Territory Tracking and Restriction System

Project Proposal

Top Dog Technologies

Denise “Merlin” Cuppett

John “Viper” Kaczmarek

Michael “Ice Man” Stewart

Chris “Jester” Wesp

Department of Computer Science

Texas A&M University

September 17, 2007

Table of Contents

1 Executive summary

The current products available for deterring pets from specific zones are very limited and overall sub-standard. Indoor deterrents involve only a single setup to where you can deter a pet from only one object (i.e. a couch) and there is no way to document how often the pet violates the off limit zone without constant supervision. These products are very limited as the majority of people have multiple objects they want to deter their pet from. It is very doubtful that anybody would buy 4-5 of those setups just to deter a pet from a few locations. Our intent is to correct this problem by developing a deterrent system that can have multiple off-limit locations and keep track of the time and place of every violation so that the user can be kept up to date with his or her pet's habits. Another aspect that sets our product apart from those currently available is that the user may choose to set up zones for just tracking. Multiple pets may be tracked by the system. Our goal is to build this new tracking and deterrent system and make it not only cost-affordable, but easy to use and setup. The Territory Tracking and Restriction System that Top Dog Technologies is developing will have higher quality than any other products currently on the market because there is a need to have a deterrent and tracking system that monitors and documents when pets enter specific zones.

Top Dog Technologies has researched the need of having a deterrent and tracking system and has defined the goal of its new product to create a network of receivers and transmitters that can record the general location of a pet and deter it from the off-limit areas. There has been a lot of research into the implementation of our project because there are some very important objectives that must be met to keep the product competitive in the market. The cost of the product and power source are very important aspects that must be kept to a minimum. The system must function well in an indoor environment without hindering or harming animals or people. The system must be easy to set up, use and adjust. With these objectives in mind, Top Dog Technologies has decided to use current RF Technology to create the Territory Tracking and Restriction System.

The design of our project involves a series of Active RFID receivers and transmitters. The transmitter will be the device placed on or around the location you wish to make off-limit. On it there will be an input that will allow the user to adjust the range of transmission, or deterrent settings. The range can be adjusted on transmitters by fluctuating the input power. The range will be anywhere from 3 to 20 feet. This allows the system to deter or track a pet from different locations ranging from a small table to an entire room. The pet will be equipped with a specialized collar that will have a receiver module on it. Whenever the receiver picks up the transmitted signal, and the zone is designated as an off limit zone, the pet will be shocked and thus will leave the zone. Whenever the animal crosses into off limit or tracking zones, the time and location will be logged and stored in the pet's collar using a PIC and then accessed by the user via USB interface. An advanced software suite will display the information in a user friendly fashion. Users may name zones so that the software displays names instead of transmitter IDs. The software interface will allow the user to choose what zones are tracking and what zones are off limit for each individual pet.

The benefits from this design we believe are exceptional. We are taking one of the best designs on the market and turning it into an advanced system with multiple locations and a source of documentation. The ability to keep track of when and where your pet is violating off-limit zones will be a new technology to the market. The user can look at all the documentation recorded for their pet and follow it's progress over time.

2 Introduction

The pet deterrent system project is addressing the problem of tracking and controlling a pet's whereabouts when humans are absent. This allows the owners to protect furniture and belongings. The general scope of the pet deterrent system is to use current technology to track a pet when it enters a certain zone, record the

event, deter the pet if necessary and allow the information to be viewed on a computer. Specifically we intend to use RF transmitters to create zones by sending an RF signal. The pet will have a collar with a receiver that receives the RF signal when it enters the zone, deters the pet if the zone is an off limit zone, and records the time and zone it entered so that the information can be uploaded onto the computer. This project is well within the domain of Computer Engineering because it combines both hardware and software in the solution.

2.1 Needs statement

There is a need to have a pet deterrent system that tracks pet movement throughout the house 24/7 by monitoring and documenting when a pet enters off-limit areas and deters the pet when needed.

2.2 Goal and objectives

The goal our group has set for this project is to create a network of receivers and transmitters that can record the general location of a pet and deter it from the off-limit areas.

Here is a list of objectives that need to be taken into consideration when designing our Pet Deterrent System:

- The system must cost less than $500 to be competitively priced based on the quality level it provides to the consumer.
- The system must use a power source accessible to the public, such as a battery, and the power source must last at least 1 month without being replaced.
- The system must not harm animals or people.
- The system must function well in a typical indoor environment.
- The collars should be light, less than 1 pound, and comfortable for the pet.
- The system must be easy for the user to set up which is defined as the set up time taking less than 30 minutes.
- The system must be easy to use and adjust, any adult with basic computer knowledge should be efficient with the system after 1 week.
- The system should have a variable range that covers an area with a 3 foot radius to an area with a 20 foot radius.
- The system should document the zone and time when a pet violates a restricted location.
- The recorded information should be displayed to the user in an organized and understandable fashion.

2.3 Design constraints and feasibility

There are many logical constraints that limit the design of the Pet Deterrent System. Most of these constraints are in place due to the nature of it becoming a consumer product once created. The constraints and feasibility assessment of such constraints are documented below.

There are two economical constraints that must be addressed. The first constraint is the cost of the system. The system must cost less than $500 to be competitively priced on the market based on the quality of service it provides. Using RF technology the Pet Deterrent System should easily meet the objective of costing under $500. The second economical constraint is the cost of the power source and power consumption. The power source should be affordable and accessible to the public. This is feasible since

batteries are common and inexpensive. The system must be designed to have low power consumption so that the batteries will not be replaced often.

The pet collars present a physical constraint that is related to the power source and other electrical components. The collars must be lightweight, less than a pound, and not hinder the animal in any way. Currently the design calls for a power source, receiver and some kind of data storage to be stored on the pet's collar. It is possible to find lightweight parts and batteries, the design must take weight into consideration when choosing parts. Another constraint that is focused on the collar is that it must receive the deterrent or tracking signal wirelessly so that the pet is not constrained why wires to an area. The design is to use an RF transmitter and receiver for communication between the tracking or deterring disk and the collar, which solves this constraint.

