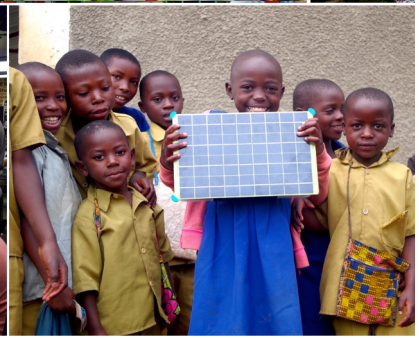
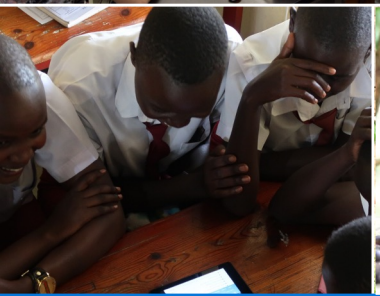








Project-Based Learning for Real-World Impact: SolarSPELL and SolarSENSE




Arizona State University

SolarSPELL

Bruce Baikie

Faculty - Arizona State University

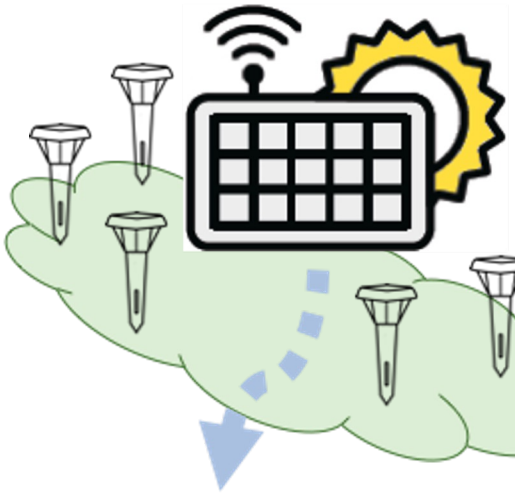
School for the Future of Innovation in Society

Co-Founder & Co-Director

ASU SolarSPELL Initiative

Solar Powered Soil Sensors

- Low Cost
- Open Source Design
- Off Grid Usage with SolarSPELL Digital Agricutrial Library



SolarSENSE

Off-grid soil sensing and digital library on the rural farm

Solar Powered Sensors

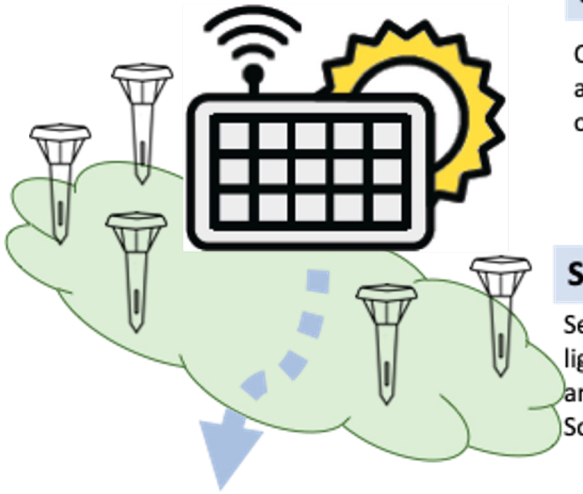
Sensors measure water, temp, light, and phosphate levels in soil and WIFI communicates data to SolarSPELL

Off-Line Farmers

Access to soil status/analysis and digital agriculture library completely off-line

