



REIS

RENEWABLE ENERGY & ISLAND SUSTAINABILITY

WIP: Quality Assurance and Verification of Wireless Environmental Sensor Modules



Undergraduates: May Chen, Kristie Lee | Faculty Advisor: Dr. Anthony Kuh
Smart Campus Energy Lab (SCEL) | Renewable Energy & Island Sustainability (REIS)

Introduction & Motivation

Hawaii has a vast amount of renewable energy resources available that can be used to make it more sustainable and less reliant on imported oil. However, Hawaii is currently the only state in the U.S. that depends on imported oil for the majority of its energy needs. In 2013, 70% of Hawaii's electricity production came from oil, while less than 10% was produced using renewable energy sources. With prices increasing and finite energy sources depleting, Hawaii may not be able to rely as heavily on fossil fuels in the future and will need to find a better way to utilize its own resources for energy.

The Smart Campus Energy Lab, or SCEL, is a research and education lab working on problems related to energy and the electric grid. Research from the lab will assist UHM and Hawaii in its energy sustainability efforts. One of SCEL's main projects is the design of wireless environmental sensor modules that collect weather data to accurately forecast possible energy generation from renewable sources.

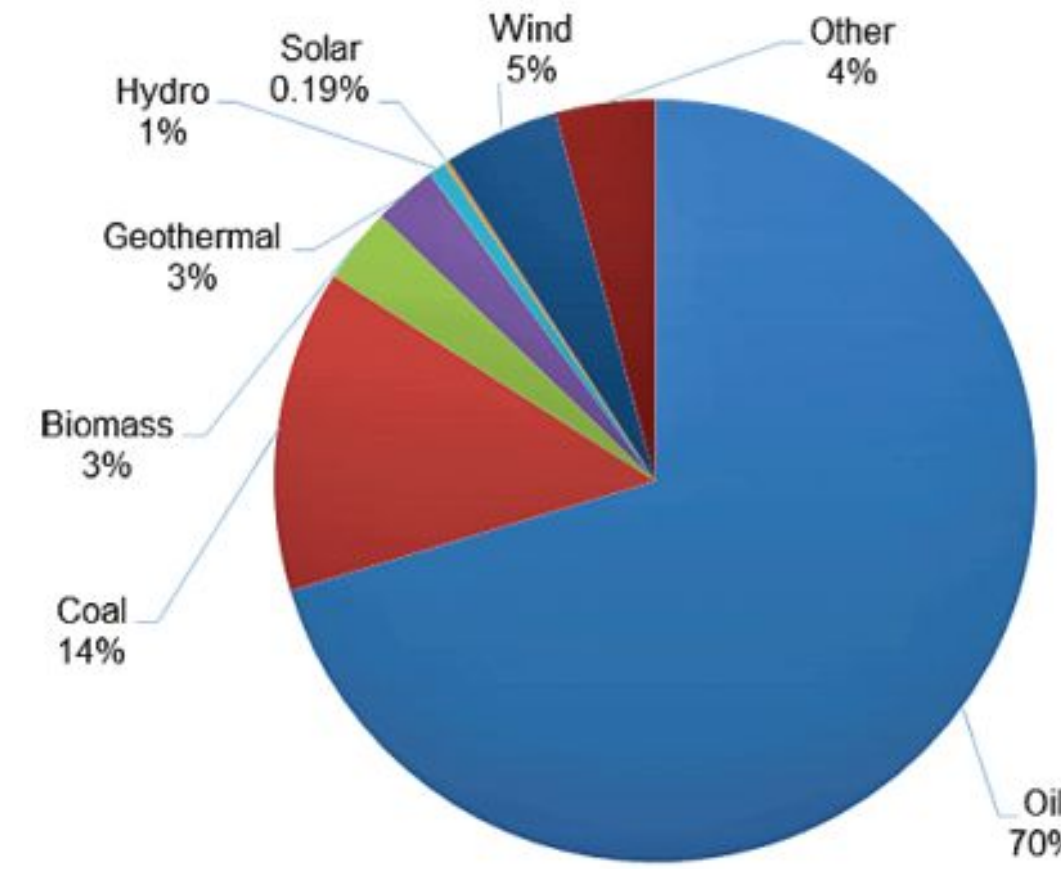


Figure 1: Hawaii's electricity production sources in 2013

Project Description

Objective: Design a verification board to test the hardware for wireless environmental sensor modules and document hardware and software test procedures.

We aim to establish an efficient and uniform methodology for testing iterations of wireless environmental sensor modules. Each design is analyzed for accuracy and documented thoroughly. A verification board will be implemented to make the process more efficient with unit testing.