There are two main technical constraints that must be considered with the product's design. The first constraint being that the system must be easy for the user to set up. Since the Pet Deterrent System is intended as a consumer product, the initial set up must be designed to be simple. A related constraint is that the system must be easy to use and adjust for any adult with basic computer knowledge. These two technical constraints are feasible to meet as long as simplicity is considered in the design of the product.

The system must not harm animals or humans and must function in an indoor environment. This last constraint is a temporal constraint that must be met for our product to be successful. Different deterring techniques must be investigated based on safety. The RF design should easily function in an indoor environment.

Overall, the Pet Deterrent System based on the team's preliminary design is feasible. There are many constraints to keep in mind, but since they are noted before the design is completed they are easy to resolve with some forethought.

3 Literature and technical survey

Indoor Positioning Systems

The goal of the Pet Deterrent System is to track pets in specific areas and deter them from off limit areas. We looked at commercial products used to track items in an indoors environment. Indoor Positioning Systems have been used in hospitals for almost 20 years to locate patients and equipment. There are many different techniques that have been put to the test over the years and this document explains the pros and cons of each. The topics covered are Passive RFID Systems, Infrared Systems, Radio Triangulation Systems, Radio Fingerprinting Systems and Active RFID Systems.

PetSafe Electronic Indoor Pet Deterrent Systems.

This product is similar to what the proposed design. A transmitter with a variable range can be placed indoors to deter a pet from that area. If the pet, with the appropriate collar, gets in range of the receiver the collar will shock the pet.

Long Range Passive RFID-tag for Sensor Networks

This is a research project done by scientists at Tohoku University in Japan that works to control distances emitted by RFID transmitters. The bulk of our project involves controlling the range of the emitted signal from the transmitter. Our need to emit an accurate, strong signal in a specified range is a must for our product to succeed. The researchers in this paper have identified the problem with short-range RFIDs and have come up with a way of adjusting better ranges thereof. They have modified the traditional RFID tag to have a microstrip antenna and a voltage regulator to amplify the signal and to better control it. Our design calls for a specific control of the range by adjusting the input power. The microstrip antenna is an option on some of the transceivers we are looking at, in particular the Ti TRF7960 unit. The benefits of

this design are mentioned and the control, combined with voltage amplification, are noted and will be considered when building this project.

Pet Deterrent Project at Texas A&M University (Spring 2007)

Last semester a group of students in the computer science department here at Texas A&M University worked on and developed a pet deterrent project similar to ours. Their work involved having a transmitter emit a signal over a controllable range and having the pet collar pick up the signal and deter whenever he was in close proximity. On the collar they made a PIC to store the information and had USB connectivity so that the user could monitor his pet's location. They ran into a problem when they ordered a long-range transmitter and were unable to successfully create the correct sized zones that would be needed in a common household. We hope to work off of their idea and develop in a more system-approach manner that would allow more options to the user during setup.

Contech ScatMat

Contech provides a pet deterrent system called a ScatMat. This product is a mat that gives the pet a mild shock when he stands on it. This is meant to keep the animal out of certain areas of the house. It has three different levels of intensity, so the user can customize it for their pet. The downside to this design is that it can only keep a small area off limits, 40''x20''. In addition to being a small area, the mat has to physically cover the entire area that the user wants to deter the pet from. If the user wanted to keep the pet off of a counter, the mat would have to cover the entire counter. Also, this would not be an effective tool to keep pets off of furniture. Another downside to this particular design is that the deterrent is only provided when the pet is standing on the mat. If the pet learns that he can walk over the mat quickly, then the pet might still get into the off limit areas. Our design accomplishes the same thing as the product, just better. Ours can cover larger areas, does not have to physically cover the entire area, and cannot be easily bypassed by the pet.

Our proposed design is unique from the designs and products above because it stores data on what zones, both off limit and tracking, the pet has entered. This data can be viewed using software on the computer. There are no products that are used to deter pets along with keeping a record of where the pet has been.

4 Proposed work

4.1 Evaluation of alternative solutions

One alternate solution to our pet deterrent system involves a system of Active RFID transceivers around a room setup to home in on a single transceiver located on the pet. The three transceivers setup on the walls would geometrically pick up the dog's signal and using the signal strength as a means of distance determine his location in the room. This would serve as a constant monitor for the pet. In order to deter him from certain objects, the user would setup an invisible perimeter by storing locations in the room (say encircling the couch). If the pet came within proximity of these areas he would be deterred by a shock on his collar. The plus side of this design is that it is low cost and low bulk. There are only 3 transceivers and a system on the dog. The user could define their own off-limit areas and update them easily. The only downside to this project is the fact that all the distance measuring is done by the RSSI signal strength pin. This method of measuring distance, no matter how many transceivers you have setup, will always produce faulty measurements and never maintain any sort of consistency.

Building off of the previous design we could implement a similar system without having to worry about RSSI and signal strength. Several of the latest indoor positioning systems developed by researchers involve using multiple technologies together so as to act off one another's flaws. For instance, RFID on its own is unreliable because of the RSSI pin. GPS is excellent for positioning things with great accuracy, but only works outdoors. Ultrasonic technology can carry a precise signal, but only in a single room. By combing these technologies to work off of each other you have the potential to implement a somewhat accurate system that you could count on for consistency. This idea was introduced by a group of

researchers at a conference in Korea in 2006. With the addition of a filter for the RFID, the system boasted the ability to search around obstacles, such as furniture, and noise that may alter the signal. The accuracy of this system was the big selling point in that it boasted a 2cm error maximum for a small room. Based on the research done this is by far some of the best results we have seen. In fact, this project could have been our first choice if it wasn't for the complexity of the system. Having GPS, Ultrasonic, and RFID's working off of each other is not simple and building this project would take more than a single semester.

