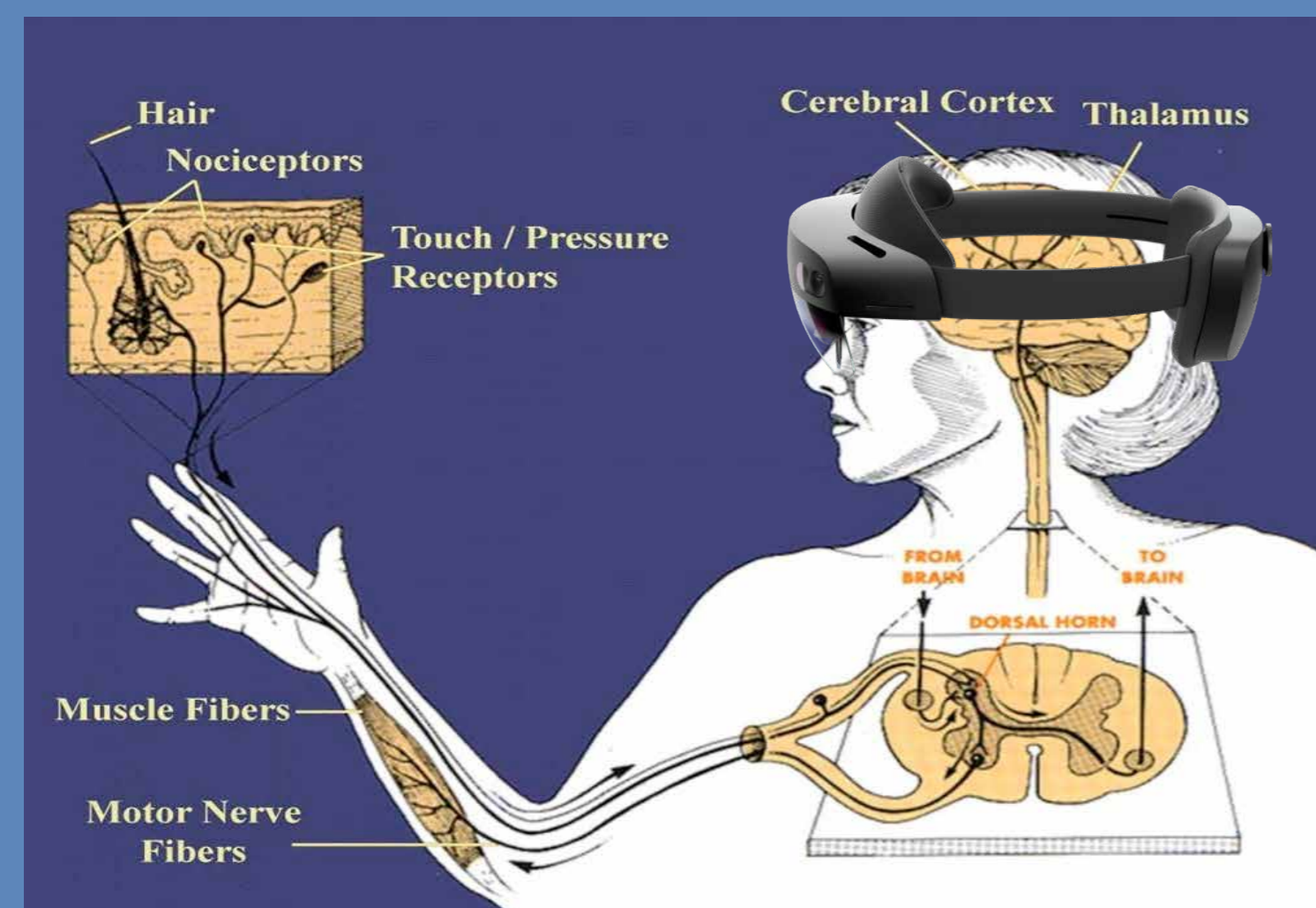


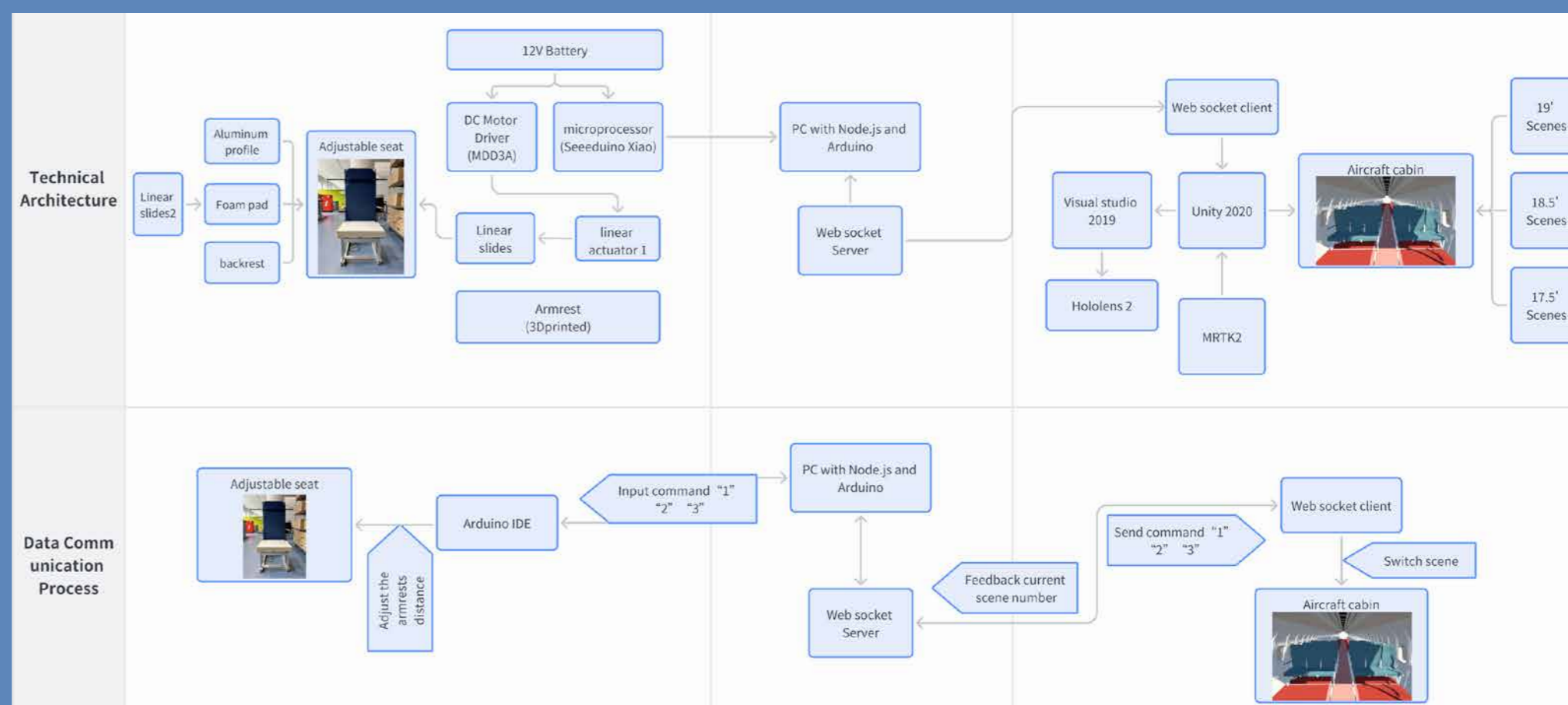
How it feels: The value and application of physical sensation in XR

Abstract



This research advocates for exploring the somatosensory system and its incorporation within XR systems, particularly in spatial recognition. This paradigm shift could introduce novel methodologies in XR design that perceive the body as a recipient of sensory stimuli and as an active participant in sensory perception. This could redefine our understanding of somatosensory in XR and contribute to a more holistic approach to multisensory design. Additionally, this study aims to examine the deployment of XR in the evaluation of aircraft interior design. The successful integration of XR technologies could potentially revolutionize the design process by presenting a more immersive and authentic user testing environment. In light of the present deficiency in precise spatial recognition within XR applications, this research could offer fresh insights into optimizing XR use in design, thereby improving spatial perception accuracy and enhancing ergonomics and user experience in real-world applications, such as aircraft interior design.