Semester Goals:

- Design a verification board compatible with the 1st generation sensor module, "Apple"
- Create documentation and test procedures for the 1st generation sensor module, "Apple"

Long-term Goals:

- Design a single verification board that can test all generations of the environmental sensor modules
- Create documentation and test procedures for all generations of the environmental sensor modules

Verification Board

- Bootloaded and mounted ATmega328P-PU microcontroller
- Implements communication with sensor module for unit testing
 - Sensors: pressure (BMP180), humidity (SHT11), temperature (DS18B20)

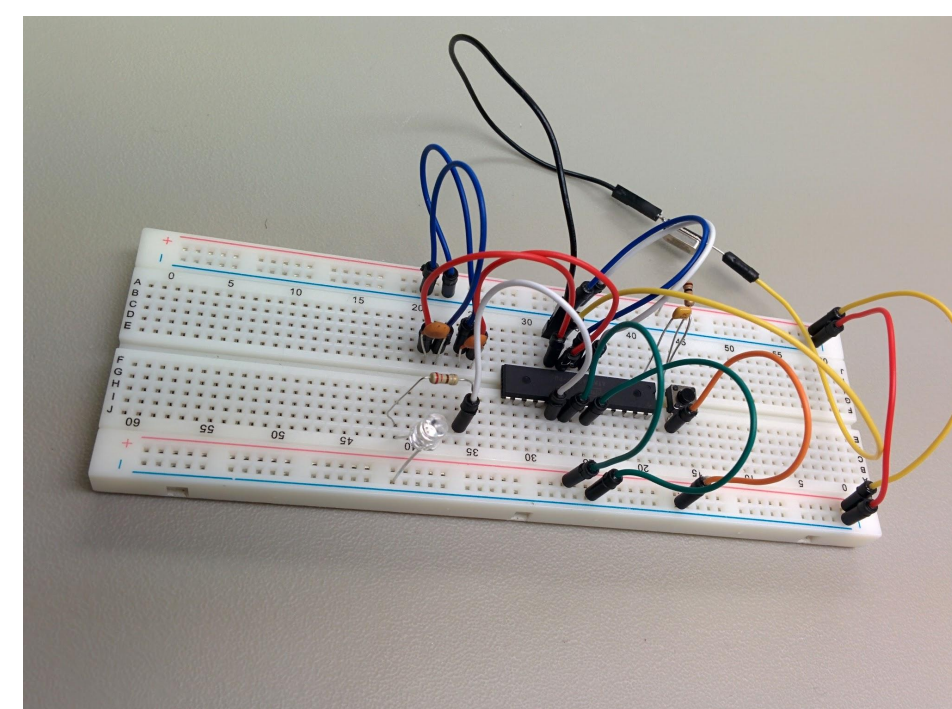


Figure 2: Bare bones circuit implementation to bootload and mount the ATmega328P-PU microcontroller.

Materials & Methods

Quality Assurance Checklist

- Established uniform procedures for hardware testing
 - Stages: pre-build, intermediate build, final build
- Ensured hardware adheres to quality assurance standards designed for sensor modules

Documentation

- Documentation of 1st generation sensor module includes parts, design, and usage information that serves as a user manual for Apple
- Documentation of ATmega328P-PU (used by all current generations of sensor modules and verification board) serves as an in-depth application guide

