Energy Monitoring and Management System: Moving Toward a Modular Design

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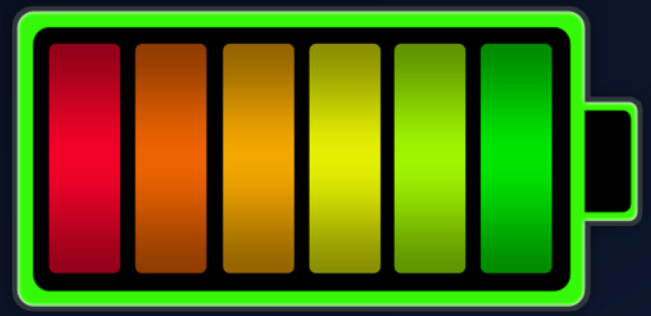
The Need

Objective – Design and implement a reliable, manufacturable device to measure, display, and limit energy usage for clients with limited access to electrical power.

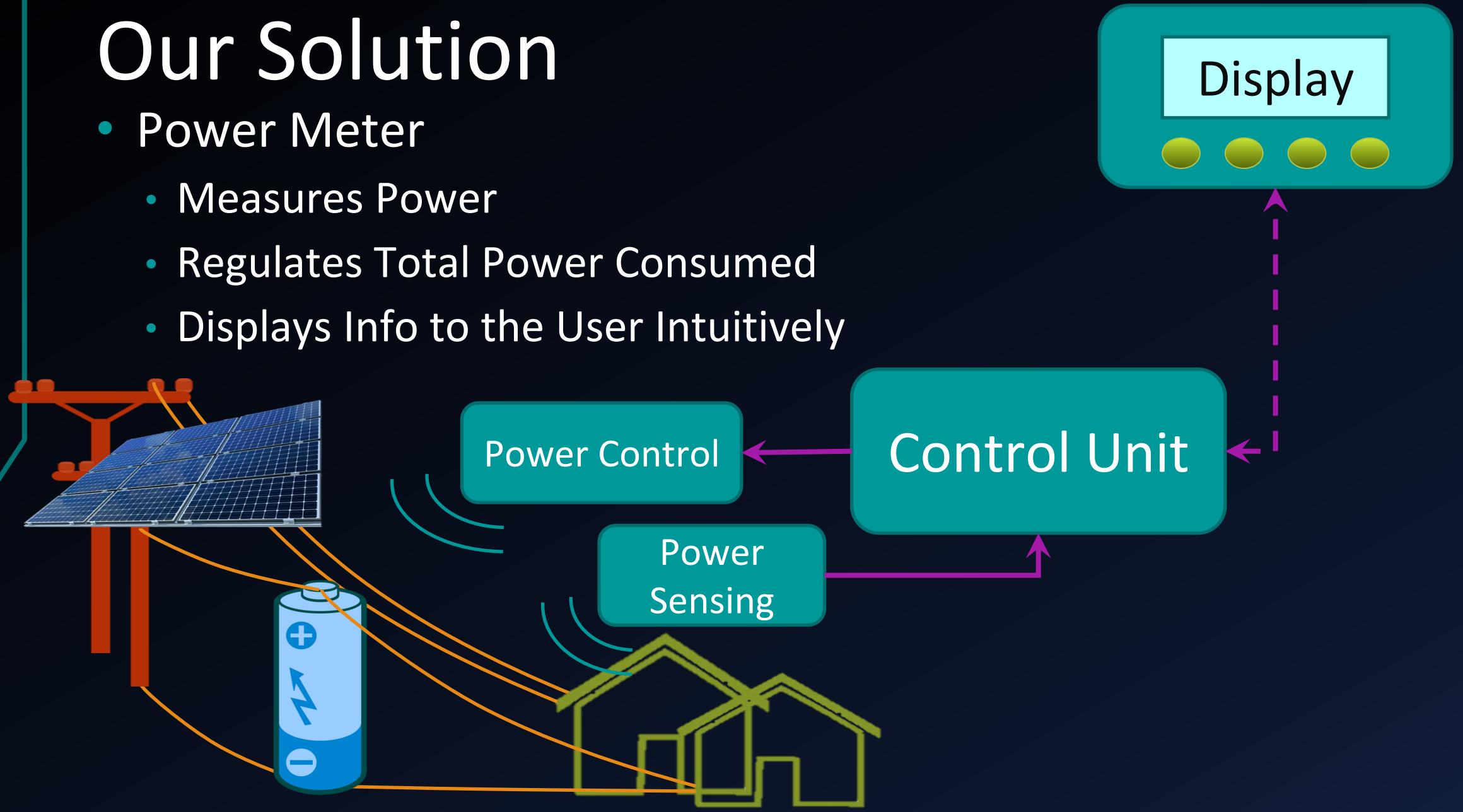
Enables:

- Reliable Energy Sharing
- Intuitive Energy Awareness
- Intelligent Energy Conservation



Our Solution

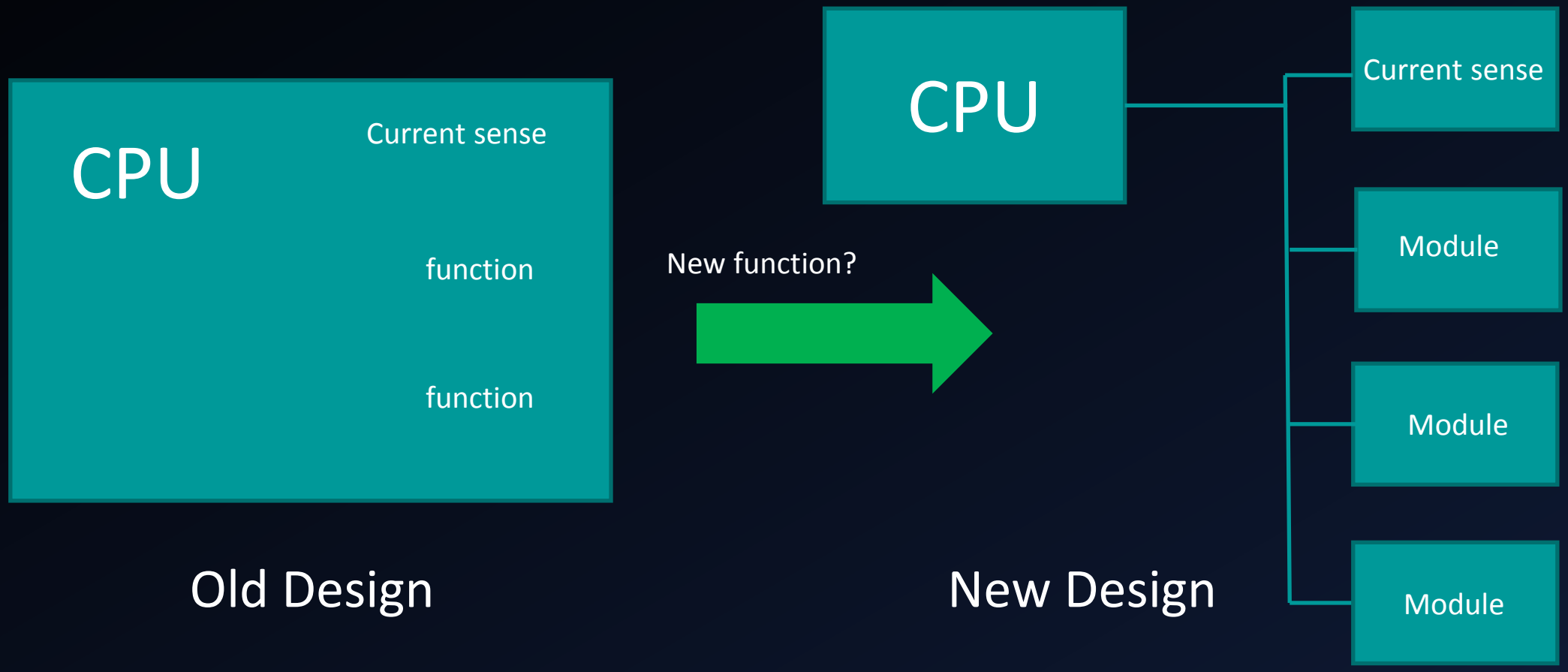
- Power Meter
  - Measures Power
  - Regulates Total Power Consumed
  - Displays Info to the User Intuitively



Clients

- SIM International (Burkina Faso)
  - Mission/Clinic Housing
- Theological College of Zimbabwe
  - Pastoral/Student Housing
- IEEE Smart Village
  - Rural Electrification Project

Making the Meter Modular… Why?

