Doggy Pal Collar

Group #33

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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 position of any dog by wireless communication. This smart collar will display all the information it collects to an Internet of Things website created 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
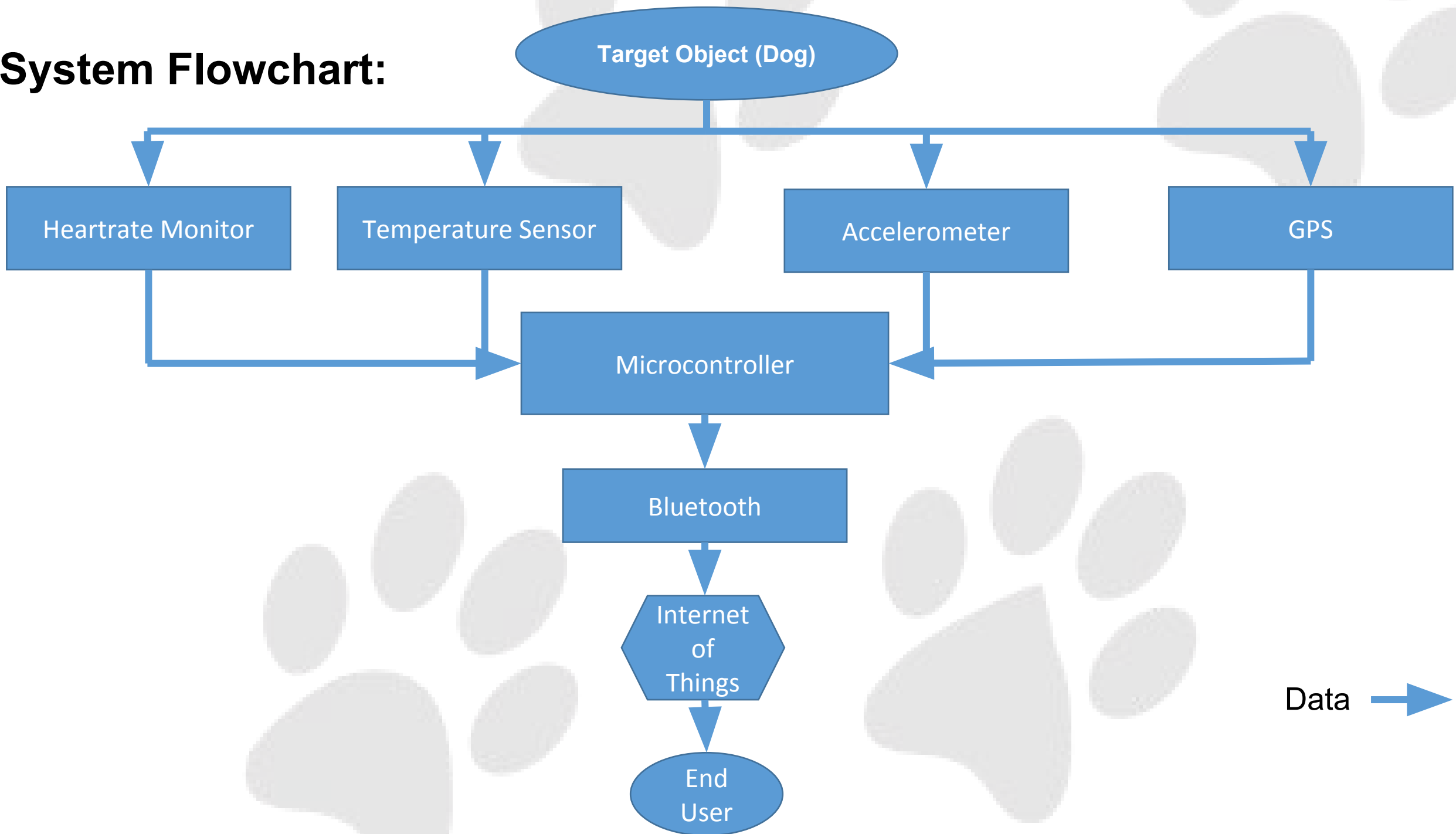- Light weight
- Long battery life

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	✓	⊘	✓
Calories Burned	Can be added	✓	✓
Quality of Rest	Can be added	✓	⊘
Respiratory Rate	⊘	✓	✓
Activity	Can be added	✓	✓
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 (Internet of Things)	$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
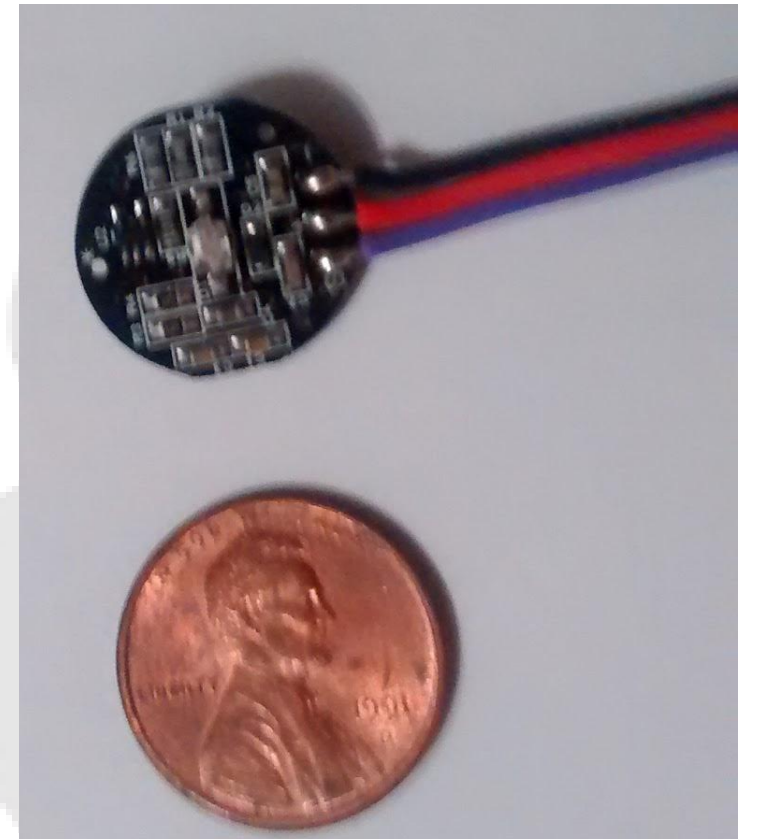
# Texas Instruments TMP007 Infrared Temperature Sensor

