BluDAQ

Team 5

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There's got to be a better way...

The Problem

Automation controls and sensors are **inaccessible** and **expensive**.

How can we make them available for **residential** use and provide an **easy-to-use interface**?

What is BluDAQ

BluDAQ is a Bluetooth Data Acquisition device that monitors environmental attributes including motion, light, humidity, temperature and pressure.

Automation within the device enables setting environmental thresholds.

Motivation

For Everyone:

- Portability and Mobile Device Integration
- Save money and time with staying informed

For Us:

- Opportunity to utilize new technologies
- Develop new engineering and management skills

Objective

- Achieve a modicum of success (working prototype)
- Test the limits of our abilities (SMT)
- Develop telekinesis

The Current Market

- Many networkable sensors available
- Automation systems are too costly for simple tasks
- Modern data acquisition systems tend to lack extensibility and user focus

Design Requirements

Requirements

- Easy to use
- Easily interfaced
- Battery Powered

- Motion detection
- Monitor temperature, humidity, pressure, and light
- Fast Wireless Response

Brief Project Schedule

- Project Proposal (10/11/16)
- Research and Design (10/20/16)
- Requirement/Specification (10/25/16)
- Design Schematic (11/5/16)
- Design PCB layout (11/17/16)
- Firmware* (11/24/16)
- Software Application* (11/23/16)
- Assemble Parts (11/29/16)
- Create Final Presentation (12/5/16)

* Software/firmware started Concurrently with layout design.

Our Design

Our Approach

Inputs:

- Power
- Bluetooth (Serial / UART)
- Push Button
- Sensor Array (I2C)
  - Temperature
  - Humidity
  - Pressure
- Photodiode
- PIR Motion Sensor

Outputs:

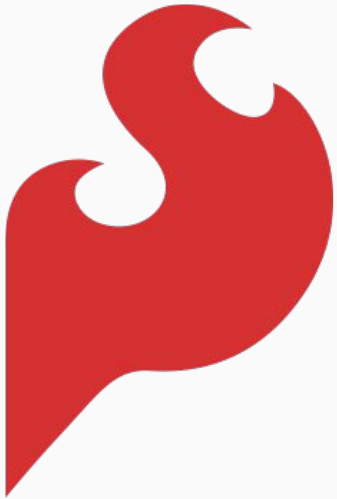
- Bluetooth Serial
- SPST Relay

Product Features

- Bluetooth connectivity
- IOS app
- Rechargeable built-in battery
- (2x) User-accessible SPST relays
- Programmable automation tasks
- Sensors:
  - Motion Sensor
  - Temperature Sensor
  - Humidity Sensor
  - Pressure Sensor
  - Light Sensor

IP and Prior Work

- Adafruit
  - Relays
- Sparkfun
  - Power management
  - LiPo charger
  - Boost converter