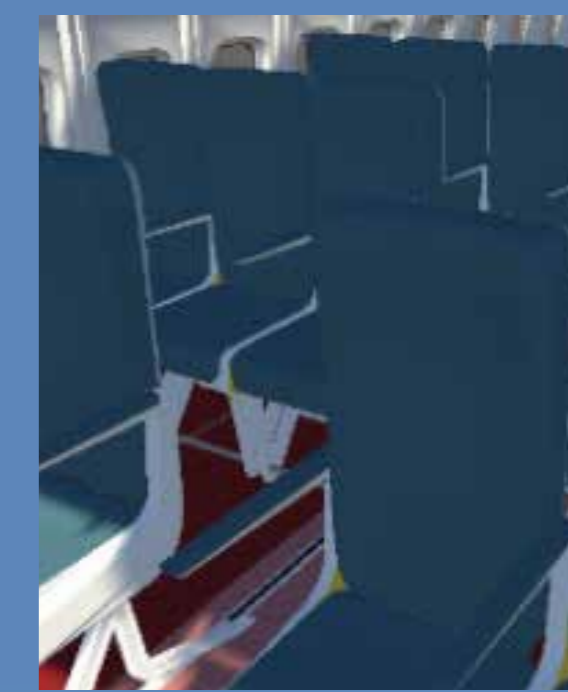
Technical Architecture



```

// Arduino IDE
// ...
void setup() {
  Serial.begin(9600);
}

void loop() {
  // ...
}
    
```



1. Virtual environment: Use HoloLens to provide users with an immersive virtual aircraft cabin with an adjustable seat.
2. Tactile experience: Provide a physically adjustable aircraft seat with the exact dimensions as the virtual cabin seat, and the spacing of the armrests can be adjusted in sync with the virtual environment.
3. Data connection: Connect the HoloLens, physical seat, and PC to achieve control, status detection, data collection, and other functions.

Materials and Methods

Primary goal

1. Explore the role of somatosensory in enhancing spatial recognition in XR systems: This research investigates the potential of somatosensory and its integration within XR systems. The goal is to develop new methods and interfaces in XR design that account for the body as an active participant in sensory perception, redefining our understanding and utilization of touch in XR.
2. Investigate the application of XR in aircraft interior design evaluation: By harnessing XR technologies, this study aims to offer a more immersive and authentic user testing environment. It seeks to identify new strategies for enhancing the fidelity of spatial perception in XR applications, leading to improvements in ergonomics and user experience in real-world design scenarios.

Secondary goal

1. Enrich the current knowledge on multisensory experiences within XR systems: By shifting the focus to somatosensory, this research hopes to contribute to a more comprehensive approach to multisensory design in XR.
2. Offer innovative insights into the use of XR in design evaluation: By addressing the existing gap in spatial recognition accuracy, this study could provide innovative insights into optimizing XR use in design, potentially revolutionizing design processes in various industries.

