Spatial Positioning On Terrain

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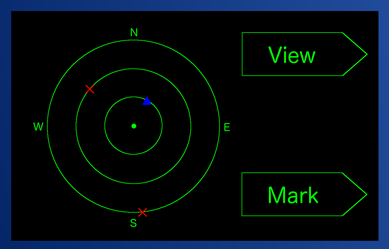
Abstract

Astronauts are overwhelmed with large amounts of information, and are unable to fully utilize their senses, making it difficult to recall their training to carry out exploration. SPOT is a prototype human communication interface designed with the goal of to reduce an astronaut's cognitive load while conducting future space exploration missions. The forearm wearable accomplishes this goal by reducing the reliance on vocal communication and reducing an astronaut's workload by seamlessly collecting and distributing mission-relevant information, such as location data and points of interest, via haptic alerts and wireless transmission.

User Interface

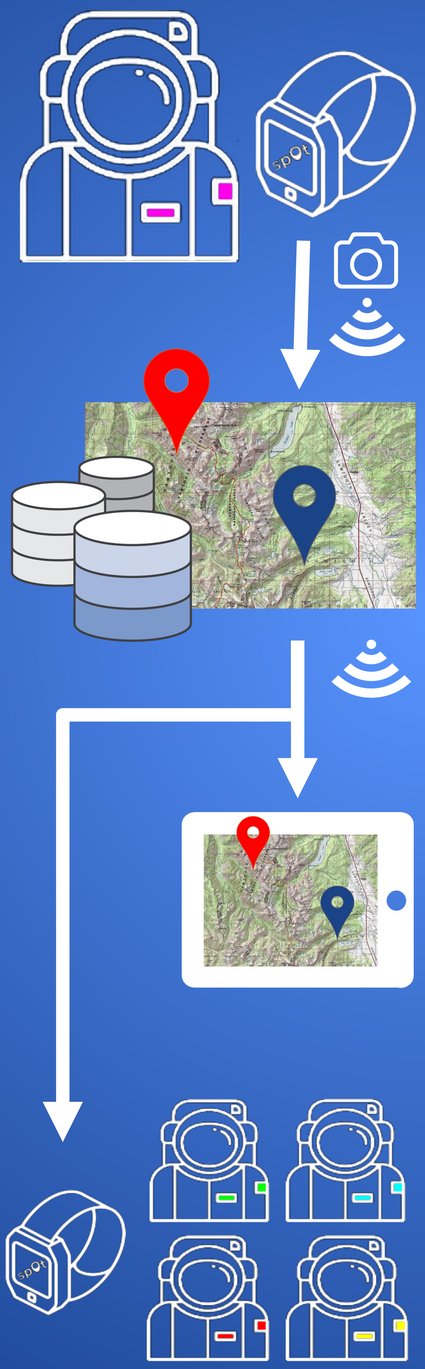
The user interface utilizes a simple, but effective organizational scheme that conveys the necessary information quickly. There is a dedicated button for canceling and additional for selecting.



The initial state has a radar style view to keep track of points of interest, and the button selects allow the user to either view points of interest around them or mark new points.

When the user enters the range of a point of interest/danger, they will be alerted with this screen. The user can then choose to dismiss the alert to return to the main activity.

User Flow



The user finds a point of interest or danger and decides to mark it on the device by utilizing the camera, rangefinder, IMU, and GPS -- all to emulate what astronauts would use in space. The astronaut classifies this point and completes the mark.

The position, description, and picture are sent back to the home base via wireless transceivers. The information is stored in a database and used to determine points of interests and danger around the astronauts.

The home base will also display the points of interests, dangers, and astronaut positions on a user interface via a web browser. As well, there is a mobile application that will allow a user to view the points easily.

The device pulls necessary information from the home base, so when other astronauts are in a certain range from a marked point, it will alert them via haptic feedback. Information can be viewed on the device through a simple user interface.

Device

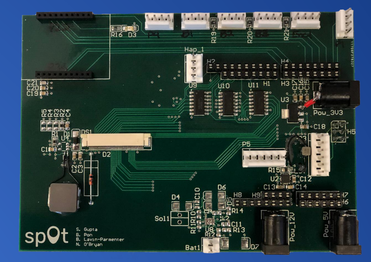


Figure 1: Printed Circuit Board

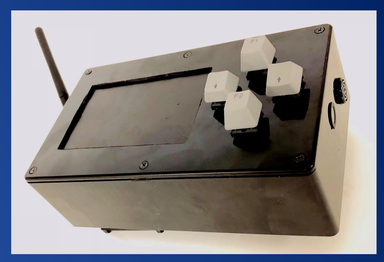
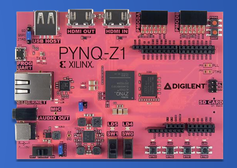
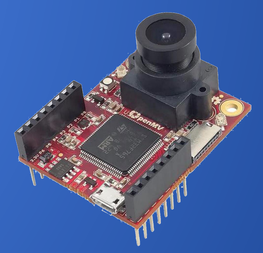


Figure 2: Assembled Device

Critical Hardware

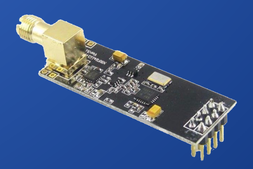


Xilinx PYNQ-Z1
- 650 MHz Dual-Core ARM Cortex A9
- 100 MHz Artix-7 FPGA
- 512 MB DDR3 @ 1050 Mbps



OpenMV M7 Camera
- 216 MHz ARM Cortex M7
- OV7725 Image Sensor (2.8mm lens)
- Resolution 640x480 (RGB888)

U-Blox NEO-M8P GPS Module
- 72-channel u-blox M8 engine
- Centimeter-level GNSS positioning
- Integrated Real Time Kinematics



Nordic NRF24L01+ Transceiver
- 2.4 GHz GFSK RF transceiver IC
- Enhanced ShockBurst™ protocol
- Up to 2Mbps on-air data-rate

Acknowledgements
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Scan to see a demo of our device!

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