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

TMP007 Temperature Sensor
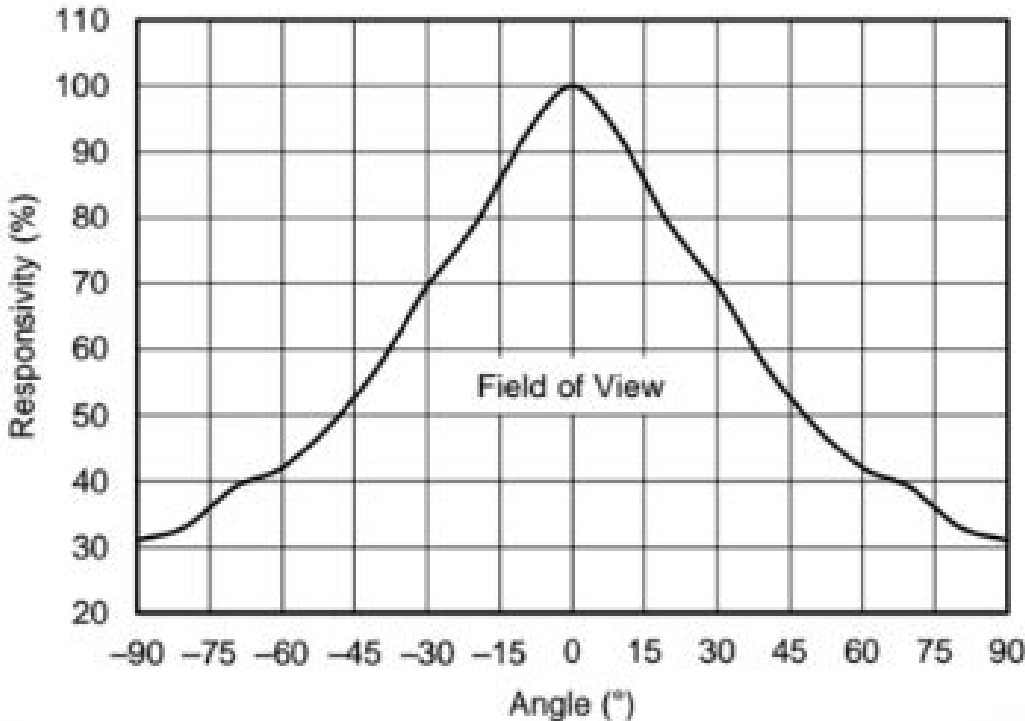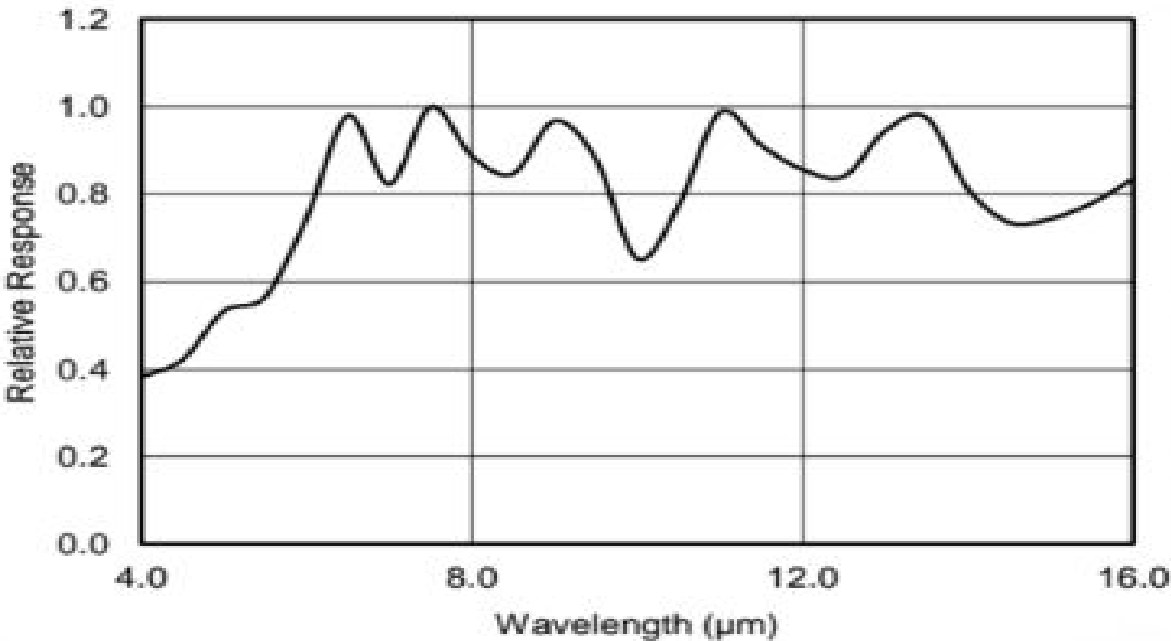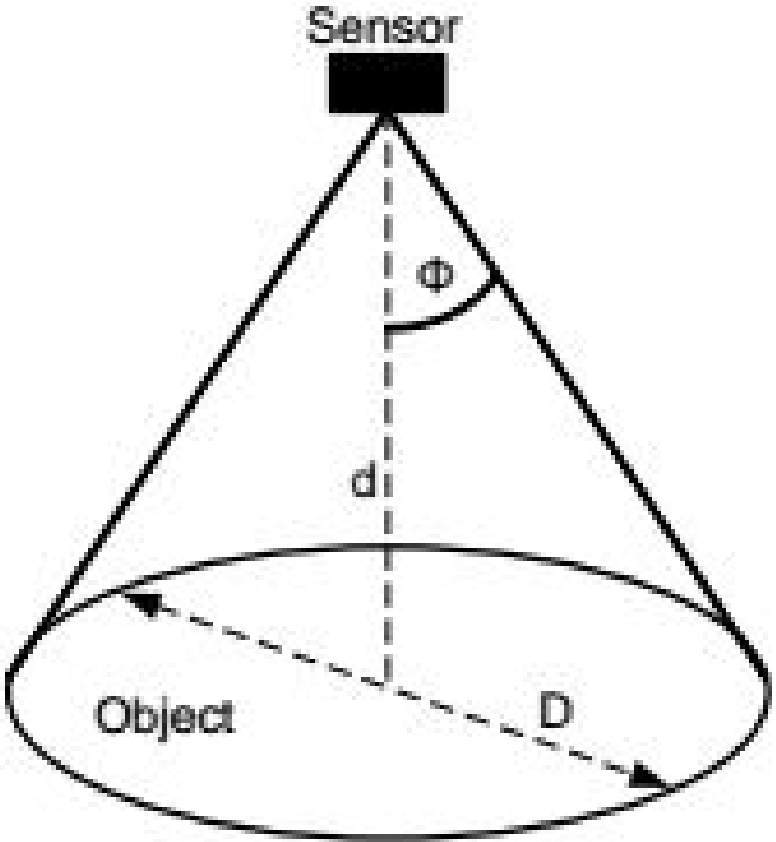
TMP007 Temperature Sensor

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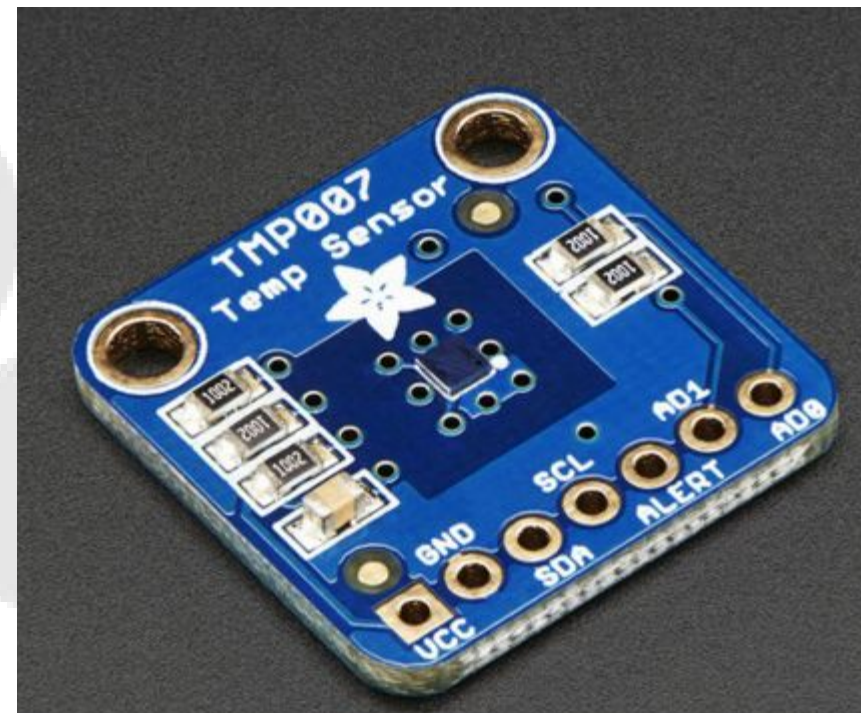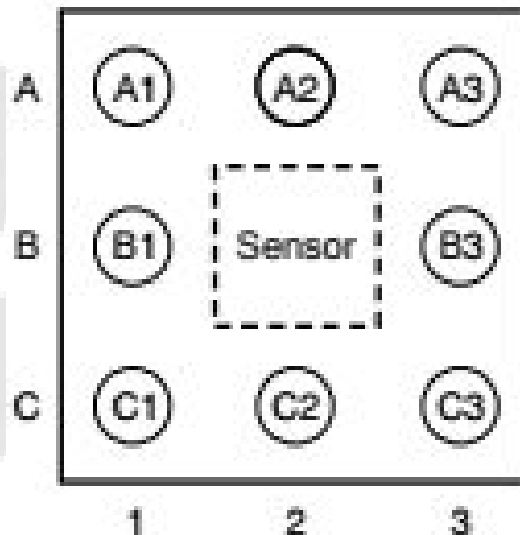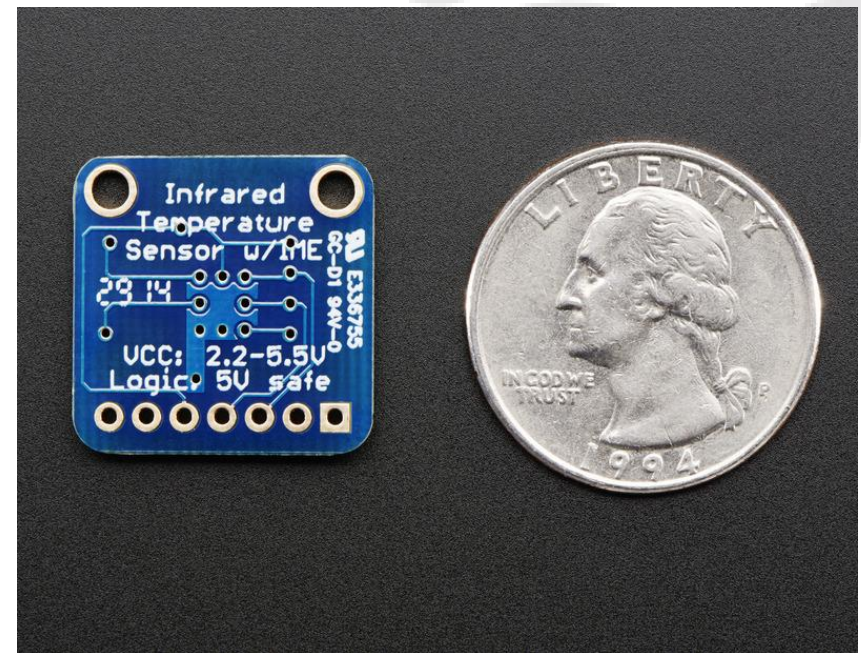
Accelerometer Sensor

