Background

Exploring Mars
Background

- Humidity
- Water
- Oxygen
- Temp
- CO2
- Power
- Monitoring Life Support

Exploring Mars
Background

Exploring Mars

Meeting Science Objectives

- Instruments
- Deployment
- Robotic Assets
- Pictures
- Descriptions

Monitoring Life Support

Humidity  Water
Oxygen    Temp
CO2       Power

Instruments
Samples

Background
Overview
Hardware
Subsystems
Construction
Software
Interface
Demo
Conclusion
Background

- Humidity
- Water
- Oxygen
- Temp
- CO2
- Power

Monitoring Life Support

- Exertion
- Heart Rate

Monitoring Physiology

- Voice
- Video
- Other Audio
- Text

Supervising Communication

- Instruments
- Samples
- Deployment
- Robotic Assets

Meeting Science Objectives

- Pictures
- Descriptions

Managing Timeline

- Tasks
- Time on
- Position
- Accuracy
- Contingencies
1 or 2 seconds delay
Background

worst case: 20 minutes delay
Overview

Wireless, forearm wearable

Central database for location data, images, and other relevant metadata

Haptic alert mechanism and simplistic user interface
Overview
Hardware System

Processor

- PS
  - ARM A9
- BRAM
- DDR
- SD
- FPGA Artix 7
- C

Sensors

- Transceiver
- SPI
- GPS
- I^2C
- RS-232
  - Rangefinder
- UART
  - Camera
- I^2C
  - Haptic Motor
- I^2C
  - IMU
- SPI
- GPIO
- Display
- Buttons

Introduction
Background
Overview
Hardware
Subsystems
Software
Interface
Construction
Demo
Conclusion
Hardware System

**Processor**
- Python
- BRAM
- DDR
- SD
- ARM A9

**PL**
- FPGA Artix 7
- C

**Communication**
- Transceiver
- GPS
- SPI
- I^2C

**Sensors**
- RS-232
- UART
- I^2C
- IMU
- Rangefinder
- Camera
- Haptic Motor

**GPIO**
- Display
- Buttons
Hardware

- PYNQ FPGA - ZYNQ XC7Z020
  - 650MHz Dual-Core Cortex A9
  - 100MHz Artix-7
  - 512MB DDR3
  - 630KB BRAM

- Processing System (PS)
  - High-level Python-based custom drivers

- Programmable Logic (PL)
  - Low-level C-based custom driver
  - Customized FPGA overlay
Hardware

PCB Revisions

Rev. A:
- Focus on peripheral flexibility
- Robust headers

Rev. B:
- Simplified (removed some test features)
- Significantly smaller
  - 50% reduction in size
- Low profile
Subsystems

- Rangefinder
- OpenMV M7 Camera
- IMU
- Haptic Motor
Subsystems

- Rangefinder
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Sensors
Subsystems

- Rangefinder
- OpenMV M7 Camera
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Subsystems

- Nordic nRF24L01 Transceiver
- uBlox NEO-M8P GPS

Communication
Subsystems

- Nordic nRF24L01 Transceiver
- uBlox NEO-M8P GPS

Communication
Software

Embedded Software

Introduction
Background
Overview
Subsystems
Hardware
Software
Interface
Construction
Demo
Conclusion
Software

Database & User Interface
Interface

- User alerted through haptic feedback
- Tactile feedback (buttons)
- 5” 800x480 TFT Display
- Extremely simple, no room for confusion
- Four buttons to select, return, and navigate between options
- User can navigate into viewing and marking states
- Two effective states:
  - Selection of a point
  - Access to the data associated to a selected point

- Navigation buttons to cycle through points

- Each point contains important data
  - Type
  - Creator
  - Distance
Interface

- Two Working States
  - Image creation view
  - Tag creation/ image verification view

- Verification State allows users to select tags and confirm or retake the image
Interface

- Interrupts the user's current state when they are within 10m of a point

- User can then dismiss the alert to be returned to the state they were in last
Construction

- Project prototype box
- 3D printed mounts
- Velcro straps
- Challenges include:
  - Wire management
  - Peripheral placement
    - Antenna
    - Sensors
    - Buttons and dial
  - Durability (strain relief)
Questions?

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