Contributions

Concept Generation

Design

Schematic

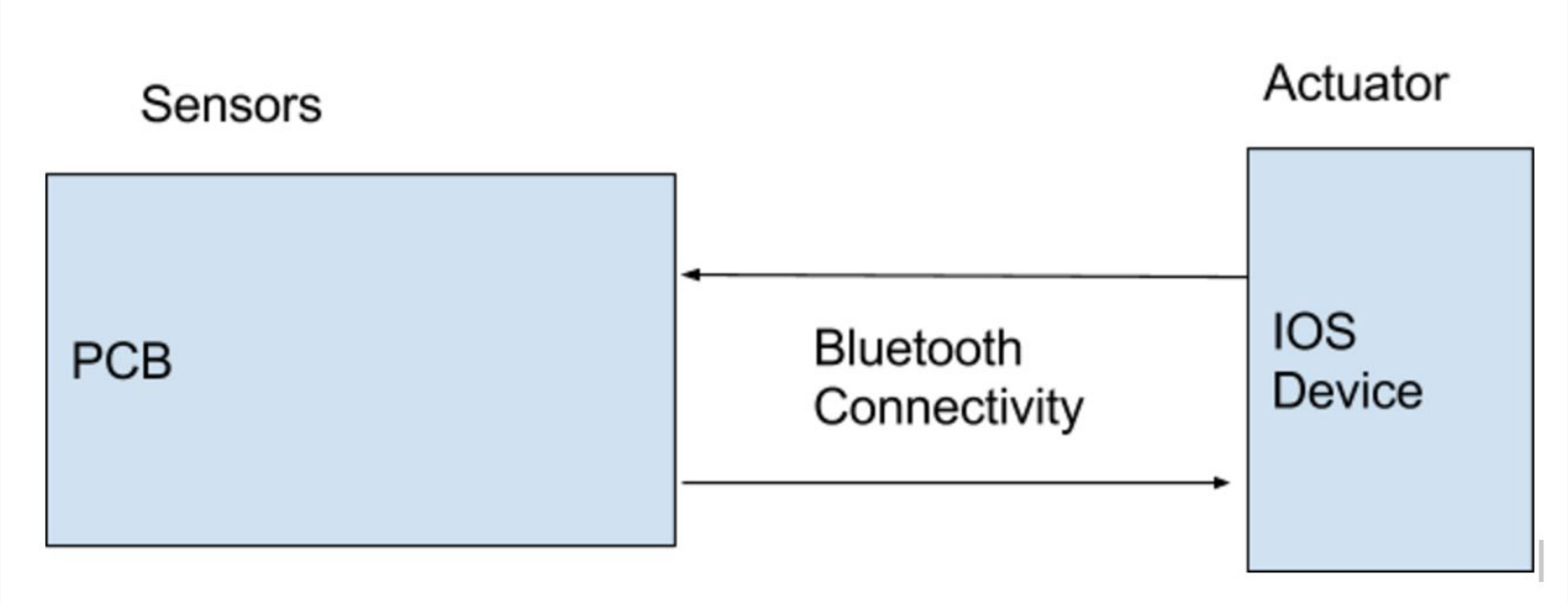
Layout, Bill of materials, Parts

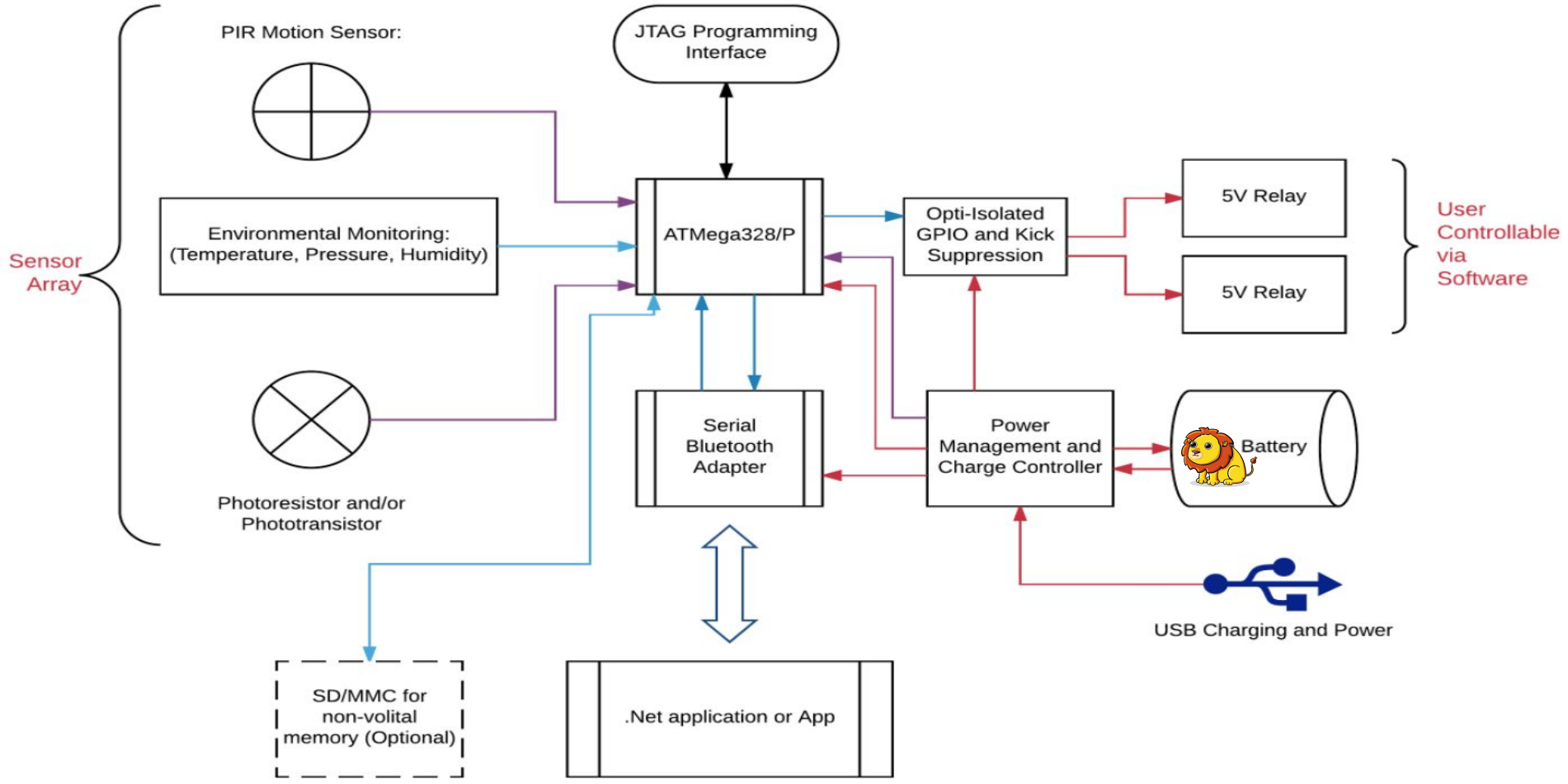
Assembly

Coding

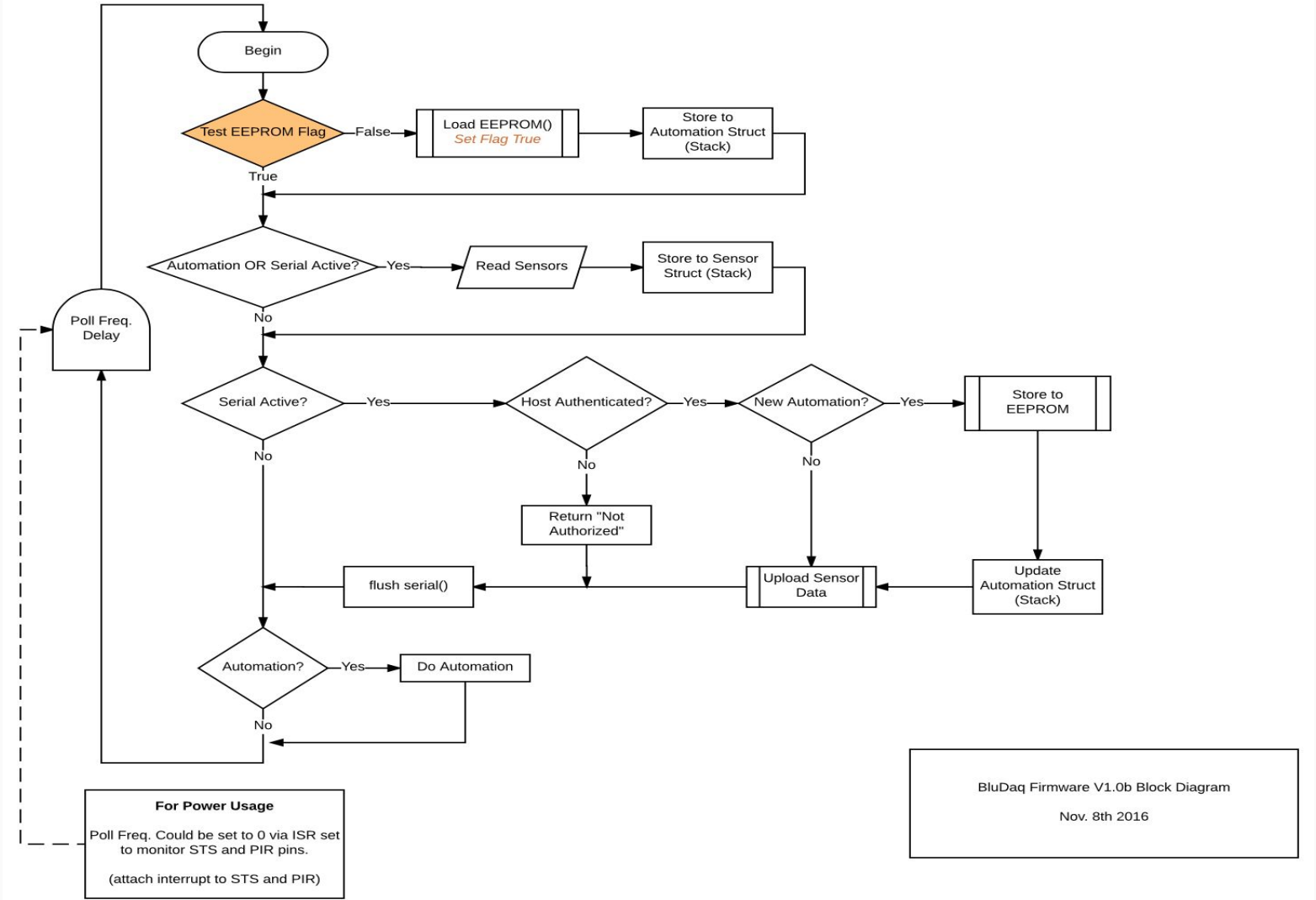
Hardware Design

