

EE/CprE/SE 491 WEEKLY REPORT 01

Start Date – End Date

Group number: sddec26-03

Project title: Squirrely Bird Feeders - Using AI to outsmart the Squirrels

Client &/Advisor: Randall Geiger

Team Members:

- Wyatt Sinclair
- Jack Morrison
- Miles Nichols
- Kenny Tran
- Benjamin Bartels
- Nolan Hoenert

- **Weekly Summary:** Our overall objective this week was to meet with our advisor and better understand his view on the project. The group was able to better understand how to start and the potential complications that could stem from our decisions. We started researching ways to deter squirrels that are both human- and environmentally-safe. Additionally, we looked at bird feeders that would be a good option for our implementation.
- **Past week accomplishments**
 - Jack Morrison: Began creating a [spreadsheet](#) that lays out many potential hardware products that we can use to implement parts of the project. It is intended to be useful once we begin working on the actual design. Especially for cost-benefit analysis.
 - Wyatt Sinclair: Researched how to implement an electronic mechanical gate. Looked into ai detecting systems and motion detection systems
 - Nolan Hoenert: Researched the different types of bird feeders such as the tube feeders, house feeders, tray feeders, suet feeders, and window feeders.
 - Benjamin Bartels: Researched ways to deter squirrels and different bird feeder gate designs.
 - Kenny Tran: Researched computer vision for squirrels
 - Miles Nichols: Researched how to deter squirrels from the bird feeders
- **Pending issues:**

Wyatt Sinclair: N/A

Jack Morrison: N/A

Nolan Hoenert: N/A

Miles Nichols: N/A

Kenny Tran: N/A

Benjamin Bartels: N/A

○ **Individual contributions:**

<u>NAME</u>	<u>Individual Contributions</u> <i>(Quick list of contributions. This should be short.)</i>	<u>Hours this week</u>	<u>HOURS cumulative</u>
Jack Morrison	Researched potential hardware components	6	6
Miles Nichols	Researched actions after identifying squirrels	6	6
Wyatt Sinclair	Researched different birdfeeder layouts and mechanical gates.	6	6
Nolan Hoenert	Researched different bird feeder styles	6	6
Kenny Tran	Research possibilities for training our own computer vision model	6	6
Ben Bartels	Researched different ways to deter squirrels	6	6

○ **Comments and extended discussion**

I've been looking into how we should handle deterrence once our computer vision program identifies a squirrel at the bird feeder. We have a few different options for the hardware integration, each with its own trade-offs.

Water Deterrents: Using a water-based deterrent is highly effective and completely harmless. Our program would trigger a GPIO pin connected to a solenoid valve or a small pump to give the squirrel a quick spritz of water. While it's very reliable, the implementation is quite complex. We'd have to deal with fluid dynamics, plumbing, a water reservoir, and the risk of leaks or freezing, which might be out of scope if we want to stay highly focused on the software side.

Audio Deterrents. If we want to stick strictly to electronics with no moving parts, audio is a great low-complexity hardware option. We'd trigger a speaker to emit ultrasonic noises or predator sounds. The challenge here shifts to the software side, which aligns with our strengths in algorithm design. Squirrels are smart and will habituate to the noise, so we'd need to write an algorithm that randomizes the sounds, volumes, and intervals to keep the system unpredictable.

Mechanical Deterrents A mechanical approach involves directly breaking the squirrel's grip or blocking access. We could use a DC motor to gently spin the feeder, or an actuator to drop a protective baffle over the food. This creates a highly reliable physical barrier. The implementation complexity is medium; it requires some mechanical engineering to modify the feeder and mount

the motors, alongside our software for precise motor control.

Visual Deterrents: Visual startles, such as triggering high-intensity strobe LEDs or using a servo to pop up a brightly colored flag, represent another low-complexity hardware option. This would just require basic GPIO triggers from our program and has a low power draw. The main drawback is that visual cues alone might not deter the bravest squirrels, and flashing lights might annoy the neighbors, depending on where the feeder is located.

Managing the Software State: Regardless of the Hardware Route We Choose, Our Core Software Logic Will Need to Carefully Handle State Management. We'll need to design a state machine that includes a strict cooldown period. For example, after triggering the actuator, the program should ignore any positive squirrel identifications for the next 30 to 60 seconds. This prevents infinite loops that could burn out a motor or empty a water reservoir while the squirrel is just trying to run away.

-Miles Nichols

Squirrel Recognition - Finding a model that can identify squirrels is easy with generic computer vision, but a bird feeder with a camera inside the feeder itself will provide a unique angle on the squirrel (close-up of the face or underbelly) that might be difficult for an off-the-shelf model to recognize. The availability of images at this angle is also sparse. Maybe a view of an entire squirrel can generalize to a close-up? Hard to test. We could design our camera system with this in mind to mitigate the issue.

Object Detection: A related issue to squirrel recognition is the general detection of objects. A system constantly running active computer vision may consume significant power. If we find that we need to limit power consumption, we might need a method of detecting objects during a low-power state. The n transitioning into the true recognition method. This is a potential concern that we might encounter during design or implementation.

- **Plans for the upcoming week** *(Please describe duties for the upcoming week for each member. What is(are) the task(s)? Who will contribute to it? Be as concise as possible.)*
- Wyatt Sinclair: Finalize top options for styles of birdfeeders and what idea we will be using to deter. Talk to the advisor about his opinions/feedback on our decisions. Present options for AI detection system.
 - Jack Morrison: Continue research on hardware products, focusing on potential deterrent hardware as well as additional controllers, cameras, and connections.
 - Miles Nichols: Continue researching how to deter squirrels and a look into how squirrels react via videos online.
 - Nolan Hoenert: Continue researching bird feeders, and discuss with the group and advisor on their vision for the bird feeder and discuss what options are out there.
 - Kenny Tran: Organize training data and available computer vision models into a spreadsheet similar to Jack Morrison's for future use. Write out paper sets for different approaches for our computer vision system.
 - Benjamin Bartels: Discussing with the group about different mechanical bird feeder gate

designs and how we want to go about deterring the squirrels from getting to the bird feed.

- **Summary of weekly advisor meeting**: Some members met in person and virtually. Started the meeting by understanding our advisor's vision and talked back and forth on solutions for how to deter the squirrels. Talked about different mechanisms, such as a gate, low-frequency sounds, and a deterrent spray. Got a better understanding of who would buy our product. We talked about additional features, such as taking pictures of birds, using motion-detection sensors to display a live portrait of the bird, and an app to view the birds. Then we followed up by asking questions we had prepared that we were still confused about. This helped us build a better understanding of how to start and work towards building a prototype for the end of the semester.