



# **Doggy Pal Collar**

**Group #33**

**Members:**

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**Stephanie Heagney - Electrical Engineering**



# Description

Doggy Pal Collar (DPC) is a device that can be attached to a dog's collar that is designed to monitor the heart rate, temperature, location, and acceleration of any dog by wireless communication. This smart collar displays all the information it collects on an Internet of Things website for the owner.

# Motivation

The idea for this project was inspired by one of the members of the group. His dog has a medical condition that unfortunately makes his dog have erratic seizures. He explained how this condition induced constant fear because he never knew when a seizure could happen. A seizure could occur when he was away; preventing his dog from getting the required attention needed until it was too late. The DPC was created in the hopes that by monitoring and tracking the dog the information gained will be able to show any patterns or important signs that a veterinarian can later view and use to help treat the dog.



# Goals and Objectives

## The Collar:

- Detect: Heart Rate, Temperature, Location, Stiff movement, Rolling, Running, Acceleration and speed
- Comfortable for the dog to continuously wear
- Light weight
- Long battery life

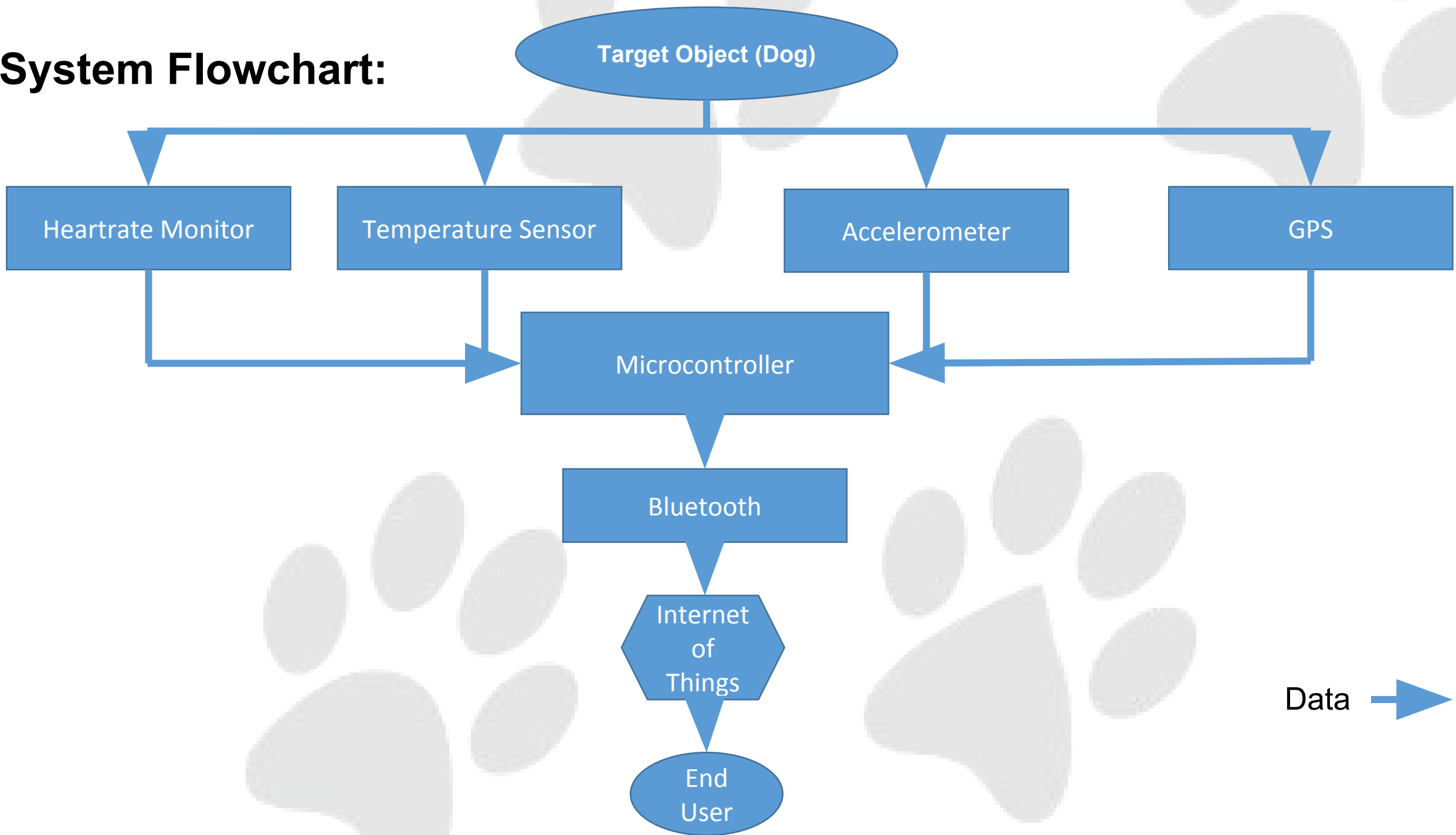
## The information:

- Present clearly
- Easy access

## The Cost:

- Lower than other similar products

# System Flowchart:



# Constraints and Standards

- Comfort
- Durable (Doggyproof)
- Size
- Weight
- No animal/human testing
- Specific placement for some devices
- Skin may need to be exposed to detect heart rate
- Dirt/Dust
- High/Low Temperatures
- Weather (aka humidity)
- Water resistant

# Functionality

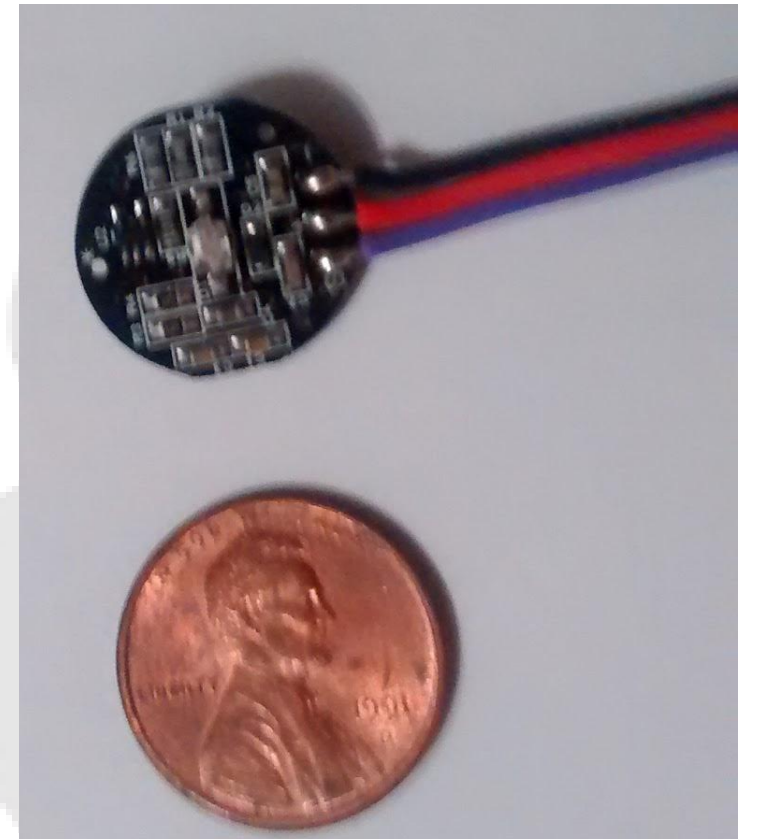
- The collar will detect, track, and log the dog's information continuously and graph for easy access using a Bluetooth connection.
- Equipped with an alert system that can notify the owner when the dog is suffering from a seizure in real time so that the dog can get the immediate treatment she needs.
- The heart rate monitor will detect any abnormal heart rates which will alert the owner something's wrong.
- The temperature sensor and accelerometer will display the current temperature and position of the dog while the Internet of Things website keeps a log of all the information.
- The GPS will find the dog quickly when she is having a seizure or should the dog get lost.

Comparing Collars	Doggy Pal Collar	Voyce	PetPace
Programmable	✓	⊘	⊘
Heart Rate	✓	✓	✓
Position	✓	⊘	✓
GPS	✓	✓	⊘
Wireless Receiver	Bluetooth	Wi-Fi	Wi-Fi
Temperature	✓	⊘	✓
Respiratory Rate	⊘	✓	✓
Alerts	✓	⊘	✓
Continuous Data Acquisition	✓	⊘	✓
Weight Of Collar	?	1.4 oz	~6 oz
Collar Size	Fits any Collar	Collar Fits Neck Size 12" – 32"	Collar Fits Neck Size 7" – 33"
Access of information	Free (Thingspeak)	\$9.50/mo	\$14.95/mo
Collar Price	\$158.92	\$199.95	\$149.95



