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# Introduction

Fortunately today in our society we have places that we can put lost pets, strays, and unwanted animals so that they won't get into trouble. These Animal shelters are facilities that house so many animals coming in and out of the facility it is hard to remember each animal's name. As uncaring as it may seem, it can be easier to keep track of the animals by an assigned identification number, which helps in managing the animals and keeping inventory of all the details pertaining to each animal. The method of inventory within an animal shelter facility can have different organization styles, but every shelter needs one in order to stay organized.

During a given day an animal can be taken out of its assigned kennel area many times. The animals could be taken outside for a walk, to the veterinarian for medical attention, along with many places other than its assigned area. This makes it hard to take inventory of the animals at the animal shelter, which gives more reason to develop a system of keeping the animals organized and accounted for.

There is an increased need to not only keep track of the animals in the shelter, but also the registered animals living with their owners. It has been mandated by law in many counties for dog owners to register their dogs with the local animal shelter. This information goes to county records and surrounding pet organizations in the case the pet gets lost. Registering animals makes more work for the staff at the local animal shelter in the short run, but gives an easy way to take inventory of all the registered animals when something may happen.

# Goal

With there being such a shortage of labor for animal shelters due to their low budget nature, it becomes even more important to have time efficient practices to make the best use their staff. This labor shortage is not only a problem for just doing the day to day tasks, but as a result, time is usually never allocated by the staff for serious reworking of their systems in order to improve their processes. Animal shelters usually don't have the staff or the funds to drive innovation within the shelter and make their procedures more efficient.

The goal of this project is to take a look at the record keeping practices within the Woods Humane Society animal shelter, determine and implement changes to produce more efficient processes within the facility. The aspect in particular is this project focuses on is the time spent on inventorying the animals within the shelter and the allocation of where the animals are at a given time. With labor being so low in animal shelters, these implemented changes will have an emphasis on being low maintenance and easy to use. Establishing procedures that are easy to understand and carry out is especially important because most shelters do not have an onsite information technologies department, or any technical support to maintain the system

# Scope

The scope of this project is looking primarily at putting in technology to make operations simpler and/or less time consuming. The project would be particularly looking at the inventory system and pet allocation throughout the facility so the animals can be easily and efficiently allocated. These improvements will have a high priority to be cost efficient and sensitive to the low staff levels within the animal shelter.

# Needs

When designing a system that is intended to be used regularly for business practices it is very important that all the needs be addressed, so that an appropriate system can be made. Animal shelters, like the Woods Humane Society, are no exception in that there are certain aspects to that greatly affect how an inventory and system is made. Here is a list of needs that have to be addressed in this project with the animal shelter:

- 1. Low number of staff, especially paid employees, to work on maintaining the inventory data base system
- 2. Limited financial resources
- 3. Low amount of IT expertise available for implementation and maintenance
- 4. Very high number of animals coming in and out of the facility at all times
- 5. Difficulty handling aggressive animals

Without addressing each one of these needs the project could be subject to failure due to the animal shelter's low resources available.

# Contribution

The end result of this project could be very effective for many shelters and animal care providers. After the project is done, the Woods Humane Society will have a more efficient way of taking inventory and be able to allocate pets within the shelter facility. This system will lay the ground work for potentially more advanced applications of the technology in the future. Because many shelters share the same software and infrastructure design, the Woods Humane Society could easily serve as a model for animal shelters or any animal centers that deal with allocation of many animals. With there being an existing data management software, Chameleon Software Products, this implementation could make an easy upgrade, while also keeping a lot of the existing data management software.

# **Literature Review**

Most of the literature pertaining to the topic and scope of this project has to do with the understanding of how RFID systems work, and how they can be applied to a working system both with live animals as well as items. With the potential use of RFID being so broad it is easy to design a system with either live animals or goods in mind and have it work for both cases without changing anything. This literature review will include a summary of the information referenced during this paper and how it pertains to the scope of the project at hand.

# **Radio Frequency Identification**

One of the most important parts of implementing an inventory system is selecting the right components to meet the specifications of the environment and the needs of the system. To implement an effective RFID system it comes down to three important parts, the reader, the tags, and the software. All RFID systems must have all three parts in order to run effectively and be a reliable, useful tool.