Solar Powered Soil Sensors

- Soil Temp
- Moisture Level
- PH Level
- Solar irradiance
- Humidity
- Air Temp



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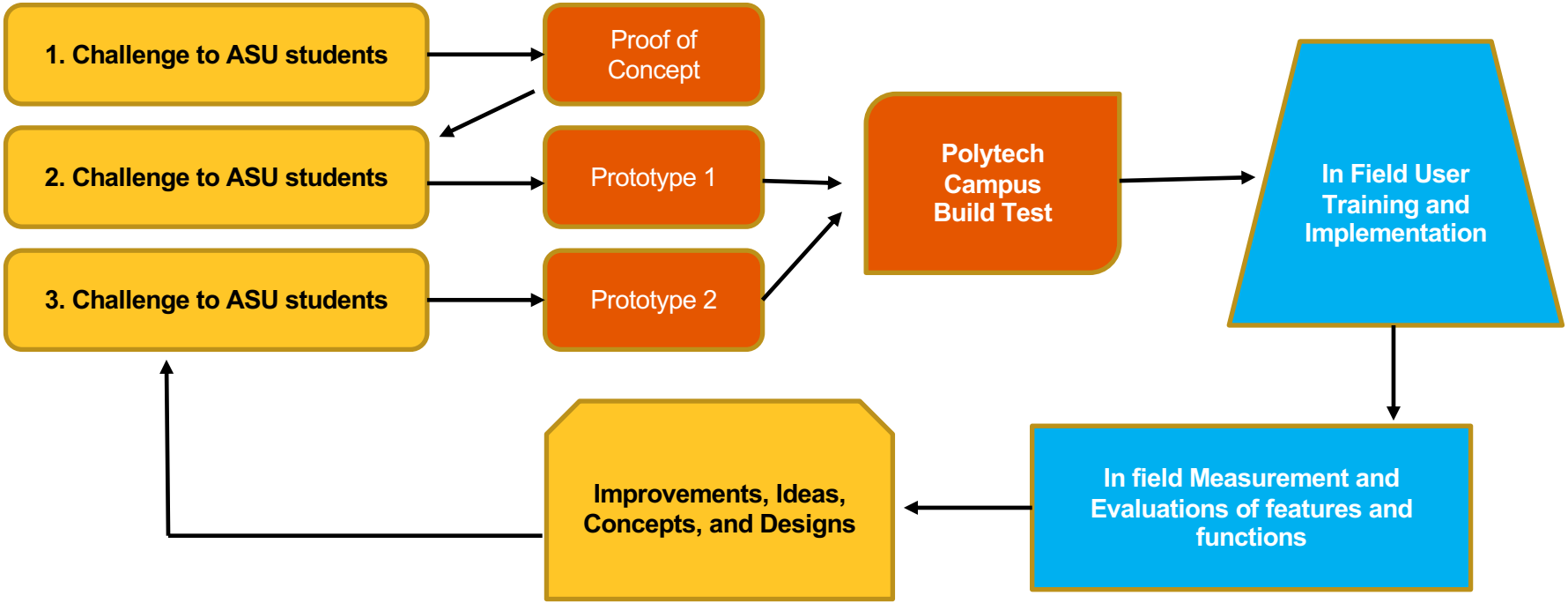
Data Flow

1. **SolarSENSE Code**
   a. **Sensor Code to collect data and relay via WiFi**
   b. **SolarSPELL to collect via WiFi data from sensors in range and collate/average.**
   c. **On SolarSPELL - AI to match sensor readings to library content**
   d. **Recommend Intervention Displayed on web browser**

