



Divide and Conquer Document v2.0

PetAid Harness



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Senior Design 1

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Project Description

The goal of this project is to design a harness for any size of animal or pet, that has some type of impairment or dysfunction condition. With the great extent of pet ownership in the United States, as described by the 2019-2020 National Pet Owners Survey conducted by the American Pet Products Association (APPA), a total of about 67% of U.S. households own a pet and this harness can be of abundance demand to the pet lovers.

This device can have multiple features integrated with the harness, these features include GPS, Heart Rate monitor sensor, temperature sensor, accelerometer, motor for vibration, and WIFI/Bluetooth transmitter. GPS allows the user or pet owner to track their pet with the locator through the phone. Heart Rate monitor sensor helps monitor the heart rate to ensure there is no excess or drop in heart rate which will help if the pet is having a seizure without the owner present. Temperature sensor can also be useful by giving the user information of their pet's body temperature to determine whether it is or not normal, and the accelerometer sensor will help display the position of the pet. All of this information will be transmitted and received to an IOT website or application by the use of the Wi-Fi/Bluetooth module.

All these sensors will be on the harness around the neck in a 3D printed case that protects the components from the elements. The electronic components must be sealed from dirt, dust, and water. Weather along with temperature is also another constraint that must be considered to prevent high and low temperatures from affecting all the electronic components. The final design of the harness must be lightweight, portable, low cost, easy to use, and receive/transmit accurate data.

The motivation for this project is due to creating a device that could monitor a sick pet that has a disability such as impairment from blindness, deafness, or disease. The idea or goal is to keep track of the heart rate of the pet, along with other additional features that can further employ usage of a device that can keep an owner more aware of the current condition of the pet, and determine if heart rate, temperature, position are abnormal. Other uses can also be used, such as the occurring scenarios where pet owners leave their animals left inside the vehicle while stopping at a small grocery store or another location. If needed, once the body temperature or the temperature inside the car is not at the recommended temperature, a notification will be sent through the website or phone application only when at close-proximity, or within Bluetooth 5.0 range could stretch up to 400 meters in a clear line of sight.

Requirement Specifications

- Size: Overall size will be small to fit around an average sized dog. The important part being that the components must be as small as possible without sacrificing quality.
- Weight: Comfort level is highest when the harness is low in weight. For similar reasons as described in the size, the components to research must also be low in weight.



There are project constraints that can occur when the pet harness is being worn and utilized. One possible constraint is the distance that must be reached for the user to communicate with the pet harness. Such as during the day when the owner is working away from the house, where the pet is located. This long-distance range is not reasonable for the owner to receive any information about the condition of the dog, just with only WiFi/Bluetooth. IOT website database must be used to collect data from the sensors on the harness sent to the cloud where the data can then be manipulated and displayed. Accessibility to the Internet of Things platform is important because a message must be sent to the smartphone of the owner of the harness if any data collected is abnormal from the heart rate sensor.

Another project constraint is the durability of the harness. Most dogs have the likelihood to scratch or destroy objects, especially if the harness is uncomfortable. If the harness is uncomfortable and fragile to being ripped or broken, then the harness would be useless if it cannot withstand the rough play put on the harness by the pet. The operating temperature of the electronic components must also have a high and low temperature range in order to withstand the various seasonal weather conditions including being weather resistant. The house of quality tables describe both the user and engineering requirements of the petaid harness in terms for accuracy of the sensors and also user interface.

Component Name	Size (mm) (LxWxH)	Weight (grams)
GPS Module	35.306x30.48x6.35	8.754
Accelerometer Module	21.59x19.05x2.0	1.4
Temperature Module	21x21x2	2.93
Heart Rate Module	16x16x3.2	3
Bluetooth Module	20.4x41x4	4.4
Battery (mm ³)	60x50x7.9	47
Microcontroller Module	3.35x2.2	1.4
3D Casing	230x185x69	200



Collar	304.8x19.05	90.72
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Table 1. Pet Collar component specification.

House of Quality

Quality requirements

Engineering Requirements			
Power Use (<12.5 Watts)	Sensor Accuracy (Temperature) (±2%)	Sensor Accuracy (Location) (±7%)	Sensor Accuracy (Heart rate) (±1%)
-	+	+	+

User Requirements	Cost	-	↓	↓	↓	↓
	Ease of use	+	↓	↓	↓	↓
	User Interface	+	↓	↑	↑	↑
	Reliability	+	↑	↑	↑	↑
	Maintenance	-	↑	↓	↓	↓

Table 2: Engineering Requirements.

