

**Designing an Automatic Fetch Machine**

**The Automatic Dog Ball Launcher and the Purpose of Unsuccessful Engineering Work**

A Thesis Prospectus

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By

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On my honor as a university student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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## Introduction

The evolution of the relationship between dogs and humans is frequently argued as many believe that humans domesticated wolves, while others think that humans had been taking care of wolves since they were puppies (NPR, 2011, para. 2). However, with 43,346,000 dogs owned in the US in 2012 (AVMA, 2021, Companion Animals), there is no denying their cultural importance and their ever-increasing presence. Now that the country is returning back to normal since the COVID-19 pandemic, dogs will be without their owners for extended periods of time as they have to go into the office for long days at work. According to the Care Center, about 20-40% of dogs struggle with separation anxiety, meaning that there are millions of owners struggling to help their dog with a mental health condition (Care Center Veterinarians, 2020, What is Separation Anxiety in Dogs). Moreover, there are still millions more dogs that experience time alone that may not be diagnosed with separation anxiety. This is due to the fact that the only true way to diagnose a case is visual cues: exhibiting persistent barking, destructive tendencies, urination and more (CVMBS News, 2021, para. 3), which typically occurs in more serious cases as not all examples lead to destructive behaviors.

In order to tackle the issue of mental health in dogs and the increased amount of alone time that they will now be dealing with, the technical project that is discussed throughout this prospectus intends to deliver an automated dog ball launcher. The launcher will be able to be scheduled by the owner prior to leaving their house via Bluetooth connection so that the mechanism will turn on for a given specific time interval throughout the day; this will allow their dog to play fetch and have some form of entertainment while they are gone. The work done on the STS side will be analyzing sources of separation anxiety in dogs and whether or not creating an automatic dog ball launcher will be able to alleviate this serious mental health issue. This

research is extremely valuable as discovering whether or not automating a process like fetch will alleviate these struggles that the dogs have, which will benefit millions of dog owners throughout the world as they will not have to deal with the destructive behavior that separation anxiety can cause.

### **Designing an Automatic Fetch Machine**

Fetch has long been an activity that both the owner and the dog have enjoyed together, and there are numerous benefits to playing fetch for the dog. Primarily, fetch gives the dog needed exercise, allows the dog to use instincts that they have and helps the owner build a bond with their pet (Tall Tails Team, 2021, 5 Key Benefits to Fetch Play with your Dog). Moreover, dogs hold a high cultural importance in society: “Of particular importance is the idea that pets have a beneficial impact on human health via social buffering” (Herzog, 2021, page 3), and they are extremely important to their owners. Dogs provide humans with a relationship that is important to millions of individuals and fetch is one of the primary ways of expressing care for the dog in return. With owners returning back to work, there will be less time for them to engage and interact with their dogs as there was before. Automating the fetch process and creating a mechanism will provide the dog with the ability to mentally engage themselves while their owner is off at work, which will be invaluable to both the dog’s mental and physical health.

There are multiple preexisting products on the market that aim to accomplish the same goal that our dog ball launcher will strive to achieve. A few examples of this are the iFetch Automatic Dog Ball Launcher (referenced in Figure One), which can fire at multiple distances, and the PetSafe Launcher, which has a motion sensor in front of the mechanism to restrict it from firing when the dog is in front of the machine (Hank, 2020, Best Automatic Ball Launchers for Dogs).

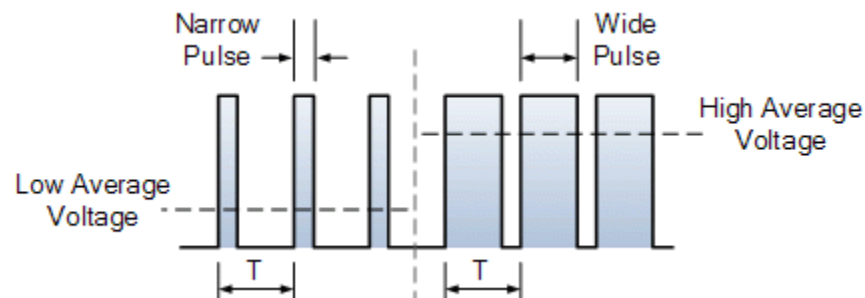


**Figure One: iFetch Launching Mechanism (iFetch, 2021)**

This image shows the iFetch launching mechanism that is currently available for purchase on the market. While these products are well-established and have defining features, they differ from the launcher that we will be designing due to their lack of a mobile application and the ability to rotate the mechanism using a servo motor. However, there has been substantial work done on creating technical designs that strive to satisfy this problem for dogs. While they may not be complete solutions, their main features were looked at by our group to ensure that our product will be different in numerous ways to set it apart from pre-existing items on the market. Two examples of this are the PetSafe launcher and how it has a motion detection system to prevent it from firing when the dog is in front of the launcher (PetSafe, 2021), and the iFetch machine which can fire at different distances (iFetch, 2021).

Overall, our group intends to create an automatic dog ball launcher that will have a mobile application which will be used to schedule the time of operation, the distance the ball fires and the rotation angle of the mechanism as a whole. The dog will be able to fetch the ball and return to the device to place the ball in a funnel at the top; the ball will then be launched

again on repeat as long as the device is scheduled to run. This device will use a web application and Bluetooth 5 external module to connect to our MSP432 microcontroller, which will decode the data that is input by the user to assign specific values to the motors and servos. The motors will be programmed using pulse width modulation signals (referenced in Figure Two), which are signals that pulse the voltage at a rate to create an effective voltage that will run the motor at a specific speed, while the servo will have to be programmed by changing the frequency of the voltage pulses.



