYNAPSES.

Acknowledgment: This material is based upon work supported by the Defense Advanced Research Projects Agency (DARPA) under Grant D15AP00098. The views, opinions, and/or findings expressed are those of the author(s) and should not be interpreted as representing the official views or policies of the Department of Defense or the U.S. Government.