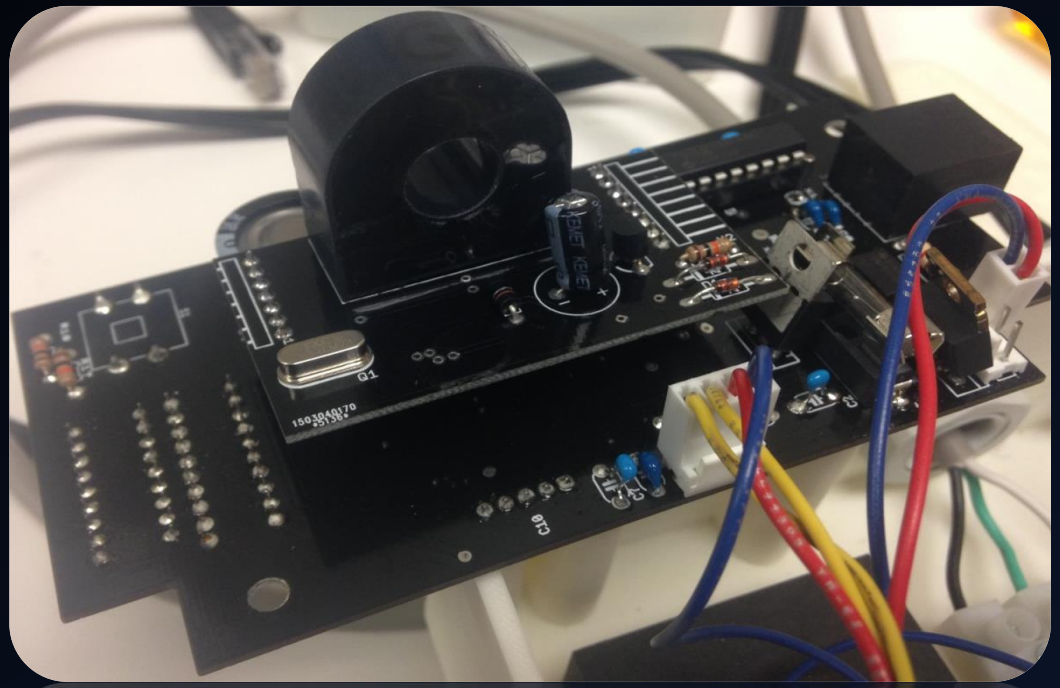


Results of Modular Design

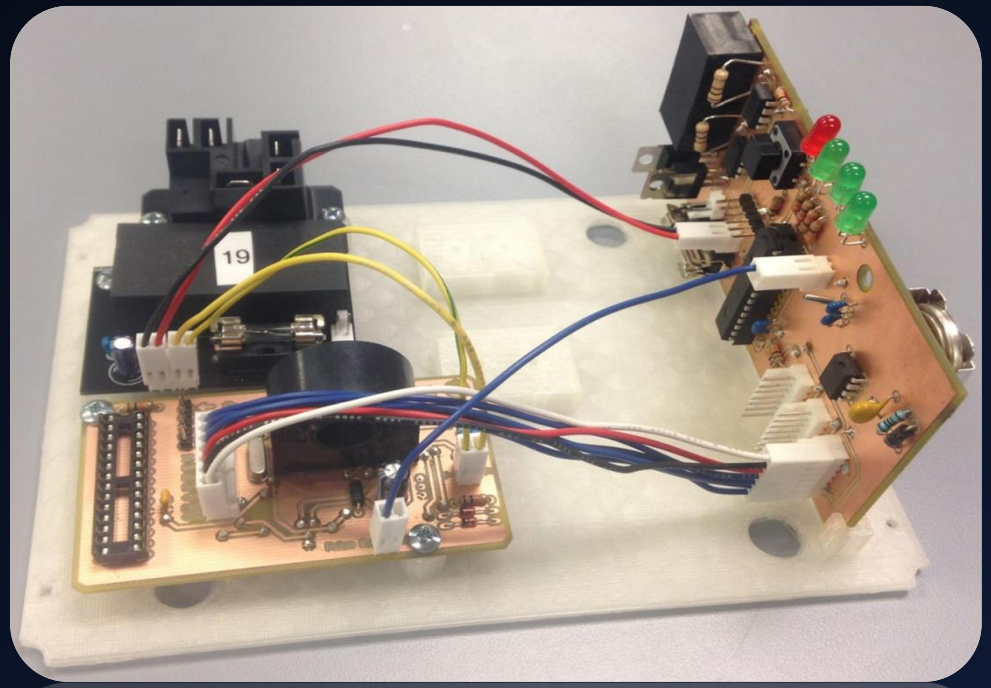
- Allows for new features with…
  - No physical changes to existing circuit boards
  - Simple Code Update
  - Plug in new module

How do you accomplish modularity?