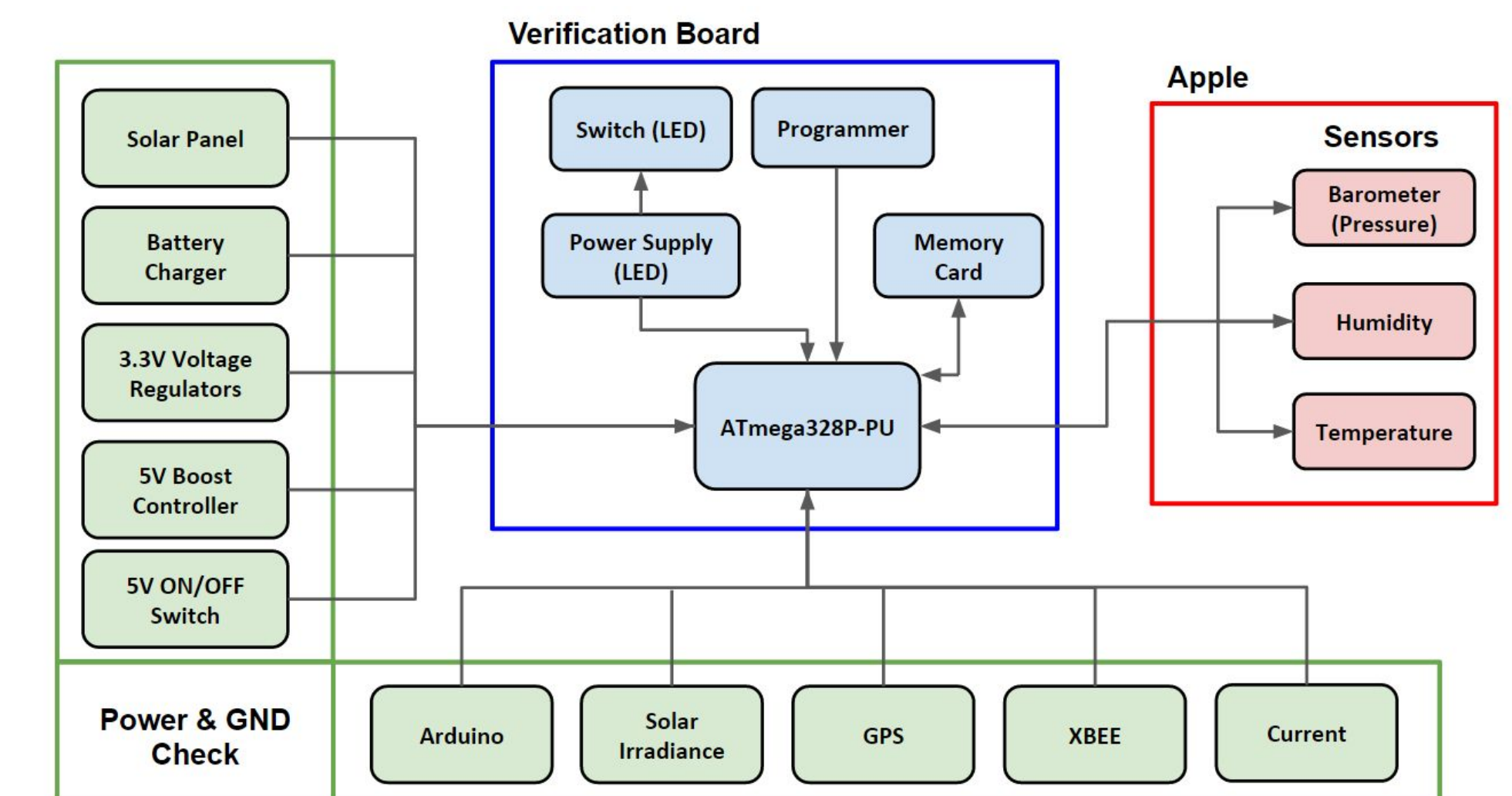


Figure 3: Verification board block diagram. The verification board will communicate with the sensor module's board

Results & Analysis

- Design a verification system to record and match manually obtained data
 - System data will mirror typical data already collected from Apple's pressure, humidity, and temperature sensors
- Verification system will communicate with sensor module to obtain values to test and verify the hardware