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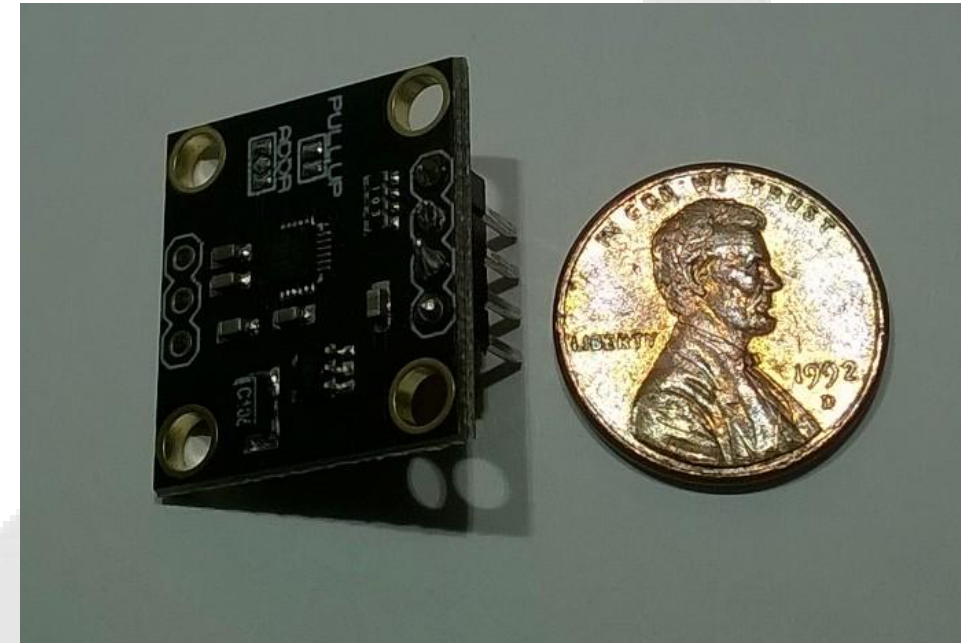
Active Operation Voltage Range	2.4V-3.6V
Typical Operation Current (2.5V) (9 Axis)	3.7mA
Specified Tempreture Range	-40C - +85C
Measurable Gravity Range	±2g, ±4g, ±8g, or ±16g.

Bluetooth: Bluefruit EZ-Link

- Cost: $22.50
- Plug and Play
- Low Power compared to Wifi
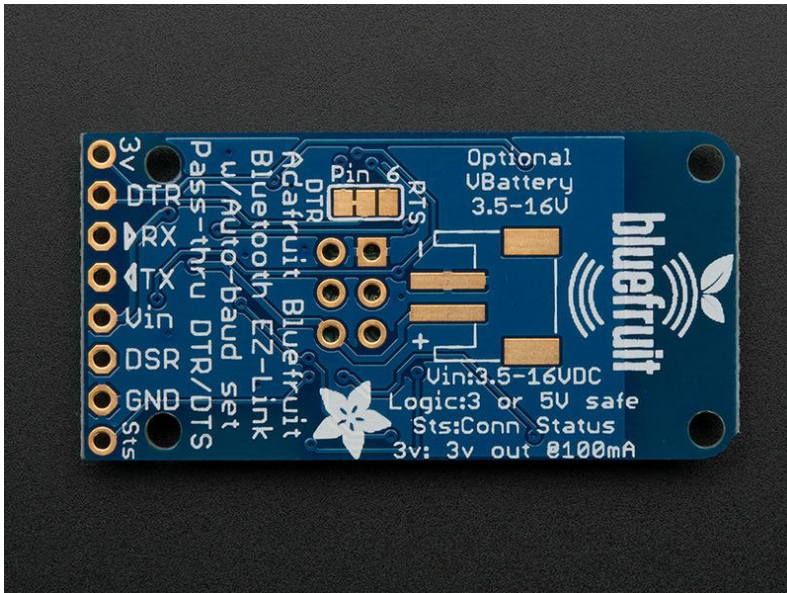
- Self Configuring
- No Code Required
- Easy Pinout
- Easy Pairing
- Internal Antenna
- Small

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
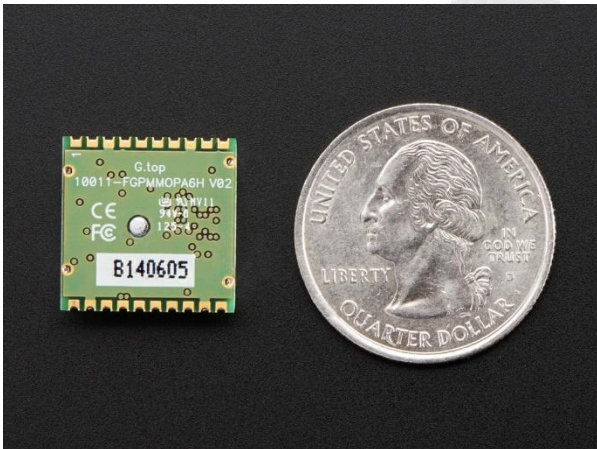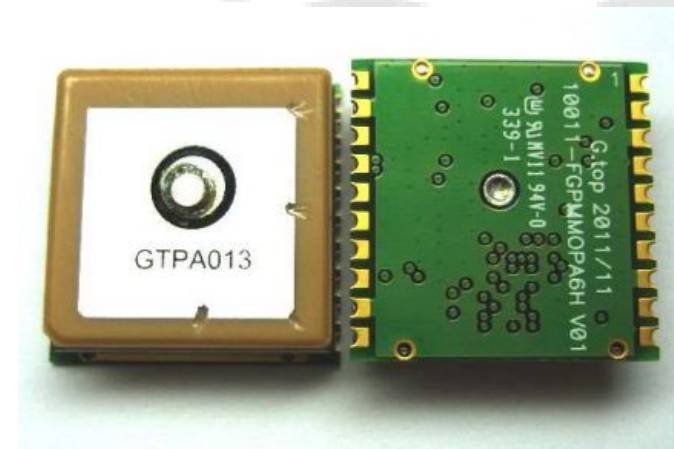
Power Supply