# Pulse Sensor

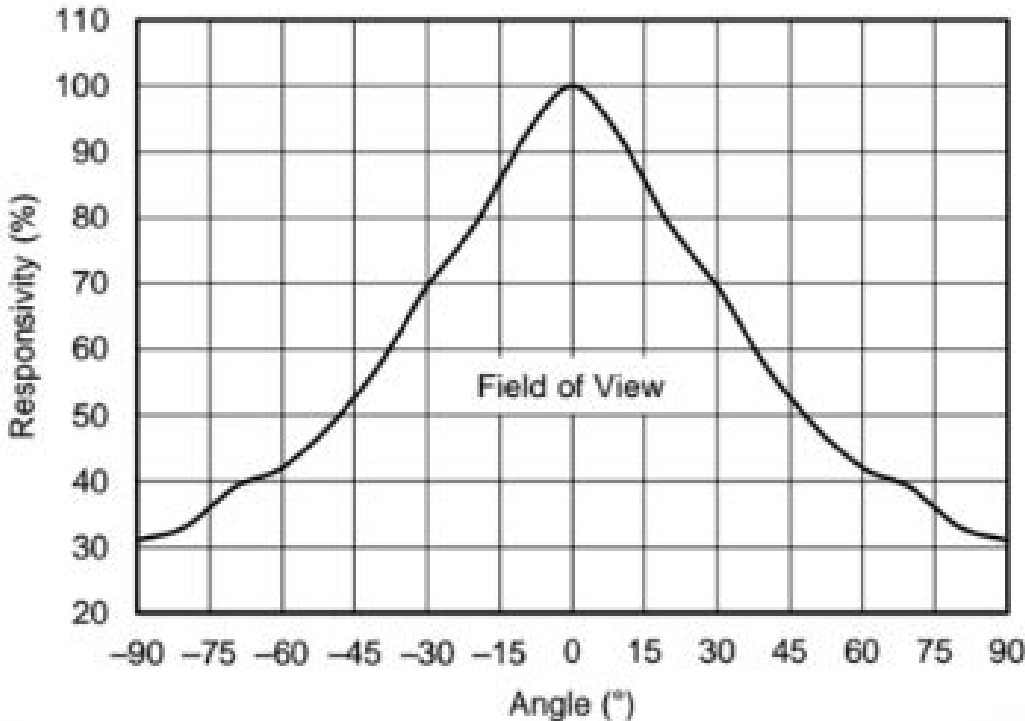
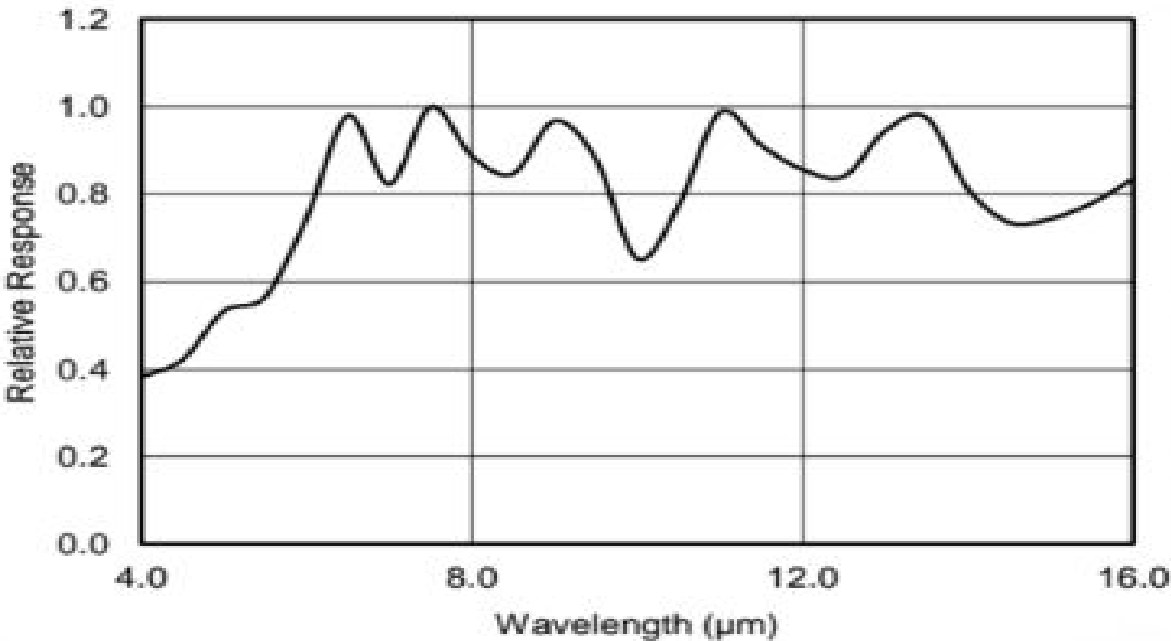
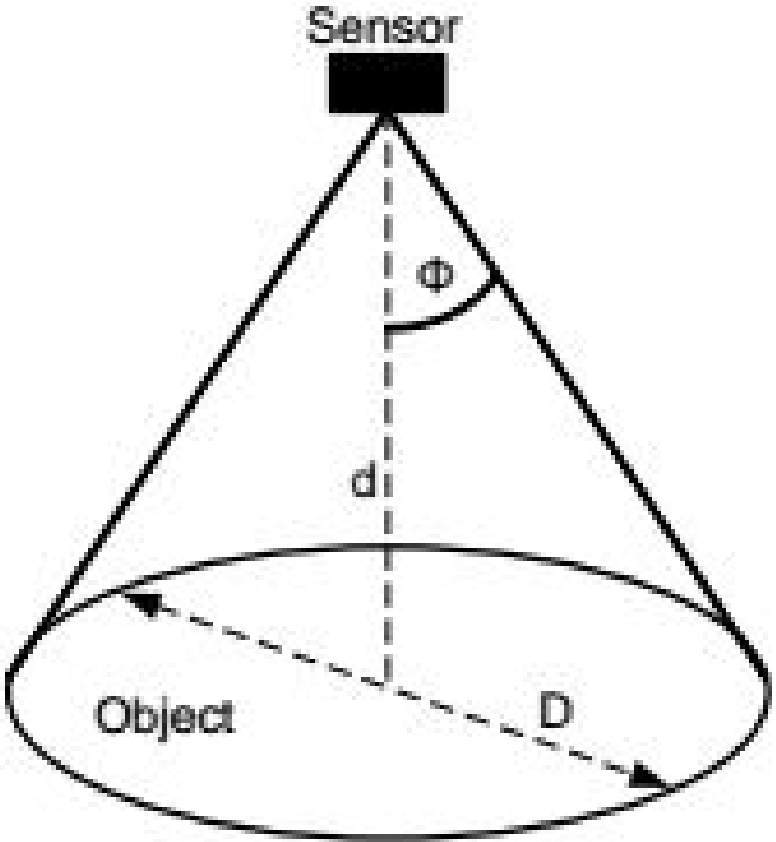
- Uses Pulse oximetry to measure heart rate
- APDS-9008 photo sensor
- Built-in noise cancellation circuitry
- 4mA current at 5V and has ability for low voltage at 3V
  - 0.625" Diameter and 0.125" Thick
- Cost \$24.95 from sparkfun



# Texas Instruments TMP007 Infrared Temperature Sensor

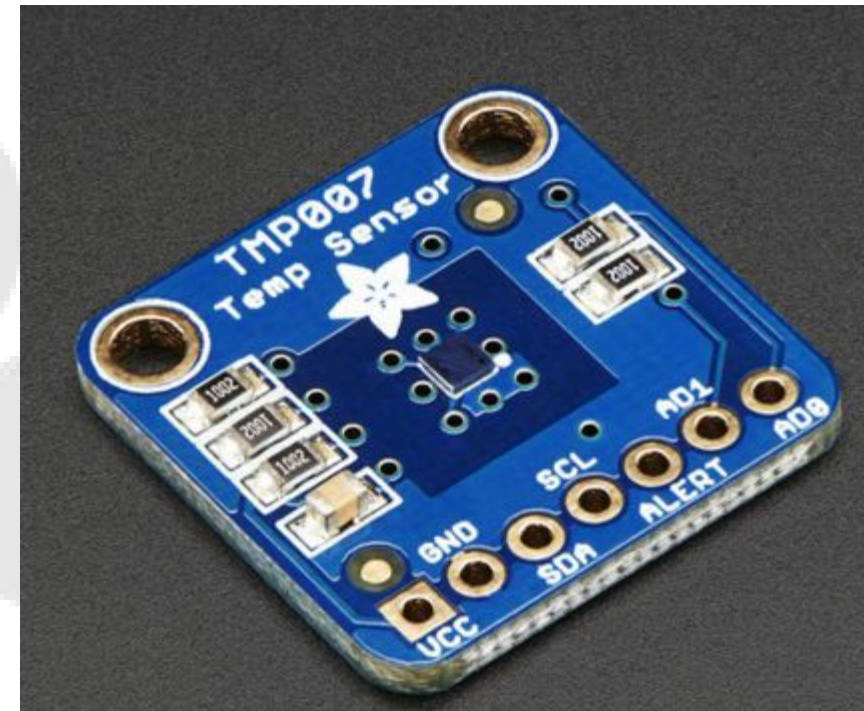
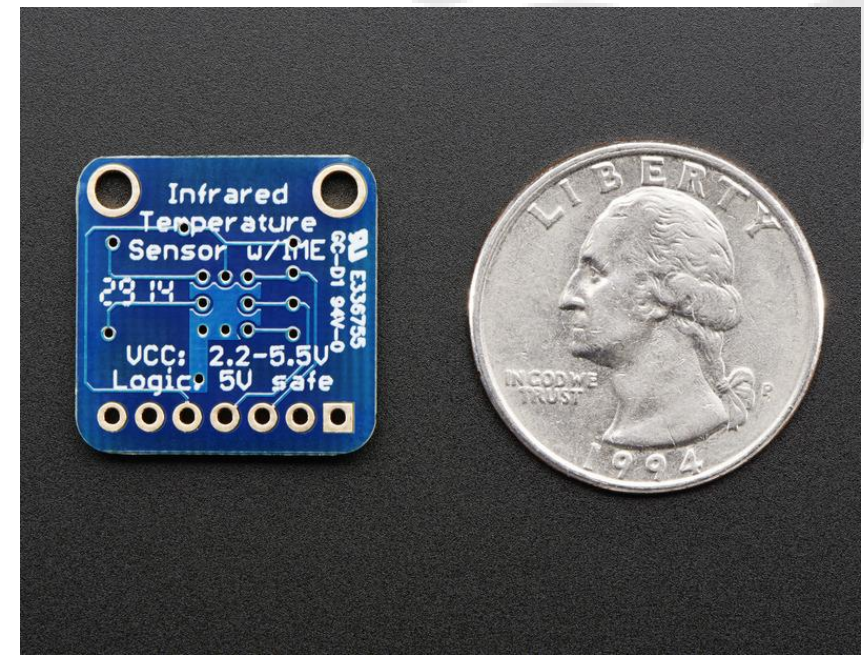
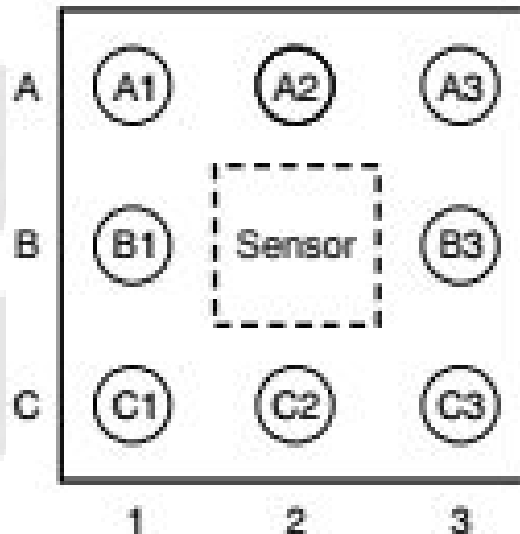
Parameters	Values
<b>Infrared Sensor Accuracy (Max) (+/- C)</b>	3
<b>Local Sensor Accuracy (Max) (+/- C)</b>	1
<b>Temp Range for Listed Accuracy</b>	0 to 60 C
<b>Temp Resolution (Max) (bits)</b>	14
<b>Operating Temperature Range</b>	-40 to 125 C
<b>Supply Voltage Min</b>	2.2 V
<b>Supply Voltage Max</b>	5.5 V
<b>Supply Current (Typ)</b>	270 uA
<b>Interface</b>	I2C
<b>Special Features</b>	Integrated Math Engine
<b>Cost</b>	\$4.75

