CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
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Project Number
S0909

Project Title
Building a Non-Contact Soil Sensor Using Electromagnetic Induction

Abstract

Objectives/Goals
Farmers can maximize crop yields by measuring soil electrical conductivity (EC), the soil#s ability to conduct electricity. By determining the soil#s EC, farmers can decide how to control their crops based on the amount of nutrients and moisture available in the soil. Two methods of testing exist: contact probes (frequently used but bulky) and non-contact devices (high cost and not accessible to most farmers). I designed and built a low cost, accessible, and portable device using electric components and computer programming to measure the soil#s electrical conductivity without contacting the soil.

Methods/Materials
This device consists of one transmitting and one receiving coil that work through the principle of electromagnetic induction. An oscillating signal is produced and sent through the transmitting coil which induces a magnetic current in the ground. The receiver reads both the transmitting coil and the eddy currents produced by the conductive soil. A microcontroller then interprets this data to determine the soil#s electrical conductivity.

Results
The sensor was tested in a controlled environment with different soil types and moisture levels. These results were compared to a gravimetric system (soil moisture) of measuring which corresponds with soil EC (the higher the EC reading, the greater the moisture in the soil). Both results showed correlation with each other.

Conclusions/Discussion
The design criteria and engineering goals were met. This non-contact sensor can greatly help farmers and gardeners determine soil EC, which correlates with other properties of soil such as salt and moisture content in the ground. This prototype is inexpensive to produce and can be distributed for widespread use. Outside of agriculture, this device can be adapted to the mineral, oil, mining, water, and archaeology industries/studies and has many potential applications.

Summary Statement
For my project, I designed and built an efficient and low cost electromagnetic induction (EMI) non-contact soil sensor to measure soil electrical conductivity.

Help Received
My father helped explain the computer programming, and my mother helped with my display. I would like to thank Mrs. Anderson and Dr. Oliver for their guidance and Telefunken for providing materials.