Maximum Power Needed

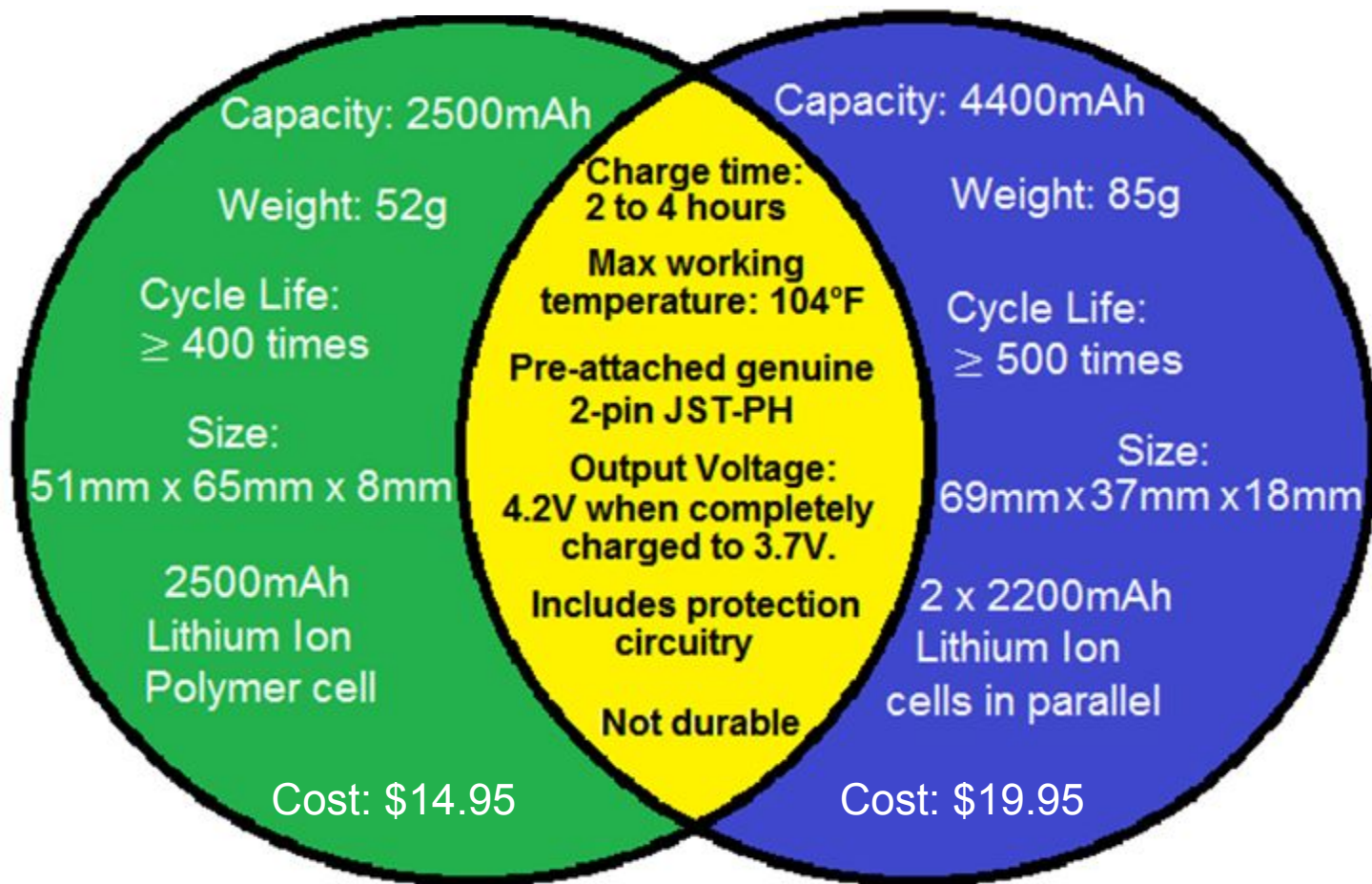| Component	Max Current Draw	Max Voltage
Microcontroller	25 mAh	4 V
Heart-rate monitor	.17 mAh	3.6 V
Temperature sensor	.27 mAh	5.5 V
Bluetooth	40 mAh	16 V
GPS	25 mAh	4.3 V
Total	Total maximum current draw is 90.44 mAh	Cannot exceed a Voltage of 3.6 V
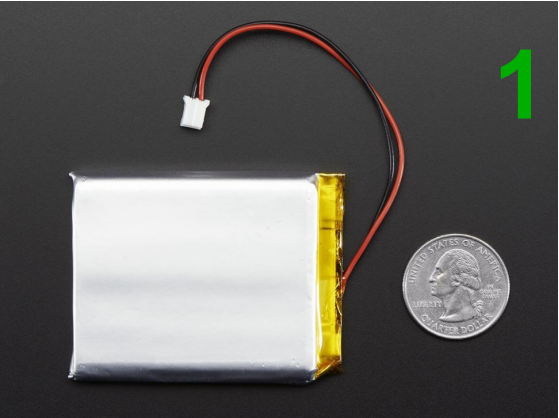
Batteries:

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/s²	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

Capacity: 2500mAh

Weight: 52g

Cycle Life: ≥ 400 times

Size: 51mm x 65mm x 8mm

2500mAh Lithium Ion Polymer cell

Cost: $14.95

Charge time: 2 to 4 hours

Max working temperature: 104°F

Pre-attached genuine 2-pin JST-PH

Output Voltage: 4.2V when completely charged to 3.7V.

Includes protection circuitry

Not durable

Capacity: 4400mAh

Weight: 85g

Cycle Life: ≥ 500 times

Size: 69mm x 37mm x 18mm

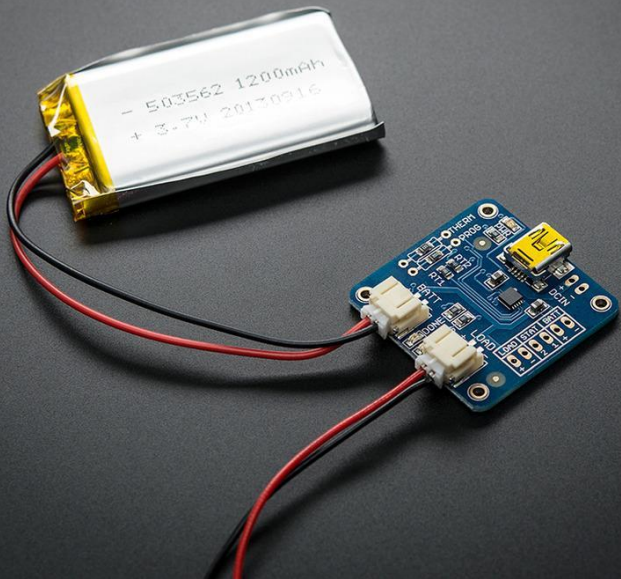2 x 2200mAh Lithium Ion cells in parallel

Cost: $19.95

Recharge:
USB Li-Ion/Li-Poly charger - v1.2

- From Adafruit
- Cost $12.50
- Weight: 5.7g
- Dimensions: 33mm x 35mm x 7mm
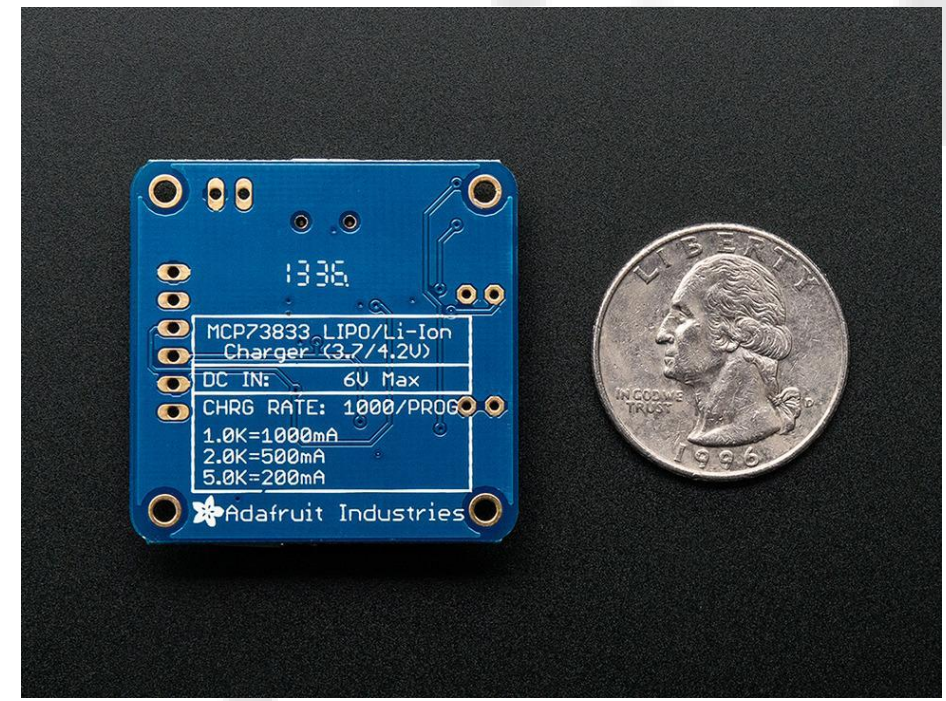
- For charging single Li-Ion/Li-Poly 3.7/4.2v batteries
- Separate JST connectors = Doesn't have to be removed for charging
- Status LEDs

