Anti-Squirrel Birdwatch Feeder

Team 7

Annika Boyd
Sal Esmaeil
Mitch Montee
Nate Sjullie
Nitin Suryadevara

October 24th, 2024

Executive Summary

Our product is a bird-watch feeder that aims to feed native birds, while attempting to keep squirrels and other non-avian critters out of the bird seed. On top of acting as a bird feeder, this product will provide the customer up close and personal images of the hungry birds and other critters trying to break into their birdseed. Our product will work by leaving the birdfeed open and available to birds until a heavier critter, most likely a squirrel, comes along and triggers the weight sensor. This then causes the access to the birdfeed to close and likely spook the squirrel away. The birdseed access will then reopen after a short period of time, until another critter triggers the weight sensor again. Additionally, a motion sensor will also be triggered by the natural movement of the bird, and a series of pictures will be captured and stored. Users should simply be able to fill and place this feeder wherever they would like, turn it on, and begin collecting their digital catalog of the birds native to their locale.

Market Analysis

The target customer and users of our product are bird-watching enthusiasts, as well as wildlife lovers, researchers, and conservationists. In regards to market competition, there are currently companies that sell bird feeders that feature imaging capabilities, but there does not appear to be any one company that sells a bird feeder with our proposed method of protecting the bird food. Pricing for similar products seems to vary between $50 and $240, subject to additional features and services included with your purchase. To be competitive within the market, we're aiming for a sub-$100 unit off-the-shelf with a 10-20% profit margin, meaning we need to ensure we get the manufacturing cost within $80-90.

Product Requirements

Must:

- This product must feature some method in differentiating between birds and small rodents
- Provide a way to view the animals that visit.
- Must not lethally harm the birds or the squirrels.

Should:

- Provide the customer/user with some type of alert that there is a bird, images taken, memory full, etc.
- Attempt to prevent non-birds from consuming or taking the majority of the birdfeed

May:

- Product may feature some level of solar charging support; the power consumption of all of the system components is likely to be greater than the power generation from a relatively small solar panel, so implementing this would likely just extend the battery life of the product.
- Add weather station capabilities (temp, humidity, light, etc).

System Architecture

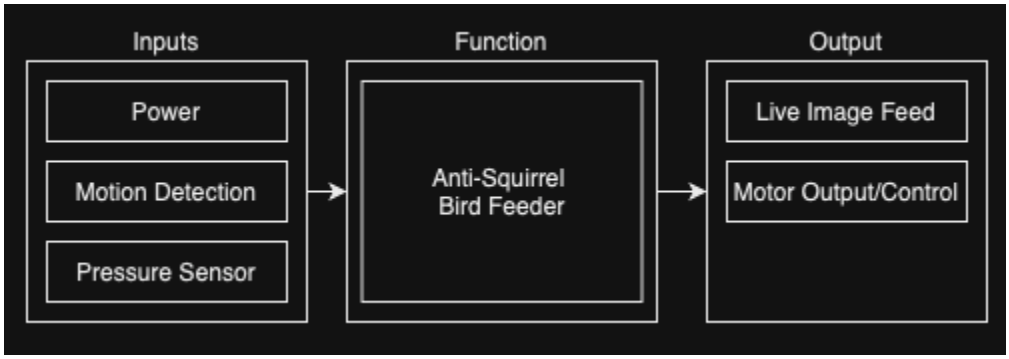

Figure 1: Level 0 Functional Decomposition

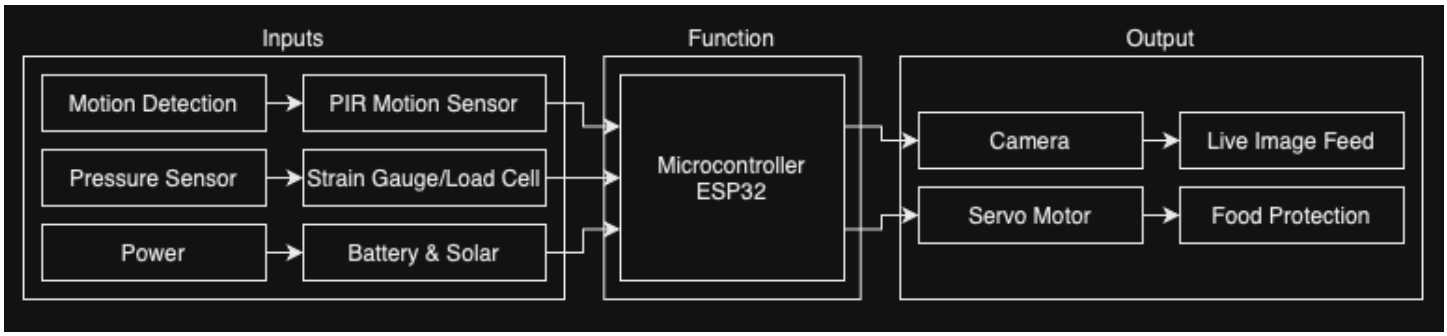

Figure 2: Level 1 Functional Decomposition

Design Specification

Sensors:

- Load Cell: Used to detect the weight of the animal on the bird feeder platform. It differentiates between birds (light) and squirrels (heavier).
- PIR (Passive Infrared) Sensor: Detects motion around the bird feeder to sense the presence of animals.

Processor:

- ESP32 Microcontroller: Controls the sensors and actuator, processes the sensor data, and makes decisions based on the input. It also handles Wi-Fi for remote monitoring or data collection, if needed.

Actuator:

- Servo Motor: Controls the opening and closing of the bird feeder access door. If a squirrel or another heavier animal is detected, the servo closes the door to prevent access.

Power:

- Battery Pack: A 5V rechargeable battery pack powers the ESP32, sensors, and servo motor.
- Possibly Solar Panel: A small solar panel could be added to recharge the battery or to use in place of the battery.

Mechanical Design:

- Feeder Platform: The load cell is mounted under the platform where the animals land.
- Feeder Door: A hinged door controlled by the servo motor, which opens or closes based on sensor input.
- Enclosure: Weatherproof housing for the electronics (ESP32, sensors, etc.).

Firmware:

- Sensor Reading and Processing: Code to read weight data from the load cell and motion data from the PIR sensor.
- Decision Logic: Compares the weight data to a predefined threshold (e.g., bird vs. squirrel weight) and triggers the servo motor to close the door when necessary.
- Camera Trigger: Triggers a couple pictures taken using the camera module when motion is detected.
- Possibly Power Management: Code to manage power consumption, possibly using sleep modes on the ESP32 to save battery.

Microcontroller:

- ESP32: Chosen for its integrated Wi-Fi, low power consumption, and support for multiple inputs/outputs, making it suitable for both controlling sensors and actuators.

Development Environment:

- Arduino IDE: Used for programming the ESP32 and developing the firmware.
- Libraries: Load cell library for weight measurement, servo library for motor control, and possibly the PIR sensor library.
- Version Control: Using GitHub for version control and collaboration on firmware development.