# TMP007 Temperature Sensor



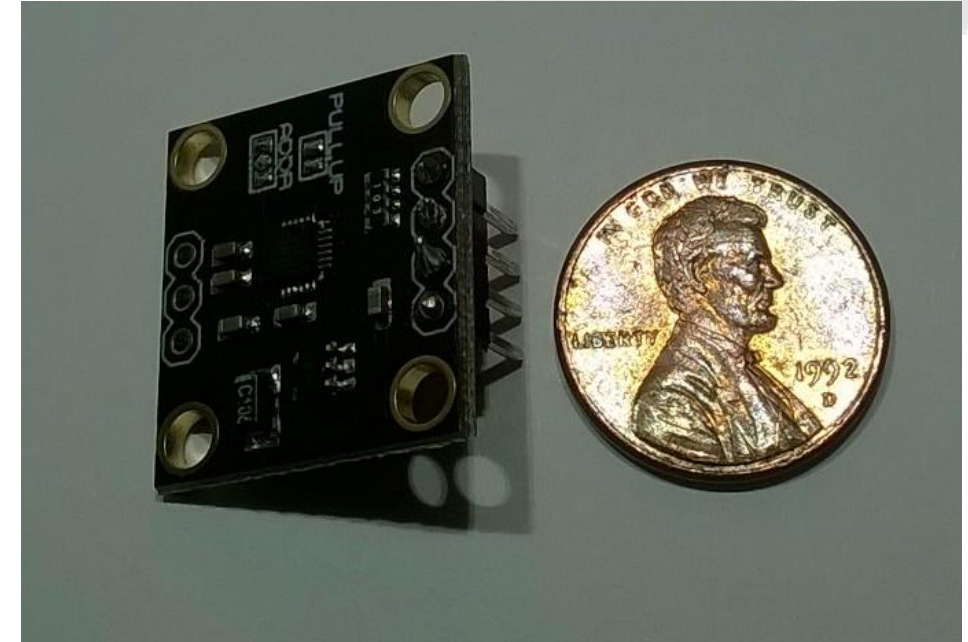
# TMP007 Temperature Sensor

- 1.9 mm x 1.9 mm
- 8 Pin surface mount package
- TMP007 Breakout board from Adafruit
- \$12.00
- Currently in testing
- Miniaturize PCB



# Accelerometer Sensor

- Selected Accelerometer: Invensense MPU-9250
- Actively Running Component
- Power Use Extremely Important due to constant use
- Low Power Modes - Modify the clock rate of the microcontroller

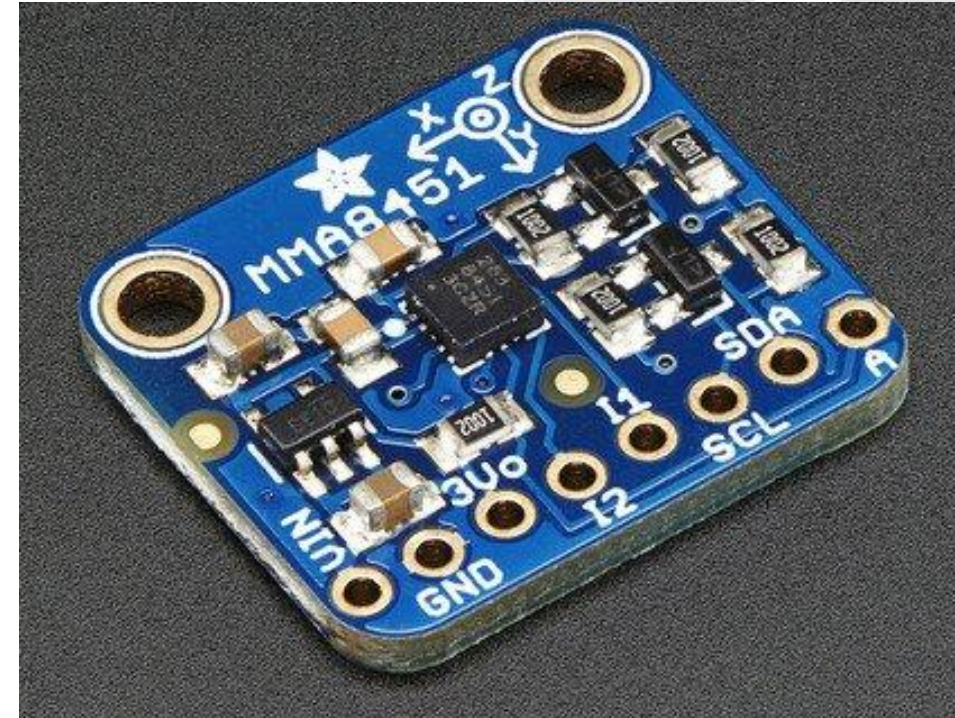


Features	Values
Active Operation Voltage Range	2.4V-3.6V
Typical Operation Current (2.5V) (9 Axis)	3.7mA
Specified Temperature Range	-40C - +85C
Measurable Gravity Range	±2g, ±4g, ±8g, or ±16g.



# Accelerometer Sensor

- Selected Accelerometer: Adafruit MMA8451 Accelerometer
- Actively Running Component
- Power Use Extremely Important due to constant use



Features	Values
Active Operation Voltage Range	3 Volts required with integrated 3.3 Voltage Regulator
Analog to Digital Conversion	14 Bits
Specified Temperature Range	-40C - +85C
Measurable Gravity Range	$\pm 2g$ , $\pm 4g$ , or $\pm 8g$

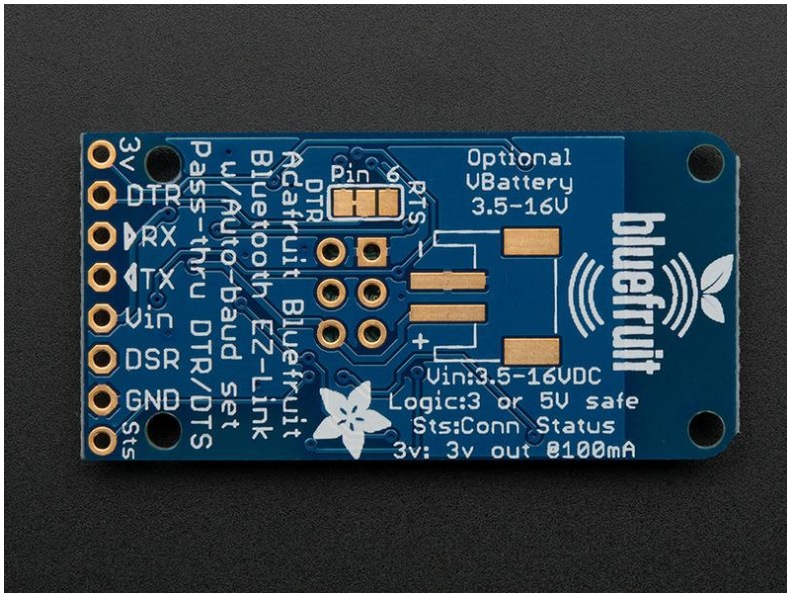
# Emergency Buzzer

- Generates a buzz sound if the animal's temperature goes over 95 fahrenheit
- Purchased at radioshack
- Requires low voltage while making a loud sound

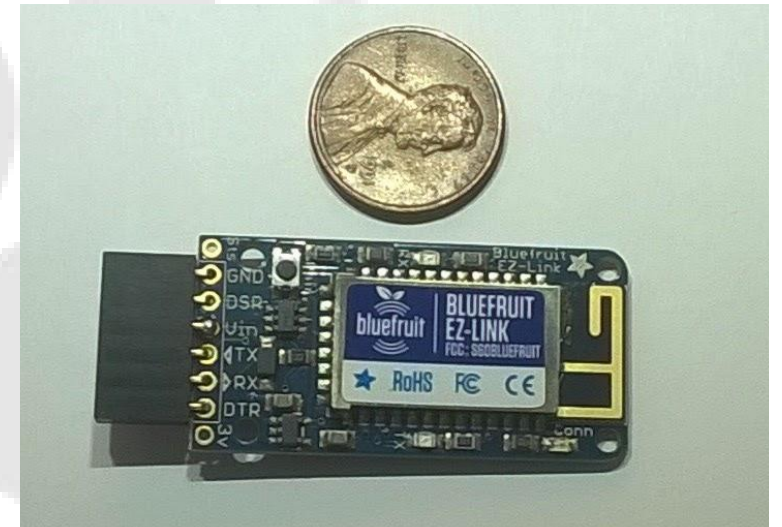


# Bluetooth: Bluefruit EZ-Link

- Cost: \$22.50
- Plug and Play
- Low Power compared to Wifi



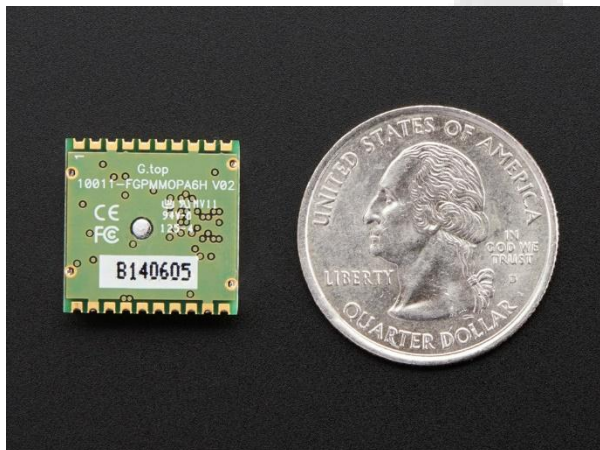
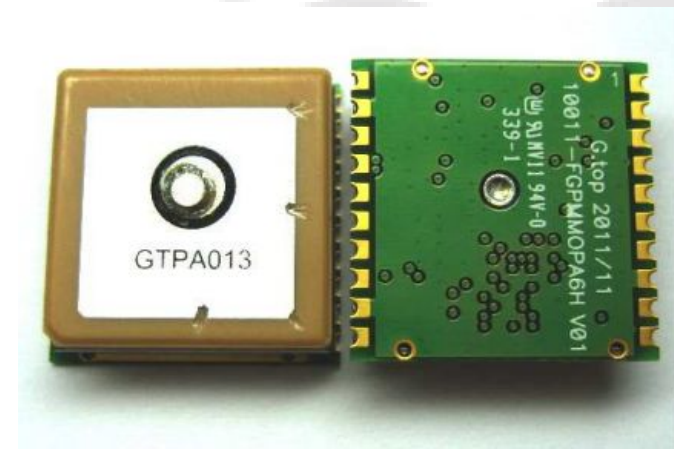
- Self Configuring
- No Code Required
- Easy Pinout
- Easy Pairing
- Internal Antenna
- Small