Microcontroller

	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
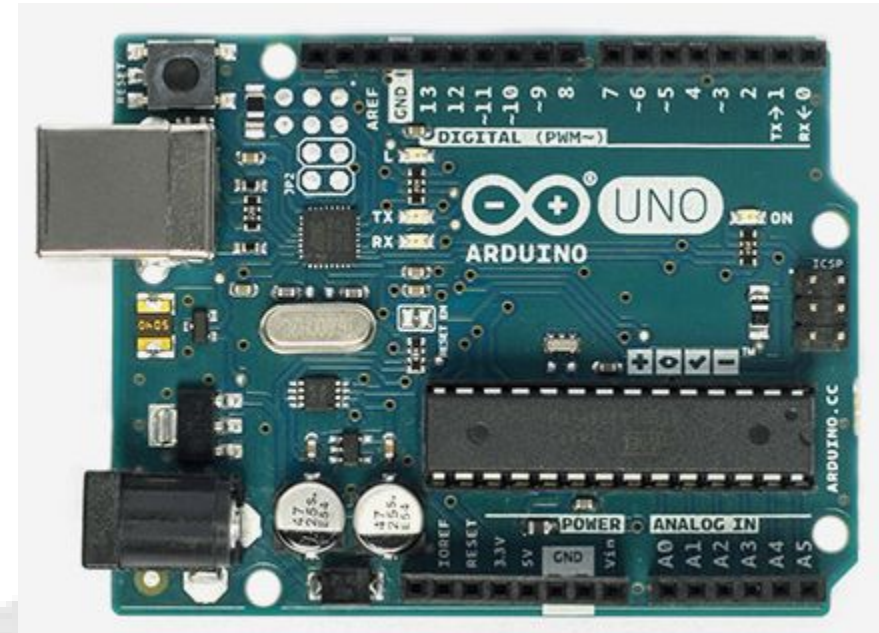
Arduino IDE

