

Project : Smart Bird Feeder

Principles and Applications of Electrical Engineering
ES 116

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Abstract—This document serves as a report to describe the project for the course “ES 116 : Principles and Applications of Electrical Engineering”.

I. AIM

To implement a smart bird feeder having self defensive intruder detection and refill alert system

II. THEORY

In order to make a smart bird feeder, the following shows the major components that were used in the project along with their functionality.

- **Arduino Uno** - Arduino Uno is a small computer board that specifically has a microcontroller to support processing of analog and digital signals.
- **Ultrasonic Sensor** - An ultrasonic sensor is a device that uses sound waves to detect the distance between itself and an object. It emits high-frequency sound waves that bounce off objects and return to the sensor. By measuring the time it takes for the sound waves to return, the sensor can determine how far away the object is.
- **Servo motor** - A servo motor is a special kind of motor that can move to a specific angle.
- **Piezoelectric Buzzer** - A piezoelectric buzzer is a type of buzzer that makes sound by using a special crystal. When an electric current is passed through the crystal, it vibrates and creates sound waves.

A bird feeder is a device used to feed birds. Often times bird feeders are attacked by animals like squirrels, rats, etc. which steal the bird food and cause various diseases in birds. Along with this, there is a problem that the user is not able to check the amount of grain left in the feeder, which leads to improper refilling of the bird feeder. To tackle these problem we have implemented an electrical system that would help in

- Component 1 : Self defensive animal detection
- Component 2 : Food grain indication (Refill Alert)

The detailed working principles of component 1 and 2 are detailed below :

A. Self defensive animal detection

Intruding animals approach the the grains in bird feeder container from the top surface (shade). The intrusion of any animal over the shade can be detected by a simple idea that distance between a rod like structure attached vertically at the center of the shade and the surrounding space of the rod can signify if there is any object on the shade. All the times when there is nothing over the shade there won't be any obstruction thus distance (between rod attached and nearest object) would be very large. But as any animal lands on the shade this distance reduces to a much lower value. Setting a minimum threshold for this distance can help in detection of presence of any animal over the shade. The distance can be measured by Then, a servo motor, having long blades, can be attached over the shade controlled by arduino. Whenever the animal would intrudes over the shade, the distance measured by ultrasonic sensor would cross threshold which will lead to arduino activating the rotation servo motor. This will blow away the intruder keeping grains safe. This can be summarized as in Fig. 1

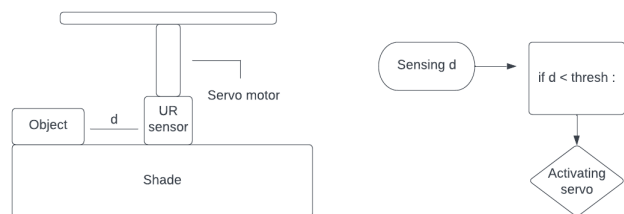


Fig. 1. Defense against intruder

B. Refill Alert

By measuring the distance between the top surface of the grains in bird feeder's container and the top surface of the container, the amount of grains left in the feeder can be easily calculated. The increase in distance would signify decrease in quantity of food grains left in the feeder. As this distance would cross a certain threshold (height of the container), an audio alert needs to be made for user to refill the feeder again. The ultrasonic sensor can be installed on the

top of the container which constantly measures the distance between the top surface of the container and surface of grains. Whenever this distance measured by sensor goes greater than the threshold value, the arduino activates the buzzer (installed on bird feeder) thus alerting the user that it needs to be refilled again. Fig. 2 represents it more visually.

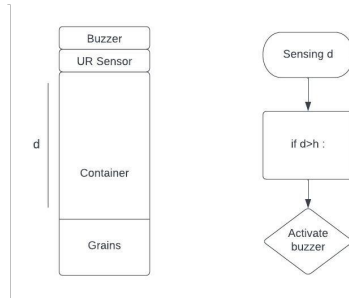


Fig. 2. Refill alert

III. INSTRUMENTS REQUIRED

The instruments required are:

- 1) Arduino Uno
- 2) Ultrasonic sensors
- 3) Servo motor
- 4) Piezoelectric Buzzer
- 5) Additional material : Jumper wires, breadboard

IV. PROCEDURE

The procedure can be divided into two subsections : 1) sensing part and 2) action part

A. Sensing

We are using two ultrasonic sensors for sensing the presence of animal over shade and amount of grain left in the feeder.

- 1) Select four arduino digital pins for echo and trig pins of the two ultrasonic sensors
- 2) Open the arduino ide and create a new sketch. Initiate the pins selected in previous step
- 3) Generate, pulse by setting trig pin of the ultrasonic sensors
- 4) Create variable for measuring the duration a echo returns back to the ultrasonic sensor
- 5) Normalize the same variable into distance according to specifications of ultrasonic sensor used
- 6) Print the values in serial monitor
- 7) Connect the sensors to arduino according the earlier pin selection
- 8) Install the code file written in arduino ide to the arduino

Circuit diagram for sensors used can be shown as in fig. 3

B. Action

There are two actions based on output of the ultrasonic sensors first, rotation of servo motor and second, activation of buzzer.

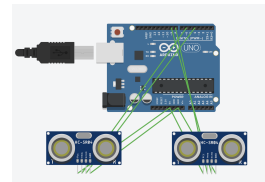


Fig. 3. Circuit diagram 1

- Select arduino digital pins for piezoelectric buzzer and servo motor
- Open arduino ide
- Create If conditionals in the existing main void loops.
- Write the conditions of threshold for both the sensors in the conditionals
- Implement activation of the acting componentd (motor and buzzer) in these conditionals
- Wire the servo motor and buzzer to arduino according to earlier pins selection.
- Install the code file to the arduino.

Fig. 4 represents the circuit diagram for this.

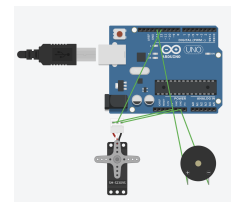


Fig. 4. Circuit diagram 2

V. RESULTS

The following results were achieved :

- The self defensive mechanism was implemented using servo motors, arduino uno and ultrasonic sensors was successfully implemented which could efficiently detect intruding animals over the bird feeder to keep them away and protect bird food.
- A refill alert system was successfully installed in the bird feeder. It alerts the user for refilling the bird feeder when it gets empty.
- The project results in a very user-friendly bird feeder to feed birds more efficiently and easily.

VI. DISCUSSION

Arduino Uno has varied applications in various domains of electrical engineering. The use of ultrasonic sensors and varied other sensors with arduino amplifies its strengths. Our project successfully used arduino uno, ultrasonic sensors, servo motors and piezoelectric buzzer to implement a smart and user-friendly bird feeder which smoothenes the process of feeding. The “sense to act” paradigm can be used to implement a lot of applications and devices.