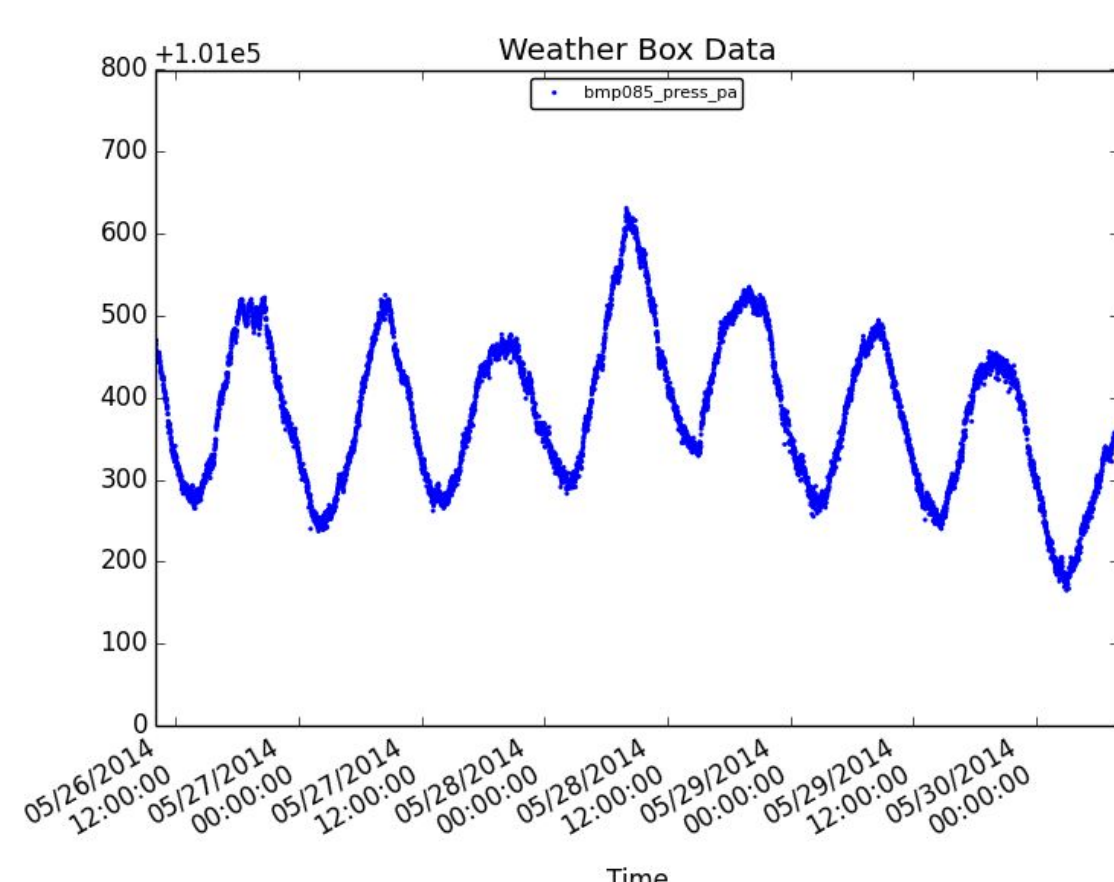


Figure 4 (Left): Pressure sensor data (May 2014) from wireless environmental sensor module, Apple.

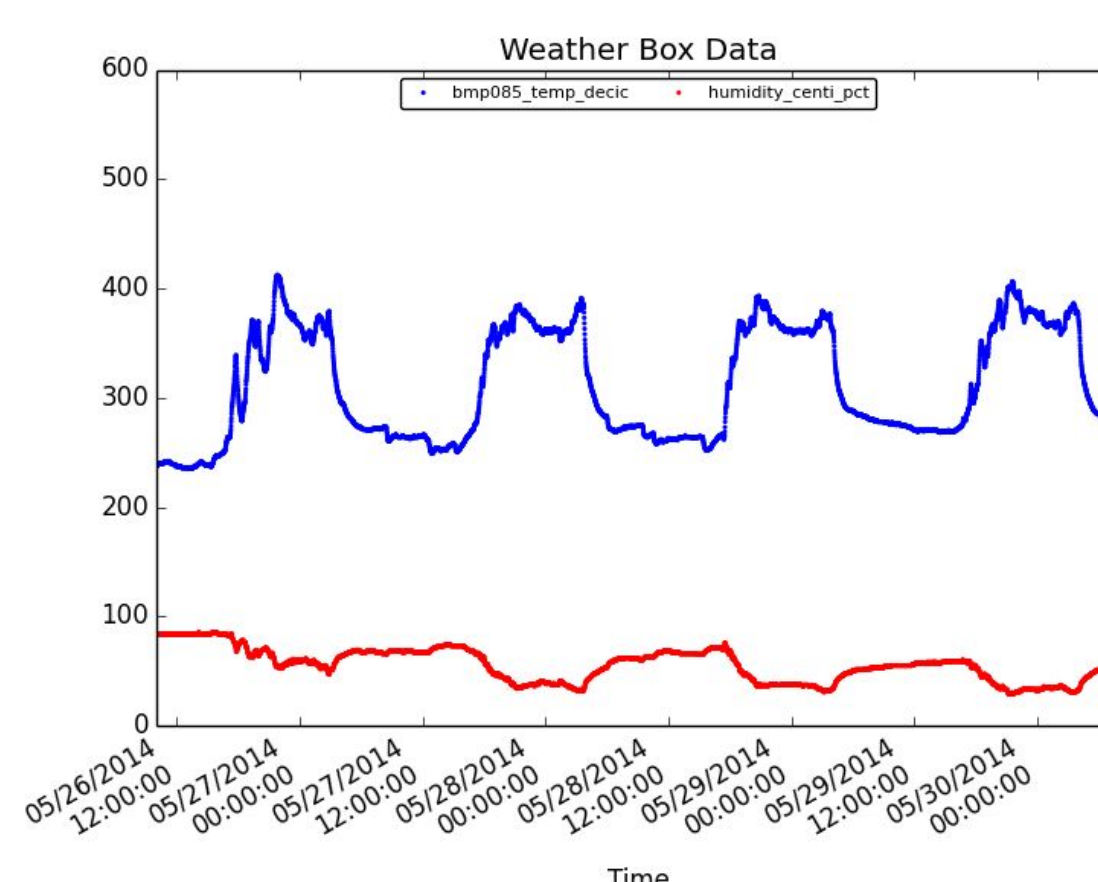


Figure 5 (Right): Temperature and humidity sensor data (May 2014) from wireless environmental sensor module, Apple.

Conclusion

Completed Objectives

- Verification board
 - Implementation of MCU to apply on board
 - Schematic of board in progress
- Quality assurance checklist applicable to general hardware tests
- Documentation for Apple and MCU are easy-to-read compilations of information & research

Future Work

- Verification board
 - Build and test
 - Expand compatibility to all generations
- Improve quality assurance checklist for individual designs
- Continue to update documentation and change log of sensor modules

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