- 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
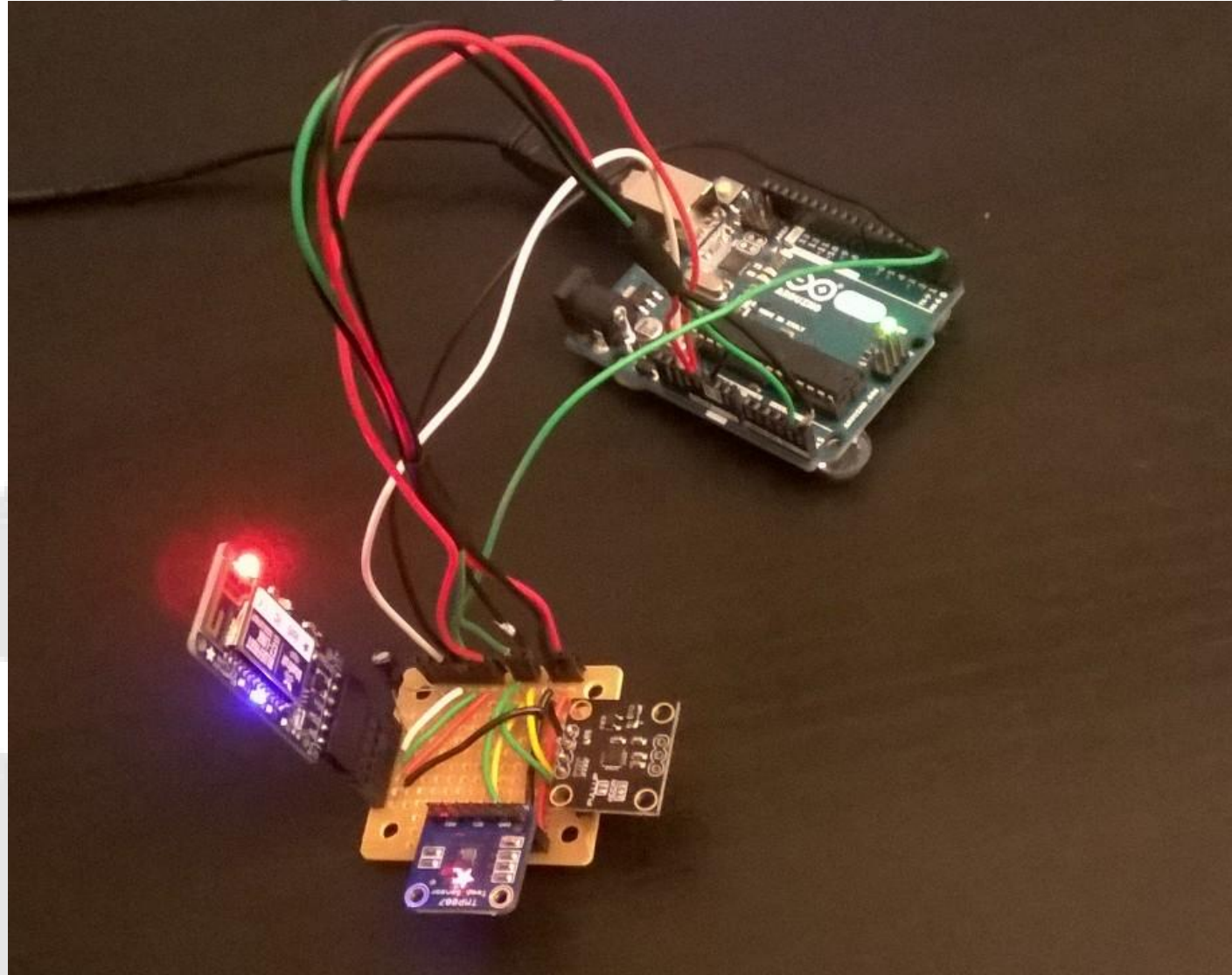 - Requires multiple pins and more code
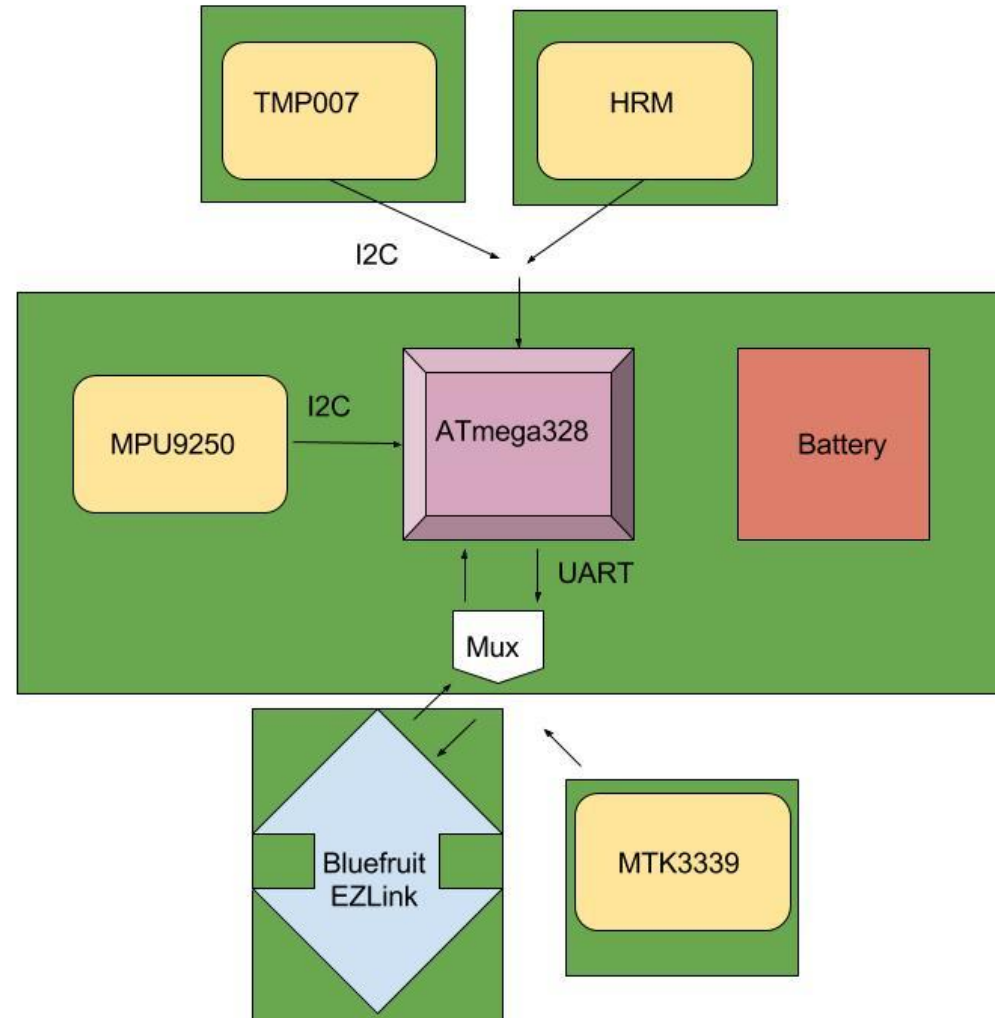
Prototype / Testing Progress
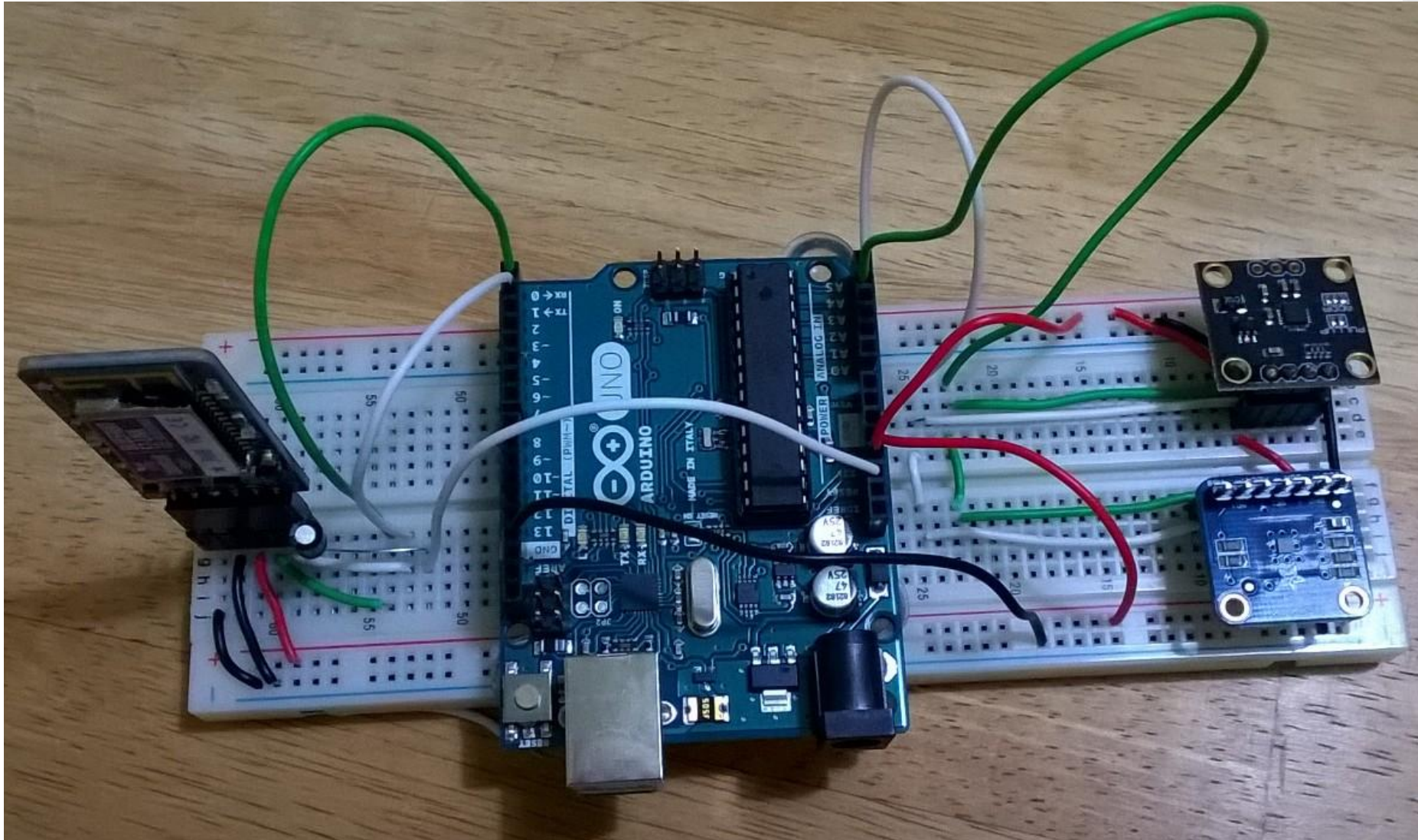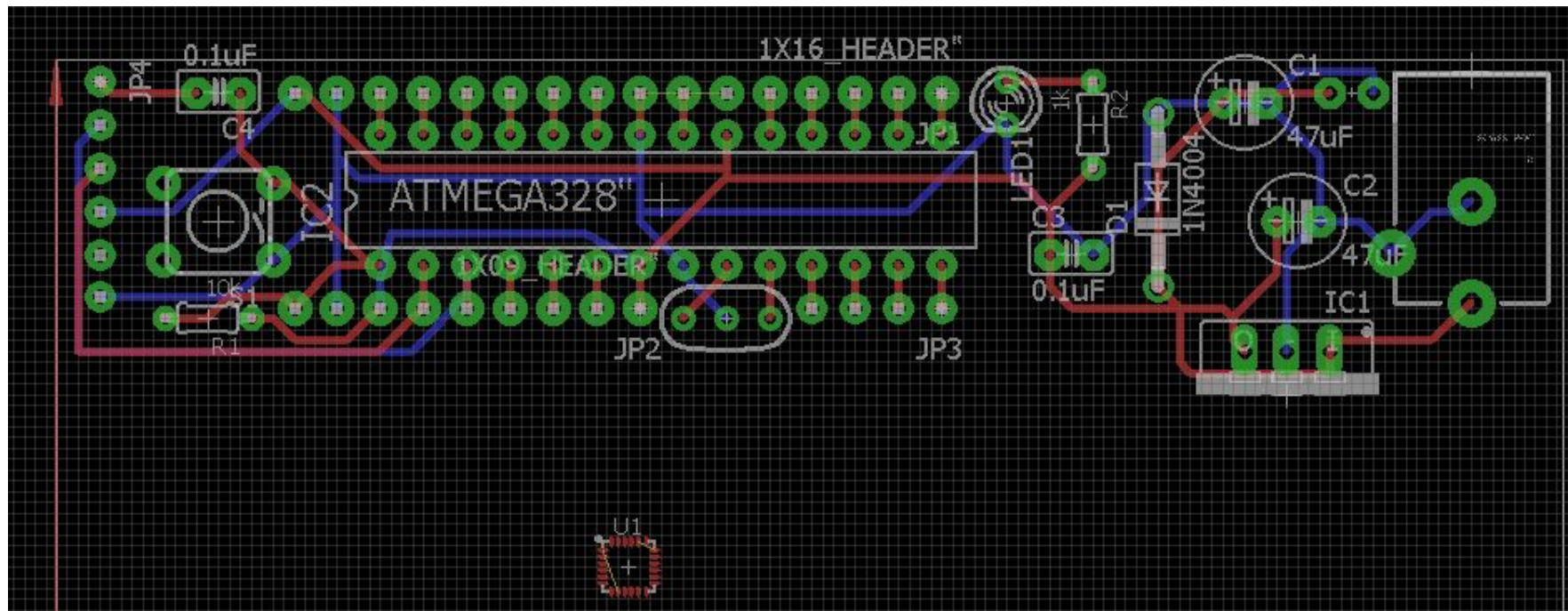
Prototype / Testing Progress
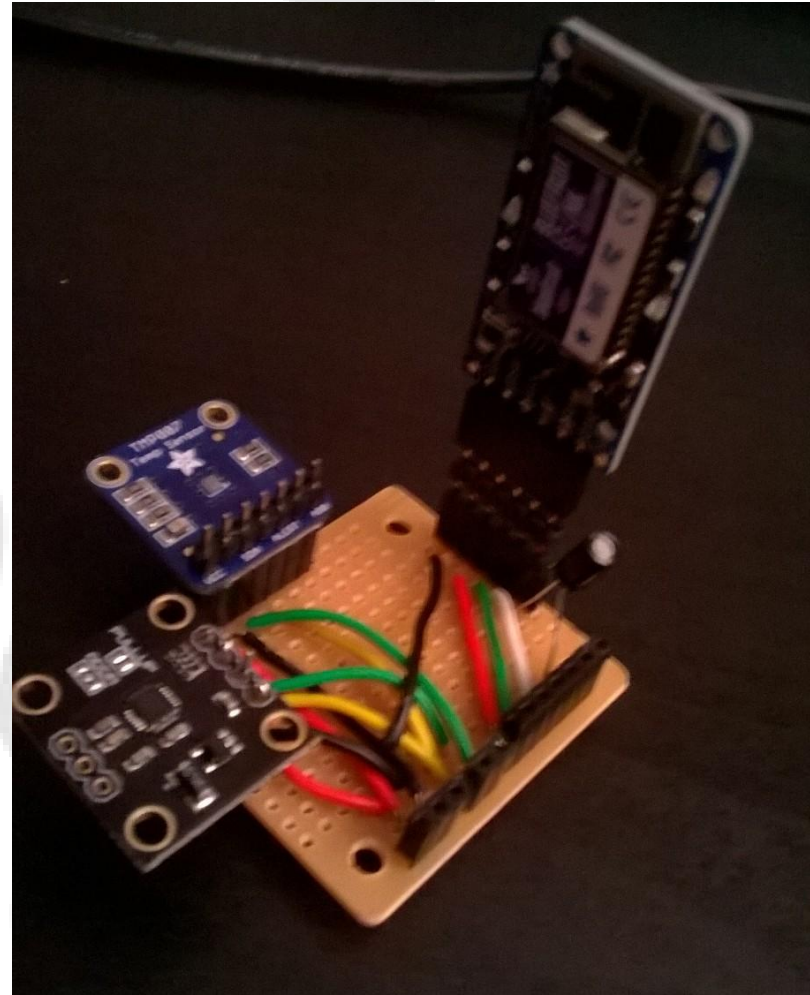
Prototype / Testing Progress