# GPS Sensor: Adafruit's MTK3339

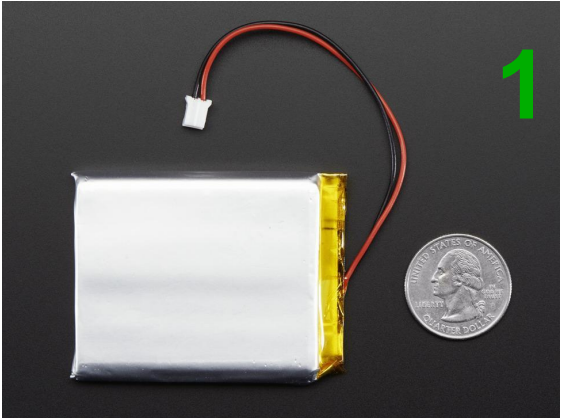
- Cost: \$29.95
- Update rate: 1 to 10 Hz
- Tracking sensitivity: -165 dBm
- Vin range: 3.0-4.3VDC
- Operating current: 25mA tracking, 20 mA current draw during navigation
- Warm/cold start: 34 seconds
- Size: 16mm x 16mm x 5mm
- Light weight: 4 grams
- Output: NMEA 0183, 9600 baud default
- Built-in datalogging
- Jammer detection and reduction
- Fix status output
- UART compatibility
- Internal patch antenna + connection for optional external active antenna
- Position Accuracy: < 3 meters
- Satellites: 22 tracking, 66 channels



# Power Supply

## Maximum Power Needed

Component	Max Current Draw	Max Voltage
Microcontroller	25 mA	4 V
Heart-rate monitor	.17 mA	3.6 V
Temperature sensor	.27 mA	5.5 V
Bluetooth	40 mA	16 V
GPS	25 mA	4.3 V
Accelerometer	.165 mA	3.6V
<b>Total:</b>	<b>Total maximum current draw is 90.605 mA</b>	<b>Cannot exceed a Voltage of 3.6 V</b>



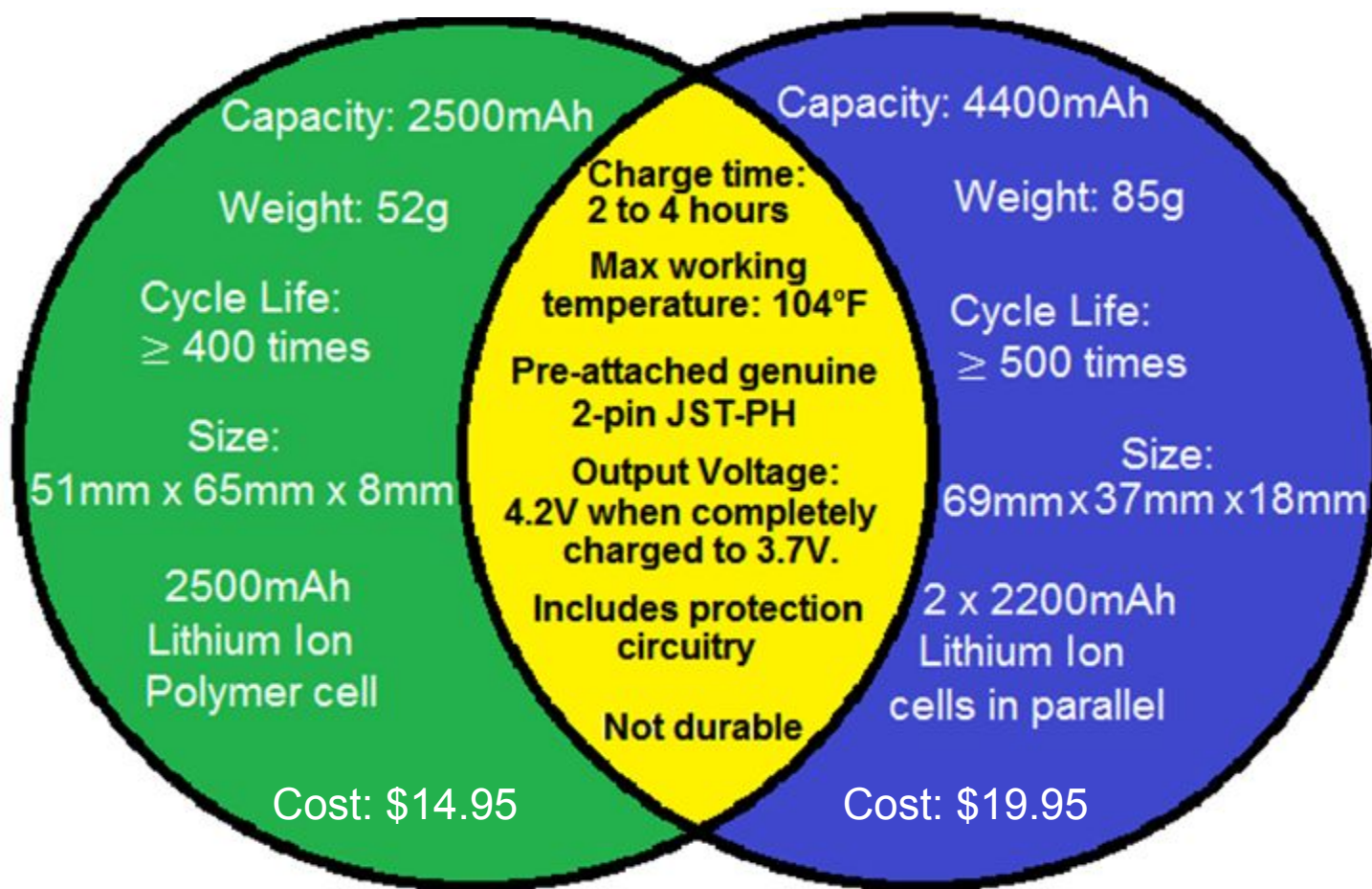
# Batteries:

1 – Adafruit’s Li-Poly  
3.7V 2500mAh

2 – Adafruit’s Lithium  
Ion Battery Pack - 3.7V  
4400mAh



Test	Methods	Results
Collision	Acceleration of 100m/s <sup>2</sup>	No change to battery
Vibration	Frequency of 10-30Hz	No change to battery
Drop	10m height drop	No explosion or fire
High Temp	140°F	Discharge time ≥ 270 minutes
Low Temp	14°F	Discharge time ≥ 210 minutes
Constant Humidity and Temperature	Range of Humidity 93±2% at 104±4°F	No distortion No electrolytes leakage Discharge time ≥ 270 minutes

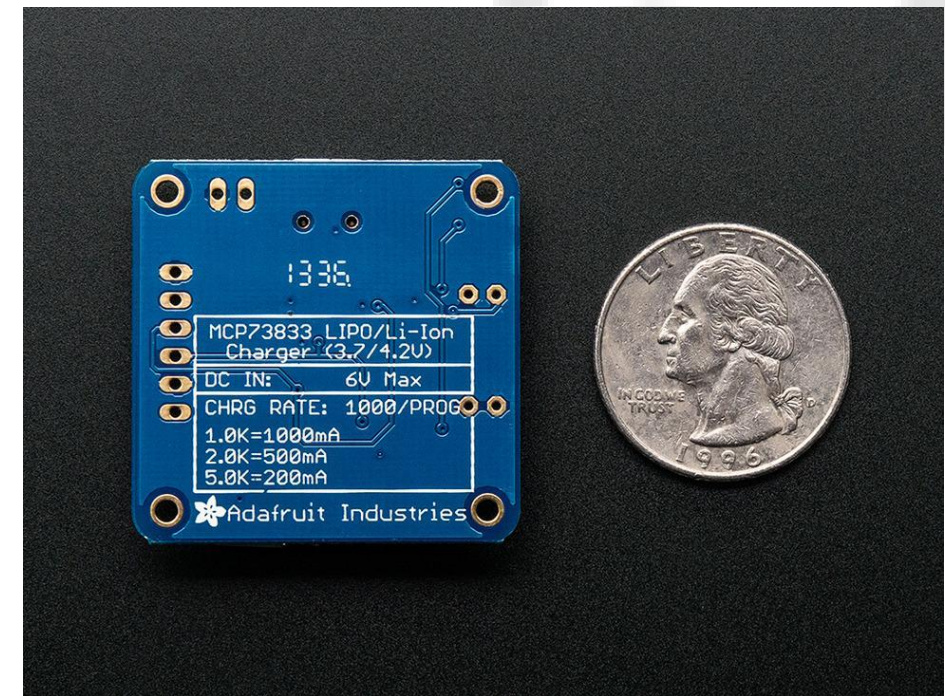




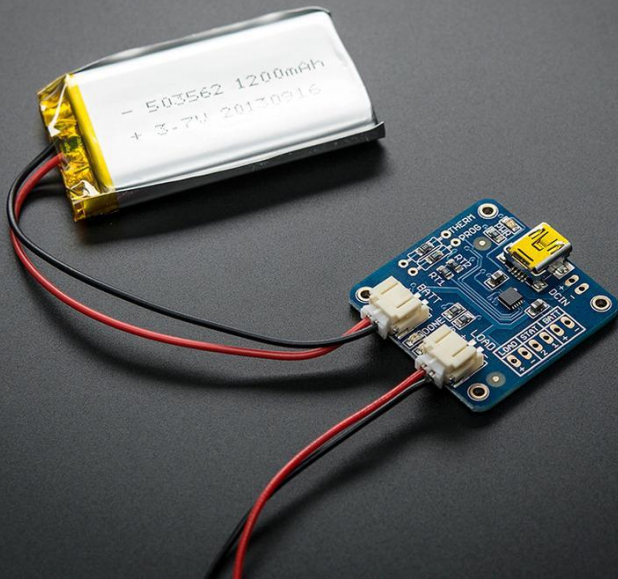
# Recharge:

## USB Li-Ion/Li-Poly charger - v1.2

- From Adafruit
- Cost \$12.50
- Weight: 5.7g
- Dimensions: 33mm x 35mm x 7mm



- For charging single Li-Ion/Li-Poly 3.7/4.2v batteries
- Separate JST connectors = Doesn't have to be removed for charging
- Status LEDs

