Synergizing Augmented Reality and Wearable Technology to Optimize Astronaut Extravehicular Activities

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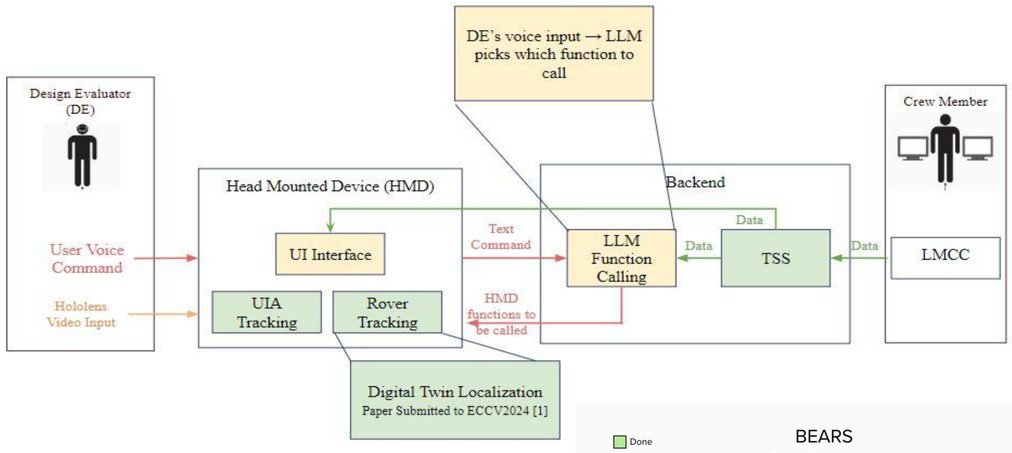
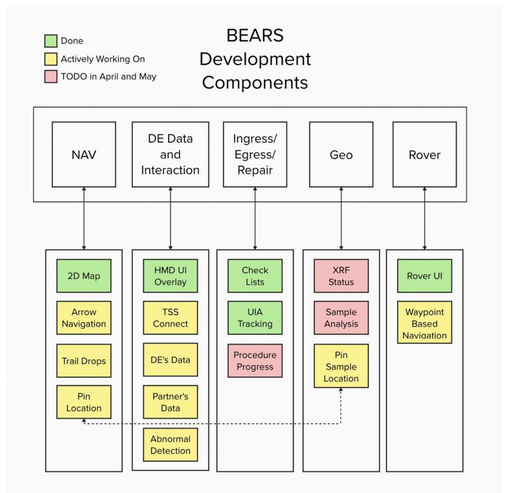
Abstract

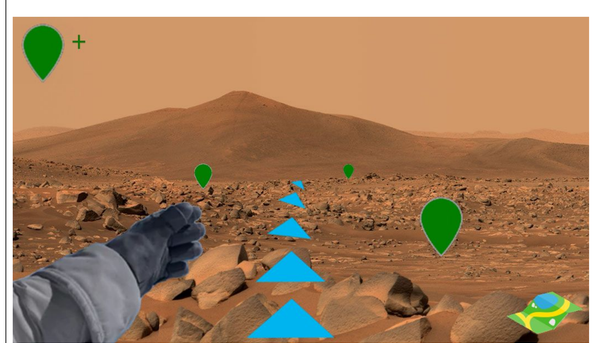
In future Extravehicular Activities (EVA) on missions to the Moon and Mars, the objective is to enable astronauts to minimize their reliance on peripherals, reducing the risk of muscle fatigue and scenarios that may lead to pinch points. Large Language Models (LLM) take one step towards removing the hand dexterity requirement necessary to interact with the Augmented Reality User Interface (UI), enabling voice commands as an alternative solution. Voice data from the Head Mounted Display (HMD) is translated into strings received by endpoints in the Mission Control Console (MCC) backend and transferred to the LMCC with keywords to process updates to its frontend or return important information to the requesting user. The MCC also utilizes UIs to prompt the user back at base for navigation updates and rock scans that are sent to the HMD using the same network. The Moon's surface has extreme sunlight levels even with a visor, hence the UI design uses neon green to highlight the text against the bright and dark backgrounds. Multiple IP Addresses are available to the astronaut on the Moon hence the design to add dropdowns to the left of the screen, along with the UI design including astronaut(s) biometrics and current procedures on the top right side of the overlay's dimensions. Spacebear' ExoSuit aims to house the peripherals to ensure that they are protected and placed in such a way that enhances user safety and comfort.

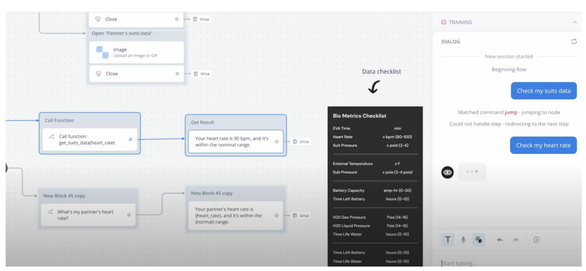
Software



For our Hololens UI we have five main components including Navigation,User/Suit information, Geo, Rover, and EVA. Each of these components aids the astronaut in their mission and has been designed for maximum efficiency and usability. One of the key features of our project is the AI voice assistant which allows the user to be able to access the different features without doing so manually and can keep their hands free to perform other tasks.







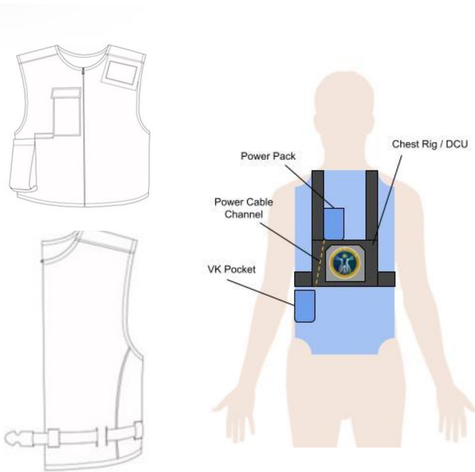
Hardware

First Prototype

Second Prototype

Our ExoSuit incorporates a Vision Kit integrated into a pocket at the rib area, specifically designed to accommodate a chest rig housing DCU (Display Control Unit), enhancing functionality and accessibility. The Vision Kit is securely fastened to the user's body and vest using its built-in belt, ensuring stability and comfort during movement. For additional protection, the Vision Kit is tethered within the pocket using a key holder mechanism, preventing it from dislodging inadvertently. Moreover, the design of the ExoSuit aligns with NASA's inclusivity goals, featuring an elastic banded cinch that allows for an adaptable fit, catering to users of varying heights and weights, ensuring both comfort and operational efficiency.

For our ExoSuit, we use durable camo canvas made from 100% cotton bottom weight fabric. Sturdy plastic utility zippers ensure reliable use, while near industrial strength Velcro provides secure, easy-to-handle closures. An elastic tether adds flexibility and enhances the equipment's utility with adjustable attachments. These materials are chosen to maximize performance and protection of components in our Exosuit which include NASA's Vision Kit and its connecting power bank.



References:
NASA, Design Review Slides

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