Level 0 Block Design

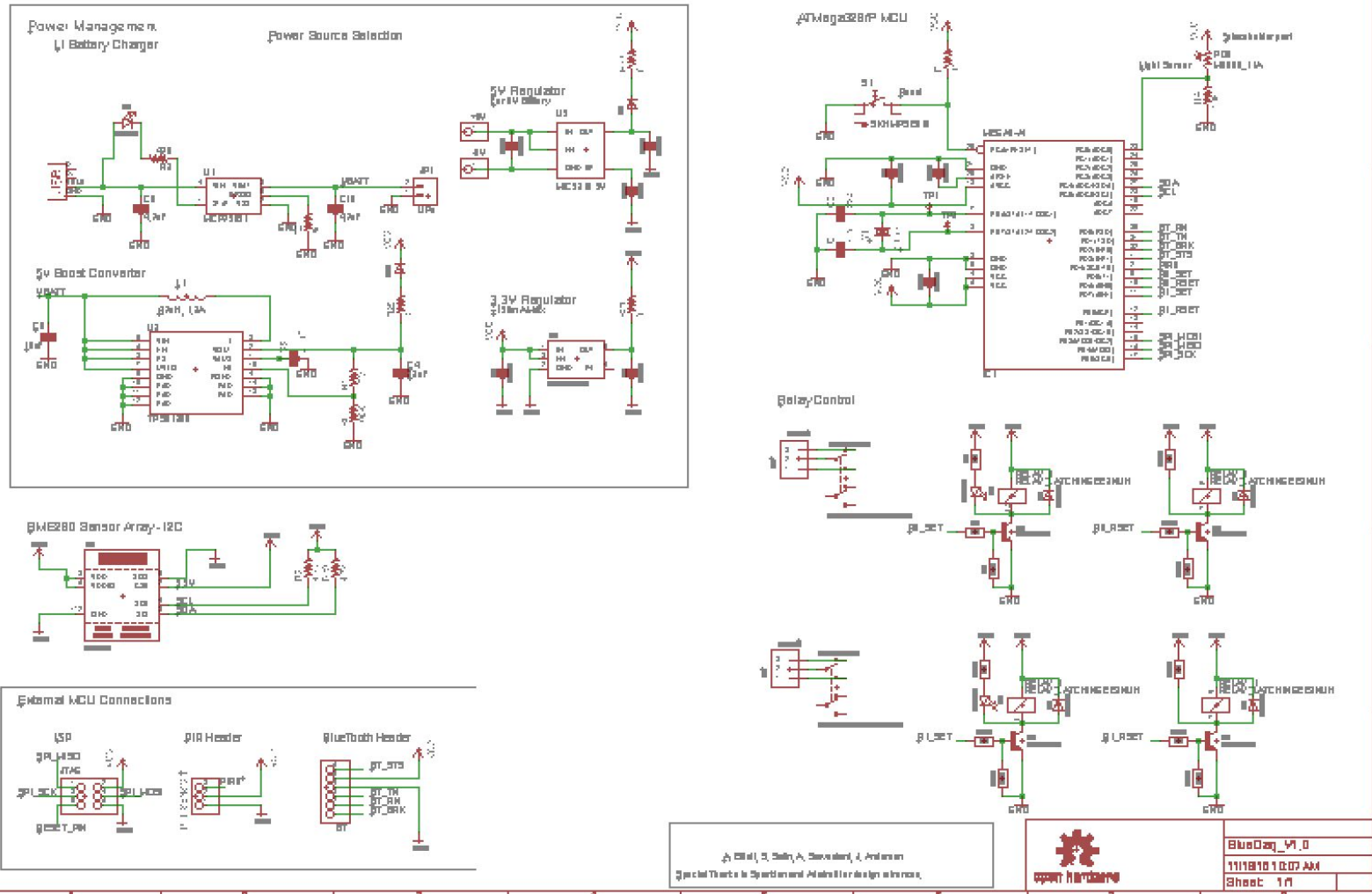



PIR Motion Sensor:
JTAG Programming Interface
Environmental Monitoring: (Temperature, Pressure, Humidity)
ATMega328/P
Opti-Isolated GPIO and Kick Suppression
5V Relay
5V Relay
User Controllable via Software
Sensor Array
Photoresistor and/or Phototransistor
Serial Bluetooth Adapter
Power Management and Charge Controller
Battery
USB Charging and Power
SD/MMC for non-volital memory (Optional)
.Net application or App