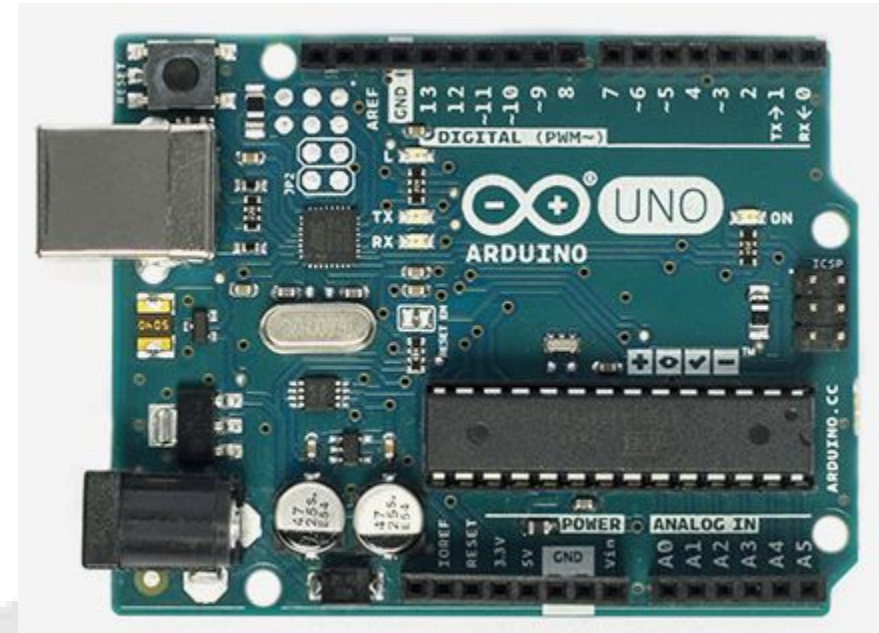


# Microcontroller

Features	ATmega328	TM4C123GH6PM
Operating Voltage	5 V	4 V Max
Digital IO Pins	14	43
Flash Memory	32 kB	256 kB
Clock Speed	16 MHz	80 MHz
UART	1	8
I2C	1	4
Cost	\$4.00	\$11.00
Package	28-pin DIP package	64-pin Surface Mount

# ATmega328

- Arduino UNO board extremely useful for prototyping
- MCU is on a header for easy replacement or breadboard/protoboard/pcb mounting
- Arduino IDE



# Arduino IDE

- Intuitive interface
- Lightweight
- Community support: easy to find libraries, example sketches, help for specific parts
- Nice to use



# Issue: UART

- Bluetooth module and GPS module both require UART, ATmega328 only has one.
- Solution A: Multiplexing
  - Requires very little code, few pins, multiplexers are cheap
  - Issue: Won't have continuous wireless connection to cloud
- Solution B: Software UART
  - Will allow continuous Bluetooth connection
  - Requires multiple pins and more code



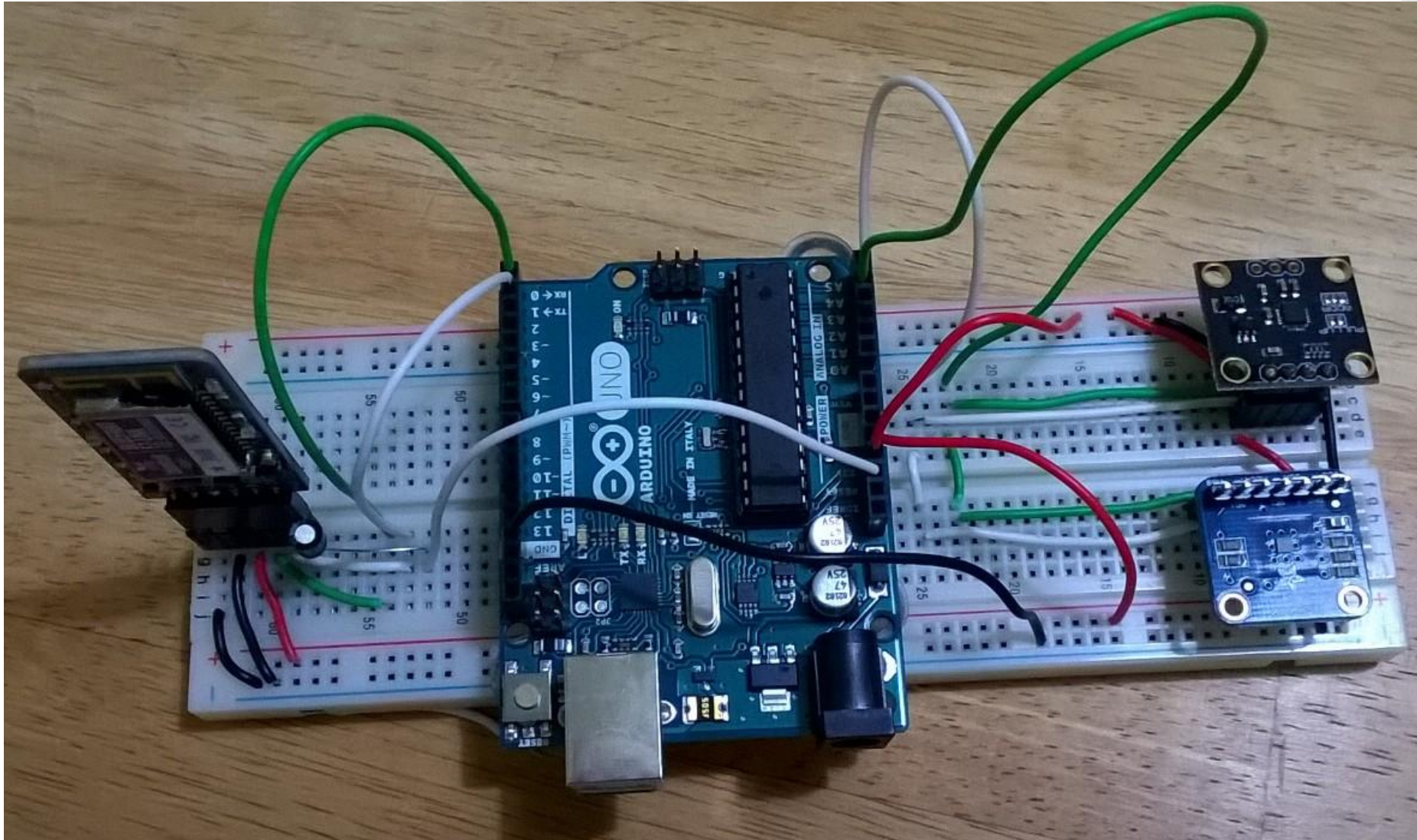
# Software

- Set up and Loop through sensors
  - Verbose print for debugging
  - IOT printing
- Accelerometer
  - Zeroing out gravity (or not)
- Temperature Sensor
  - Averaging
  - Discarding NaN reads