#### Readers

First let us look at the reader aspect of the RFID system. There are many different readers out there, but there are a few ways to categorize all the products. An article from Intermec, "Intermec RFID Readers" suggests a few main questions to determine the kind of reader needed for a particular system:

- Will filtering of redundant tag data need to be performed at the reader level (smart) or by a server or host (simple)?
- 2. Are Industrial PC's or PLCs currently used (simple) or will local decision making need to be handled by the reader (smart)?
- 3. Do you need integration of business processes at the point of activity to minimize RFID integration without disruption to existing business process and backend systems (smart)? Or, are you modifying your backend system to accommodate new RFID business process (simple)?
- 4. Will manipulating the tag data format need to be performed at the reader level (smart) or by a server or host (simple)?

The obvious two categories that almost all readers fall under are either "smart" or "simple." Simple Readers, in general, only have the capability to detect the tags that are in range. Although, when integrated into a server or PC setup a simple reader can accomplish some of the same characteristics of using a smart reader. This can save money and possibly be easier to integrate with an already existing inventory system. A smart reader can be defined as a reader that can accomplish more than the simple detection of the RFID tags. This can be writing data into an existing inventory system through a portable reader, or in general manipulating the information associated with the

system or tag without the use of a computer. The smart reader still has the capability to only detect the RFID tags, the same way a simple reader can.

These readers come in three main categories, a handheld device, a stationary reader, or a mounted reader. There are many different types of readers that fall into each of these categories, with features like increased range, different frequencies of detection, and rugged structure to fight against weather and intense work conditions. Most handheld devices would fall into the smart reader category, and would seem like the obvious choice for most applications, although, these readers have decreased range, which tends to be an essential aspect of most applications of RFID. These handheld readers are most commonly used as mobile, off site detection tools. Stationary readers usually have the highest capability, in terms of hardware potential and detection range. These readers are usually used within the work facility, typically in inventory or supply chain applications. Mounted readers are typically put on forklifts or moveable machinery, usually used in a warehouse type application to detect orders while moving them throughout a work facility.

Dynasys, a division of Texas Instruments, developed a mobile reader cart that used a single stationary reader connected to a laptop computer to accomplish tasks that, under normal application, a more mobile solution would have to be implemented. This set up utilizes a stationary reader that offers better capability and read range, while also making use of several antennae hooked into the same reader. The maneuverability of the cart with the combination of the multiple antennae virtually eliminates dead spots, giving an extremely error-proof system of detection. By using this mobile cart, Dynasys utilized real time updating via the online allocation software. Access to the online software is

obtained through the laptop, which is connected wirelessly through the LAN in the building.

Dynasys reported a project using the mentioned mobile RFID reader cart, along with barcode and software integration, to manage cage sterilization done in the University of Florida Cancer Genetics Research Lab. It was possible in their applications to get precise reading capability within tight corridors, even when there would normally be interference from metal cages. With hundreds of cages being stored in the same area, the RFID mobile cart reader was able to take account of hundreds of ID tags in seconds. If this task was done without this technology, by taking normal inventory, it could have taken hours. This example is especially useful because many of their practices are aimed towards animal care. This can be particularly helpful in implementing an RFID system within the Woods Humane Society, along with other animal care facilities.

#### Tags

Another part of implementing an RFID system is the choice of tags that identify the asset or animal. There are a couple different factors that determine which tag is appropriate for the system at hand. A big distinction between tags is if a tag is active, passive or battery assisted passive (BAP). A tag is considered active if there is a battery used to constantly transmit signals from the tag to a potential reader in range. Otherwise the reader must initiate signal transmissions to all tags in range, and only after the reader transmits signal will the tag respond to the reader. These tags do not require batteries for operation, and are called passive tags. There is also a of hybrid of both active and passive tags, battery assisted passive tags. These tags remain dormant until a signal is initiated by a reader, but

when the signal is initiated the tag has better read range. The selection of the tag is purely dependent on the job the RFID system is designed to accomplish. It could be essential for one project to have tags that have the longest read range possible, but for a different job a tag may have a low read range desired in order to control the number of tags that need to be detected. For this reason, Intermec stated a few factors in their article "Intermec RFID Tags & Media" that are typical issues for most applications of RFID:

- 1. Frequency Range
- 2. Memory Size
- 3. Range Performance
- 4. Form Factor
- 5. Environmental Conditions
- 6. Standards Compliance

Typically the most important for many applications is the "Range Performance," or how far away the tag can be detected, along with a factor that is not included on the list, cost. With the tags being the most significant reoccurring cost for an RFID system, it is one of the most important aspects to minimize. While implementing a cheap system that works inconsistently doesn't help anyone, the main reason why more companies don't invest in RFID systems is simply because its costs. Along with cost, the "Form Factor" and "Environmental Conditions" play a big part in how the tag looks and is attached to items. For example, if a tag is attached to a pallet, something that will likely have to take some extreme work conditions, the Form Factor of the tag will have to be designed to take large amounts of wear and tear to accommodate the work environment. Although in many applications the memory stored and transmitted by the tag is usually used as a

reference number to a database, the amount of information able to be transmitted is an important influence on the choice of tag for a given application. If sub categories were to be made through this tag ID, it would become increasingly important to be able to store a reasonable amount of data on the tag. For example, if an RFID system used in an animal shelter categorized their pets into pet type, dog, cat, snake, and the breed of the animal, Shiatsu, Labrador, Terrier, along with its given name, it would require the tag to be capable of storing quite a few bits of information.

Big improvements have been made in recent years to improve these tags as a whole, including increasing read range, decreased size, decreased cost, better durability and ability to read through materials like wood, metal, plastics and water. All these contribute to the increasing popularity of the RFID technology in normal business practices.

#### Software

Software is essential to tie together the hardware being implemented. The best part of RFID technology is that it can be used to enhance many different markets and applications, but this all depends upon how the RFID hardware is used in combination with software. There are many companies that have templates for common uses of the technology such as supply chain and inventory type applications, but RFID can also be integrated into an already established system. For example, many companies thinking about implementing RFID in their inventory practices are probably already using barcode technology to identify items in the system. This same database software could be used with RFID because an RFID tag gives most of the advantages of barcodes along with many other benefits. When a barcode is scanned, it reads that barcode sticker as a number

referenced to a database system in order to bring an item description, price, etc. RFID tags can have the same ID number referencing techniques as the barcode, so by using RFID the only thing that would have to change is the way the reference number is picked up. The difference is that using RFID tags doesn't require the operator to take the time to find the barcode and scan it with the scan gun, or worry about a smudged barcode tag. Because of the similarities to the barcode, implementing an RFID system is made easy with the huge benefit of having potential to improve the inventory system tremendously with day-to-day tasks while implementing further infrastructure to increase item allocation.

One software package is available by Chameleon Software Products. This software is an animal specific database software that looks at managing all the useful information to a pet. Some of the information recorded is a permanent record of the animal, spay/neuter information, photo identification, behavior profiles etc. This software has many different applicable options to accommodate most animal data inventory needs even for among many different animal organizations, such as animal shelters, dog kennels, veterinary practices etc. This software works as a cloud type program that allows a facility to maintain this program with the intention to manage many of the needs within a facility, from getting inventory of the animals, to dealing with the finances, to scheduling staff and volunteers. This company prides itself by working closely to what is needed by their customers. They offer customer support as well as online resources to trouble shoot a problem. Chameleon also reinforces customer satisfaction by using suggestions that can be sent in via the internet that they use to make their software better. They also tend to the specific needs of companies that their existing Chameleon software may not

accommodate. Full software installation and implementation of these inventory systems is also done by Chameleon if the client desires.

This integrated software management system is being used by many animal care facilities, such as animal control, humane control, SPCA, including the test facility for this project, The Woods Humane Society. While this software does not directly manage the RFID reader or data tag, it could still remain as the facility's main infrastructure program, but overlay RFID technology for the use of animal tag data detection. This makes for an easier implementation of the RFID upgrade than starting the facility with a totally new animal information data base program. Due Chameleon's openness to many different programming languages, it is easy for updates to be made for the program. A competitor to Chameleon's software is called Kennel Connection; this program also works as an animal information data base and time management program. Kennel Connection has made a package of programs that are aimed specifically at certain businesses such as, animal grooming, pet daycare, and pet training. They also offer several additional updates to their basic packages to add more customization. Most of these packages work with barcode and magnetic strip technology and some even come with magnetic strip writing and barcode generation capability. Kennel Connection runs similarly to Chameleon as an infrastructure program that includes most sides of the business like time management, finance, data storage, and record reporting all within the same program.