Dr Hosman's Humanitarian Engineering Innovation Model



Proof of Concept Student Team

POC Field Test - MA‘O Organic Farms

Prototype One - EGR 307 Humanitarian Engineering Class

System Development - EGR 307 Humanitarian Engineering

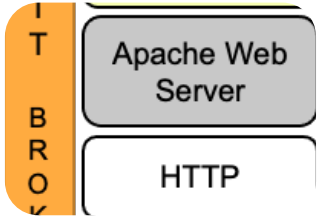
Four Student Teams

1. Hardware – Industrial Design
2. Electrical & PCB Design
3. Embedded Software Design
4. Linux software stack Design

Hardware

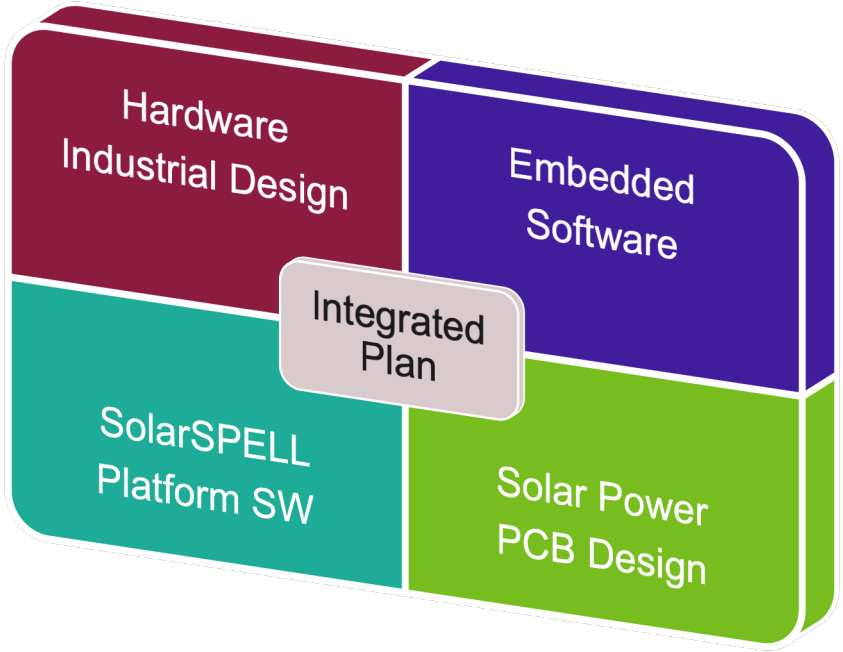
Solar Power System

Sensor Embedded Software

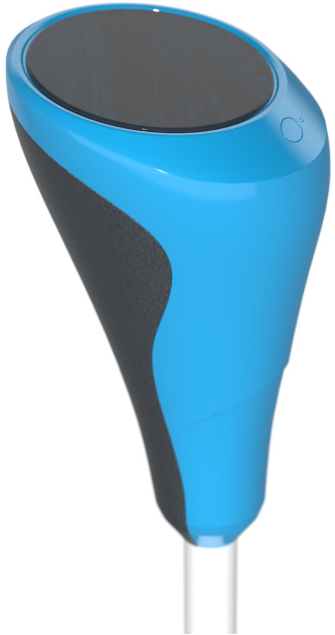


SolarSPELL System Software

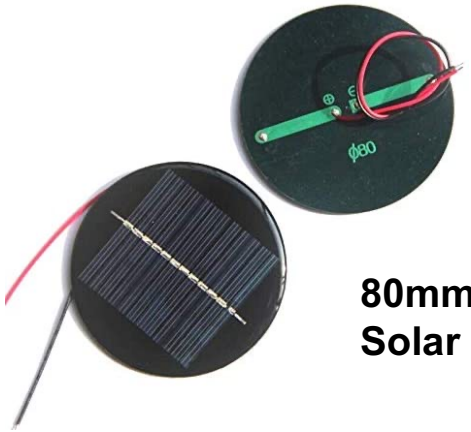
Four Teams – Integrated Plan



Hardware – Industrial Design
Team 1



Solar Power – PCB Design Team 2



80mm diameter Solar Panel

Charge Controller Board

Li-ion Battery

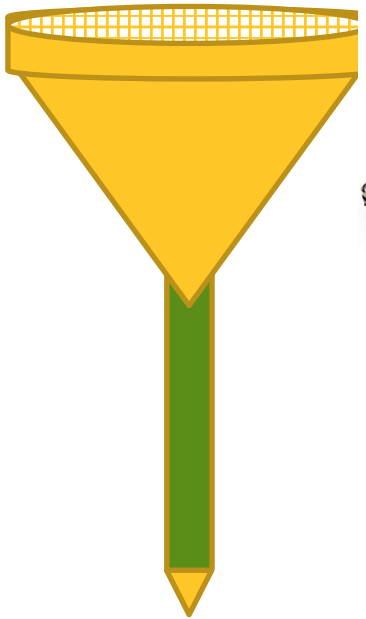
System Power Requirements

Component capacities

- Solar Power
- Battery
- Charge Controller

PCB - Charge Controller Reference Design

Embedded Software Design Team 3