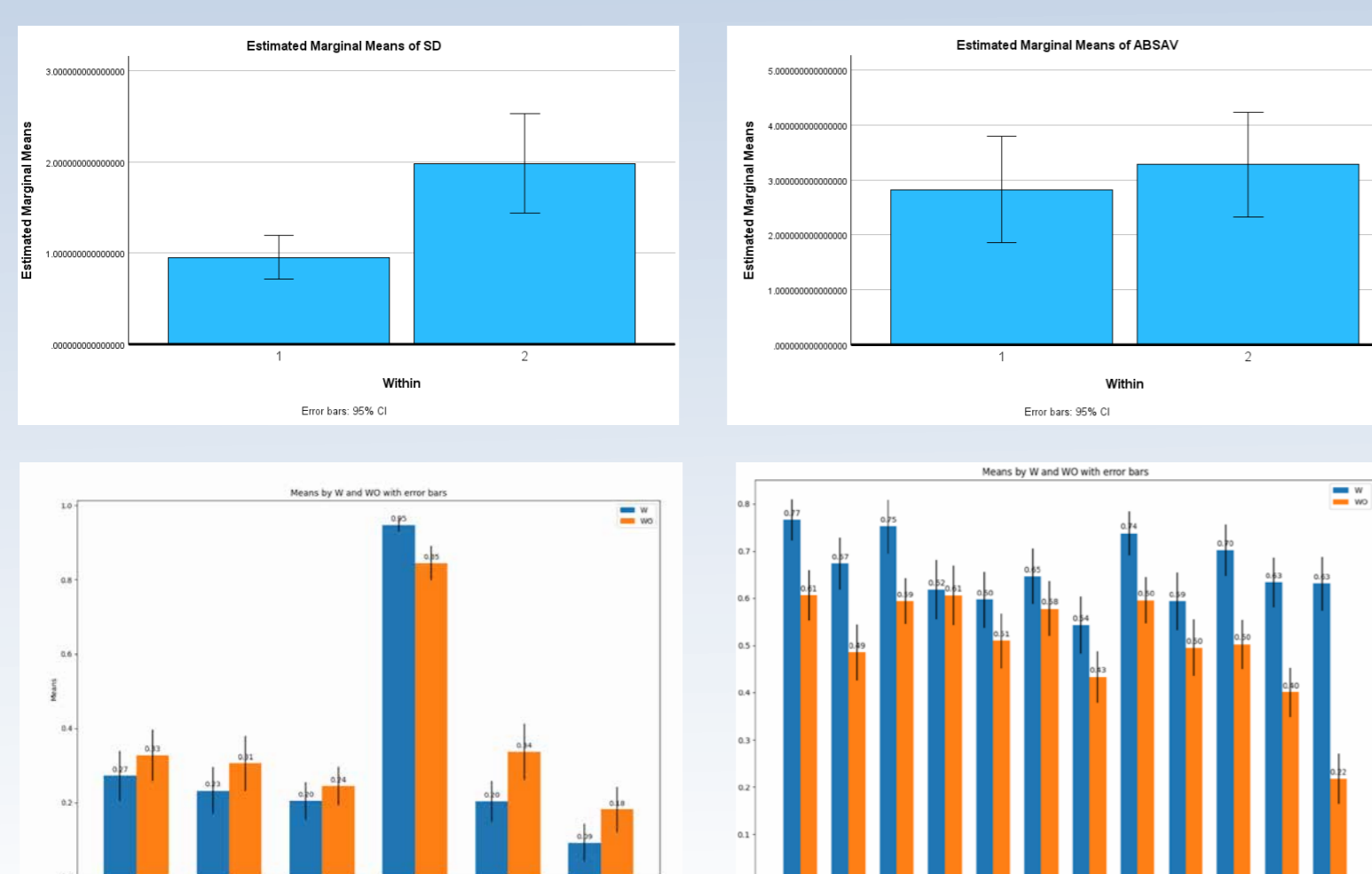
Hypothesis

The somatosensory can enhance users' perception of changes in virtual space and improve their ability to estimate distances between people/virtual objects and other virtual objects.

Protocol



Results and Conclusion



Conclusion

The study offers new insights into the intricate relationship between somatosensory and the user's presence experience and spatial perception in an XR environment. It uncovers the nuanced role of somatosensory in shaping the user's perception of the virtual environment and its interactions.

The study found that somatosensory significantly affects the precision of distance estimations but not their overall accuracy. This highlights the potential of somatosensory to enhance the user's spatial perception, particularly regarding precision. Also, it revealed that while somatosensory enhances certain aspects of presence and realism in an XR environment, such as the general sense of being there and the perceived realism of objects, it may not impact other aspects like captivation, involvement, and the naturalness of interactions. This suggests that the influence of somatosensory on the user's presence experience is complex and multifaceted, warranting further investigation. The study also found a potential trend toward decreased negative emotional states with somatosensory. This promising finding could have significant implications for enhancing user experience in the XR environment. However, more data is needed to confirm this trend. The last insight is that integrating somatosensory does not significantly impact the perceived mental and physical workload, pace, success, or effort required for the task. This suggests that adding somatosensory does not increase the cognitive or physical demands on the user, thereby maintaining the user-friendliness of the XR environment.

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How it feels: The value and application
of physical sensation in XR
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Integrated Product Design

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