**Figure Two: Pulse Width Modulation Signal (Basic Electronics Tutorials, 2020)**

This illustrates a pulse width modulation signal that will create an effective voltage over time that can be used to control motors, servos and other mechanisms.

With the completion of this system, our group believes that dogs will have a way to play fetch without their owners that will be set on a scheduled time period to save power, hopefully alleviating the mental health issues that they may be dealing with and provide them with a source of entertainment. Finally, there were multiple issues that occurred throughout the production of the device with the main one being that the parts we had selected were not nearly strong enough to complete the job of launching the ball. With no real way to test until they came, we had to quickly make decisions to order new ones and redesign the system. Moreover, it was very difficult to get the Bluetooth connection work on the mobile application which took a large amount of our time.

## **The Origins of Separation Anxiety and the Emotional Connection of Dogs to Humans**

According to the University of Michigan, about 10% of US adults adopted a new pet in the year 2020 (AAHA, 2021, para. 2). These pets have spent an unprecedented amount of time with their owners due to the pandemic as individuals were forced to work from home, and this could cause a large rise in separation anxiety in dogs across the United States as the owners are now beginning to return to work and the dogs have never experienced this much time alone (AAHA, 2021, para. 2). Separation anxiety is a mental health issue that is usually caused by sudden schedule changes by the guardian, extended periods of time alone or lack of attention/exercise (ASPCA, 2021, para. 1). Symptoms of separation anxiety include destructive behavior such as urination, barking, escaping, and chewing, and other mental health conditions like depression, anxiety, and nervousness (ASPCA, 2021, para. 4-7). As of now, one of the main ways to treat separation anxiety is counterconditioning. Counterconditioning entails associating an event, person, or item that the dog strongly dislikes with something that the dog loves, like treats or toys (ASPCA, 2021, para. 23). A great example would be to leave a puzzle toy for the dog that has treats/snacks inside it that the dog has to solve for about 30 minutes when the owner leaves the house for work (ASPCA, 2021, para. 23). This leads into the main focus of the STS research paper which will revolve around the automatic fetch system and whether or not this will alleviate separation anxiety in dogs through counterconditioning as dogs that love fetch will see the owner leaving as a chance to play their favorite game with the new machine.

With separation anxiety and the typical treatment in mind, this STS paper will mainly focus on understanding the relationship between dogs and humans to try and gauge whether or not an automatic fetch machine would alleviate separation anxiety in dogs. According to Sargisson, “The bond formed between dogs and their human owners is consistent with an

attachment” (Sargisson, 2014, para. 2). Moreover, a 1965 study done by Scott and Fuller found that 10-week-old puppies were more likely to focus on the social relationship with a human being than to search out food (Parthasarathy, V., & Crowell-Davis, 2006, Attachment). This leads to the discussion of whether or not an automatic fetch robot would alleviate any mental health issue that the dog may be having, as there is virtually zero emotional connection between the dog and a robotic machine. The point made by the ASPCA alludes to the fact that counterconditioning should alleviate separation anxiety as the fetch machine would positively reinforce the owner leaving due to an activity being turned on that the dog loves to do (ASPCA 2021, para. 23). However, many studies have been done analyzing the extent of the dog’s attachment to the owner and whether or not that is one of the main causes of separation anxiety (Parthasarathy, V., & Crowell-Davis, 2006, Separation Anxiety and Attachment). This makes for an interesting discussion as typical treatment implies that the automated machine will benefit the separation anxiety that the dog is experiencing, but there is a valid argument in the fact that it may not be the act of “fetch” that makes the dog happy, and it is actually the interaction with the owner that helps the dog. This would mean that the fetch machine would not actually provide any help with the problem as the dog would receive little to no emotional benefit from the mechanism.

In examining such a topic, it will be extremely useful to look at both the origins of the relationship between dogs and humans to try and understand the foundation for the emotional attachment that dogs have, and the studies that have been completed to uncover the effects of emotional attachment on separation anxiety in dogs. Sargisson describes the emotional attachment that dogs have with their owners to resemble that of a human adult and a child, which emphasizes one of the main causes of the separation anxiety that a dog may feel (Sargisson,

2014, para. 2). Moreover, in a study done by Parthasarathy, V., & Crowell-Davis, found that the main cause for separation anxiety appears to be the dysfunctional attachment between a dog and the owner (Parthasarathy, V., & Crowell-Davis, 2006, Discussion). Due to the strong emotional attachment that dogs develop with their owners, having a very dysfunctional relationship will lead to separation anxiety. This study analyzed multiple dogs of different sex with and without separation anxiety and put them through a series of tests to determine whether it was an excess of attachment to the owner or a dysfunctional relationship/attachment with the owner. Utilizing studies like this one will prove extremely useful to determine whether or not automating fetch will alleviate separation anxiety in dogs when they are experiencing time alone.

### **Conclusion**

Separation anxiety in dogs is an ever-growing problem that was emphasized by the sudden schedule changes that COVID-19 caused. The technical portion of the thesis will create an automatic dog ball launcher with the goal of providing dogs with some form of entertainment for long days alone. The system will have an advanced scheduling application so that the owner can optimally schedule when the machine should be on or off and will be beneficial to dogs that love playing fetch. On the other hand, the STS paper will discuss separation anxiety as a whole and whether or not dogs will benefit from an automated fetch machine. These discussions will both provide dogs with a machine that will entertain them and delineate whether or not the machine achieves the primary goal it was made for, which will allow for a deeper understanding of separation anxiety and mental health in dogs to reduce separation anxiety and prevent harmful dog behavior.



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