# **How Inventory Affects Livestock**

Although when somebody usually talks about inventory systems they are referring to a large warehouse or retail store, it can also take place in livestock allocation. At the end of the day both livestock and goods can be dealt with in similar ways in regards to inventory. Although animals can't be kept on a shelf like a pallet of diapers, they are kept in space similar to it, such as a numbered dog kennel, a particular cattle pasture, or specific bird cage that the animals are assigned to. They both can be identified by a given name or code and assigned to a specific place where they can be located, whether it be a soda on the shelf or an animal in its pen.

While it may seem inhumane, an animal can be dealt with in the same way as another item on the shelf by using identification tools. It has become common to identify registered dogs by an RFID chip implanted within the dog's neck area. This allows dogs to be identified easily by animal collection agencies such as animal services or animal shelters in the case that they are separated them from their owners. Unfortunately, the article "Evaluation of U.S. Pet Microchip Scanning Network Microchip Readers" explains that this implanted chip is difficult to incorporate into an efficient animal inventory system because of its very low read range. For this reason most facilities use barcode technology to aid their animal allocation needs.

The same practice is incorporated in cattle farm inventory; many ranchers identify a particular cow, its breed, medications needed, along with any other pertinent information by attaching an identification tag in the cow's ear. These tags have a long enough read rage to allow identification in corralling procedures without labor intensive scanning like the RFID chips put in dogs. Zig Beef boasts extremely good results from the RFID

systems they install, with a read range greater the 200ft. This allows cattle identification without fighting with the animal to scan the tag the right way.

In the article "RFID Goes to the Dogs" a business was made possible by assigning an RFID tag to each dog that comes to their business. This business established a dog park that serves as a dog daycare where clients can drop their dog off before they have to go somewhere. The dog is identified by the RFID tag on the dog collar which shows a short description of the dog and connects it to an account. This allows the business to bill the owner for the time the dog is left at the dog daycare. The dog daycare used its inventory system to identify which dogs are in the facility at a given time in order to determine how much time the dog has spent in the dog daycare. The time collected by the RFID system is then used to figure out how much to bill the owner of the dog. This is all done without using service people to operate a check-in and check-out station, thus minimizing costs for the business and giving greater convenience to their customers when they drop off their dogs.

This article gives a starting point at how an inventory system could be implemented at a small animal level, such as dogs, cats, etc. This article goes into some detail on how they implemented their RFID inventory and billing system which proved very helpful in determining a useful system for this project. This article was especially helpful as a model of showing how time records can be updated using RFID techonology. The diagram shown below shows a depiction of the RFID system process used in the dog daycare:



The article also referred to specific hardware and software companies that were used for the implementation of the system, which also proved to be useful for the choice of the hardware of this project. Specially, the article mentioned that they used EPC Gen 2 RFID inlays within the tags to store the RFID reference numbers assigned to each pet.

# Methodology

As stated previously, the purpose of this project was to implement an inventory system utilizing RFID technology to improve the inventorying system in an animal care facility. The Woods Humane Society served as a sample animal care organization for analysis and testing of the proposed RFID system. From analyzing the animal care facility, the goal of this project was to implement an animal inventory system, without re-inventing the wheel, utilizing RFID with the intention to:

- 1. Reduce the time it takes to inventory of the animals
- 2. Reduce amount of errors with animal records
- 3. Gain the ability to take inventory without coming in physical contact with the animals
- 4. Provide an easy way to correct animal records if errors are discovered

By incorporating RFID tags it can reduce the amount of time needed to identify the animal and reduce the amount of identification errors. Rather than having to go inside of an animal area and read the animal collar, which takes more time and requires close contact with dog, the RFID reader device can identify the animal and its records outside of a given caged animal area. If an animal is aggressive, and possibly dangerous, this can prove quite useful for the staff of the animal care facility.