PCB Configuration Plan

EagleCAD

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 and 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.
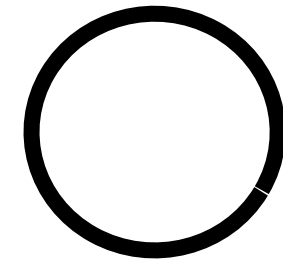
Internet of Things Flowchart
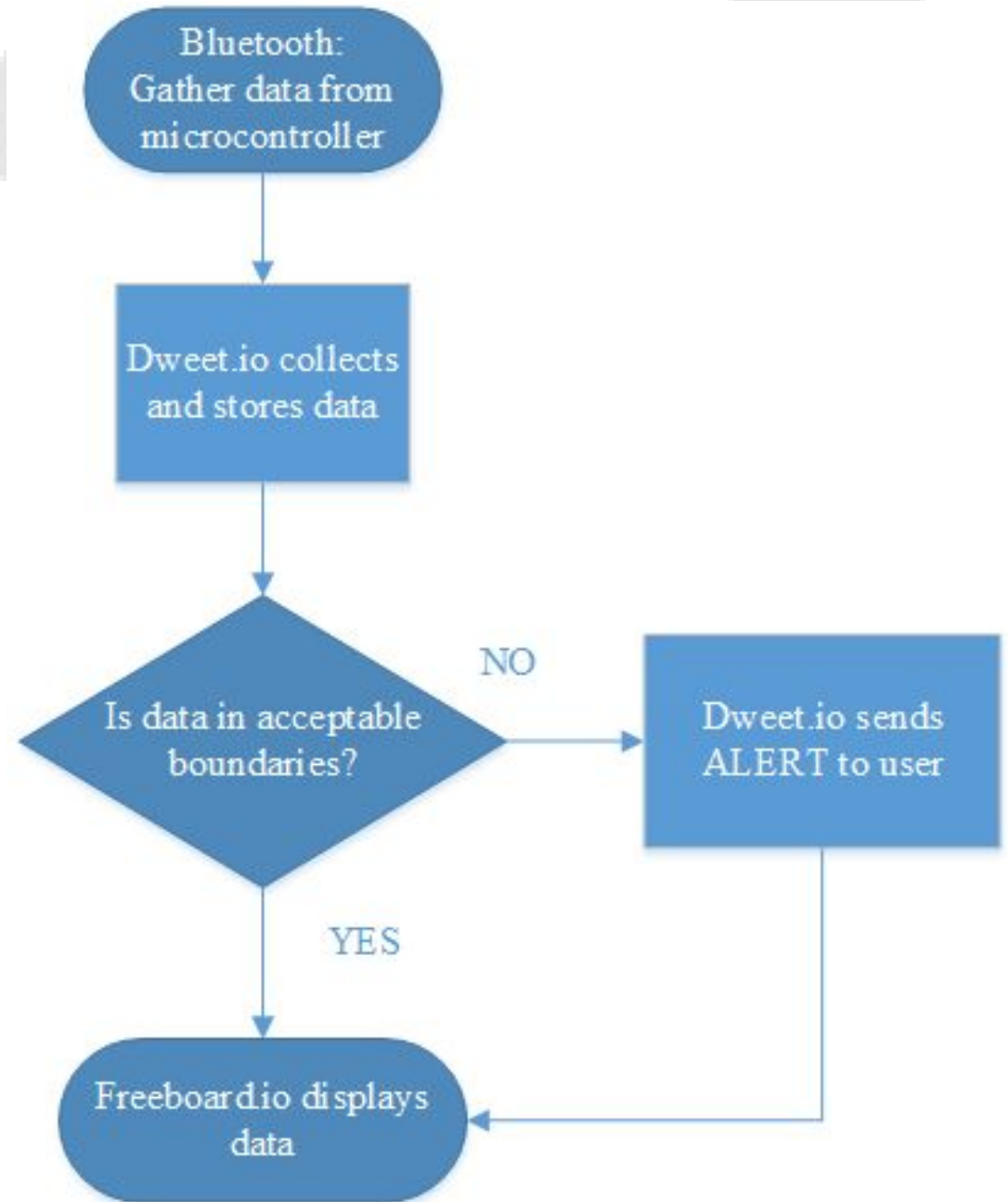
Collar Design

Idea 1

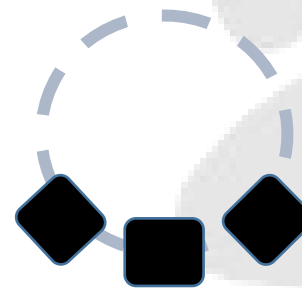An attachment that could be used with any collar