- Step 1: Modify circuitry to allow for SPI data communication to replace current direct on board data transfers



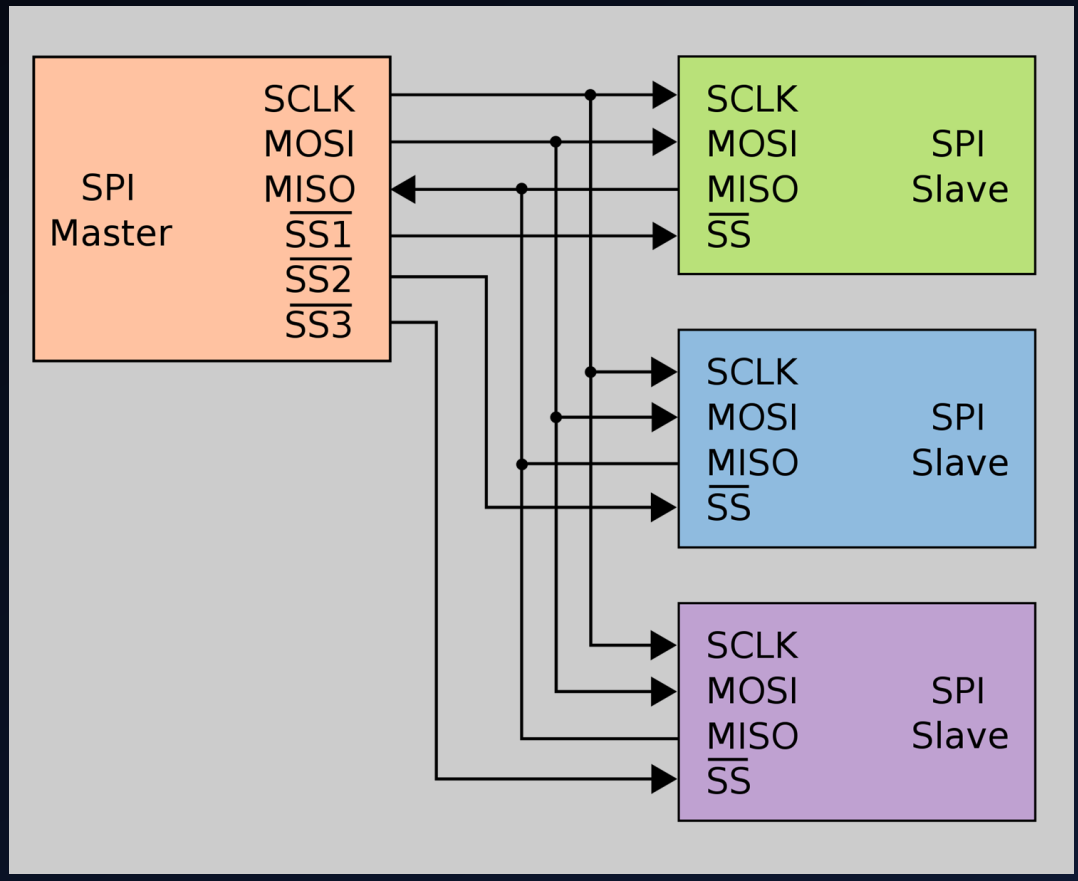
Before



After

How do you accomplish modularity?

- Step 2: Implement SPI (Serial Peripheral Interface) communication protocol in the firmware running on the Command Board and new module boards



First Module: Current Sense Board

Why?

- Interface with a Dedicated Microcontroller
  - Provides capability for better communication
  - Provides capability to receive faster and more reliable data
- Accurate calibration and more information on power usage

