GPS Dog Shock Collar

Senior Design Project Proposal
September 19, 2012

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Table of Contents

Introduction

Concept : Most pet owners appreciate the safety of knowing where their pet is at all times. A modern solution to the problem of pet containment is a Shock Collar. A user sets up posts in their yard which serve as invisible boundaries against a pet's movement. When the pet crosses the threshold between two posts, a sensor in the collar is alerted and a training pulse causes displeasure to the dog. The problem with this design is that only one perimeter can be set up for the pet, and it must be set up using a cumbersome outdoor fence system. Our idea is to replace the standard "fence" idea with GPS coordinates as set by the user. Not only is there no physical fence setup, but now multiple user locations can be specified for different occasions such as the user's home, office, or favorite park.

Behind the Concept : Instead of the standard magnetic sensing on current dog collars, ours will use GPS coordinates to achieve the same affect. The GPS module will receive the current location from GPS satellites; transmitting the data via the NMEA-0183 serial protocol to the microcontroller. The microcontroller is in charge of interpreting all of the data given to it; determining whether the shock mechanism should be activated and making sure that the shock collar works only over certain intervals so as not to unjustly punish the pet. These coordinates will be written to RAM in the microcontroller using a few possible methods:

- Instant: Triggering of a barrier with a certain radius as specified by a dial on the computer. A dial on the collar with selectable radii and an activation button will trigger an instant perimeter. This feature is beneficial when on vacation somewhere such as the beach and you want an instant perimeter for your pet. Good for small portable perimeters.
- Set-Point: A user will put the collar into set mode upon which time he/she will walk around the perimeter to set the various corners of the perimeter. Pressing the corner activation button will trigger a new corner point for the perimeter. Good for medium/large perimeters.
- Online: With the collar connected via USB to a user's computer, the user can go to a website such as Google Maps (maps.google.com) and hand select the boundary which will be interpreted through the collar's User Interface. This method might not be fully

plausible at this point as we will need to figure out the discrepancies between our GPS coordinates and Google's. Good for large perimeters.

In addition to GPS, there are a few other features that we planned on implementing, but due to the time restraints of this class have only chosen one for the time being: detection of nearby pets wearing the same type of collar. A small transmitting antenna in the collar will transmit each dog's unique I.D. to a small proximity radius. A small receiving antenna will pick up the I.D.'s of other pets in the near vicinity and determine whether contact is allowed between these two pets. The factor of whether two pets are allowed to interact or not comes from the user's selection to put certain pet's I.D. tags on a "No-Contact List" within the RAM on the pet's collar. The prohibited list will be programmable via the computer user interface. The option of preventing contact with all dogs wearing this collar will also be available. Some other features that could possibly be implanted into the collar include barking & jumping detection, and a possible GPS locator in case of a missing pet. The barking detection and GPS locator already exist as stand-alone products, but if all of these are implanted in one collar, then we could see potential in having an all-in-one training solution. Users could even select different models with different amounts of features at a lower cost to suit their needs.