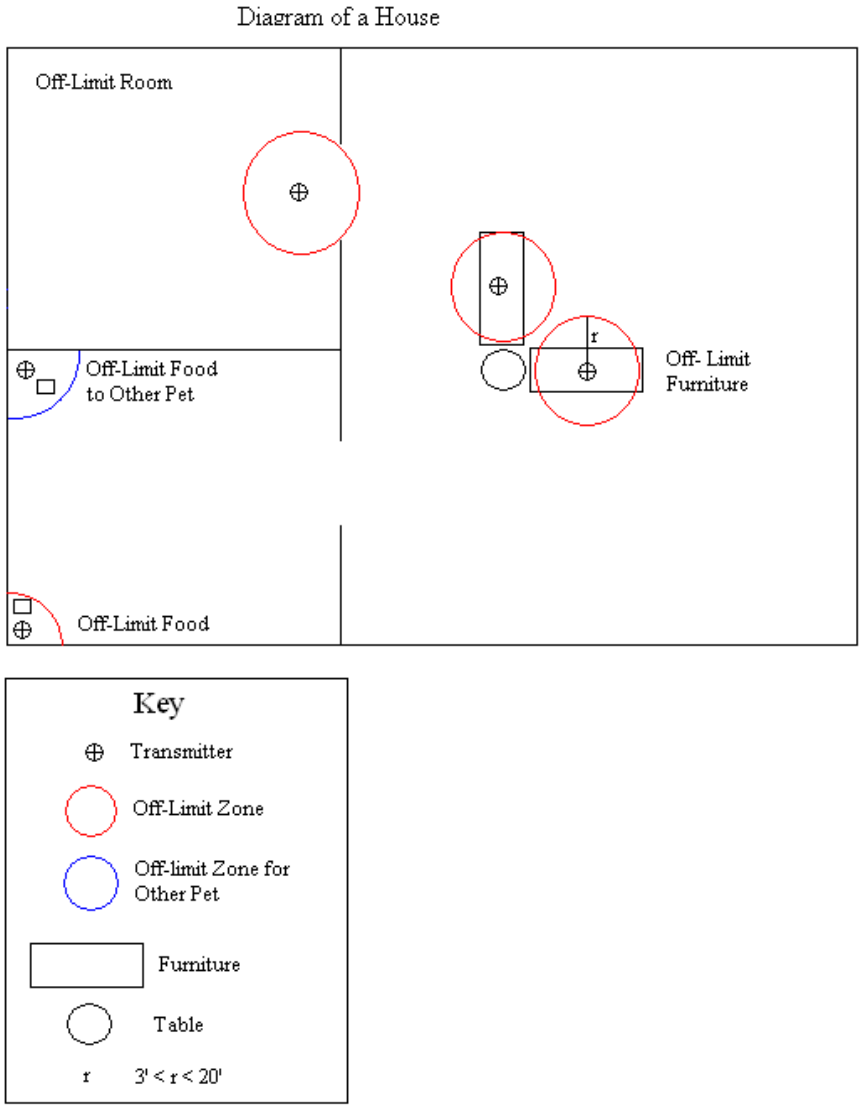
UWB is a radio frequency called ultra-wide band. UWB is not affected that much by multipath fading (distortion of a signal due to reflections), which is one of the main problems of normal narrow-band RF signals. This is because UWB uses short pulses that are not as prone to signal reflections overlapping the original pulse. Since they are not affected by the multipath distortion, the calculation for flight time/distance can be done by time of arrival instead of signal strength, and the signal can go through objects. Setting this up would be similar to the triangulation method as mentioned before, except that you would only need three receivers for the whole house. However, the downside to UWB is that it is so new. Because it is new, there are practically no receivers and transmitters for sell, and the ones that are for sell are very expensive.

RFID stands for radio-frequency identification. The passive technology has no power source for the RFID tags. Instaed they are powered by the electrical current induced from a signal by the reader. This gives the passive tags the advantage of using no power source that has to be replaced when it runs out. The downside to RFID is that it has a very short range, making it unusable for our project.

Unlike the passive RFID, active RFID can have a short or long range based on the transmitter. Even though it needs power, battery life in some RFID tags can last a few years. For tracking purpose's RFID has two major drawback. It cannot go through walls or objects well due to multipathing. The signal tends to reflect off objects making it hard to determine the signal strength. Secondly, signal strength has to be measured to determine distance, and this measurement is very inaccurate. The best accuracy we found using active RFID for tracking was with the LANDMARC system. The LANDMARC system used extra tags placed around the room to serve as reference points. Multiple readers are then used to read signal strengths from the reference tags and the tags being tracked. By comparing the readings, it can be determined which reference tags, the tracked tags are closest too. Using this data, and approximate location can be determined. However, even using this system, error was still in the 1-2 meter range, which is to high for a deterrent system. Also, placing all of these reference tags would make our system more expensive and impractical. No one will buy a commercial product requiring them to use reference tags.

4.2 Design specifications

The design of our project involves a series of Active RFID receivers and transmitters The transmitter used in this project is the cornerstone of the deterrent. A user will have the ability to put the transmitter anywhere in the house (for instance under the couch) and be able to manually set the range of deterrent. The range of deterrent should be anywhere from 3 feet all the way up to about 20. This would allow you to use it to deter anything from a small table to a room. The transmitter would emit its signal in the specified range and deter the pet from crossing into it by causing a shock on the collar to be set off whenever the receiver on the dog collar picks up the transmitted signal. This of course would only happen if the pet crossed into the off-limit area.



The transmitter to be used would be a variable range Active RFID module. Since this is a relatively low-range system (considering RFIDs usually have a range of more than a 100 ft.) we will also need a lower frequency than the standard of 2.4 GHz. After exploring the market we came up with two possible choices: The Ti TRF7960 and the Analog Devices ADF7020. The TRF7960 is a low frequency (13.56 MHz), low range system with variable power to manually adjust the range. By definition, this reader is used for proximity and vicinity RFID systems, which is what our application requires. The ADF7020 is a variable frequency, variable range RF transceiver. According to a representative from Analog Devices the range should be able to go from large distances to a relatively small area at about roughly six feet.

