Group Dec 15-19

Project Plan

Version 1.0

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Problem Statement

The world's first satellites able to remotely observe near-surface soil moisture from space either have recently been launched (European Space Agency, 2010) or will soon be launched (NASA, 2015). Near-surface soil moisture is the water content of the top 3 to 5 cm of the soil surface. Near-surface soil moisture affects how water and energy move between Earth's surface and atmosphere, and observations of this phenomenon will be used to make better weather and climate forecasts. Before they can be used, the near-surface soil moisture observations must be validated using on-the-ground measurements. As we have begun to validate these observations, we have found that soil surface "roughness" or the mm-scale variations in the height of the soil surface (microtopography) can "confuse" satellites and therefore must be taken into account. The problem is that it is difficult and time-consuming to make good measurements of soil microtopography. I've heard rumors that the Xbox Kinect can be hacked to make scans of surfaces. Or perhaps commercial camera technology can be used to measure microtopography. Hence I challenge a senior design group to come up with a method of measuring soil microtopography that is quick, accurate, and precise using commerically-available technologies that may have not been intended for this use.

Deliverables

Minimal Viable Product

After further review, our group decided to utilize existing hardware such as the Xbox Kinect and Raspberry Pi to assist us in working on the senior design. By incorporating the said hardware and our knowledge, ideally we should at least engineer a prototype that addresses the hardware aspect of the said issue.

Future Iterations

Upon completion of the hardware, we should work on the software that interfaces with the hardware.

Specifications

The product will allow the client to take soil roughness measurements quickly and accurately without large heavy equipment needed. The measurements will be taken using the Kinect IR camera and the data is then transferred to the Raspberry PI for storage purposes. The Raspberry PI is chosen as storage medium due to its small size and its small power consumption. After the data has been transferred to the Raspberry PI, it can then be transferred to a computer for further processing.

User Interface Description

The user interface will be very easy to use and will mainly comprise of a center view that will contain a two dimensional map/array that will show the value of the highest point in that section of the soil. The array will have cells that will be equivalent to a cm x cm patch of the soil. There will also be buttons to select which file the data will be pulled from and another to start the processing of the data.

Functional Requirements

Hardware	Our system should use a Xbox 360 Kinect and Raspberry Pi in order to take in the field measurements of soil roughness.
	The Raspberry Pi will need to store the measurements until the user is able to move them to a PC for processing.
Software	The software should take in the measurements from the field and output an array where each cell contains the height of the soil in that cell.

Non-Functional Requirements

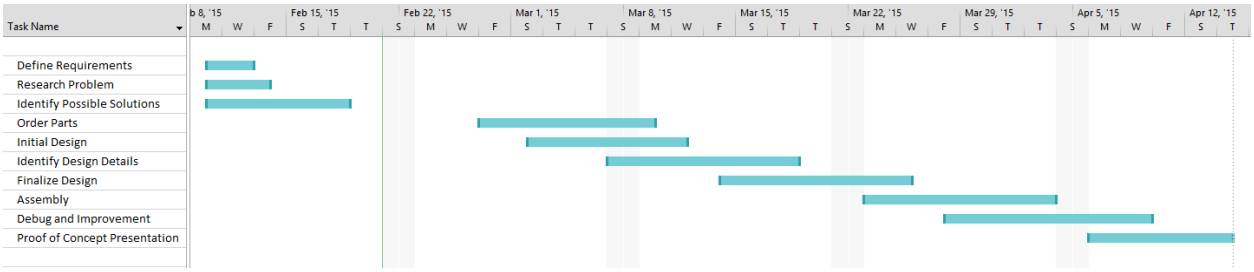
Easy to use	The hardware and software should be easy to pick up and use for the end user
Simple interface	The hardware should be simple and easy to use where the end user will be able to pick it up and figure out how to use it.
	The software should be easy to use and simple to import the field measurements.
Responsiveness	

Work Breakdown Structure

Resource Requirements

Resource	Purpose	Means of acquiring	Estimated cost
Xbox Kinect	Used to photograph the soil	Purchase	$200
Raspberry PI	Used to store the data	Purchase	$35 - $50
Battery Pack	Used to power the devices	Purchase	$100 - $150

Project Schedule



Risks

Accuracy: There are concerns that the final product might not be as accurate as what our client wants. Additionally, the hardware that we are using is not capable of producing a high quality photographs at the first place, so that might be an issue even if there is method to improve the output quality.

Competition: The product that we are making is essentially competing with existing similar products in the market. Since we do not have a lot of budget in the project as a whole, we only have access to limited amount of available hardware with decent functionality.