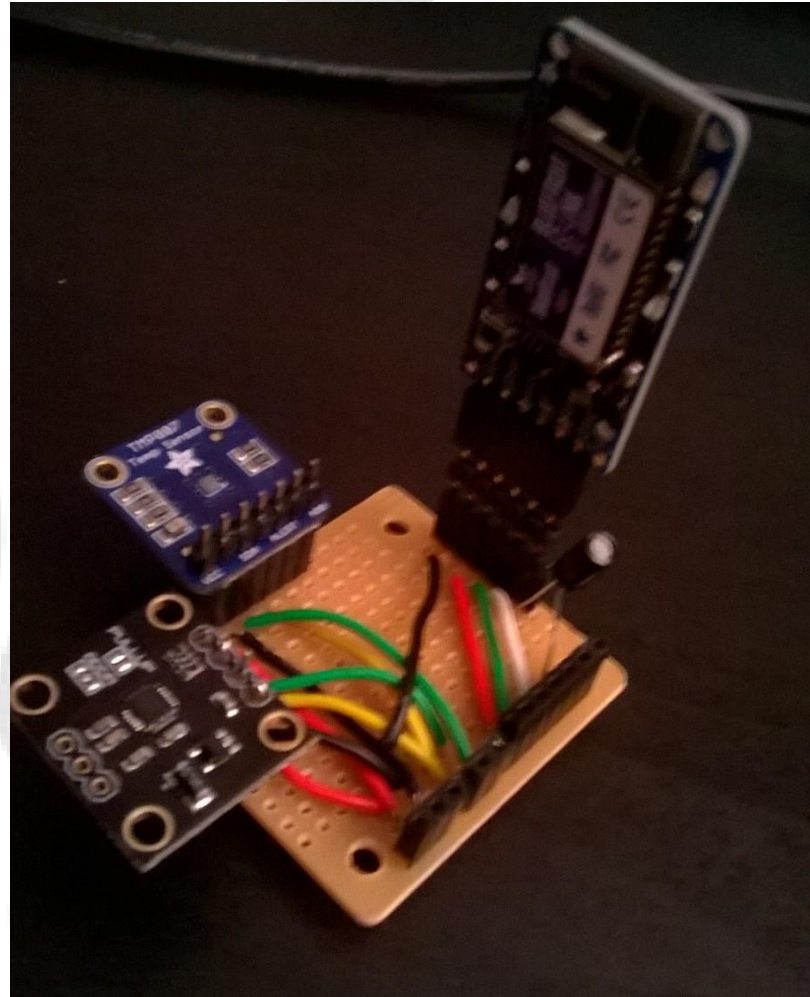
## IOT Printing Format:

```
COM12
-0.51,-0.12,9.39,83.58,0.0000,0.0000,209, |
-0.49,-0.12,9.40,83.58,0.0000,0.0000,196, |
-0.55,-0.09,9.49,83.58,0.0000,0.0000,193, |
-0.52,-0.14,9.48,83.58,100.0000,0.0000,215, |
-0.52,-0.10,9.38,83.62,100.0000,0.0000,235, |
-0.50,-0.13,9.43,83.63,100.0000,0.0000,227, |
-0.49,-0.13,9.48,83.64,0.0000,0.0000,218, |
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```

# Prototyping

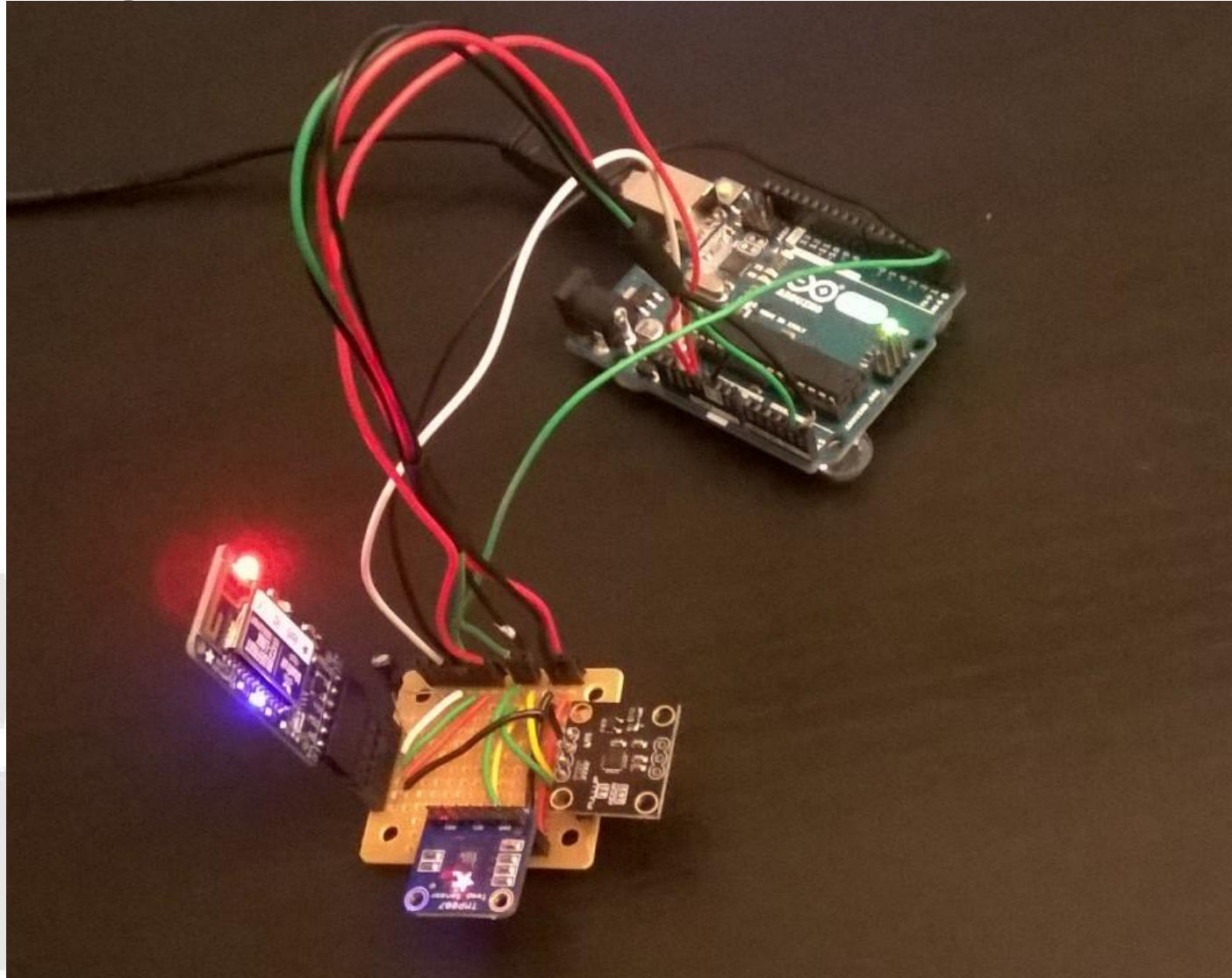


# Prototyping

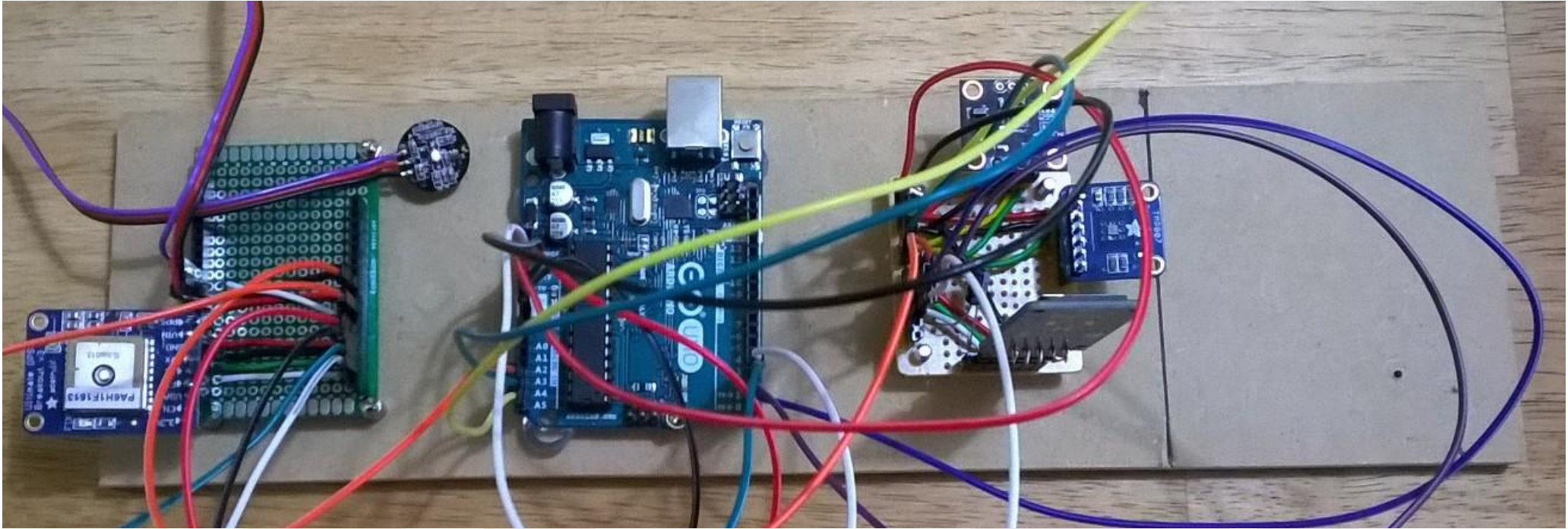




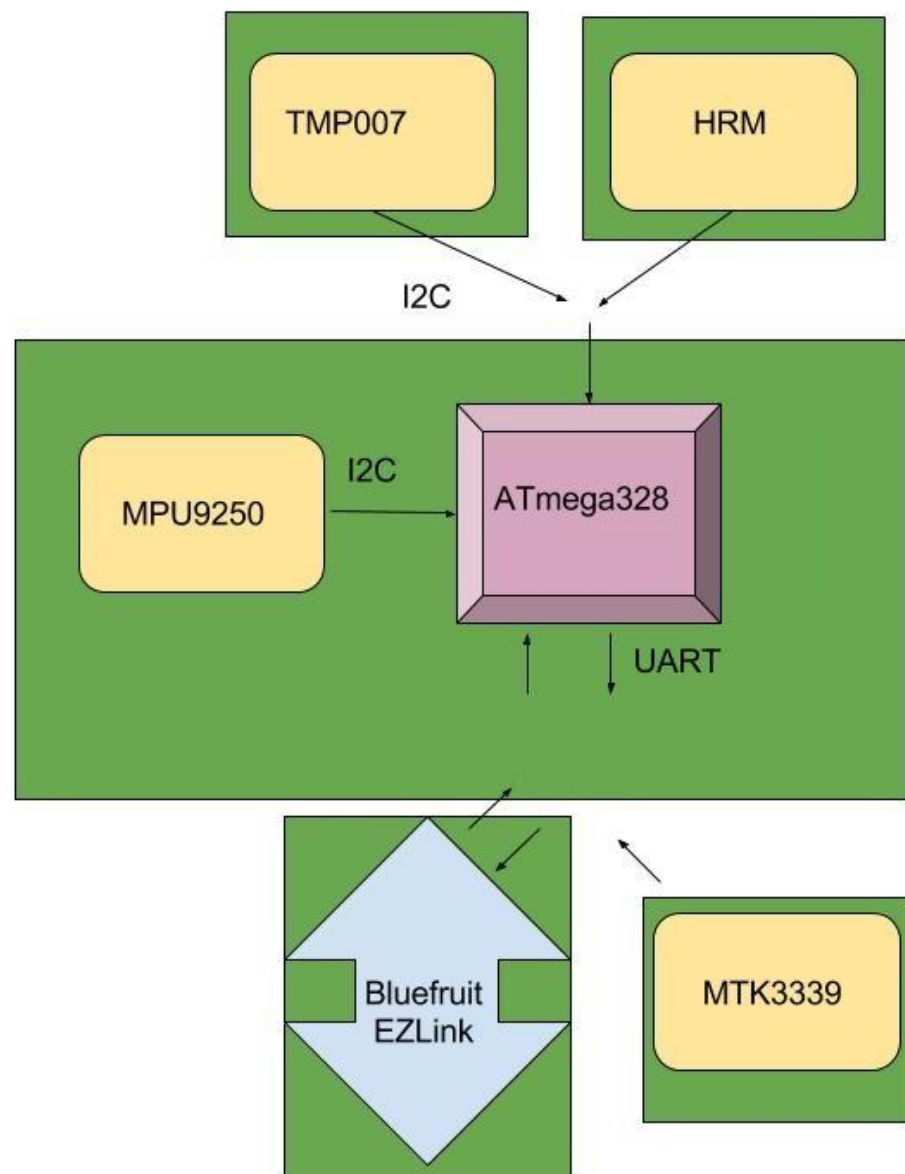
# Prototyping



# Prototyping

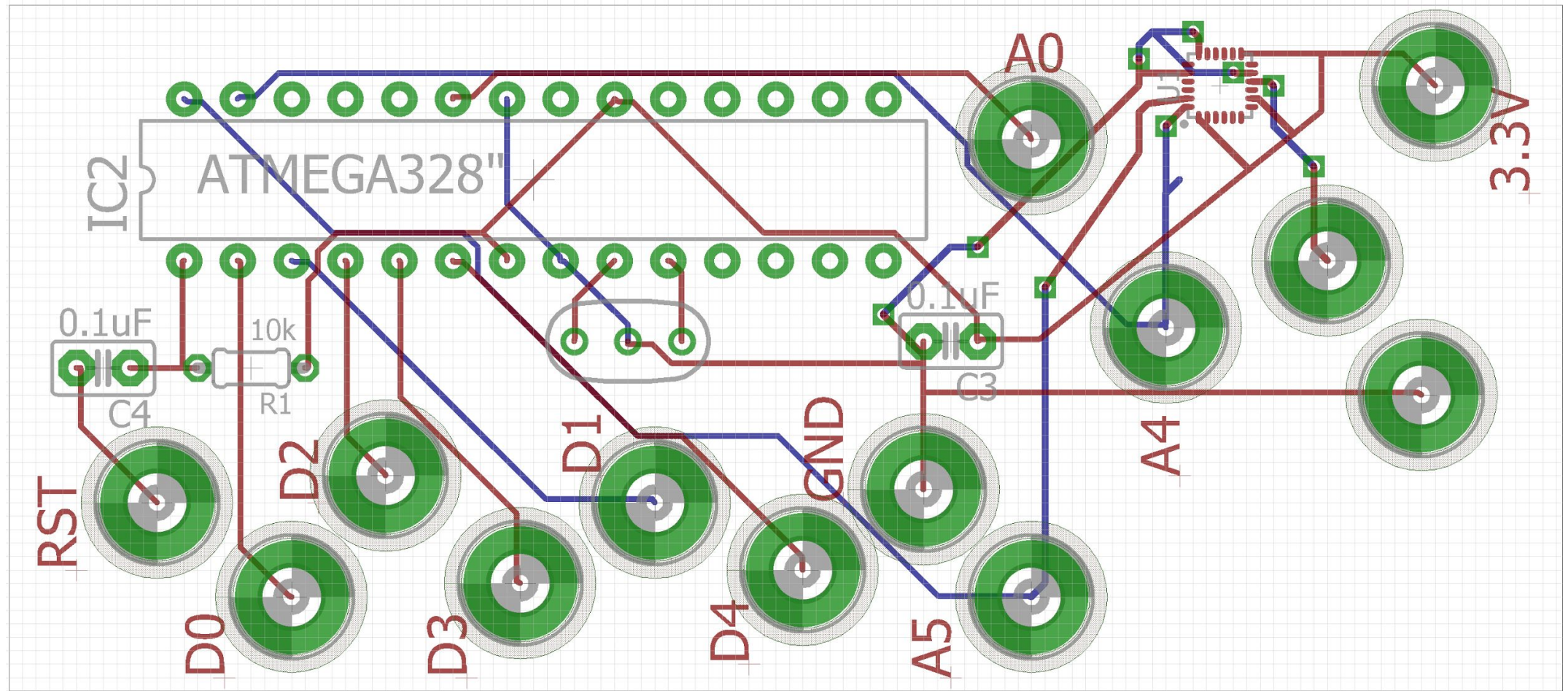


# PCB Configuration Plan

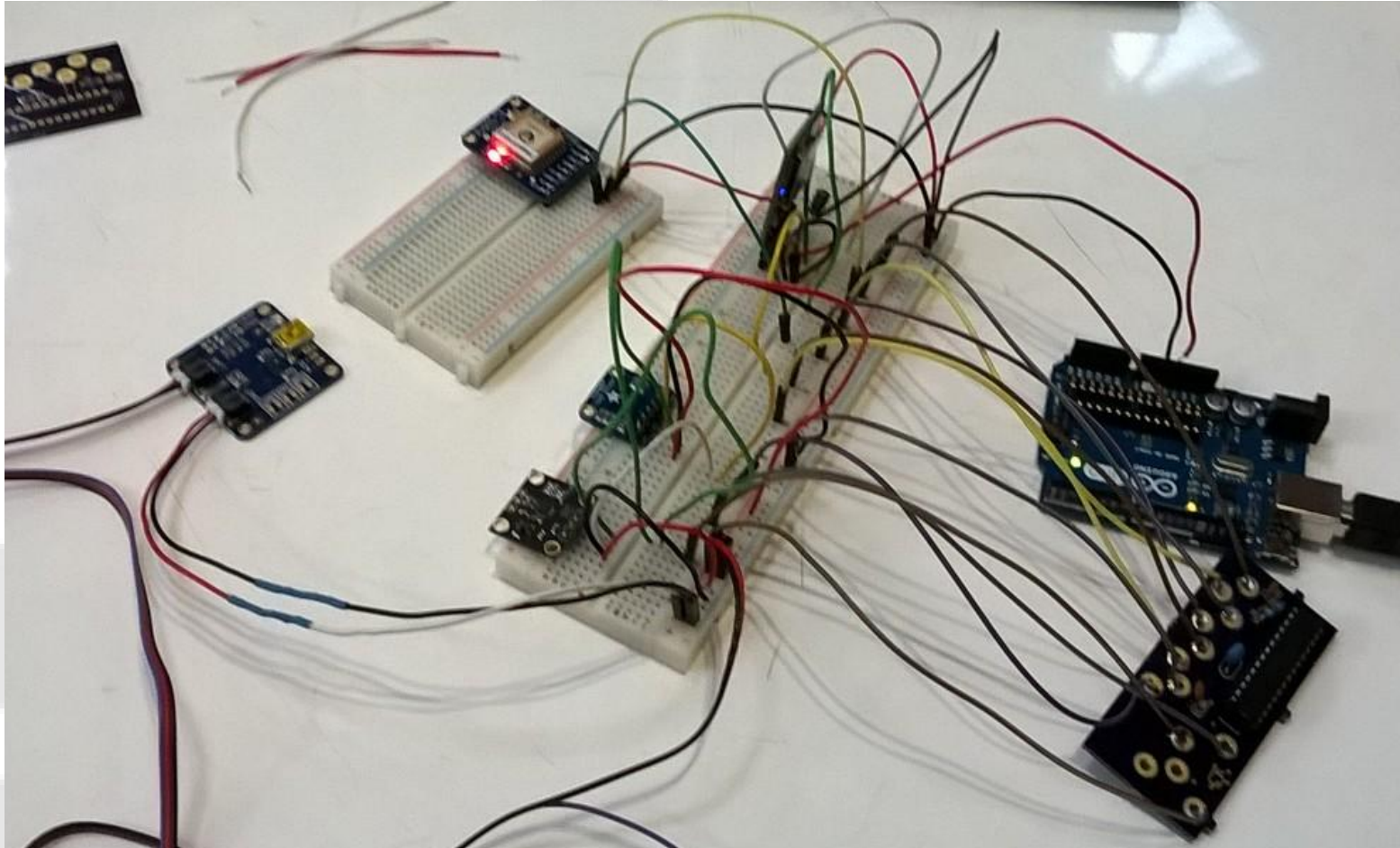




# EagleCAD



# PCB Testing



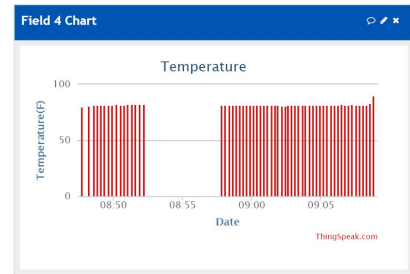
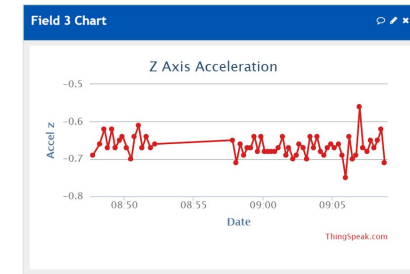
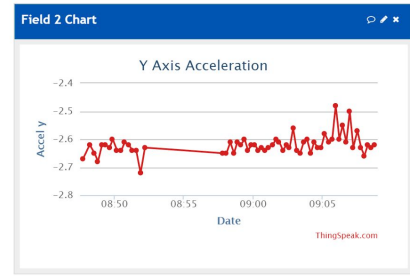
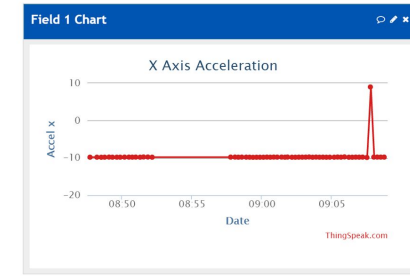


# Internet of Things (IoT)

- Allows information to be shared and manipulated easily.
- Networking technology is used to collect data from devices and send data to devices.