Since the user will probably want multiple transmitters to deter the pet away from multiple objects there will need to be a way to determine which transmitter is which. One of the major factors in our project was the ability to store information about when a pet violates an off-limit zone and where. The user would be able to view all the violations and their locations by downloading the information stored in the dog's collar. So, making the transmitters identifiable is a must. To do this, we simply act on the RFID technology given to us. Each transmitter will have a unique ID that will go with them and will constantly be transmitted. So, when the pet crosses into the off-limit zone the receiver will pick up the signal and store the ID. The user can specify on the computer which tag goes with what (couch, table, room, etc.)

during the installation process. Another important aspect of this technology is the incorporation of multiple pets. Notice in the diagram above there are multiple pet transceivers. For instance, say you have a cat and a dog. You want to keep the other away from the other's food, but not deter it away from its own. The only way to do this is have the receiver on the collar pick up the signal and then process it on the PIC. We can do this by using the RFID tags that come with this technology. On installation, when the user sets up his system and programs each transmitter with a location name he can also specify which pet and cannot go where. This way the user can have as many pets with as many off-limit locations as possible all in one universal system.

The design of the module for the transmitter will require some basic engineering. Obviously since the transmitter is just an exposed PCB we will need to encase it in some sort of enclosure. The only thing that needs to be added to it is an external control to adjust the range. Since the range is adjusted by changing the inputted power all we need is knob or even a digital input pad that can manually change the power to the system. In fact, we simply attach a variable power supply to the module and have the user adjust that.

The software is going to be composed of a GUI (graphical user interface) written in C, C++, Java, or C# that will allow the user to upload and view data from the pet readers. First, the software will connect to the reader through an USB interface. This will allow the user to download the data of what zones the pet has been in that day. Also, by connecting to the pet's reader, the user can set which zones that pet is allowed to enter safely and set zones that the pet will be deterred from. The software will also be able to connect to new pet readers, so the user can add more pets to their deterrent system. Each zone has its own unique id as given by its RFID tag. When the user sets up an off limit zone for a pet, the software uploads the id of the transmitter to the reader.

After the user has uploaded data from the pet reader to the software, the software will organize the data so the user can more easily view it, such as converting zone ids into names the user is more familiar with. The software will also provide other ways to view the data. Charts and graphs will be shown to allow better interpretation of the data. For instance, the user could pull up a chart showing the percentages of zones that pet entered to see which off limit zones the pet enters the most.

The receivers will be embedded in the pet collars along with a power source and a LED, which will be used to signify the deterrent is activated. Once the receiver comes within range of one of the transmitters and receives the RF signal it will determine if the zone is off limits and if so it will activate the deterrent. Key concerns for the receiver are size and frequency. The size needs to be extremely small and light weight since it will be on a pet's collar and will need to be useable by smaller sized pets. In addition to the receiver the collar must also hold the battery and most likely the deterrent device itself. Therefore, keeping the receivers size as limited as we can is an issue we will keep in mind. Secondly, we have to be sure that our transmitters work on the same frequency range as our receivers so that they can actually communicate with each other. For this reason, the current option we are leaning towards is buying a group of transceivers and setting them to be either receivers or transmitters. This way we know they will work together since they are mechanically identical.

In order to store all the information regarding the pet's violations a PIC microcontroller will be attached to the reader on the pet. This will have Flash EEPROM to store all the data until the user retrieves it for later observation. Also, the processing power of the PIC will be utilized in that the tag from the transmitter will have to be processed in accordance to each pet and determined if he is violating his particular off-limit zone. The PIC chosen is a 18F2455 that is USB compliant, making it up to par with consumer standards.

Whenever the pet violates a particular zone and the receiver picks up a signal, the PIC is told to store the current time and the location of the violation as determined by the RFID tag sent by the transmitter. This data remains there until the user takes the collar and, using the USB interface, connects it to a computer and runs the software.

4.3 Approach for design validation

The best way to test the design of the pet deterrent system is to test it in various stages of the development. This concept is used in many design modules because if a problem is detected early it does not cost as much time and money to fix. For a project to be completed in one semester, time is a very key variable. Whenever one of the below aspects is able to be tested it will be tested. If adjustments are made to any hardware or software that part of the system will be retested to ensure that it continues to work correctly.

The transmitter and receiver must be tested in an indoor environment for its range and reliability. The transmitter should be adjusted to all possible ranges and the receiver should check to see if it receives the signal at the appropriate location. The range should vary between a 3 foot radius and a 20 foot radius. If the transmitter is in deter mode the receiver should act accordingly, either beep or display a light for validation. If the transmitter is in track mode the receiver should document that it entered that zone at the correct time. The user may wish to place the transmitter under a piece of furniture to deter the pet from that furniture. Therefore we need to place the transmitter under common household objects, such as a couch or table, and test the range. There will be some variation between the tests with and without the objects, and the test will ensure that the range does not change by a significant amount.

The batteries used in the transmitter and receiver should be closely watched. The power of the batteries will be checked before running the system continuously. The system should be on for at least three days before the battery power of the transmitter and receiver are tested again. This will give an estimate of how long the power source can maintain the system. If the battery power is not sufficient alternate power sources may be checked or the system redesigned for efficiency. After the batteries are drained to half their normal power the range of the transmitter needs to be checked again. The battery power may have a significant impact on the range and it should be recorded.

Another series of tests should ensure that the data stored on the collar can be uploaded to the computer. This will require the transmitter and receiver to be working. The receiver on the collar needs to be taken into the range of the transmitter and the team should record how many times it entered the zone and at what times it entered the zone. The information should be uploaded on the computer and checked for accuracy. This test needs to be done for the transmitter in different modes and ranges. The test also should be repeated to make sure information does not remain on the collar after it has been uploaded. A stress test should also be completed and make sure that the collar can hold a week’s worth of information.

The software aspect of the pet deterrent system must also be tested. Uploaded information needs to be displayed and checked for accuracy. The program should also remain running to check for memory leaks. The software needs to be checked by trying all combinations of options or buttons.

The interface should also be tested by a random person who is not involved with the project and has basic computer knowledge. This tester should look verify that the system is easy to use. Once the project is complete the tester should try and set up the system and change the range and determent options of the transmitter. This information will be used to verify that our system meets the objective of being easy to set up, use and adjust.