#### System Design

After considering the prior cases and research reported earlier in the paper, the system utilizing RFID has been determined. This system consists of the three necessary parts to create a working RFID network, the antenna, the reader, UHF tags, a computer interface,

and the software the computer is running to communicate to the reader. The following is a depiction of how the RFID network will work together:



Computer Interface

The system will work by having a staff member walk through the hall area where the animals are kept with the RFID reader device, and because the RFID reader can pick up the identification tags of the animals without going into the individual animal cells, the reader device can identify the animals quickly and efficiently. After the animal ID is picked up by the RFID reader device, the software assigns the animal to the current location in the facility, and records it into the animal records database. The reader device will be able to detect its current location within the animal care facility by having UHF tags not only assigned to each animal, but also in the door ways of each area in the facility. When one the location tags is detected, it sends a signal back to the computer interface telling the device it has changed areas. It will then assign its new current location to the location tag being detected. Since the RFID reader device will have the

capability to view and alter records while taking inventory, staff members can alter records in the case of misinformation as they are discovered.

#### **Test Procedures**

When testing for equipment solutions for the implementation of the RFID system, the emphasis is to find hardware that works to the specifications of the facility. Since RFID equipment is expensive, the lowest costing solution that satisfies the constraints of the system was chosen. The read range necessary for the animal care facility is a constraint that must be satisfied in order to have a working system, making the tested equipment either usable or not useable upon this constraint. The read range necessary was determined to be greater than 8 feet, since the maximum necessary detection distance goes from the middle of the kennel hallway to the back of the kennel cell, roughly 8 feet. Even with this being said, each solution was still rated by an evaluation. This evaluation consisted of a critique of physical ergonomics, ease of use, tag read range, and tag consistency.

During testing each RFID reader solution takes inventory of the identification tags by going through the halls of the animal areas, the dog kennel and the cat room. While the reader is going through the animal areas a count of how many properly detected animal identification tags was collected. A time to complete the inventory was also recorded in order to compare to the existing inventory methods.

### Results

#### Solution number 1:

The first proposed solution used UHF tags with a mobile RFID reader made by Motorola. This option offered great physical ergonomics, ease of use, and tag consistency, but

lacked largely in read range. This would have been a very convenient tool for staff personnel to use due to its small size and innovative touch screen interface. This device incorporated a UHF RFID reader and antenna, alongside a mobile computer that has the capability to run many windows programs. The difficultly with this would be integrating database syncing software for updating the internal database. Building a database GUI within the limitations of the mobile computer would also pose a big problem. What made this solution unsatisfactory was the read range of the device. Although the RFID reader solution had very consistent readings within its range, it failed to have the necessary read range greater than 8 feet. Without the capability of the specified read range, the device renders itself unusable for this project.

#### **Solution number 2:**

The second proposed solution utilized a reader that for most purposes would be stationary, but for the purposes of this project, was attached to a mobile cart powered by an attached battery. A computer interface is then mounted and connected to the reader; this gives much of the instantaneous database manipulation power to this solution. Rather than having antennas packaged in the same casing as the reader, like the mobile reader, antennas must be connected to the reader to allow data transmission, which were mounted on the mobile cart for convenience.

This solution proved to be much closer to the specifications needed by the facility than the first solution. One of the key improvements over solution number one is it satisfies the main constraint of having a greater than 8 feet read range. With incorporating a full computer interface, the solution allows for much more direct manipulation of the database information, along with having the capability of running more elaborate

software. Since this solution utilizes a mobile cart, it lends itself less ease to use than the mobile reader solution. Although, even though the cart is more bulky than the mobile cart, a laptop computer interface is placed at an ergonomic height for the natural standing position, allowing easy use of the computer while taking inventory

The problem with this solution was that the read consistency was lacking. Tags were consistently picked up at lower heights, but if an animal were to jump on the caged door of the dog kennel, the animal identification tag would not be able to be read. In the cat area, the mobile cart solution was not able to detect tags in the cat kennel boxes mounted at higher heights. This poses a serious problem because the RFID reader solution will have to be used for taking inventory in both the dog and cat area.