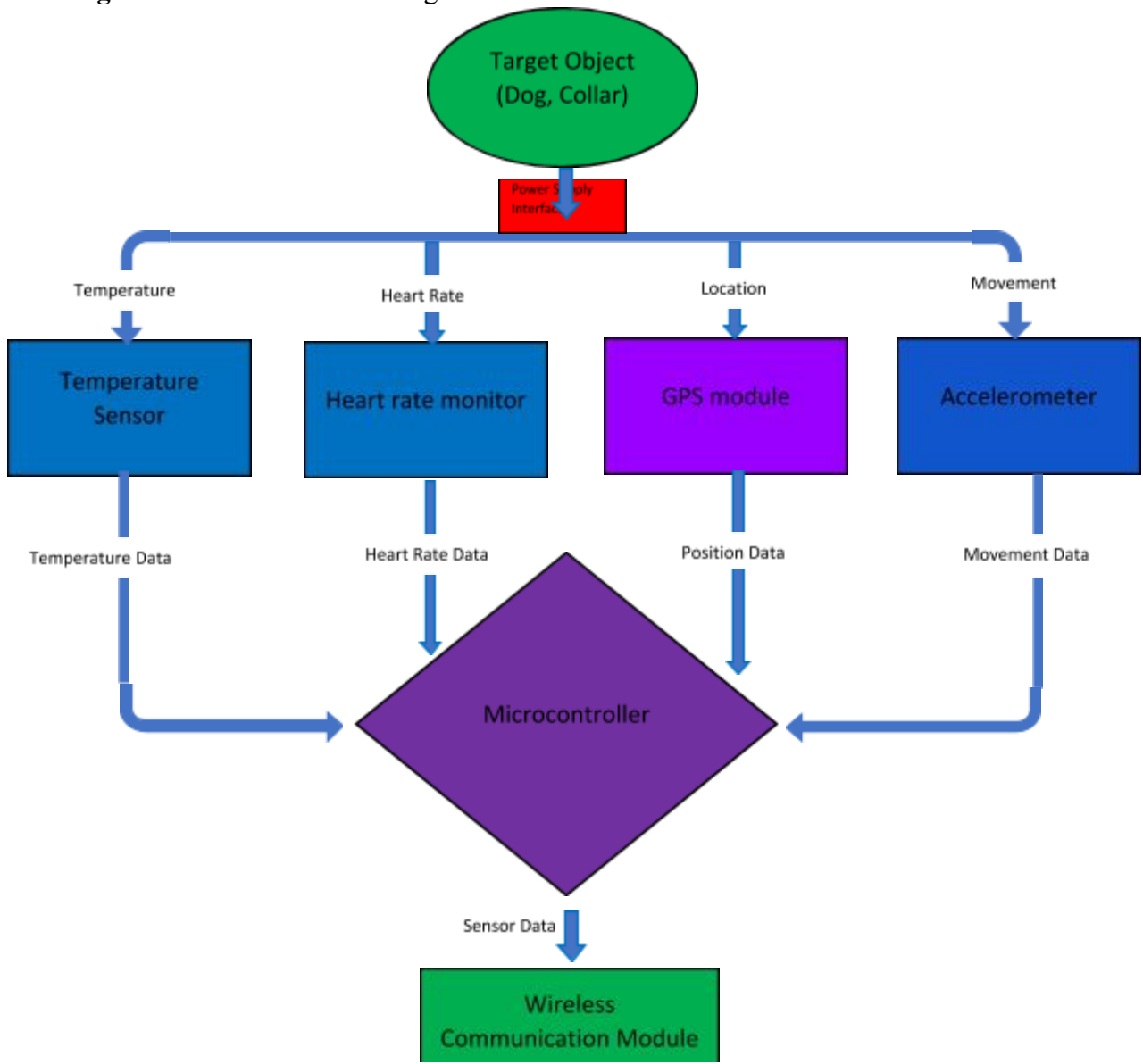
Strong Positive Relationship	↑
Positive Relationship	↑
Negative Relationship	↓
Strong Negative Relationship	↓



Positive Polarity	+
Negative Polarity	-

Table 3: Correlation Factors.

