The Energy Monitoring and Management System

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Our Project

The Need

In areas of the world with limited to no access to electricity, there is a lack of energy conservation among shared energy systems causing unreliable access.

Solution

The Energy Monitoring and Management System project is producing a meter to both regulate and educate about energy use in order to maintain a reliable energy supply for these impoverished areas.

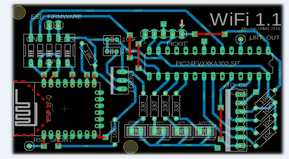
Developing a Manufacturing Process

Purpose: Producing the requested total of thirty meters required special consideration towards developing a production process. Six separate printed circuit boards (PCB) are required for each board, leading to a total of 180. Each circuit board needs to be populated, soldering electronic components into the correct positions, as well as tested. With the amount of time spent on testing and development, production time has been limited to a two month window. Thus, it was incredibly important to develop a streamlined process this semester to be able to avoid manufacturing errors and hang-ups.

Process: In the development of our operational procedures, our main goals were time management and error avoidance. To achieve these goals, we designed specific roles of "checkers" so that, as various stages of production for a given part were completed, the quality and accuracy of the work was surveyed to avoid errors. In order to test meters, it was decided to test individual boards in a pre-existing meter, which will take longer, but will hopefully expedite the troubleshooting process.

Results: By now, a large portion of manufacturing has been completed, showing success of that aspect of our plans. Testing is still in the process of being set-up, however once it begins, we expect to have a fairly strong consistency between boards, making the testing process a reasonable task.

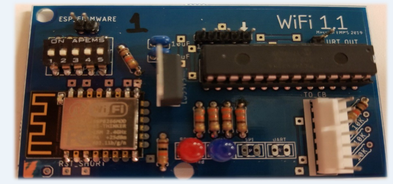
Wi-Fi Module



Purpose: With the goal of making a centralized way to access multiple meters, and adding an additional layer of security, we worked towards a goal of a wireless data transmission between a remote computer and our meters.

Process: We first prototyped using a microchip made for WiFi. Using a small router as a medium for wireless communication, first incoming TCP socket connections were tested, followed by confirming data sends correctly. After verifying a successful communication from wireless input through the module into the heart of the meter, the breadboard circuit was turned into a schematic and milled. The initial version contained hardware bugs, including misplaced communication pins and a short circuit. Those were fixed to produce our current WiFi V1.1 module.

Results: Live data gathered by the meter is accessible through not only the User Interface, but also remotely through a computer over a wireless network. Our future goal is to produce more complex software that allows for simultaneous connection of multiple meters.

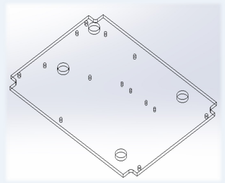


Partners

- Matt Walsh; *Open Door Development*, Mahadaga, Burkina Faso.
- Ray Motsi; *President of the Theological College of Zimbabwe*
- *IEEE Smart Village*

Baseplate Design

Purpose: With the goal of making the meter cheaper and easier to manufacture, we worked towards creating a baseplate to secure the circuitry of the main box that could be machine manufactured, replacing the previous 3D printed plate.



Process: We created a SolidWorks design that has holes in the appropriate places for the components to be secured with off the shelf hardware to the back of the enclosure. Acrylic was chosen to be the material of the baseplate since it can be laser cut and its material properties are suitable for the plate's function. Cutting with the laser made this part easier to manufacture, since it can be cut in about a minute, using the SolidWorks file.

Results: We laser cut 30 baseplates out of 10 sq. ft. of acrylic. The part can be screwed to the enclosure and machine screws and female-female standoffs can secure the circuitry.

Progress

- **Power Sense:** Power Sense module has been finalized.
- **WiFi**: WiFi communication has successfully been implemented.
- **Bill of Materials:** All required components for assembly have been both documented and ordered.

Future Work

- **Assembly:** We need to produce a total of 30 functioning meters to deliver to our clients.
- **Testing:** In addition to assembling the meters, we will need to verify that they function as intended.
- **Site Team Trip:** We will be sending a group to TCZ this summer to assist in installation of the meters we have produced this semester.
- **System Improvements:** Includes the ability to connect multiple meters through WiFi, and additional security measures.
- **Develop Payment System:** Meet the micro-grid needs of our clients, and set groundwork for future large-scale systems.

Acknowledgements

We would like to thank Dr. Randall Fish, Tony Beers, Bob Hentz, Erik Weenink, Art Du Rea, Nathan Chaney, Zach Sorrel, Greg Talamo, John Meyer, and Paul Myers for their technical contributions and support for this project.

We would also like to thank Tom Austin, project manager, for his continuing support and leadership.