Sensor EPS32 Control Board

Sensor Tip

Sensor Control Board

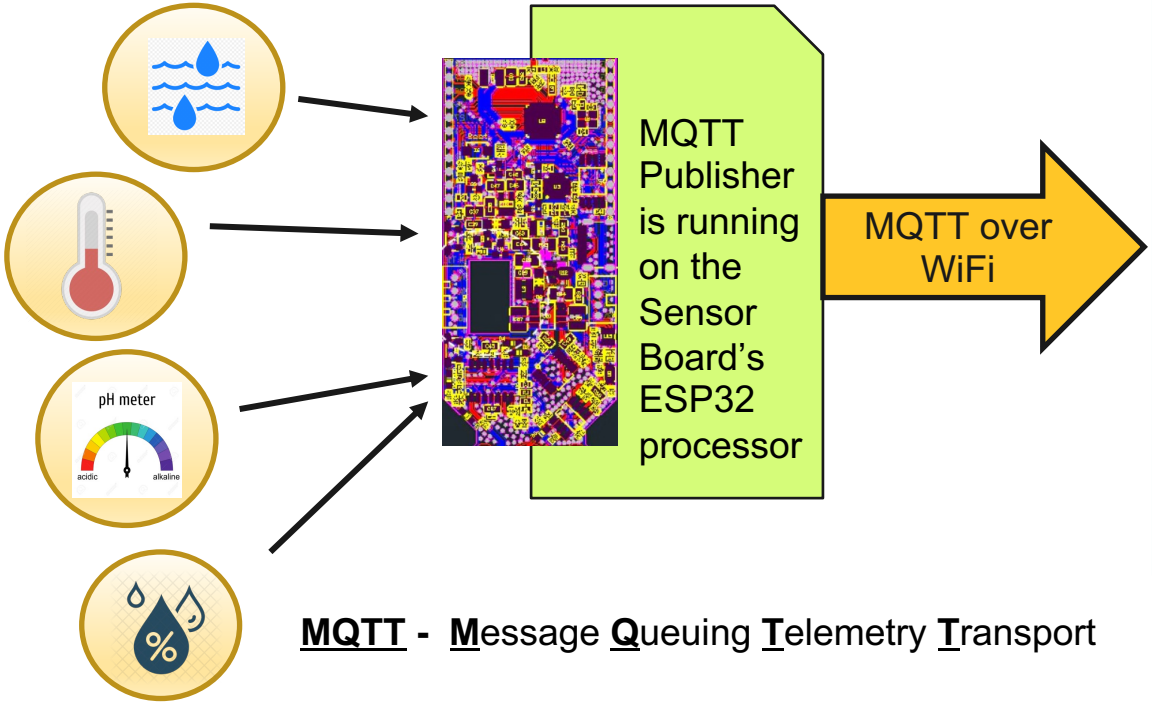
ESPRESS ESP32 Xtensa® 32-bit LX6 micro processor

- WiFi 802.11 b/g/n
- OS - FreeRTOS
- Onboard DHT11 - Humidity Sensor

Sensors

- pH
- Temp
- h2o
- Humidity

SolarSPELL Platform
Software Design – Team 4



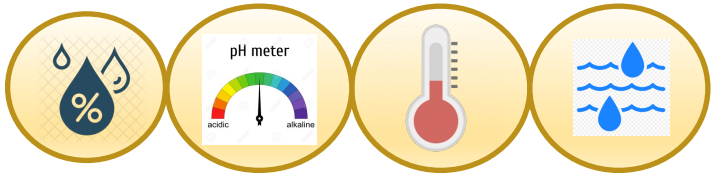
MQTT - **M**essage **Q**ueuing **T**elemetry **T**ransport

Field Beta Test and feedback

1. Hardware communication and data gathering from sensors
2. User Interface via web server on SolarSPELL
3. Compare data to standard soil testing

Solar Powered Soil Sensors

• Soil Temp	18 C
• Moisture Level	34%
• PH Level	8.9
• Solar irradiance	4.8 kWh
• Humidity	57%
• Air Temp	29 C



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- Moisture Level 34%
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- Solar irradiance 4.8 kWh
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Questions?


ASU
Arizona State
University


SolarSPELL®