When all of these tests are completed the system is capable of being a pet deterrent system that solves the need stated in the introduction.

5 Engineering standards

5.1 Project management

Denise Cuppett has been assigned two areas of charge for the Pet Deterrent Project. The first area that Denise is in charge of is hardware design. All team members have and will continue to contribute to designing the transmitter and receiver for the project. Denise will oversee the progress and make sure

things are on track for the project. Denise is qualified for this position because she has taken hardware classes and designed multiple robots over the years. The second area that Denise is in charge of is testing the design. In her internships with IBM, Denise has spent two summers testing various aspects of the AIX and Linux operating systems. She has created documentation, created test cases, and ran tests. With this background Denise is qualified to determine the test plan for the Pet Deterrent System and oversee that the tests fully verify the functionality of the system.

From his past summers, John Kaczmarek is has experience in software engineering and application design. He likes high-level views and planning. For these reasons John will be filling the roles of leading the total systems design and general reporting, which is all non-technical documentation. He also like problem solving and troubleshooting so he will be helping with the testing and debugging aspects as well.

Michael Stewart will be in charge of the team and all the financial responsibilities. He has had experience at Texas A&M with system design and software development. In his most project in CPSC 462 he worked on a Rubik's Cube solver and covered software, hardware, as well as the apparatus structure. His experience in all aspects of that project in addition to the other projects he has worked on has allowed him to maintain a strong grasp on all aspects of a major project.

Chris Wesp will be in charge of the software design and technical reporting. He has been on multiple projects in the past where he designed and implemented software. In CPSC 462, microcomputer systems, he wrote the software that allowed for communication between a python GUI and a FPGA via the serial com port. The python program allowed user input that helped control two motors and a laser which created a display on a wall. Chris has written other software programs for various computer science classes at Texas A&M. For Chevron, Chris worked on multiple projects the most relevant being a monitor tool for a cluster file system. The tool provided a GUI that displayed the current status of the various nodes in the cluster system. For this tool and the other projects at Chevron, various reports had to be given on what the software did and how to use it.

There are a handful of project management mechanisms that the Top Dog team has decided to implement to make the project run smoothly. Each member tracks his or her progress by keeping a record of every task in their journal. The team meets twice a week to discuss the progress of each member and hold members accountable for getting their work done in a timely manner. Currently the meetings are set for Monday and Wednesday at 3pm and usually a third meeting is held sometime on the weekend. The first few minutes of every meeting are set aside for casual discussion to encourage team bonding and trust among team members. Brainstorming is done both during and outside of meetings. Members are encouraged to email the team if they come across a problem or new idea. This open communication keeps the team on track without waiting for a meeting to discuss something important. The team is applying key lessons from the book, The Five Dysfunctions of a Team, so that the project runs smoothly and the end result is excellent.

5.2 Schedule of tasks, Pert and Gantt charts

See Attached.

5.3 Economic analysis

- Economical viability:

  We foresee the potential marketability of our system to be very good. It offers both a high level of utility for a low cost. Volume production will continue to reduce cost factors and allow for continued system improvements. Prototyping budget is limited but once the primary system is perfected lowered cost could also be used to buy higher performing components. Another helpful factor is that this technology is continually improving and therefore cost of current "top-level" components will also be reduced as they become "mid-range" components.

- Sustainability:

  There are several vendors for the components that our project requires. Each of them are evaluated on a cost basis under the analysis of meeting the minimal system requirements that our customer needs. As RF technologies becomes more and more popular we will see gains in competition which will benefit sustainable production. There will be no continued maintenance besides battery upkeep and information downloading to a PC.

- Manufacturability:

  Component tolerances are one of our primary concerns based on the experiences of previous team who had difficulty managing transmission ranges. It is therefore crucial the component research is performed thoroughly and completely. Known issues relating to range are the indoor confines of our products tracking area and the discrete product positioning. Our transmitters will most likely placed underneath furniture or other obstacles. The indoor setting will be filled with obstructions that will dampen signal strength. We are also aware that battery power will greatly impact signal power. These and other tolerances will be rigorously tested throughout the design and build process to comply with customer demands. Worst case analysis is that our ranges will experience high degrees of variability and will therefore be confusing both for the pet and their owners when trying to interpret the recordings. Finally, we will be sure to comply with the FCC on their Radio Frequency Safety regulations. A general summary from their website is stated below and the real impact is discussed further in the safety analysis.

  "The FCC is required by the National Environmental Policy Act of 1969 to evaluate the effect of emissions from FCC-regulated transmitters on the quality of the human environment. At the present time there is no federally-mandated radio frequency (RF) exposure standard. However, several non-government organizations, such as the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers, Inc. (IEEE), and the National Council on Radiation Protection and Measurements (NCRP) have issued recommendations for human exposure to RF electromagnetic fields. The potential hazards associated with RF electromagnetic fields are discussed in OET Bulletin No. 56, "Questions and Answers About the Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields.""

  - *FFC Office of Engineering and Technology on Radio Frequency Safety*

5.4 Societal, safety and environmental analysis

We are designing and creating a commercial product for the everyday consumer and pet owner. Therefore, our project has the potential to reach a large percentage of people. The impact it will have on society on a whole is not a significant in either the positive or the negative directions. We see this as a good thing. We are not wishing to revolutionize peoples' lives with some incredible change. Neither are we invading the private space or asking them to give up something in return for what we offer. We are simply providing a product which will make their lives easier when it comes to training and controlling their pets within their serenity of their homes.

