The Person-Portable Soil Moisture Mapping System is an alternative to unmanned aerial, or satellite systems of similar technology. Its higher resolution design can be more useful for surface mapping validation, precision agriculture, evaporation and transpiration studies of boundary layer heat transport. The more affordable Person-Portable Soil Moisture Mapping System allows users such as researchers, landowners and farmers to map their land for Volumetric Soil Moisture (VSM), Normalized Difference Vegetation Index (NDVI), and thermal temperature in real-time.

### Decameter Resolution

NDVI (NIR, SWIR Wavelength)

Not Real-Time

### Lobe Difference Correlation Radiometer (LDCR)

Then the Raspi 400 will combine GPS data and soil moisture saturation data and map the correlation radiometer (LDCR). The product uses optical sensors to determine NDVI and uses Lobe Difference correlation radiometer (LDCR) to measure the microwave. The user interface Raspberry Pi (Raspi 400) takes two inputs (NDVI and microwave) and determines the soil moisture saturation.

Then the Raspi 400 will combine GPS data and soil moisture saturation data and map the real-time soil moisture saturation.

### Optical sensor (OPT301)

This photodiode will change the voltage across it according to the light intensity hit on it connected to an amplifier. According to the figure 3, the ratio of voltage across the photodiode and the power of light with different wavelengths hit on the photodiode.

To get rid of the effect of ambient radiation, one sensing board faces up which the majority of its measurement is ambient radiation. The other facing down board is measuring the ambient radiation and radiation reflected back from ground. By measuring both two kinds of radiation and applying our algorithm, the ambient radiation can be filtered out.

### The Unmanned Aerial/Satellite Design

- Decimeter Resolution
- NDWI (NIR, SWIR Wavelength)
- Not Real-Time

### Person-Portable Design

- Meter Resolution
- NDVI (Red, NIR & Green Wavelength)
- Real-Time

### Person-Portable Soil Moisture Mapping System

The Person-Portable Soil Moisture Mapping System is a product that can help users to determine such as researchers, landowners and farmers to map their land for surface mapping validation, precision agriculture, evaporation and transpiration studies of boundary layer heat transport. The more affordable Person-Portable Soil Moisture Mapping System allows users such as researchers, landowners and farmers to map their land for Volumetric Soil Moisture (VSM), Normalized Difference Vegetation Index (NDVI), and thermal temperature in real-time.

### Normalized Differential Vegetation Index Sensor (NDVI)

VSM is known to be correlated with vegetation indices such as NDVI and Normalized Difference Water Index (NDWI). The unmanned aerial system designed by the CET lab uses NDWI to calculate the soil moisture, whereas the Person-Portable Soil Moisture Mapping System uses NDVI and extra GREEN wavelengths to improve accuracy over previous methods.

### Mechanical Structure

#### Design:

- Frame
  - Child Carrier Hiking Backpack designed to be ergonomic and hold a significant load
- Cantilever Arms
  - Designed to keep weight low while retaining structural integrity.
  - Seven foot carbon fiber rods
  - 3D Printed Nylon Carbon Fiber parts
  - Laser cut Acrylic plates
- Suspension
  - A system of five pulleys holds the apparatus upright
  - The rope is secured near the user with a rope cleat for easy adjustment
- Counterweight
  - Mounted to the back of the backpack frame, the counterweight, along with the battery produces the backward torque necessary to balance the system.

### Results

#### Expected Real-time VSM Map

#### Expected Final VSM Map

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**Acknowledgement**

Thank you to Professor Albin Gasiewski (Center for Environmental Technologies) for his help and support thought this project. We’d like to also thank Eryan Dai, Jason Elston, BlackSwift, Professor Eric Bogatin, Mason Bell for their generous assistance and knowledge.

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**Objectives**

The Person-Portable Soil Moisture Mapping System is an alternative to unmanned aerial, or satellite systems of similar technology. Its higher resolution design can be more useful for surface mapping validation, precision agriculture, evaporation and transpiration studies of boundary layer heat transport. The more affordable Person-Portable Soil Moisture Mapping System allows users such as researchers, landowners and farmers to map their land for Volumetric Soil Moisture (VSM), Normalized Difference Vegetation Index (NDVI), and thermal temperature in real-time.

**Sub-Systems**

- Normalized Differential Vegetation Index Sensor (NDVI)
- Lobe Difference Correlation Radiometer (LDCR)
- Optical sensor (OPT301)

**Introduction**

The Person-Portable Soil Moisture Mapping System is a product that can help users to determine the soil moisture saturation in a range from 2-3 square meters at one time. Users can carry the product and walk around to determine the large scale of soil moisture saturation and map it for 2.5 hours. The product uses optical sensors to determine NDVI and uses Lobe Difference correlation radiometer (LDCR) to measure the microwave. The user interface Raspberry Pi (Raspi 400) takes two inputs (NDVI and microwave) and determines the soil moisture saturation.

Then the Raspi 400 will combine GPS data and soil moisture saturation data and map the real-time soil moisture saturation.

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**Sub-Systems**

- Normalized Differential Vegetation Index Sensor (NDVI)
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