First Module: Current Sense Board

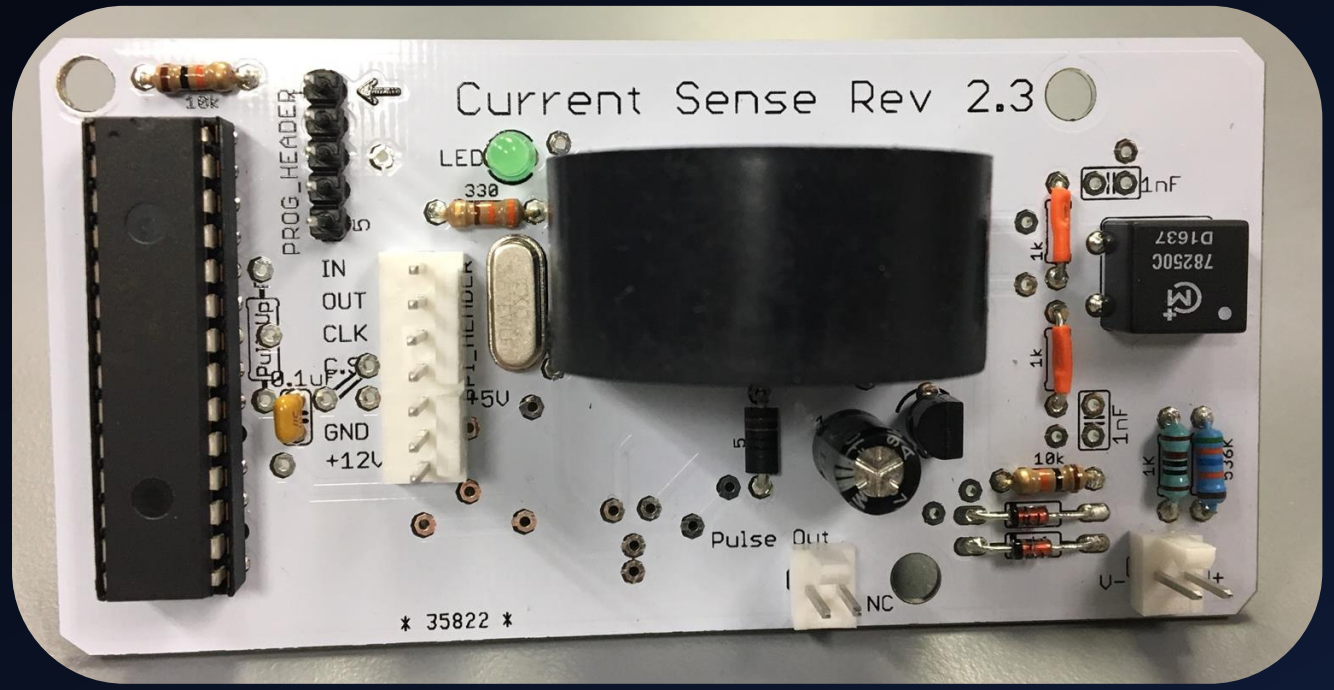
Two Main Goals

- Work with SPI communication
- Transfer Power Data

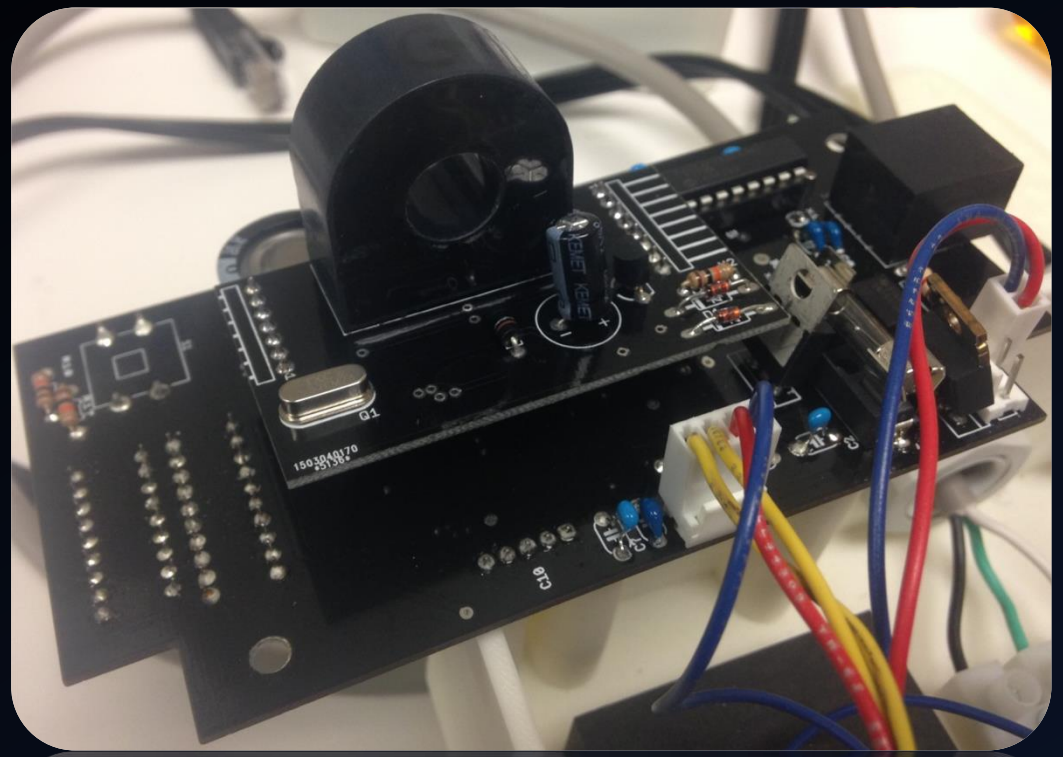
Changes Include

- Implemented SPI software
- Perform calculations with processor on new modular Current Sense board rather than Command Board processor