#### Solution Number 3:

The final solution combined the leanings of the past solutions to create one that meets all the requirements of the project. Because the previous solution had problems detecting the identification tags at higher heights, this solution uses the same reader set up with the improvement of adding a handheld antenna, which largely increases the versatility of the cart. The handheld antenna can be used to pick up the tags at higher heights by pointing the antenna at the given area. This will solve the predicament of picking up the identification tags of dogs that jump up on the cage, and the cats staying in the higher cat kennel boxes. This new handheld antenna also serves as a catch all for identification tags that are not being picked up. If the staff observes a tag failing to be picked up, they can use the handheld antenna to aim the antenna at whatever tag that is not being detected to give more direct signal projection.

This solution allows all the animal identification tags to be detected, which solves the constraint of picking up all the ID tags within 8 ft. It also allows great versatility of the mobile reader cart. Without the handheld antenna improvement; the previous reader cart set up was unable to provide the detection capability necessary to have a reliable RFID system. The physical ergonomics and ease of use remain the same as solution number 2 because it utilizes the same mobile reader cart design. The read range and read consistency are improved over the previous solution from the addition of the handheld antenna, this solution's biggest benefit.

#### Software

A prototype software interface was designed for the inventory system using Microsoft Access. This software manages the commands sent to the reader and organizes the data associated with each tag ID. Microsoft Access was able to manage the reader by using commands embedded in a reference library. The reference library converts coding that normally needs to be coded in Java, and converts it to a set of commands executable by VBA coding language. Without this reference library that links the two coding languages, the database interface created in Microsoft Access would not work.

#### Tags

One of the best things about using this RFID system is that the identification tags are reusable. As earlier explained in this paper, each animal is identified by the identification number embedded in the RF tag. While the animal stays at the shelter it keeps its identification number, but after the animal has left the shelter that tag, and its identification number can be reassigned. When an animal leaves the shelter its identification number has no use, so if that same identification number is reassigned to a

new animal coming in, the tag can be reused. The shelter can take the tag that was issued to the pet that is no longer staying at the shelter, and reissue the tag and the identification number to a new animal. This would reduce ongoing costs by not having to buy new RF tags for each new animal.

#### Benefit

By implementing this RFID inventory system the animal shelter would be drastically reducing the time needed to inventory the animals, and update records. In the animal shelter's existing process they rarely get around to taking inventory of the animals because of how time consuming it is, 45 minutes to an hour per inventory update. If this system is implemented, it has been tested to take roughly half the time, 25 minutes. When the shelter updates the animal inventory records, it takes up to two hours a day. Part of the reason for the long length of this task is because the animals are moved around quite frequently, sometimes more than 3 times a day. With the reduced inventory time of the proposed system, it allows the shelter to take inventory more often. Rather than updating each animal individually, all the animals can be updated in one inventory check. This not only reduces the time needed to update records, but it also reduces the possible errors in the records system by inventorying more frequently.

#### Conclusion

During the course of this project, several solutions to implement the RFID system have tested and analyzed. These solutions were examined not only to compare their read range and read consistency, but also their ease of use and physical ergonomics. After piloting this RFID system and comparing it to the animal shelter's (Woods Humane Society) existing inventory system, it is evident the proposed system will serve as a useful cost

saving tool for the facility. The system shows evidence of reducing the time to take inventory, update, and maintain quality records. Although the initial investment to purchase the RFID equipment is high, the RF tags are reusable so the system will have very little ongoing cost to the facility.

# **Future Work**

Although this project has shown great success, the RFID system can still be improved further. The following is a list of potential opportunities to improve this inventorying process:

- The Woods Humane Society, along with many other animal care organizations, already has a records database software made by Chameleon Inc. If the hardware of this system was integrated onto the existing database software it would simplify the integration of the RFID inventorying system.
- The limited budget for this project only allowed for a system to have a low amount of sensitivity showing the location of the animals. If more money could be invested into this project, additional hardware could be incorporated so a more precise location could be determined.
- The mobile RFID reader cart used to take inventory is merely a prototype. The casing, antenna mounting, and battery are just a few areas to improve the reader cart.

