IOWA STATE UNIVERSITY
SE/CprE/EE

Senior Design Presentation
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# Project Squirrel

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Client: Bob Thompson Advisor: Dr. Gary Tuttle

## Introduction

### Problem

- Our client Bob has a problem with squirrels chewing on his deck and destroying it.
- A barking dog and other loud noises is not enough to scare the squirrels
- Bob wants a new solution to scare the squirrels.

### Solution

- We will build a turret system that will launch ping pong balls at the squirrels

## Design Requirements

### Functional Requirements

The device should start tracking and targeting squirrels as soon as it is powered on. The product should launch a projectile that will scare squirrels off the deck without damaging the house. The device should be able to attach to the deck without damaging it.

### Non-functional Requirements

The device should be low in cost, and be produced within the budget provided for the course. The device should be autonomous and require minimal manual intervention. The device should be simple enough that it can be reproduced and scaled to multiple devices that cover an entire deck. The product should operate for long periods of time without maintenance

### Operating Environment

The design was made to be built on an outdoor porch. It should be resistant to snow, wind, rain, and small animals.

## Intended Users and Uses

- Anyone who has squirrel problems
- Could also be easily re-trained to target other pests besides squirrels such as rabbits

## Design Approach

Concept Sketches

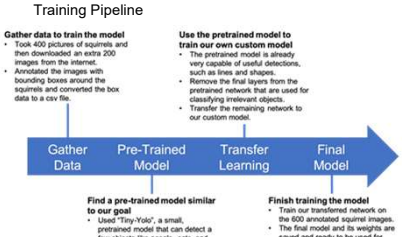
Four-bar launching mechanism

Targeting mechanism

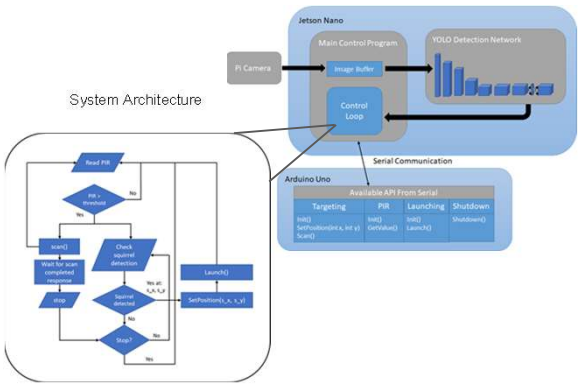
Targeting Assembly

### Block Diagram

Training Pipeline

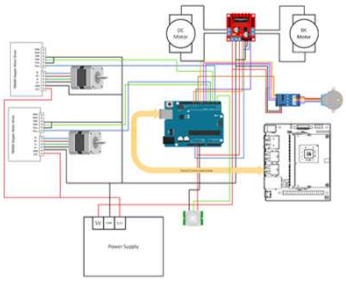



System Architecture




## Technical Details

### Schematic



### Software Libraries

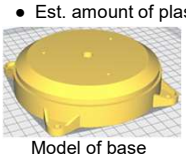
- Jetson SDK
- RPIO
- Python Programing
- Tensorflow
- Arduino IDE

### CAD Modeling

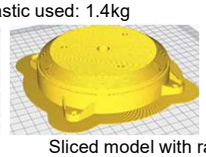
- Autodesk Inventor
- Gimbal design by Fhuable from Thingiverse
- Fritzing (schematic drawing tool)
- Cura

### 3D Printing

- # of parts: 27
- Total print time of successful prints: 167 hours
- Average print time of only successful prints: 6.3 hours
- Est. amount of plastic used: 1.4kg



Model of base Part

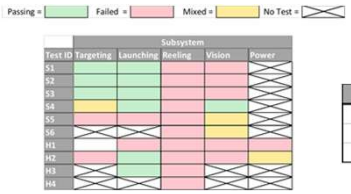


Sliced model with raft (25 hr print time)

Printed

## Testing

### Functional Testing Results




| Testing Breakdown | | | | |
|---|---|---|---|---|
| Unit | Acceptance | Integration | Systems | Total Tests |
| 20 | 8 | 8 | 4 | 40 |
| 50% | 20% | 20% | 10% | 100% |

### Testing Environment

- Code for Targeting and Launching System was tested in an indoor environment
- Tested on target arduino with motors attached.

### Testing Strategy

- We used primarily unit testing to test our components
- Once integration is completed we will use integration, acceptance, and systems test to verify performance

## Project Resources

| Part | Quantity | Cost |
|---|---|---|
| Jetson | 1 | $99 |
| StepD-01 | 1 | $14.95 |
| Pi Camera | 1 | $29.33 |
| Nano Power Supply | 1 | $7.50 |
| SSD 64 GB | 1 | $14.99 |
| Nema 17 Steppers | 2 | $27.98 |
| DC Motors | 2 | $13.78 |
| L298N H-Brige | 1 | $5.99 |
| TB6600 Driver | 2 | $23.98 |
| 6 ' Power Cord | 1 | $6.16 |
| 3D-printing plastic | 2 | $40 |
| Casing | 1 | $15 |
| Power Supply | 1 | $20.77 |
| Wirering | 1 | $20 |
| Arduino | 1 | $15 |
| Total | | $354 |

### Citations

J. Redmon, S. Divvala, R. Girshick and A. Farhadi, "You Only Look Once: Unified, Real-Time Object Detection," 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Las Vegas, NV, 2016, pp. 779-788, doi: 10.1109/CVPR.2016.91.