Utilizing Mixed Reality Glasses as a Computer Peripheral Device for Users with Mobility Disabilities

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- Physicians with mobility disabilities experience bodily stress when using trackball/mouse and dictation microphone interfaces to interact with medical image viewer software over extended periods of time. According to the CDC, 8.4 million Americans live with mobility disabilities that hinder them in a similar fashion to this. [1]
- This problem also extends to individuals that spend long periods of time scrolling and navigating software with computer peripheral device like a mouse or keyboard.
- In this project, we present an approach for employing a Mixed Reality Head Mounted Display (HoloLens 2) to accomplish mouse and keyboard actions on a PC. This done by collecting Gaze and Voice input from the HMD and establishing a wireless connection with the PC to command certain actions like cursor positioning and clicking. With this approach, we intend to address common occupational injuries and soreness from body overuse.

HoloLens Development

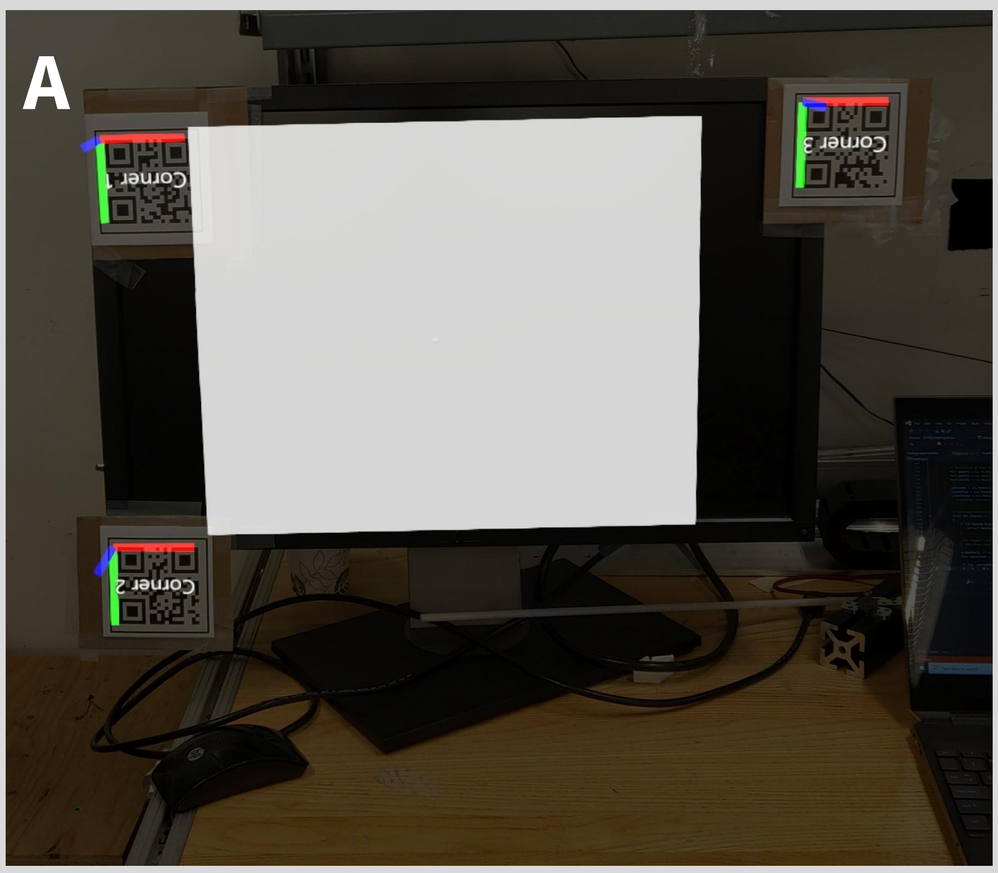

Fig.1: **A** Defining Screen Space on HoloLens 2. Using StereoKit, an open-source mixed reality library, App development in C# on the HoloLens 2 began with defining a plane that would serve as the workspace for the eventual PC screen. The plane was defined using 3 points embedded in QR Codes to allow continuous point tracking to update the plane as necessary. Next, gaze input from the HoloLens 2 was recorded at the point of intersection between the eye gaze and the defined screen plane. This gaze input was transformed from the World Space to the Plane Space to allow easy translation of cursor movement in 2D for the PC screen. This information is then sent to the PC

Communication

Communication between the HoloLens 2 and PC is handled by using a User Datagram Protocol (UDP) Client to send Datagrams from the HoloLens 2 to the PC via each device's IP address. This setup requires both devices to share the same Internet Network to work.