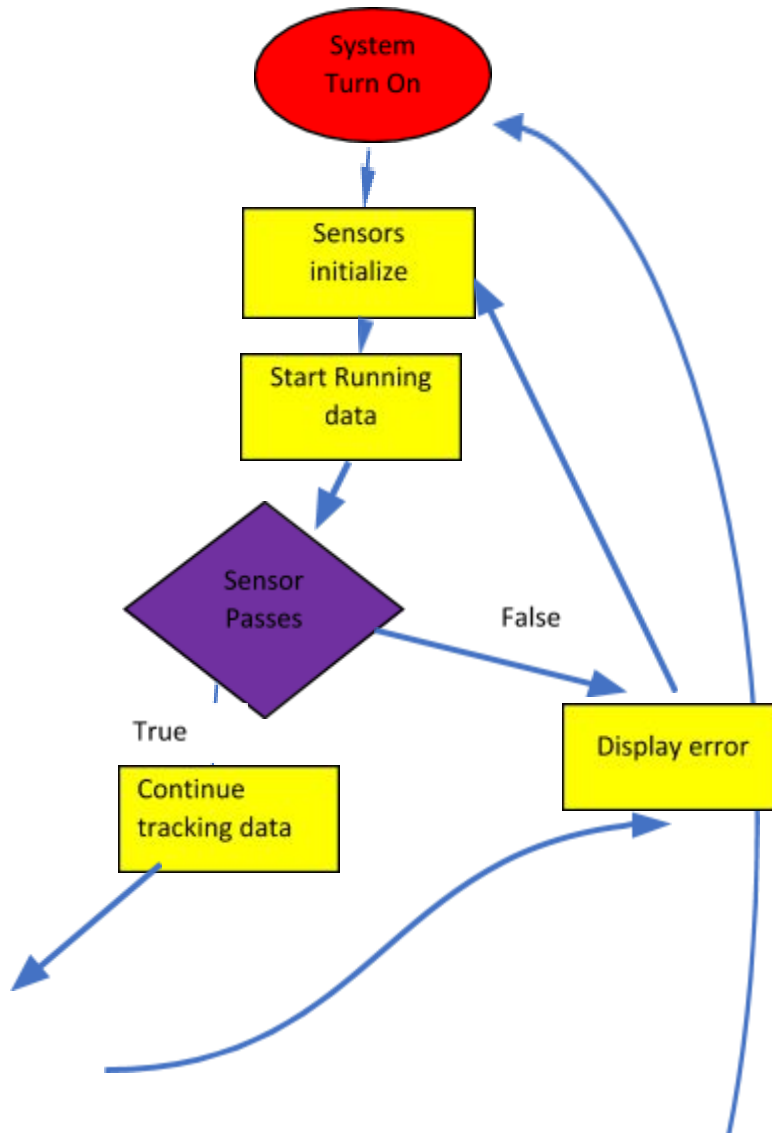
Block Diagrams: Hardware Block Diagram

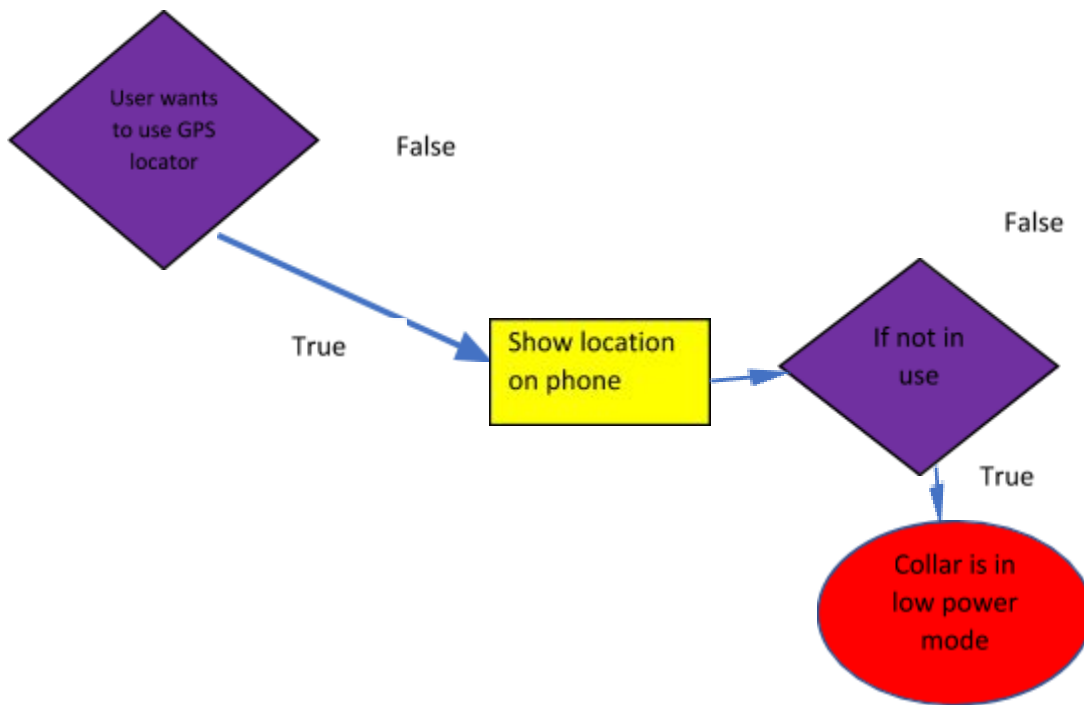




- Pedro
- Edgar
- Pascal
- Adam

Software Block Diagram





The block diagrams above provide a clear and concise structure to provide the team for future planning on parts needed and for modification. Each of the blocks can be specified a “leader” whose responsibility is to provide the proper documentation and correct hardware part model to fit the specifications of the pet collar. On the other hand, almost all parts can involve a combination of work between the hardware and software section of the project for all team members.

Budget/Financing

The total cost of the project must be determined beforehand, to ensure it meets the maximum budget requirements decided as achievable by the whole group. Since the finances for the PetAid collar will be split between the members of the team, the decided set budget that is both an efficient cost between the team and many pet lovers throughout the U.S is obtained as \$100. The total cost needed to build and design the project, excluding the 3D-printed case, as shown below is \$87.54.

Component	Prototype Items	Vendor	Cost
Temperature Sensor	TMP007	Digi-Key	\$6.40
Heart rate monitor	AD8232	Digi-Key	\$3.53



GPS	MPU-9255	Invensense	\$29.95
Accelerometer	MTK3339	Adafruit	\$7.22
Wi-Fi/Bluetooth	CC3100	Digi-Key	\$14.07
Battery	Lithium Ion Polymer Battery 3.7V 2500mAh	Adafruit	\$14.95
Microcontroller	TMP4C123GH6PM	Mouser Electronics	\$11.42