Safety is a primary concern for us. People value their pets and often have close relationships with them that involve trust and respect just like normal relationships. Therefore our product must be guaranteed to in no way pose any potential threat to their animal friend. We would also need to limit any discomfort or stress on the pets as well. Our team is not dealing with the actual deterrent of the system. So we will not need to concern ourselves with animal safety from the aspect. For both the pet's and the owner's safety we will need to be sure that our product follows any and all safety guidelines for radio frequency devices as well as be sure that our power supplies comply with similarly related safety guidelines. There are FCC

regulations setting the limits on the maximum permissible exposure (MPE) permitted from operation of transmitters in all radio services. However, products like ours should be exempt from the evaluation requirements because the relatively low power makes it unlikely that the MPE levels would be exceeded. Size concerns should also be closely worked on for the reason that we intend for our product to be useable for smaller dogs and even cats. Therefore, the collar must be both small in size and light in weight to prevent discomfort or annoyance.

Finally, we can foresee absolutely no environmental impact coming from our product.

5.5 Itemized budget

(4) Ti TRF7960 Transceivers OR	4 X $4.86
(4) Analog Devices ADF7020	4 X $5.00
(2) Dog Collar	2 X $3.00
(2) PIC18F2455 Microcontroller	2 X $7.90
http://www.futurlec.com/ICMicrochip_PIC18.shtml	
(2) Project Enclosures	2 X $2.79
(2) USB Interfaces	Negotiable
(2) Power Supplies	Negotiable
Various IC Components	
Various Parts	
Total:	$46.59

6 References

Ubisense, “System Overvew”, [Online]. Available: http://www.ubisense.net/content/8.html

Tim Kridel, “What's Next: Location, Location, Location**,” (**2007, Jan.). [Online]. Available: http://www.indoorlbs.com/id236.html

SmartCode™ Corp. 2005. Passive Tags. [Online]. Available: http://www.smartcodecorp.com/products/passive_tags.asp

P. Sorrells. 1998. “Passive RFID Basics,”[Online]. Available: http://ww1.microchip.com/downloads/en/AppNotes/00680b.pdf

Lionel M. Ni, Yunhao Liu, Yiu Cho Lau and Abhishek P. Patil. *LANDMARC: Indoor Location Sensing Using Active RFID*. [Online]. Availabe: http://ieeexplore.ieee.org/iel5/8487/26747/01192765.pdf

Lionel M. Ni, Yunhao Liu, Yiu Cho Lau and Abhishek P. Patil. “LANDMARC Indoor Location Sensing Using Active RFID,” [Online]. Available: www.cacs.louisiana.edu/~wu/619/presentations/LANDMARC.ppt

Contech. ScatMat® Automatic Indoor Pet Training Mat. [Online]. Available: http://www.contech-inc.com/products/scatmat/

Mike Dempsey. Indoor Positioning Systems. *Biomedical Instrumentation and Technology.* [Online] Available: http://www.radianse.com/download/news-bit-2004.pdf

Hitoshi Kitayoshi, Kunio Sawaya. (2005, June). Long Range Passive RFID-Tag for Sensor Networks. Tohoku University. [Online] Available: http://ieeexplore.ieee.org/iel5/10422/33099/01559038.pdf?arnumber=1559038

7 Appendices

7.1 Product datasheets

All data sheets are attached at the end of this document.

7.2 Bios and CVs

Denise Garrett Cuppett is a senior at Texas A&M University. She will obtain her Bachelor of Science degree in Computer Engineering in December 2007. As a student at Texas A&M University, Ms. Cuppett collaborated with classmates and expanded her knowledge on electronics and programming through required classes.

Ms. Cuppett has contributed to the field of robotics. She spent two years of her undergraduate degree as a Peer Teacher for the freshman course Foundations of Engineering, which focused on students building a robot to learn about engineering. As part of this job Ms. Cuppett spent her time leading lab sessions and hosting extra tutorial sessions to help students construct their robots. She would teach students different principles of robotics and electronics. Ms. Cuppett was the president of a student organization entitled AggieBOTS for two years. AggieBOTS is a volunteer organization that helps robotics competitions such as BEST. (Boosting Engineering Science and Technology) and FIRST (For Inspiration and Recognition of Science and Technology). Ms. Cuppett volunteered during the competitions to perform a variety of jobs such as refereeing, scorekeeping and general crowd control. Another task that Ms. Cuppett undertook as a member of AggieBOTS was to mentor middle and high school robotics teams to help them develop a sound robot for the BEST competition.

Ms. Cuppett has interned with IBM in Austin, TX for the summers of 2005, 2006 and 2007. In 2005 she worked in the Linux Technology Center for the Operating System Security Development Department where she executed and edited numerous automated and manual tests to verify that Red Hat Enterprise Linux 4 Update1 met the CAPP/EAL4 level of security. In the year 2006 Ms. Cuppett worked on a Functional Verification Testing Speed Team in the AIX TCP/IP Department. That summer consisted of writing test plan documents, coding test cases and debugging defects for various aspects of the AIX Operating System. Ms. Cuppett returned to the AIX TCP/IP Department in 2007 where she developed a virtualization performance feature for a networking aspect of the AIX Operating System.

After graduation in December 2007, Ms. Cuppett will begin a career in Computer Engineering.

Denise Cuppett

P.O. Box 13932
College Station, TX 77841

(817) 301-6066
denisecuppett@gmail.com

Objective To begin a career in the field of Computer Engineering

Education **Texas A&M University, College Station, TX** Graduation: December 2007

Bachelor of Science in Computer Engineering

GPA Overall 3.72/4.0

Distinguished Student Award from College of Engineering

Experience

IBM, TCP/IP Department, Austin, TX Summer 2007

Co-op Pre-Professional Programmer

- Developed a virtualization performance feature to a networking aspect of the AIX Operating System
- Diagnosed and implemented solutions to AIX defects

IBM, Functional Verification Testing Speed Team, Austin, TX Summer 2006

Co-op Pre-Professional Software Engineer

- Created test plan document which outlines over 100 tests on networking aspects of the AIX operating system
- Wrote and debugged automated tests using the Expect language
- Diagnosed and implemented solutions to AIX defects

Texas A&M University, College of Engineering, College Station, TX 2004-2006

Peer Teacher for Foundations of Engineering I & II

- Assisted students with lab work that dealt with circuits and robots by explaining how specific electronic components work or examining their circuit to find errors
- Educated students on debugging techniques for their C++ programs and explained why errors were caused with their code
- Clarified concepts taught in the lecture by aiding students with homework during lab time and at help sessions
- Edited chapters of textbook Dr. Stroustrup and Dr. Petersen wrote for students

