

Design of a Low-Cost Monkey
Deterrent System

Dynamics control and instrumentation

GOEE4002

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17/04/2026

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Introduction

In this assignment the task is to design a low-cost monkey deterrent system for Chom Zangari women's cooperative. The monkey deterrent systems are needed because their crops are being destroyed and their current solutions are failing. Currently they're using things like scarecrows and guards. The need for automation will make it a lot easier for the women to not worry about their crops being destroyed whilst their sleeping/eating. There are a few challenges with one of them being that they have no electricity so the deterrent system would have to use solar power or other renewable energies, while another challenge is that monkeys are highly intelligent animals that can adapt and learn patterns.

Analysis and design

What deters monkeys?

Monkeys are highly intelligent and adaptable creatures and the use of “Ultrasonic devices show mixed results for monkey deterrence, with effectiveness varying significantly by species, habituation levels, and environmental conditions. Initial studies indicate 45-55% success rates during the first 2-3 weeks, declining to 20-30% effectiveness after 30 days of continuous use.” (Alex, 2026) with the rapid deterioration of effect on the monkeys ultrasonic devices would have to be paired with other devices such as bright lights and/or swapped frequently enough for them to not gain immunity to the devices.

Another way “To keep monkeys away from garden plants, vegetables, and fruits, natural repellents such as spices like pepper, a boxy device with a solar-powered flashing light, and toy snakes, scarecrows, dogs, and smoke can be used.” (Goodall, 2024) this idea of using a demister was considered but with the women having to refill it with scents over time it would be less cost effective due to the cost of the products themselves.

System concept

The proposed monkey deterrent system is designed to protect agricultural crops by automatically detecting monkey activity and activating deterrent mechanisms. The system is intended to operate in remote environments where access to grid electricity is unavailable. As a result, the design must incorporate a low-power control system and utilise renewable energy sources, such as solar power, to ensure reliable and sustainable operation. The system is composed of three primary subsystems: the power subsystem, the detection subsystem, and the deterrent subsystem.

Power Subsystem

To enable operation in locations without access to an electrical grid, the system will be powered by solar panels. Solar energy provides a renewable and sustainable power source, allowing the device to function independently without reliance on external electrical infrastructure. This approach also reduces operational costs and improves the system’s suitability for rural agricultural environments.

Detection Subsystem

The detection subsystem will utilise a motion sensor to identify the presence of monkeys near the protected area. When movement is detected within a predefined range, the sensor will trigger the control system, which activates the deterrent mechanisms. This ensures that the system only operates when necessary, helping to minimise power consumption and increase overall efficiency.

Deterrent Subsystem

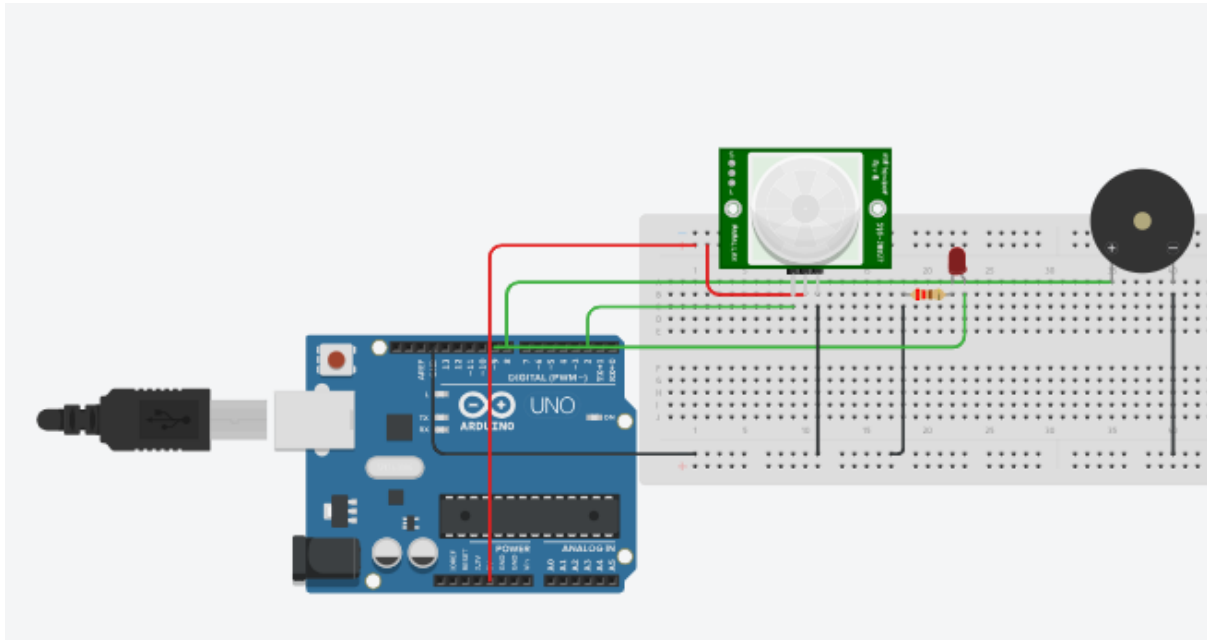
Given that monkeys are highly intelligent and capable of adapting to repetitive stimuli, the deterrent subsystem will employ a combination of ultrasonic sound emitters and visual deterrents such as flashing lights. Research indicates that monkeys may eventually become accustomed to ultrasonic devices when used alone. Therefore, combining multiple deterrent methods increases the likelihood of successfully discouraging monkeys from approaching the crops.