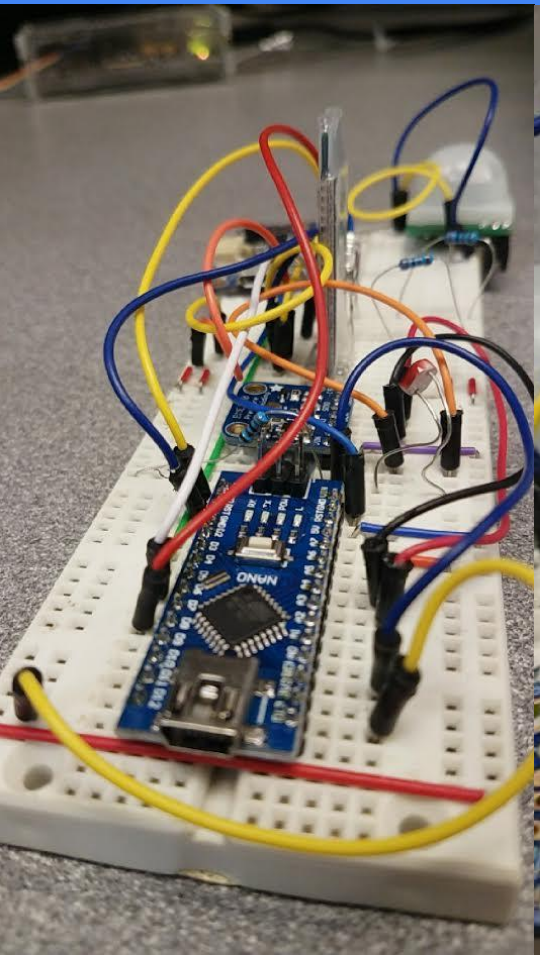
Firmware Design

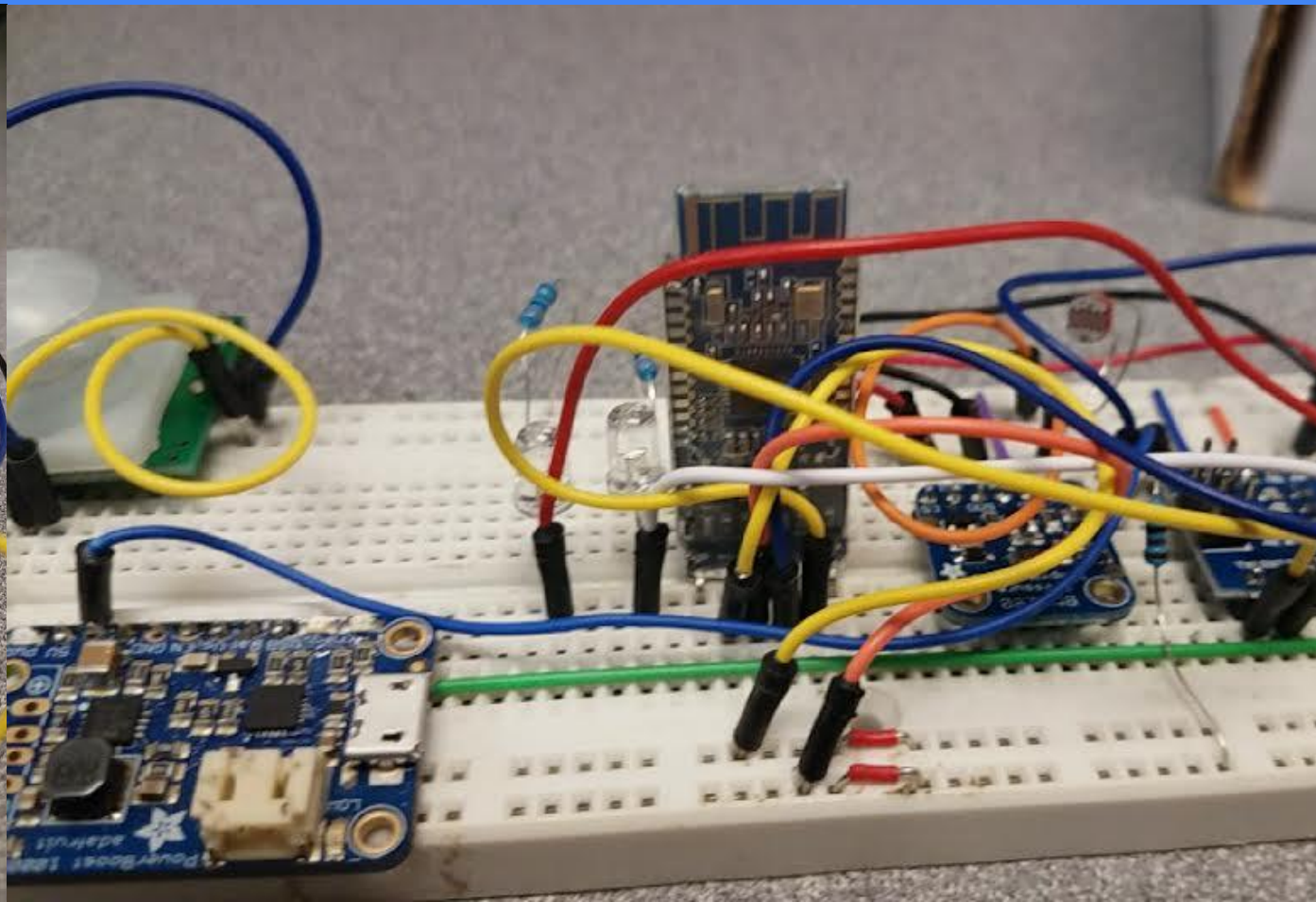

Begin
Test EEPROM Flag
False
Load EEPROM()
Set Flag True
Store to Automation Struct (Stack)
True
Automation OR Serial Active?
Yes
Read Sensors
Store to Sensor Struct (Stack)
No
Poll Freq. Delay
Serial Active?
Yes
Host Authenticated?
Yes
New Automation?
Yes
Store to EEPROM
No
No
No
Return "Not Authorized"
flush serial()
Upload Sensor Data
Update Automation Struct (Stack)
Automation?
Yes
Do Automation
No
For Power Usage
Poll Freq. Could be set to 0 via ISR set to monitor STS and PIR pins.
(attach interrupt to STS and PIR)
BluDaq Firmware V1.0b Block Diagram
Nov. 8th 2016