IBM, Linux Technology Center-OS Security Development, Austin, TX Summer 2005

Co-op Pre-Professional Software Engineer

- Executed numerous automated and manual tests verifying Red Hat Enterprise Linux 4 Update1 meets CAPP/EAL4 level of security
- Debugged and updated tests to remain compatible with updated kernels and packages

Skills

- Literate in C, C++, Expect, Verilog, MIPS Assembly and Java
- Skilled with AIX, Solaris Unix, Red Hat Linux, Windows, Frontpage, Dreamweaver, CVS (Concurrent Versions System) and Microsoft Office
- Knowledgeable about electronics, circuitry and digital logic
- Lobbied for the Texas Engineering and Technical Consortium in Washington D.C. as engineering student representative

Memberships **AggieBOTS (Boosters Of Technology and Science)**

- Served as President of this volunteer organization for two years
- Officiated in and supported high school robotics competitions such as B.E.S.T, F.I.R.S.T. and Science Olympiad

Aggie Women in Computer Science (ACM-W Chapter of Texas A&M)

- Attended the Grace Hopper Celebration of Women in Computer Science
- Learned from distinguished lecturers speaking at A.W.I.C.S. events

John Kaczmarek is a Computer Engineering undergraduate student at Texas A&M University. Originally from Houston, he attended Westbury Christian High School and came to Texas A&M in the Fall semester of 2003. Starting off as a Chemical Engineering Major he quickly changed to Computer Engineering (Computer Science Track) after realizing his natural affinity towards electronics and emerging technologies. He had very limited prior experience in programming languages but rapidly developed those skills particularly taking interest in design.

John's Sophomore and Junior year summers were spent conducting research at Texas A&M University as part of an undergraduate research program call USRG (Undergraduate Summer Research Grant). In the summer of 2005 he studied fault diagnosis in integrated circuits using critical path tracing techniques. This same summer he taught himself the programming language C++ (having only used C and Java up to that point). He successfully implemented some of his findings and presented them to his peers as part of a final presentation. The experience taught him valuable information about circuit logic and and hardware design, but he found it not to be what interested him the most.

The following summer (2006) John experimented in the area of software engineering. His research was mainly focused on the understanding of software engineering concepts and the most efficient means to teach them. While no ground breaking studies were carried out he did gain a vast amount of understanding on the topics of software engineering which spurred his interest in total system design. John found out the complete design process from the requirements stage all the way to testing and implementing was fascinating and allowed him to use his creative abilities as well as his analytical talents.

Continuing on through his Senior year he progressed in his studies and ended up taking a internship position at National Instruments in Austin. Still not sure exactly how to describe his interests, John worked with his managers to develop a project that could accomplish meaningful results in a brief time period. The final solution came to be a modification of a PERL script that collected information about various software components and then designing and creating a web application using Ruby on Rails that allowed project managers to better manage SEP practices used by the company. John and his managers were extremely pleased with the results and the amount that John was able to accomplish in the short time. He exposed himself to PERL and also picked up quite a bit of Ruby and the Rails framework.

John is now completing his final semester at Texas A&M and is looking forward to finding a career that allows him to use his strengths in working towards doing a job the he finds exciting and challenging.

John M. Kaczmarek

902 Holik Dr. Email:
kaz88@neo.tamu.edu

College Station, TX 77840 Phone: (713) 305-5876

EDUCATION

Texas A&M University, College Station, TX
December 2007

Bachelor of Science in Computer Engineering Computer Science Track

Minor in Business

GPA: 3.666

EMPLOYMENT HISTORY

National Instruments – Internship, Austin, TX
Summer '07

- Learned PERL and Ruby programming languages as well as the Ruby on Rails framework.
- Modified an existing PERL script to add new functionality and outputs, and fixed minor bugs.
- Designed and wrote a new web-based tool for project manages in Ruby on Rails.
- Presented the tool and it's features at a project managers meeting.

Texas A&M Libraries – Systems Department, College Station, TX
Fall '06 – Spring '07

- Provide HelpDesk assistant to all four campus libraries as a Student Technician.
- Install new software, drivers, and hardware and reimage machines for new users

Texas A&M University USRG Program, College Station, TX
Summer '05, '06

- Preformed research on the use of tools and standards in teaching Software Engineering. -'06
- Applied findings in a revision of teaching methods and course layout. -'06
- Assisted with Critical Path Tracing research in the area of fault diagnosis. -'05
- Contributed to C++ program that used Verilog files to find critical paths. –'05
- Presented research before faculty and peers during seminars and a symposium. -'05, '06

Mediterranean International, Houston, TX
Summer '04

- Generated list of oil well drilling equipment needs for vendor bid process

- Distributed urgent product needs for bids
- Collected bid information and created spreadsheet for final quote selection

TECHNICAL SKILLS

- **Languages:** Java, C++, C, PERL, Ruby, MySQL, HTML, CSS, MIPS Assembly, Verilog
- **Programs & Tools:** MS Office, Visual Studio, ClearCase, Rose, Eclipse, Photoshop

AWARDS AND HONORS

- Outstanding Academic Achievement Award
- Distinguished Student Award (Dwight Look College of Engineering)
- William A. Brookshire Foundation Scholarship Recipient 2005-2006 and 2003-2004
- National Advanced Placement Scholars Award

ORGANIZATIONS

- Texas A&M Honors Program
- Golden Key International Honour Society
- National Society of Collegiate Scholars
- Aggies for Christ

VOLUNTEER WORK

Aggie HYPE (Helping Youth Prepare for Eternity)

- Coordinate class activities weekly for 10-15 young elementary students
- Lead and Direct volunteers in my class as they interact with the children

Several other Aggies for Christ activities including mission trips and service projects

Michael Stewart is a 2007 soon-to-be graduate of Texas A&M majoring in Computer Engineering with a minor in Math. Over his tenure at A&M he has learned core knowledge in computer science, electrical engineering, and overall system design. He has completed projects that include in-depth programming as well as low-level hardware design. A more recent project he worked on was a robotic Rubik's Cube Solver. The system involved using microcontrollers, stepper motors, serial communication, and an intricate algorithm coded in C++. The project was featured at the Microsoft Research DemoFest over the summer and was noted in a Microsoft publication. Most recently he accepted a job at Raytheon Space and Airborne Systems in McKinney as a Software Engineer.