Revised Design



Current Sense Layout



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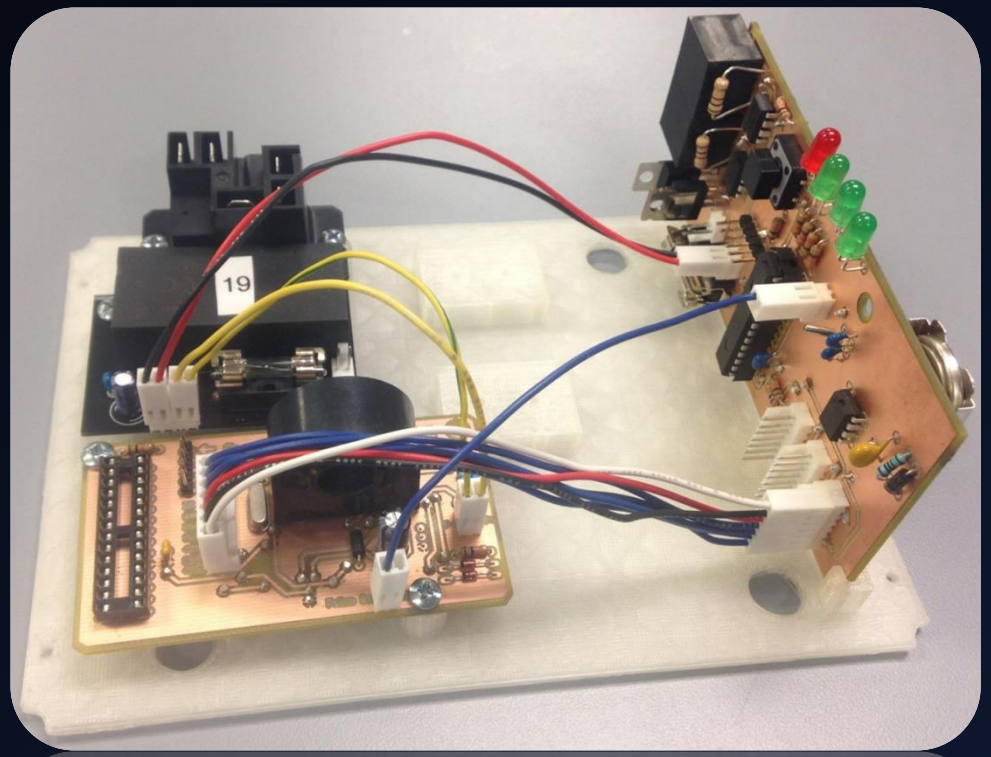