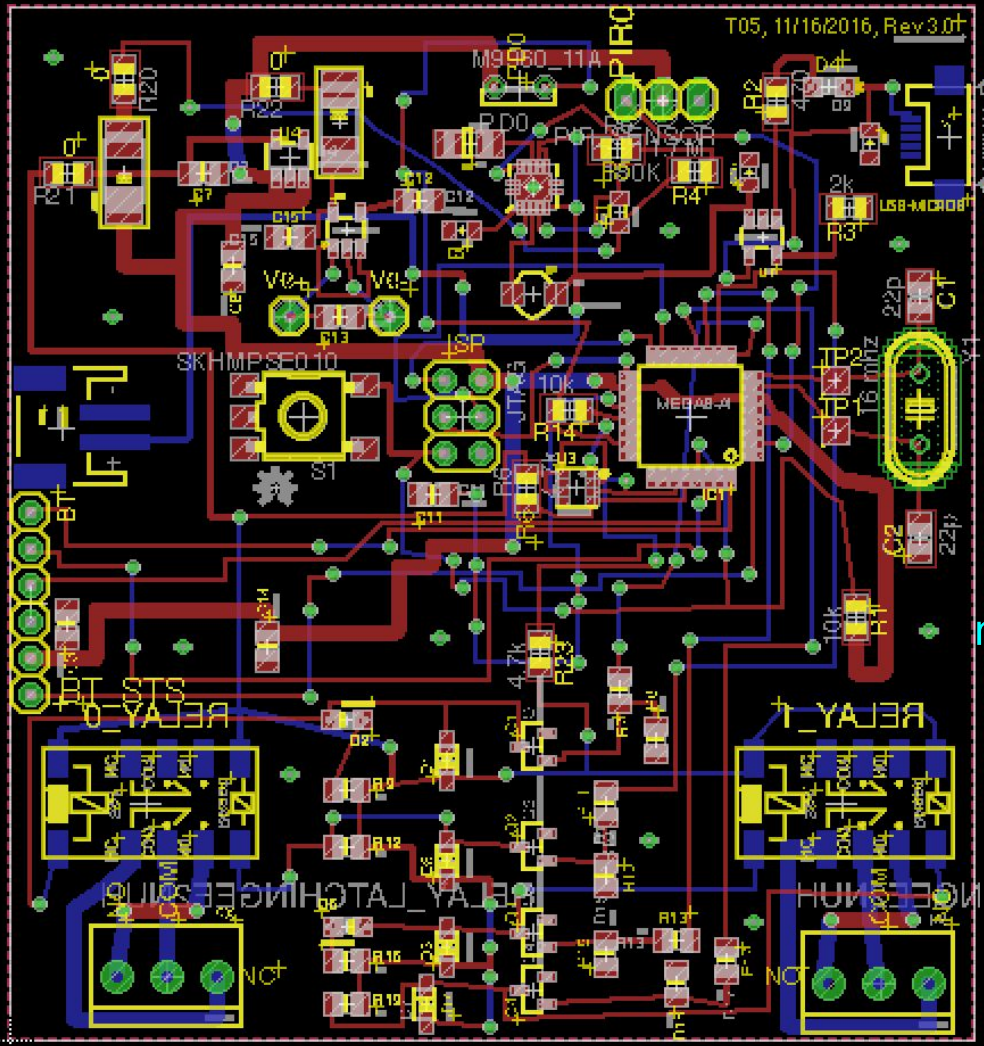
Implementation


Power Management
LI Battery Charger
Power Source Selection
5V Regulator
5v Boost Converter
3.3V Regulator
ATMega328P MCU
Relay Control
BME280 Sensor Array - I2C
External MCU Connections
ISP
PIR Header
BlueTooth Header
BlueDog_V1.0
open hardware