# Appendix.

Evaluation		
Solution Number: Description:	1	scale = 1 to 5
Motorolla's mobile hand	dheld reader	
Physical Ergonomics: Ease of Use: Read Range (Accept/Reject): Read Consistency: Time of Inventory:	5 4 Reject 20/20 NA	
Notes:		

Mobile reader was not able to pick up identification tags from outside of the individual animal cells. Time to inventory was not taken because reader was not capable of conducting inventory

# **Evaluation Form**

Solution Number:

2

scale = 1 to 5

Description:

Ease of Use: Read Range (Accept/Reject):

Alien Reader with two Alien Antennas mounted on mobile reader cart, connected to laptop computer interface

Physical Ergonomics:

Read Consistency:

Time of Inventory:



Notes:

Reader cart was able to achieve necessary read range, but does not detect higher than 2.5 ft off the ground. Reader cart is more bulky to take around, but keyboard is still at ergonomic standing height. No tags detected in cat area other than lowest cat kennel boxes.

# **Evaluation Form**

Solution Number:

3

scale = 1 to 5

Description:

Alien Reader with two Alien Antennas, one mounted on

4

mobile reader cart, the other is a handheld antenna; connected to laptop computer interface

Physical Ergonomics:

Ease of Use: **Read Range** 

(Accept/Reject):

Read Consistency:

Time of Inventory:

5
Accept
20/20
25 min

Notes:

Reader cart was able to achieve necessary read range, using handheld antenna it was possible to detect all tags in both dog and cat areas. Reader cart is more bulky to take around, but still at ergonomic standing height.

# Alien 915 MHz Circular Antenna (ALR-9611-CR)



ALR-9611 Circular Polarized

The **ALR-9611-CR circularly-polarized antenna** uses circular polarization to distribute the UHF energy uniformly in a radially symmetrical pattern, providing the ability to read RFID tas regardless of orientation.

#### **PRODUCT FEATURES:**

FREQUENCY RANGE:	890 - 930 MHz
POLARIZATION:	circular
GAIN:	6dBi max
BEAM WIDTH (3DB):	40 degrees nominal
CROSS POLARIZATION REJECTION:	20 dB, min
INPUT IMPEDANCE:	50 Ohm nominal
RETURN LOSS:	-15 dB across frequency range
CABLE:	LMR-195, 50 ohm coaxial, reverse polarity TNC connector
SIZE:	11.18" x 7.68" x 1.7"
WEIGHT:	24 oz.
DC INPUT IMPEDANCE:	10k Ohm

#### About Alien

Alien Technology provides UHF Radio Frequency Identification (RFID) products and services to customers in retail, consumer goods, manufacturing, defense, transportation and logistics, pharmaceuticals and other industries. Organizations use Alien's RFID products and services to improve the effectiveness, efficiency and security of their supply chains, logistics and asset tracking operations. Alien's products include RFID tags, RFID readers and related training and professional services. Alien's patented Fluidic Self Assembly (FSA) technology and related proprietary manufacturing processes are designed to enable the manufacture of high volume, low cost RFID tags.

Alien was founded in 1994 and employees about 235 people worldwide. The company's facilities include: its corporate headquarters in Morgan Hill, CA; an RFID tag manufacturing facility in Fargo, ND; the Alien RFID Solutions Center, in the Dayton, Ohio area, and sales offices in the US, Europe and Asia. Alien is a member of EPCGlobal.

# ALR-9900 Enterprise RFID Reader Family

# High Performance, Easy to Deploy, Easy to Manage

The Alien ALR-9900 Enterprise Reader enables users to deploy manageable, robust, best-in-class EPC Gen 2 RFID solutions for supply chain, manufacturing and asset management applications. The result is highly reliable, automatic data capture.



# **Interoperable and Broadly Supported**

Alien pioneered the network-ready EPC RFID reader with the widely-supported Alien Reader Protocol. The ALR-9900 is supported by key RFID platforms including Microsoft BizTalk RFID, IBM WebSphere 6.0, Oat Systems, Oracle, GlobeRanger, BEA and many others. Proven support for SAP through 3rd-party middleware is also available. A welldocumented SDK featuring .NET and Java libraries enables easy, custom interfaces to control the reader if desired.