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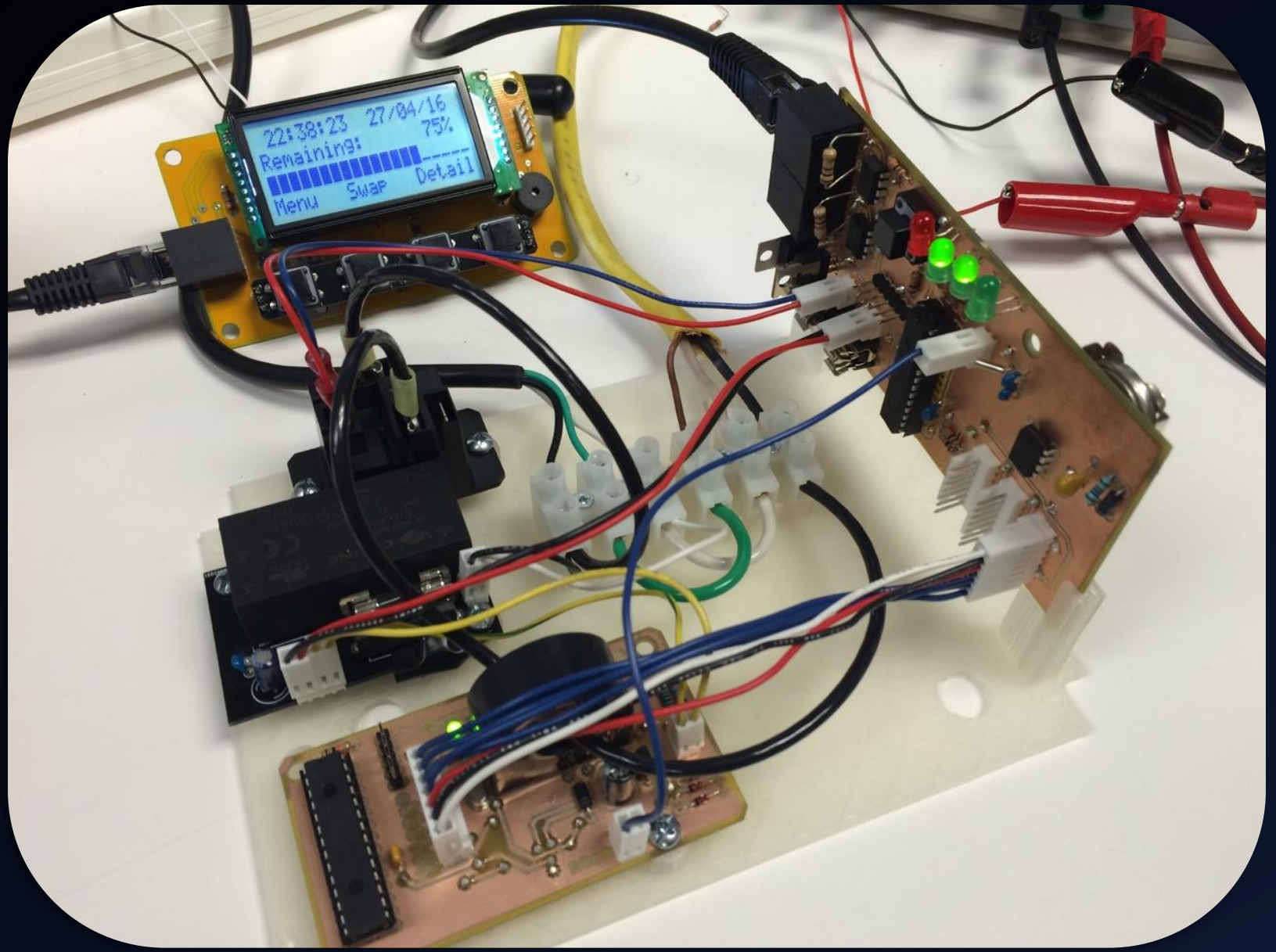
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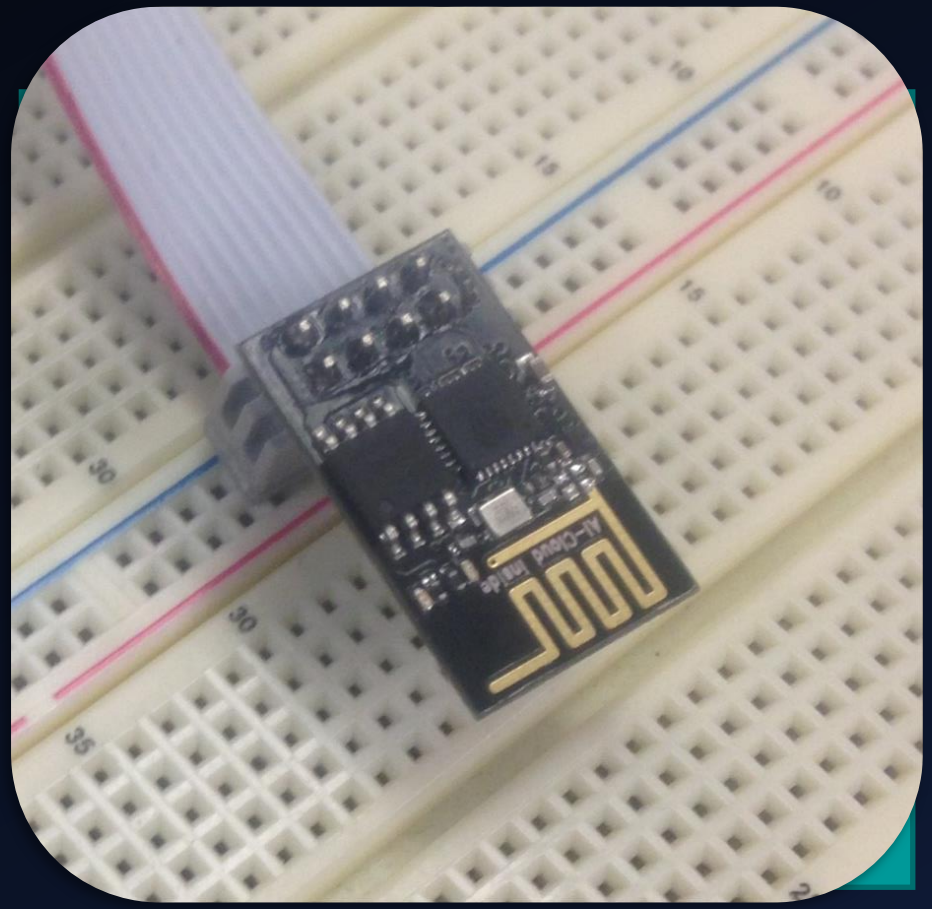
Remaining: 75%
Menu Swap Detail

