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?

Old Design

New Design

CPU

Current sense function

New function?

CPU

Current sense

Module

Module

Module
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
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
Current Sense Layout

Before

After
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
Summary

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