# **Backward Compatible for Easy Integration**

The Alien Reader Protocol features Autonomous Mode, a programmable state machine that enables the reader to operate independently based on external I/O triggers, timing or software inputs. This flexible system leads to best-in-class read rates by enabling users to precisely control the parameters for timing, protocols, antenna usage and other critical variables without network latency.

The ALR-9900 is backward compatible and interchangeable with previous Alien readers such as the popular ALR-9800 and ALR-9780, ensuring easy transition.

# **Monostatic Simplicity**

The ALR-9900 provides the added simplicity of a monostatic antenna topology, which provides a smaller footprint and easier integration for certain applications such as small item tagging. Only one antenna per read point is required, reducing system cost and complexity. A proprietary, active, noise cancellation mechanism ensures high read rates from the monostatic antenna system.

# Power and LAN Failsafe Mechanisms Protect Data

The loss of power or LAN connectivity does not lead to the loss of critical tag data. The ALR-9900 caches tag lists in non-volatile memory, preserving data even in the event of a

power loss. When operating in Autonomous Mode, the reader will continue to collect tag data even if the LAN connection is interrupted.

# **Interference Management**

The ALR-9900 offers several methods for interference mitigation that provide a powerful solution to the challenge of noisy environments.

### Good Citizen: EPC Gen 2 Dense Reader Mode

The ALR-9900 is compliant with the EPC Gen 2 Dense Interrogator specification, which reduces interference impact on other readers.

#### Strong Filtering for Interference Rejection

The powerful, dynamically adjustable signal processing architecture of the ALR-9900 ensures strong interference rejection in the presence of other readers or devices.

#### Event-triggered operation and Autonomous Mode

The Autonomous Mode functionality of the Alien Reader Protocol enables the reader to collect tag data when triggered by external events detected by electric eyes and other sensors. In this mode, readers are activated only when needed, thereby reducing the ambient signal level.

# High Performance, Easy to Deploy, Easy to Manage

The Alien ALR-9900 Enterprise RFID Reader enables users to deploy manageable, robust, best-in-class RFID thanks to:

- A flexible API with broad software support
- A high performance radio
- Data protection
- Robust dense reader interference management



# MC9090-G RFID Handheld Mobile Computer

Motorola's MC9090-G RFID handheld reader gives your workers the ability to capture a comprehensive range of data — from RFID tags and bar codes to images — with this flexible multi-function RFID handheld reader, which reads data in remote areas where fixed RFID readers can't reach.

Single device simplicity translates into simpler and cost-effective mobility architecture with fewer devices to purchase, support, and manage. And whether your workers are on the manufacturing floor, in the warehouse, on the loading dock or out in the yard, the rugged design ensures reliable performance.

# Superior application flexibility

Multi-modal single device supports 1D, 1D ER (extended range, US only) and 2D bar code scanning, RFID and imaging.

# Supports EPC Gen 2 and Dense Reader Mode (DRM)

Allows easy integration of RFID as part of your supply chain processes.

# **Exceptionally rugged construction**

Gives you the flexibility to work in nearly any environment and dramatically reduces repair and downtime costs. This device passes the industry's most stringent drop and tumble tests, has an IP64 sealing rating and integrated internal antennas.

# Flexibility to support global deployment needs

Multiple configurations available that support standards around the world.

# Superior wireless connectivity

Enable real-time data communications with Integrated 802.11 a/b/g.

# Maximize software development investment

Windows Mobile 5.0 provides an advanced mobile operating system for robust application support (Windows or application specific).

# Persistent storage and multimedia application support

Ensure retention of mission-critical data with Intel XScale PXA270 processor and 624 MHz enhanced memory architecture.

# Wirelessly synchronize, print, and connect to a headset

WPAN: Bluetooth v1.2 radio with BT Explorer (Manager included).

# Easy to read in a variety of lighting conditions

Large QVGA display: exceptional clarity and contrast.

# Forward scanning, pistol grip ergonomics

Reduces user fatigue in bar code scanning and RFID tag reading intensive applications.

# Integrated directional antenna (70 degree forward-looking)

Enables isolation of desired tags.

# Familiar tools

API (Application Programming Interface) for Microsoft® Windows® CE.NET 4.2 and Windows Mobile 5.0 simplify and reduce the time required to develop RFID-enabled applications.

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