- Doggy Pal Collar will use the IoT platform to communicate the collected data from the separate devices to the end user using bluetooth technology.
- Two IoT websites will be used; [dweet.io](https://dweet.io) and [freeboard.io](https://freeboard.io)

# ThingSpeak

- Real time data collection
- Real time data storage
- Allows devices to publish data to the cloud
- 15 second update delay
- Send alerts via twitter
- Free to use, only need to sign up for account
- Doggy Pal Collar will send live data to thingspeak

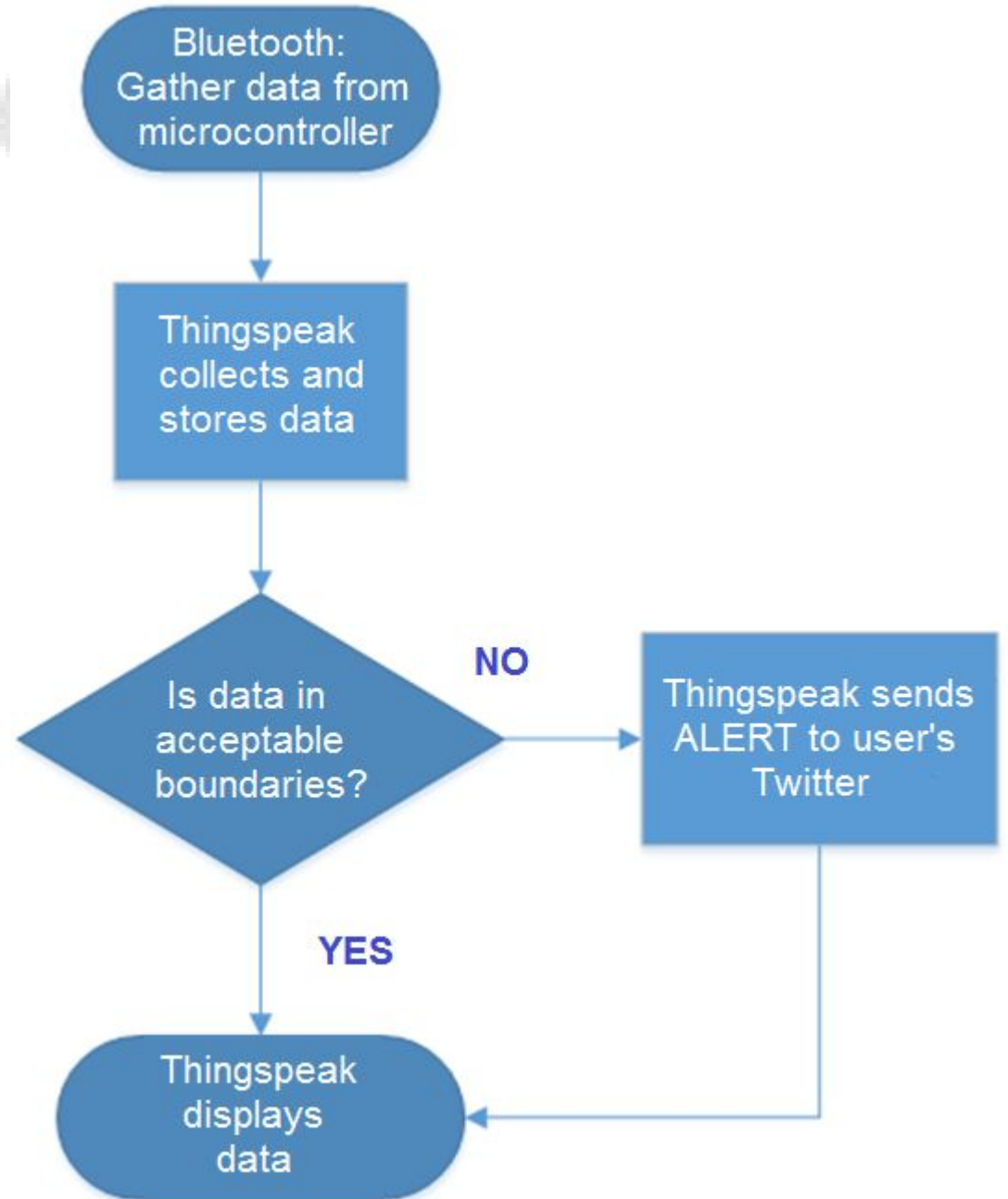


# Processing

- Sketch language code
- Open source with many different libraries available
- Used as “middle man” between Doggy Pal Collar and ThingSpeak
- Will Collect data from Doggy Pal Collar via bluetooth connection on computer and send data to ThingSpeak via internet connection of computer.



# Internet of Things Flowchart



# Collar Design

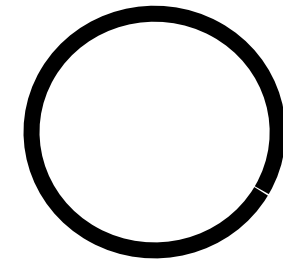
## Idea 1

An attachment that could be used with any collar



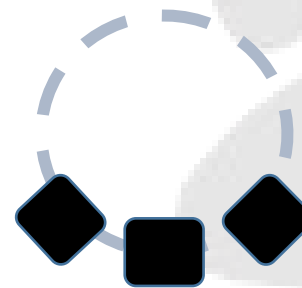