Idea 2
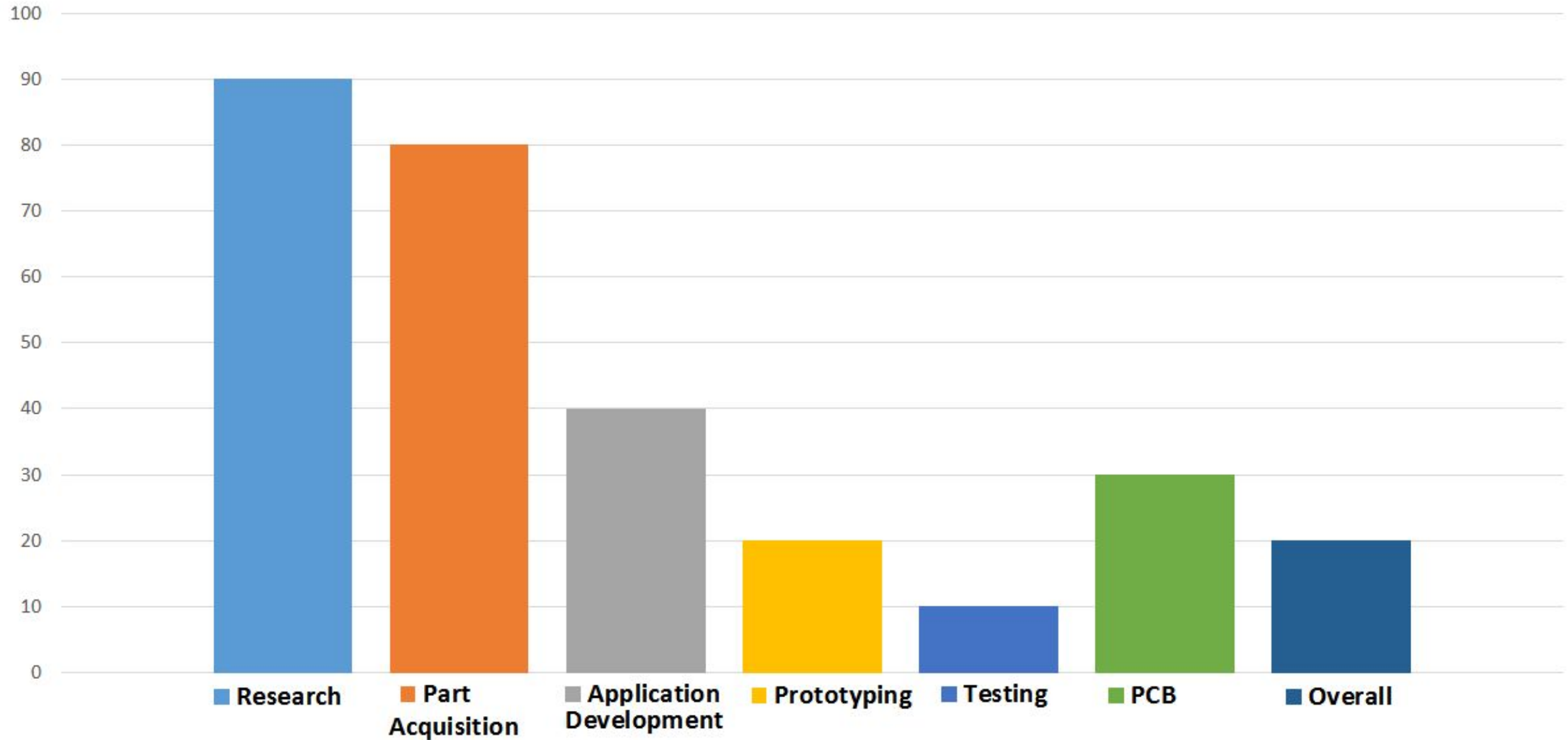
A 3D printed collar with all the components throughout

Idea 3

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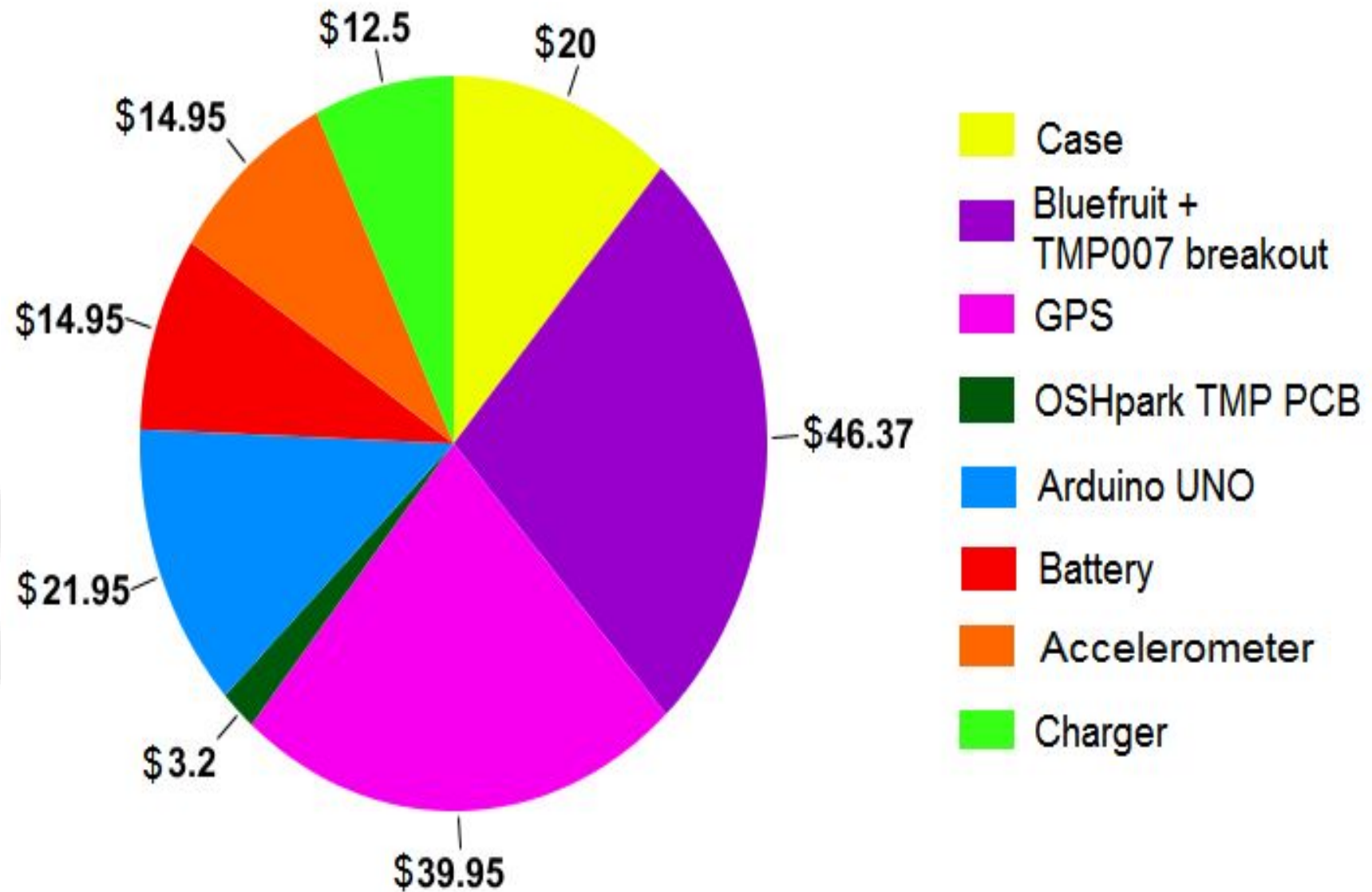
Project Distribution

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

Completion Chart

Financing so far….

Collar Total $158.92

Overall Total: $233.32

Collar Cost

$12.5
$14.95
$14.95
$20
$21.95
$3.2
$39.95
$46.37

- Case
- Bluefruit + TMP007 breakout
- GPS
- OSHpark TMP PCB
- Arduino UNO
- Battery
- Accelerometer
- Charger

Future Plans

I. Build and Complete Prototype

II. Complete EagleCAD diagrams

III. Construct 3D Printed outer casing

IV. Send files for PCB Completion

V. Assemble the outer casing and the completed PCB

VI. Test Prototype

Questions?