Enhancing Autism Research with Apple Vision Pro: Developing Software for Data Collection

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Introduction

- Autism Spectrum Disorder (ASD) presents a complex neurodevelopmental challenge marked by difficulties in social interaction, communication, and repetitive behaviors. With a prevalence of approximately 1 in 36 children, its varied manifestations underscore its significance, ranging from mild to severe. The classification of ASD is notably intricate due to its diverse presentations. Despite these complexities, ASD classification offers significant benefits, including improved understanding, treatment, and support. Attention focus plays a crucial role in diagnosis, offering insights into cognitive functioning, sensory processing, and adaptive behavior, thereby aiding in tailored interventions for individuals with ASD.
- The recently released Apple Vision Pro is a state-of-the-art device in spatial computing, offering users immersive experiences in virtual environments with lifelike virtual objects. For researchers, it presents an unprecedented opportunity to conduct behavior research experiments, promising enhanced effectiveness and efficiency. Equipped with advanced sensors, including eye-tracking cameras, LiDAR Scanner, world-facing tracking cameras, and IMUs, the Apple Vision Pro boasts remarkable capabilities.
- In this study, the main objective is to develop software primarily focused on collecting attention data from the Apple Vision Pro. In the future, researchers could utilize this software to gather data from individuals with ASD and apply machine learning or AI methods to analyze attentional patterns and behaviors, thereby enhancing early diagnosis and classification of ASD.

Methods

- **Literature Review**: A literature review was conducted to explore attentional patterns in individuals with ASD and the utilization of technology for data collection in similar studies. This involved accessing scientific databases such as PubMed, PsycINFO, and Google Scholar to gather relevant peer-reviewed articles, research papers, and studies.
- **Application Development:** The Xcode beta software, available on MacOS, was employed to develop an immersive application using SwiftUI and RealityKit. This application was specifically tailored for compatibility with the Apple Vision Pro device, ensuring optimal functionality and performance. Through iterative development and testing, the application underwent refinement to enhance user experience and data collection capabilities.
- **Pilot Software Development**: A pilot software was developed with a primary focus on measuring user attention within a 3D immersive space. Leveraging the capabilities of SwiftUI and RealityKit, the software was designed to capture and analyze attentional data in real-time, enabling precise monitoring of user interactions within the virtual environment.
- **Pilot Software Testing:** The developed pilot software underwent rigorous testing to ensure that the desired data was accurately collected. This testing phase involved conducting simulated user interactions and scenarios within the immersive application environment, with a focus on verifying the functionality and reliability of the software in capturing attentional patterns effectively. Any identified issues or discrepancies were addressed through iterative refinement and optimization of the software.
- **Experiment Design:** Collaboration with ASD researchers were initiated to design a research experiment aimed at collecting attention data from users. This collaborative effort involved defining the parameters and objectives of the experiment, as well as determining the specific metrics to be captured by the pilot software during data

Results and Conclusion

- The pilot software was successfully developed and is capable of collecting the desired data from Apple Vision Pro.
- This project provides an innovative approach to collecting attention data for ASD research, leveraging the capabilities of Apple Vision Pro. Further research is planned to test the pilot software with individuals diagnosed with ASD and to analyze the collected data using machine learning approaches for early diagnosis and classification of ASD.

Plan for Further Research

- **Phase 2: Algorithm Development**
- Objective:
- Develop algorithms for the classification of attentional patterns using machine learning techniques.
- Activities:
- 2.1 Gather and preprocess attention data collected by the pilot application, collaborating with ASD researchers to obtain data from both ASD patients and normal controls.
- 2.2 Explore a variety of machine learning algorithms suitable for effectively classifying attentional patterns.
- 2.3 Train and validate the machine learning models using labeled data acquired from individuals with ASD.
- 2.4 Evaluate the sensitivity and accuracy of the developed algorithms for diagnosis.
- 2.5 Conduct a comparative analysis of the results obtained with existing methodologies.
- 2.6 Prepare and publish reports detailing the findings.
- **Phase 3: Experiment Design and Collaboration**
- Objective:
- Collaborate with ASD researchers to design experiments utilizing Apple Vision Pro for improving the early diagnosis and classification of ASD.
- Activities:
- 3.1 Establish communication and collaboration with ASD investigators.
- 3.2 Integrate findings from Phases 1 and 2 into the experimental design.
- 3.3 Develop experiments specifically aimed at utilizing Apple Vision Pro to enhance the early diagnosis and classification of ASD, incorporating attentional patterns and spatial data.
- 3.4 Obtain ethical approvals and permissions necessary for conducting the experiments.