“Smart” Garden Irrigation: A WiFi-connected system to measure soil moisture and make watering your plants easy and fun!

Jay Ham Lab Group
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COVID-19 Community Health Recovery in Colorado
Our Team

• Investigator and Coordinator
  • Jay Ham, Professor, Soil and Crop Sciences
  • Katie Dunker, Colorado Master Gardener Statewide Coordinator

• Graduate Students
  • Ian Aksland, Dylan Casey, Hairik Honarchian

• Undergraduate Students
  • Lucille Rollins, Andrew Barney
Rationale and Benefits

• Jay Ham’s team has been developing low-cost, internet-connect soil moisture sensing technology to improve irrigation management.

• A DIY simplified “Homeowner” version is possible that could be used by Colorado home gardeners in 2020.

• This technology could integrate with the Colorado State University Master Gardener Extension Program. Jay Ham’s group would benefit by getting user feedback from Master Gardeners on how to improve the technology. The Gardeners would benefit with improved irrigation management and plant productivity. The effort would also have considerable STEM learning potential for K-12 students.

• Overall, the project could enhance community recovery from the COVID-19 pandemic by: 1) Improved local food production (food security), 2) promote solitary outdoor activity for physical and mental health, and 3) create outdoor hands-on STEM related educational opportunities for k-12 students when school buildings are closed from stay-at-home orders.
Objectives - Our team will:

• Design, build and test a DIY internet-connected, low-cost system that measures soil moisture in gardens every hour and sends data to a free cloud service using existing on-site WiFi.

• Configure an IoT system that displays real-time soil water status on the users smart phone and sends them an email when its time to water.

• Develop training materials such as videos, website content, and webinars to assist in building, installing, and using the system.

• Build custom hardware (soil sensors, and carrier boards) that will allow users to easily and economically acquire the parts they need to build the system.

• Train extension personnel and master gardeners how to use the technology.

• Track the success of the project over time

• Teach basic irrigation practices and concepts along the way
Real-time soil moisture data and weather forecast, and email notifications sent to gardeners and their teams. If they want, they can share data with others (e.g., master gardener).
The IoT Soil Moisture Technology Requirements

- Low Initial Equipment Cost
- No reoccurring costs (no monthly fees)
- User friendly Installation - no special tools, no special software skills.
- Easy to setup IoT account and interpret the data and notifications using phone, tablet, or pc
- Easy to train, teach, and support the technology via the Master Gardener Extension Program
- It works!
The Soil Moisture Sensors
Soil Moisture Measurement System: Block Diagram

- Battery Pack: 3 x AA 4.7V
- Carrier Board: ESP 32
- Enclosure
- Sensors
- Signal Cable
- Cable Glands
- Max of 6 sensors
Training and Outreach Program

- Instructables
- Videos
- Webinars
- Demonstrations
- Beta testing at several gardens in Northern Colorado
Training Modules

**Hardware**
- How to install the measurement system in the garden
- How to decide where soil sensors should be located
- How to change batteries

**Software**
- How to program (setup) my soil monitor – programming my WiFi and location
- How to use Thingspeak so I can see my data
- How to set my soil moisture threshold i.e., “trigger point” that will send email when its time to water
2020 Timeline

• May 1, Have a prototype system running in a garden
• May 15, Have a basic Instructables and instructional video completed on how to use the system and ready to post online
• June 1, be ready to deployment at multiple test locations (e.g., 10) across northern Colorado. Have carrier boards and sensors ready.
• June, conduct video demonstrations and webinars
• July - Sept, collect data and feedback from users.