Future Work

- Summer Delivery and Installation
  - Deliver seven meters to Matt Walsh in Burkina Faso
  - Assembly in May and final delivery in June
- Box to Box Communication
  - Wi-Fi and Radio modules
- Potential Additional Modules
  - Pay as you go



Wi-Fi Module

Summary

- Implemented Modularity
  - Physical circuit board redesign
  - Data communication using SPI
  - Current Sense Board: First working module

Acknowledgements

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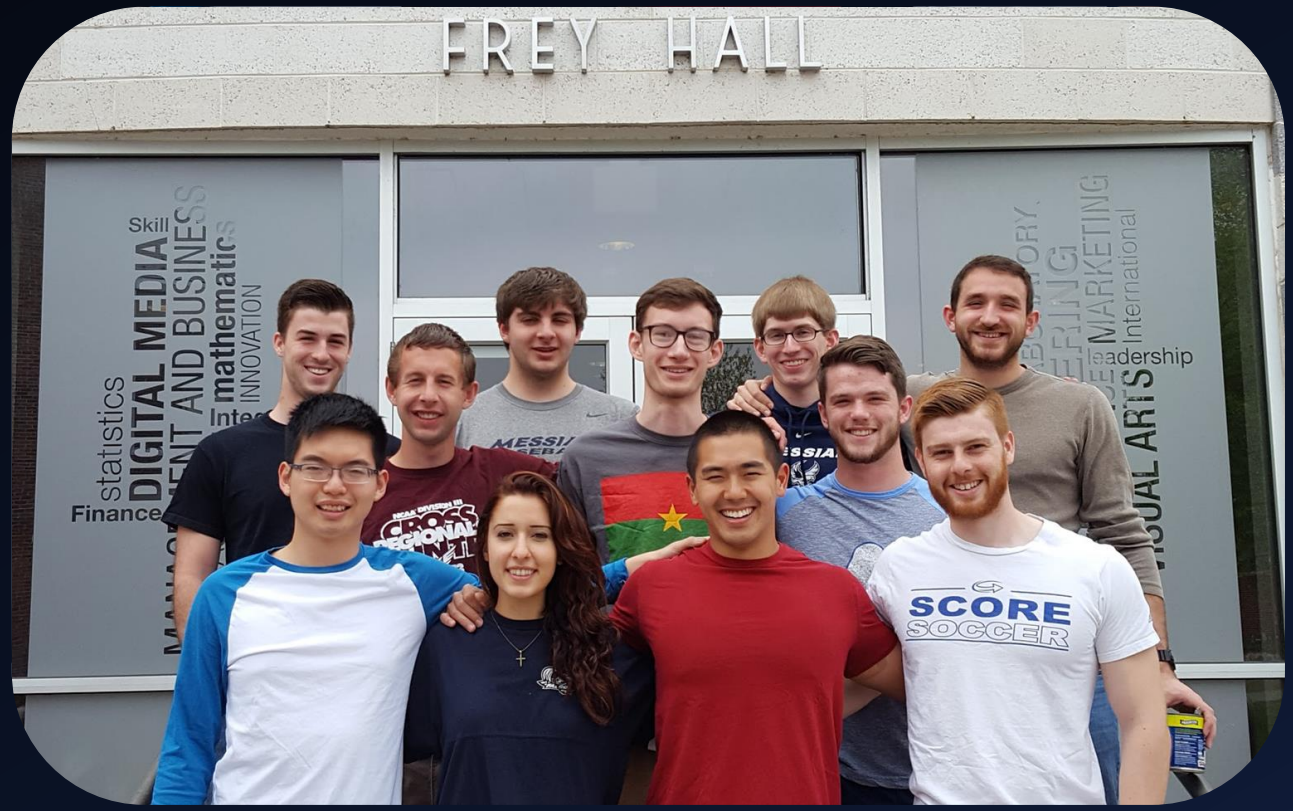

Questions?