## Idea 2

A 3D printed collar with all the components throughout



## Idea 3

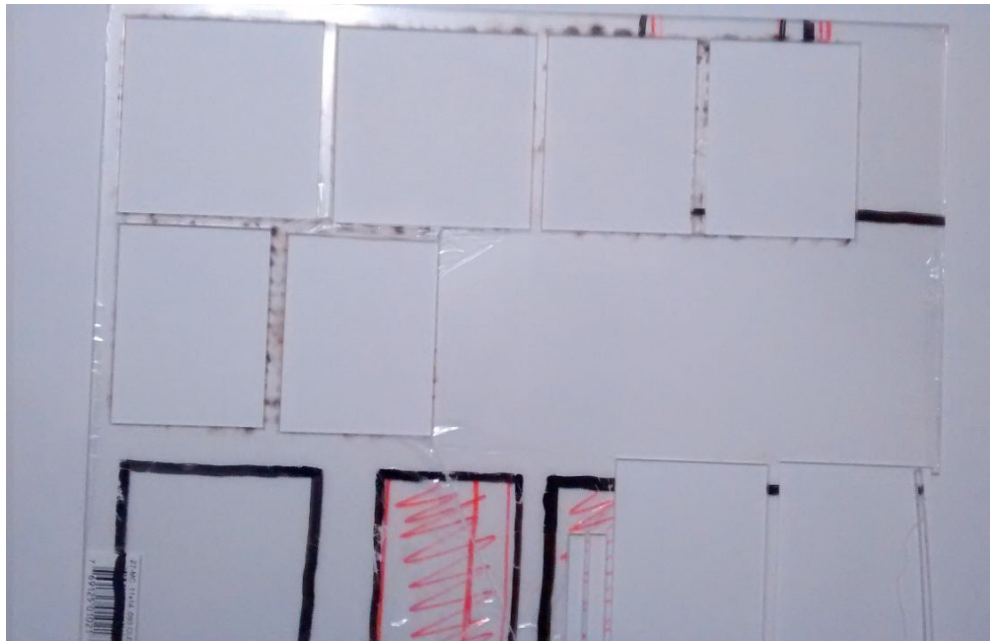
Two or more attachments with wires running through the collar to connect all the devices



# Collar Design

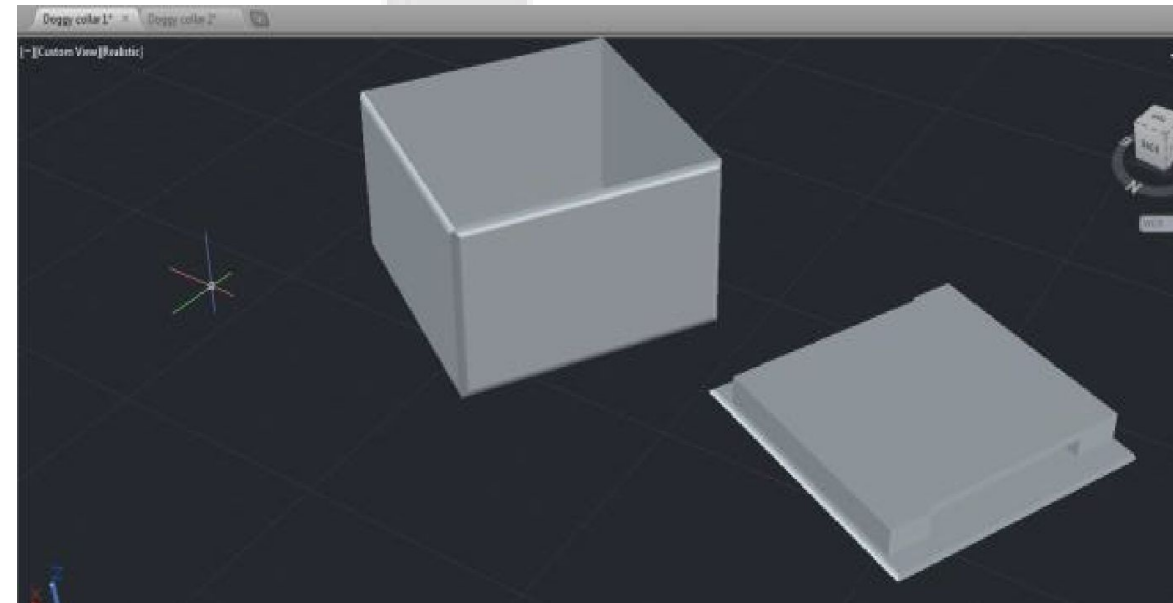
## Plastic Box:

- Size: 88.9x88.9x63.5 (LxWxH) mm
- Used the UCF's Lazer Cutter



## 3D printing:

- UCF has a 3D printer that they allow their students to use for free
- Learning to design in AutoCAD
- The design for the casing was a hollowed box
- Size: 88.9x88.9x63.5 (LxWxH) mm
- An area on one side that will allow the owner of the dog to pass a collar through so that the attachment can work for an size dog.

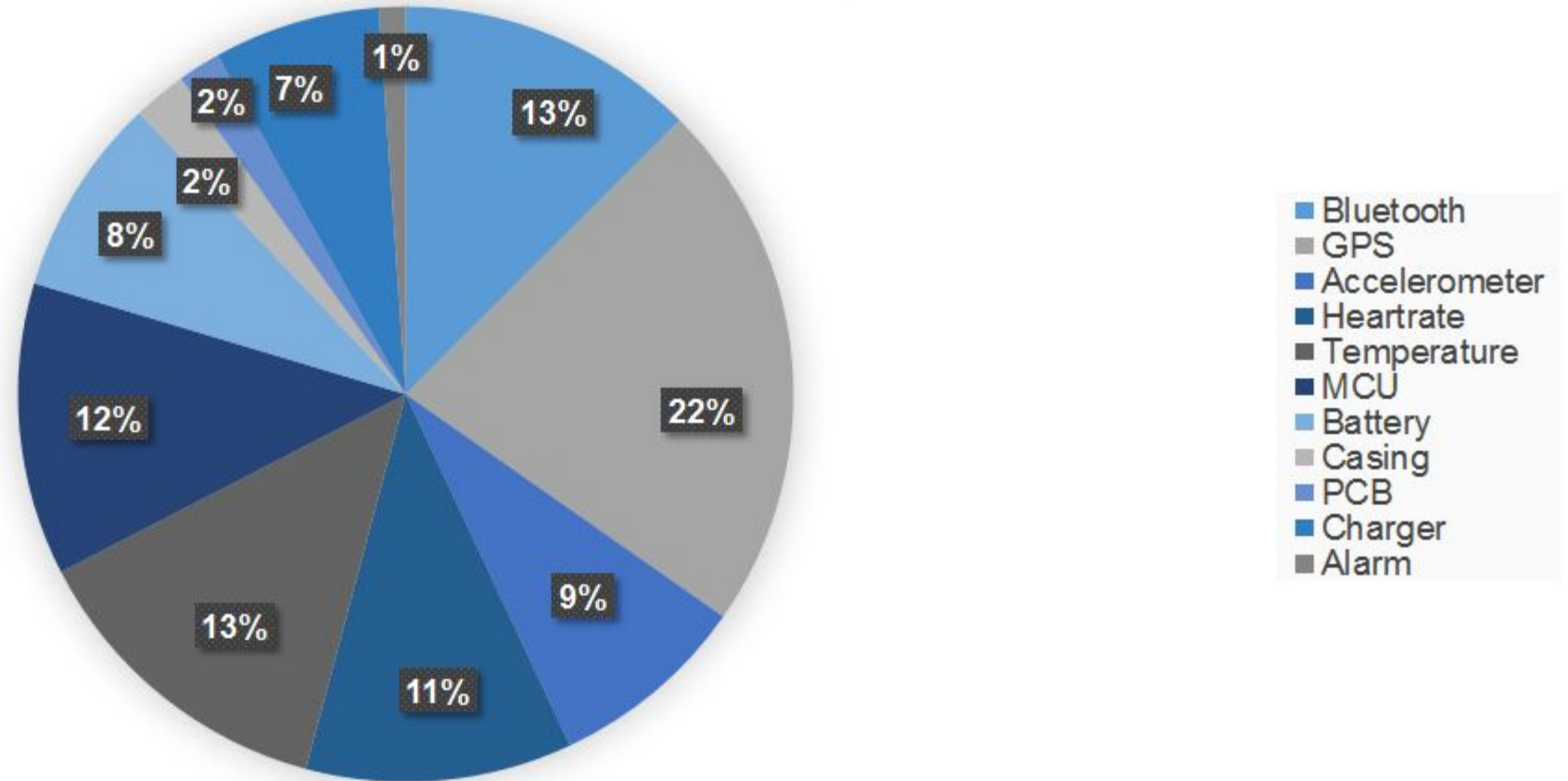


# Project Distribution

Sections	Bryon	Dustin	Steven	Stephanie
Internet of Things (IoT)			✓	
Heart Rate			✓	
Microcontroller	✓			
Temperature	✓			
Accelerometer		✓		
Battery				✓
GPS				✓
Bluetooth		✓		
Collar Design		✓		✓
PCB	✓		✓	

# Financing

## Prototype Parts Percentage



**Collar Total \$158.92**

**Overall Total: \$233.32**





**Questions?**