PC Setup

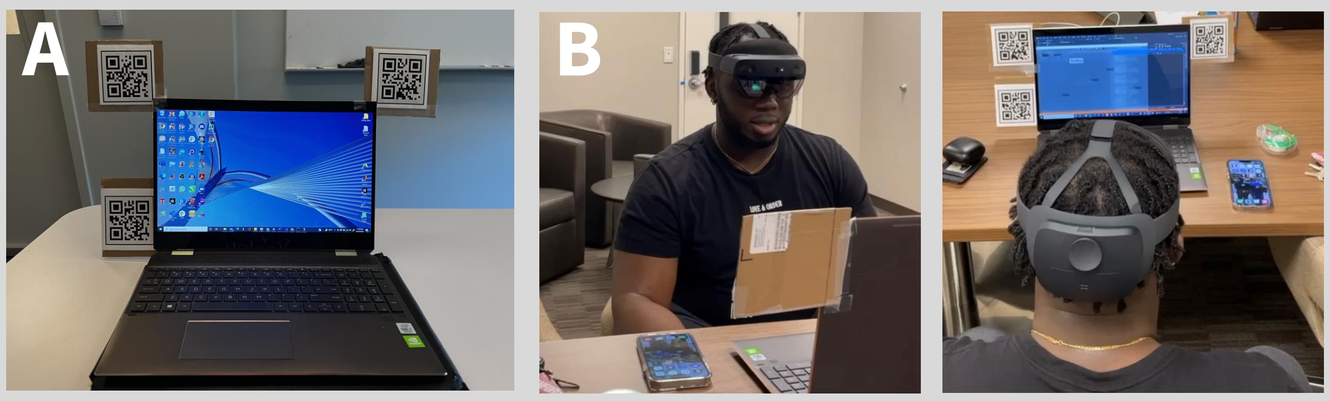

Fig.2: A QR Code Placement on PC for Development. The QR Codes are placed along the edges of the PC to make the points defining the Virtual screen plane lie with the Real screen plane as precise as possible. After setting up the plane, the user is then able to calibrate the setup so that the PC cursor follows their gaze across the screen. **B** Front and Back view of a user defining and calibrating the Screen Space using the HoloLens 2.

Calibration

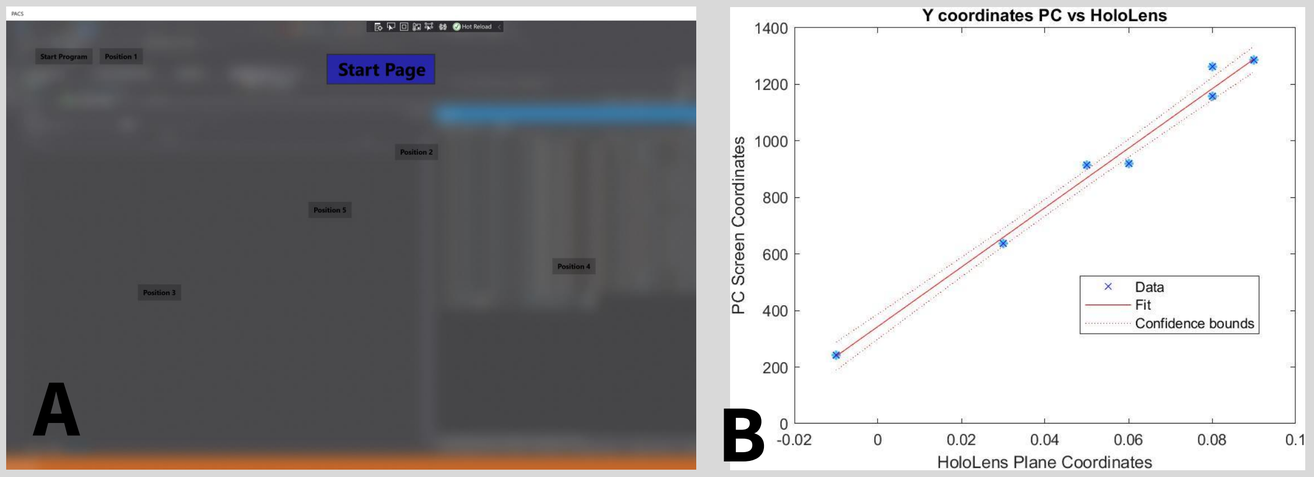

Fig.4: A PC App Displaying Calibration Points. Calibration of the Project is done by having the user look through the HoloLens 2 at 5 points on the Start Page of the PC app and matching their mouse cursor position with the same points. Users click each point as soon as their eye gaze and mouse cursor positions are aligned. These actions record the gaze input position as collected by the HoloLens 2 as well as the mouse cursor position as collected by the PC. This data is fit to a simple linear regression model to create two functions (one for each coordinate point X and Y) that translate the eye gaze position to the correct intended mouse cursor position.
B Calibration Model Fit. A graph depicting the accuracy of the models for Y coordinate.

Discussion and Next Steps

- There are several opportunities to make the software more robust.
  - This project is meant to interact with other applications on the PC to activate operations like shortcuts embedded into these applications and the capability for that is yet to be added.
  - Troubleshooting for eye saccades and ways to make the user experience more fluid.
- User testing still needs to be done to assess the user-friendliness of this project in a typical work environments. In particular, questions around the comfort of wearing the HoloLens for extended periods of time need to be answered.

Reference: Centers for Disease Control and Prevention. (2020, September 16). *Disability impacts all of us infographic*. Centers for Disease Control and Prevention. Retrieved December 2, 2021, from https://www.cdc.gov/ncbddd/disabilityandhealth/infographic-disability-impacts-all.html.