J. Michael Stewart

5615 Mercedes
Dallas, TX 75206

(214) 356 - 3338
jamesmichaelstewart@gmail.edu

Objective To make the team for the Lunar Lander project in CPSC 483 so that I may use my skills

to work with students of various backgrounds and expand my overall knowledge of system design.

Education

University of Texas at Dallas, Dallas, TX Enrolled: September 2003
Studies toward degree of Bachelor of Science End: May 2004
in Computer Engineering

Blinn College, Bryan, TX Enrolled: May 2004
Studies toward degree of Bachelor of Science End: December 2004
in Computer Engineering

Texas A&M University, College Station, TX Enrolled: January 2005
Bachelor of Science in Computer Engineering Graduation: December 2007
Department of Computer Science
GPA 3.558/4.0 (*Cumulative as of Spring 2006*)

High School

Plano East Senior High, Plano, TX Graduation: May 2003
Graduated in the top 15% of my class
Honors/ DAP Graduate

Coursework

- Analysis of Algorithms
- Operating Systems
- Database Systems
- Computer Architecture
- Software Engineering
- Signals and Systems
- Electronics
- Electric Circuit Theory
- Digital System Design
- Microprocessor Design

Skills

- Literate in C, C++, Assembly, Verilog, SQL, and Java programming languages
- Familiar with circuits, digital logic, and an understanding of entry-level state machines in design.
- Have worked in numerous large-scale projects at Texas A&M including a mechanical Rubik's cube solver in CPSC 462.

Publications **Embedded Systems Research at DemoFest'07**

- Published by Microsoft, July 2007
- Technical Report MSR-TR-2007-94
- Pages 9-12, 56
- Co-authors: Chris Boyce, David Chaszar, Doug Toney

Awards and Honors

- Made the Dean's List in the College of Engineering at Texas A&M in Fall 2005 for a semester GPA of 3.80
- Recipient of an IAP scholarship sponsored by Adobe from the Department of Computer Science at Texas A&M for Fall 2007.

Interests

- Since I am going to work in the Defense Industry my interest is very high for this project. I thrive to be involved with an assignment that would allow me to have some real-time experience with something I may be involved with in my future career.

Chris Wesp graduated from Center High School in Center, Texas. He applied and was accepted to Texas A&M University as an Electrical Engineer with scholarships in Computer Science due to his High School achievements in Computer Science UIL. After his freshman year, he changed his major to Computer Engineering due to his growing interest in software design.

In 2003, he designed and coded Aggieman for Computer Science 111. Aggieman was a 2D side scroller game written in Java using the Java swing toolkit for graphics. In the Spring of 2003, Chris took ENGR 112, a course in C++. After taking this course, Chris went on to Peer teach for this class for the next two semesters under Dr. Petersen and Dr. Stroustrup.

In the summer 2005, Chris peer taught for the CPSC 211 class, a data structures class. For this job, he gave presentations over actual code to help the students understand the data structures.

In Fall 2006, Chris took CPSC 462, computer Microsystems where he helped design a laser display. His main work on this project was design and coding of the software system that controlled the two motors and laser.

Chris worked for Chevron in the summer of 2006 in their Technical Computing Department. Three projects were assigned and completed for Chevron. A monitor was written in Java to monitor a cluster file system, and later another monitor tool from LLNL written in python was modified to work with Chevron's network. The other two projects were editing a webpage and monitoring a data center with thermal imagery.

He is currently a senior undergraduate student at the Texas A&M University finishing his last year to receive his Computer Engineering degree.

Curriculum Vitae

1612E Holleman 936-488-1507
College Station, TX 77840 chris_wesp@tamu.edu

Technical Skills

Platforms:

Linux/Unix,Windows

Languages:

Java, C++, C, Python, Verilog, Assembly, MATLAB, MySQL, XML, HTML

Toolkits:

Qt, Tk, AWT/JavaSwing, FLTK

Experience

Chevron Intern **Summer 2006**

- Assigned three projects to work on during the internship: Thermal Imagery of Data Center, Updating ETC-TC Webpage, and the Lustre Monitor.
- Used FLIR IR thermal camera to take thermal images of data center. Loaded data into 3D volumes for visual interpretation and arrived at conclusion that thermal cameras are not the best solution for monitoring data center on a daily basis.
- Used Java to write a tool for monitoring Lustre, a cluster file system. During development, LLNL released a free open source monitor written in Python. Switched to their tool and added features to it, so their monitor would better suit Chevron's needs.
- Updated the ETC-TC webpage, so it can be more easily standardized in the future. Verified content was up to date and correct, deleting when necessary, and added some content that was missing.

Peer Teacher **Fall and Spring 2004, Fall 2005**

- Peer teacher under Dr. Bjarne Stroustrup and Dr. Petersen for Engineering 112, a C++ class for electrical and computer engineers.
- Helped students learn course material, assisted students when they needed help with their labs, and graded tests.

Peer Teacher **Summer 2005**

- Peer teacher for Dr. Teresa Leyk for Computer Science 211, Data Structures and their Implementations.
- Helped students learn course material, assisted them when they needed help with their labs, and helped them debug their code.

Education

Bachelor of Science in Computer Engineering Expected Graduation: May 2008

Texas A&M University, College Station, TX

Other Information

- Member of the Tennis Club at Texas A&M.

- Received the Carl B. & Florence E. King Foundation Scholarship for Accomplishments in Computer Science UIL
- 1st Place Team State UIL Computer Science in High School
- 4th Place Individual UIL Computer Science in High School
- Graduated 3rd in High School Class
- Member of National Honor Society in High School.