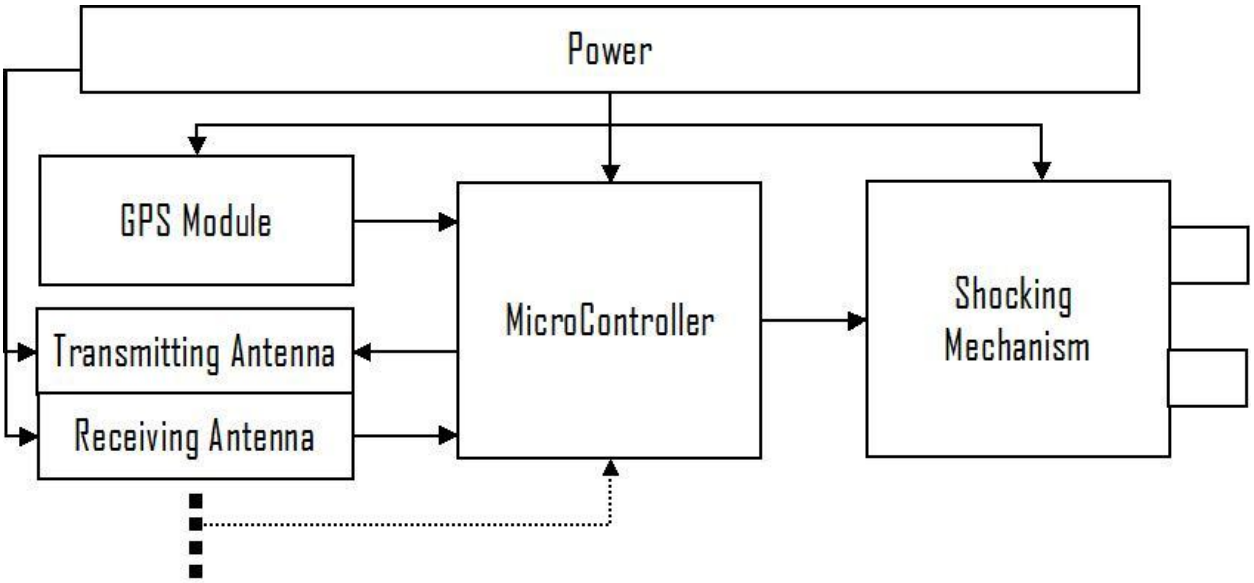
The shocking mechanism would be a two-pronged output, delivering varying amounts of current as set by the user on a selectable dial on the collar. A circuit delivering a variable amplitude alternating current between the two prongs is the main idea. Different waveforms, voltages, and currents can be implemented; therefore, testing will have to be undertaken to prevent any harm to any animals. Two LED indicators and an activation sound will be implemented to provide warning to the pet and owner of an infraction before the shock occurs. The activation sound will be a short beep that goes off whenever a dog violates one of the collar's regulations such as stepping out of bounds or coming in to too close of contact with a prohibited pet. It serves as a warning to the pet that it can avoid the oncoming shock if it removes itself from the infraction area. A yellow LED will be triggered along with the beep to let the owner know that the pet is either out of bounds or near a prohibited pet. The red LED will trigger only during the shock.
(http://en.wikipedia.org/wiki/Shock_collar)

Features :

- GPS Accuracy (the Venus model has 2.5m accuracy with up to a 20 Hz refresh rate)
- Multiple user-programmable perimeters
- Multiple perimeter entry modes including Instant and Set-Point perimeters
- Prevention of unwanted contact with other pets as specified by the user
- Adjustable shock levels
- LED/sound shock indicators
- Battery powered
- Connects to computer via USB
- Computer user interface
- Future component expandability

Design

Block Diagram :



Component Descriptions :

- Power Source – Battery/Power Source for all other components in the project.
- GPS Module – Receives and transmits current coordinates to the Microcontroller portion for cross-reference against non-allowed zones.

- Close Proximity Beacon/Transmitter – Transmits the unique ID of the pet collar and identifies others in the near proximity.
- Extension Space – Room in microcontroller for further pet-training additions such as barking correction, jumping correction, and location of lost pets.
- MicroController – Takes input from all the various detectors of bad behavior and determines if a violation is in progress. It gives the go ahead for the shocking mechanism to activate.
- Shocking Mechanism – Provides the electric energy pulse through the collar that trains the dog whenever bad behavior is committed.

Project Requirements :

- Project needs to fit on a dog's collar.
- Accurate to a reasonable proximity, preferably 10 feet or less within perimeter
- Accurate relay of pet ID's through antennas
- Controllable shocking mechanism that proves to not continuously shock, or shock in between intervals of 5 seconds
- Safe to all pets (dogs the main consideration at the moment) for all shock levels
- Warning sound before shock with LED status indicators (yellow for out of proximity and red during the actual shock)
- Power Source accounts for all components and works via a commercial means such as a common AAA battery.
- Safe testing (probably on ourselves at first)

Verification

Development : The product development will move through phases based on the importance of certain components within the overall design. Since the GPS application is our novel idea, we will first work to achieve that; first only with the Instant perimeter method. Proper barrier detection will at first be indicated through LED since the shocking mechanism will be implemented later. After GPS, we will move on to the antenna calibration. This antenna portion will require another test collar that will be stripped of GPS for monetary sake. This is

justifiable by the fact that the select collar is there strictly for pet proximity testing. Also, the antenna portion will require a computer user interface design to adjust pet I.D.'s. The shocking mechanism will be implemented next. It is not as important for the context of this project as it is not a new idea by any means, just that we will be building our own model if time allows. Finally the alternate means of GPS detection will be implemented.