Total			\$87.54

Table 3. Prototype Items Cost.

Milestone

Senior Design 1

Milestone	Completion Week
Project Idea Decided	1/22/2020
Divide and Conquer Rough Draft	1/31/2020
Divide and Conquer Approved	2/5/2020
Research- Components	2/12/2020
Research- Operating Systems	2/19/2020
Hardware/Software Agreement	3/4/2020
PCB software tutorial complete	3/18/2020
PCB Simulated	4/1/2020
PCB Constructed and Tested	4/21/2020

Senior Design 2

Milestone	Completion Week
Project Building- Casing/Non-sensor Hardware	5/11/2020



Project Building- Software for sensors completed	5/25/2020
Project Building- Motor system and sensors	6/8/2020
Project Building- All hardware combined	6/15/2020
Project Building- Software interface completed	6/22/2020
Project Building- Initial testing w/ adjustment	6/29/2020
Project Testing- Fine-Tune testing	7/6/2020
Project Testing- Prototype test completed	7/10/2020
Project Testing- Finished Product	7/17/2020
Project Presentation	TBD

Stretch Goals Provided by Dr. Ritchie

- Create our own phone application
- Upgraded physical design appearance: Final design should have surface mount parts such as a surface mount bluetooth module to reduce all the wiring done for prototype testing, Infrared red temperature sensor to be able to test on a stuff puppet.
- Make project case as light as possible
- Use GSM module instead of GPS module itself, so that phone can communicate data both close and far away at different location by using sim card SMS services.
- Reference products: fit paws, “smart harness for dogs”,