Prototyping







wow

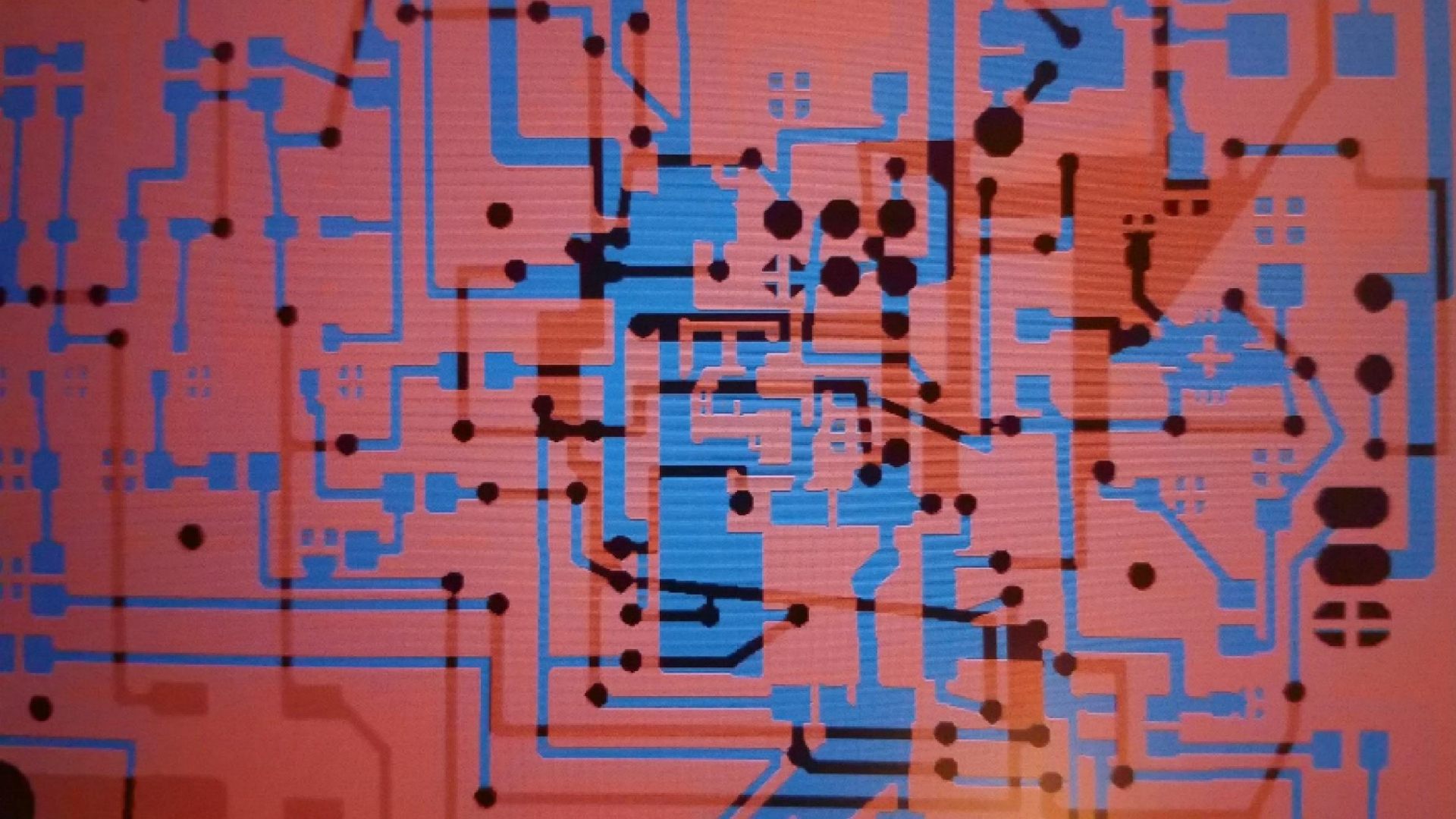
much draw

many hours

so fabe

Layout

- Many components, very tedious
- Many schematic modifications
  - Lots of rerouting



Bill of Materials

- Total Project Cost: $403.13
- Money Lost: $100
- Expensive Parts: LiPo Battery, PCB Board, BME280, BLE
- Low Volume Cost: $80.90
- Production Run Cost: $64.72
- Time

Testing

Hardware

- Built disconnected from power supplies
- Checked power supplies before connecting to rest of board
- Test with voltage meter

Hardware Test Results

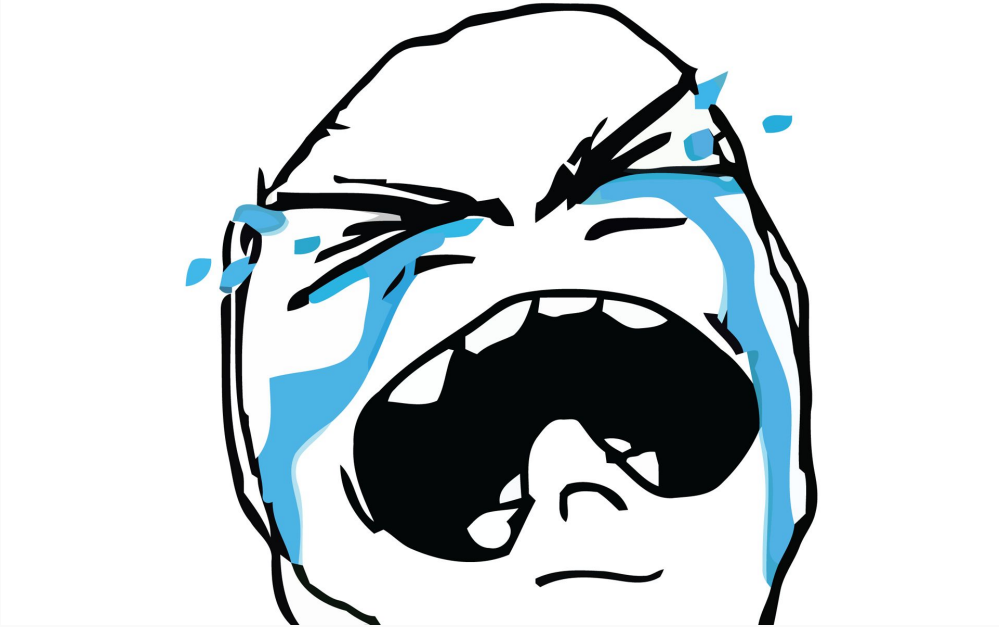
- Bad Power Supplies
- Strange grounding behavior

Firmware

- Bluetooth Connection
- Host Authentication
- Serial Communication with IOS application
- Reading sensor values
- Automation

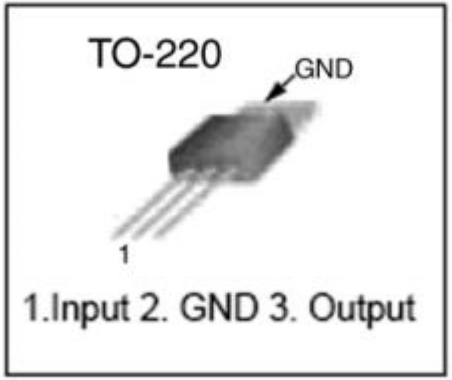
Problems

- Relays not switching on PCB. (Current problem?)
- Automation



More Problems

- Fun with datasheets!
- Strange ground behavior



Lessons Learned

- Select bigger chips (BME280, Boost Converter)
- Check parts availability before using in design
- Triple check before ordering. Twice.
- Use cheaper components (BME280)

Lessons Learned

- More test pads & in better places
- Laser Cutting
- Enhanced Soldering skills
- Github
- More vias for flooded ground