Testing : The first stage includes building a prototype on the breadboard. GPS accuracy will have to be tested with a fairly long extension cable (at least 2*2.5m = 5m long). Once we are more familiar with the project, we will move on to the portable, battery-powered implementation. The breadboard will be used from there on for development of the shocking mechanism until it is also portable and therefore can be combined with the now portable GPS and antenna implemented product.

Preliminary Statistics :

Power

- Four AAA batteries gives 6V
- Venus GPS rated 2.7-3.3V
- Microchips rated 4.5-5.5V

Shock Ratings

- 5 microJoules – 300 microJoules
- Currents, Voltages, and AC Waveforms dependent on manufacturer

GPS

- Venus GPS with SMA Connector GPS-11058
- 2.5m Accuracy
- NMEA-1083 Serial Protocol
- RoHS Compliant
- GPS-00177 SMA Antenna

Cost/Labor

Labor :

Name	Hourly Rate	Total Hours	Total = 2.5 * HR * TH
Jacob Hardy	$40.00	200	$20,000.00
Joshua Passwater	$40.00	200	$20,000.00
Total	$80.00	400	$40,000.00

Total Hours = 20 hours/week * 10 weeks

Parts :

Part	Price/Part	Quantity	Cost
Dog Collar	$10.00	2	$20.00
Venus GPS : GPS-11058	$49.95	1	$49.95
GPS Antenna	$11.95	1	$11.95
AAA Battery Holder	$1.45	3	$4.35
Button Single-Throw	$0.35	10	$3.50
Slide Switch	$1.50	4	$6.00
Rocker Switch	$1.50	4	$6.00
Rotary Switch 6 Position	$1.25	4	$5.00
Knobs for Rotary Switch	$0.99	4	$3.96
Estimated Prices			
Small Plastic Enclosure	Machine Shop Free	2	$0.00
PCB	$40.00	1	$40.00
Prongs, Resistors, etc.	cheap	assorted	$18.00
Antennas (Bluetooth?)	$10.00	4	$40.00
USB interface (arduino?)	$10.00	2	$20.00
Microchip	$10.00	3	$30.00
Total			$258.71

Labor	$40,000.00
Parts	$258.71
Total	$40,258.71

Proposed Schedule

Week	Responsibility	
9/16	Proposal Write-up & PCB Design	JH
	Parts Search, Documentation & Premilinary Code Write-up	JP
9/23	Parts Review & Order Parts	JH
	Design Review Sign-up & Microcontroller Planning	JP
9/30	Design PCB & Assemble Parts Received	JH
	Work out GPS Serial Interfacing if GPS received	JP
10/7	Order PCB, more parts if necessary, work out more hrdwre specs	JH
	Work on Computer Interface for GPS Coordinates	JP
10/14	Work on Computer Interface for GPS Coordinates	JH
	Work on Computer Interface for GPS Coordinates	JP
10/21	Individual Progress Report & Shock Mechanism	JH
	Individual Progress Report	JP
10/28	Assembly	JH
	Assembly & Interface GPS Method Implementation	JP
11/4	Mock-up Demo	JH
	Mock-up Demo	JP
11/11	Troubleshooting	JH
	Troubleshooting	JP
11/18	Start writing Final Paper/presentations	JH
	Start writing Final Paper/presentations	JP
11/25	Demo/Presentation Sign-up & Notebook analysis	JH
	Notebook Analysis for Final Paper	JP
12/2	Demo/Presentation & Prepare Final Paper	JH
	Demo/Presentation & Prepare Final Paper	JP
12/9	Presentation/Final Paper Finish & Checkout	JH
	Presentation/Final Paper Finish & Checkout	JP