Together, these subsystems form a closed-loop control system that continuously monitors the surrounding environment, detects potential threats, and responds automatically. This

integrated approach enables rapid response to monkey activity and helps to reduce the risk of crop damage.

Simulation and Results

Tinker CAD design



[tinker cad](#) (Wheland, 2026)

In this design, the Arduino is powered by a solar panel and connected to a PIR motion sensor, an LED, a 220 Ω resistor, and a buzzer. The PIR sensor has three pins: signal, power, and ground. The signal pin is connected to pin 2 on the Arduino. The power pin is connected to the 5V pin on the Arduino, which is linked to the positive rail of the breadboard. The ground pin is connected to the GND pin on the Arduino, which is connected to the negative rail of the breadboard. For the LED, the cathode is connected to a 220 Ω resistor, which is then connected to the negative rail of the breadboard. The anode of the LED is connected to pin 9 on the Arduino. The buzzer has two pins. The positive pin is connected to pin 8 on the Arduino, while the negative pin is connected to the negative rail of the breadboard.

Code

```
int pirPin = 2;
int ledPin = 9;
int buzzerPin = 8;

int motionState = LOW;
int lastMotionState = LOW;

void setup()
{
  pinMode(pirPin, INPUT);
  pinMode(ledPin, OUTPUT);
  pinMode(buzzerPin, OUTPUT);

  Serial.begin(9600);
}

void loop()
```

```
{
motionState = digitalRead(pirPin);

// Detect when motion starts
if (motionState == HIGH && lastMotionState == LOW)
{
    Serial.println("Motion Detected!");

    digitalWrite(ledPin, HIGH);
    tone(buzzerPin, 20000);

    delay(1000); // deterrent active for 1 seconds

    digitalWrite(ledPin, LOW);
    noTone(buzzerPin);
}

// Detect when motion stops
if (motionState == LOW && lastMotionState == HIGH)
{
    Serial.println("Motion Ended");
}

lastMotionState = motionState;

delay(200);
}
```

Discussion and Evaluation

Cost analysis

Item	Example Product	Price	Where to Buy
Arduino board	UNO R3 Development Board for Arduino	£11.99	Amazon UK
PIR Motion Sensor	HC-SR501 PIR Motion Sensor Module	£1.19	eBay / electronics retailers
Buzzer	5V Electromagnetic PCB Buzzer	£0.66	Switch Electronics
LED	Red 5mm LED	£0.12	Switch Electronics
220Ω Resistor	220Ω Resistor Pack	£1.44	Kitronik
Small Solar Panel	6V Mini Solar Panel Module	£6.52	eBay
Breadboard	400 Tie-Point Breadboard	£1.61	Switch Electronics
Jumper Wires	Jumper Wire Set	£1.20	Kitronik
Total cost		£24.73	

The total cost of all the components comes to £24.73 depending on where the components are sourced, which maintains the low cost of the deterrent system to make it affordable for the Chom Zangari women although this is the price for one single unit but many of the products such as the breadboard, jump wires, resistors, and LED's can be bought in larger quantities so that they can produce more of the deterrent systems for a lower all together cost.

Deterrent system review

The deterrent system works effectively to detect motion and deter monkeys from entering the area. When movement is detected by the PIR motion sensor, the Arduino activates both the LED and the buzzer. The LED provides a visual signal while the buzzer produces a loud sound to scare away monkeys. This helps prevent monkeys from approaching or damaging the protected area. One advantage of the system is that it is powered by a solar panel, which means it can operate without needing a constant electrical supply. This makes it suitable for outdoor use and more environmentally friendly. The components used are also relatively low cost, making the device affordable to build. However, there are some limitations. The PIR sensor may sometimes detect other movement, such as birds, animals, or changes in temperature, which could trigger the system unnecessarily. Additionally, the buzzer may not always be loud enough to scare away monkeys in larger open areas. Overall, the deterrent system is a simple, low-cost, and effective solution for detecting motion and deterring monkeys. With further improvements such as a louder alarm, weatherproof casing, or adjustable sensor sensitivity, the system could become even more reliable and practical.

Conclusion

In conclusion, this project successfully designed a low-cost monkey deterrent system intended to help protect crops for the Chom Zangari women's cooperative. The system uses a solar-powered Arduino connected to a PIR motion sensor, LED, and buzzer to detect movement and activate deterrent signals. This allows the device to automatically respond when monkeys approach the protected area.

The design addresses the key challenges identified in the project, including the lack of access to grid electricity and the need for an affordable solution. By using solar power and low-cost electronic components, the system is able to operate independently while keeping the overall cost relatively low. The total estimated cost of approximately £24.73 makes it feasible for multiple units to be produced and deployed in agricultural areas.

Although the system demonstrates a practical and effective approach to deterring monkeys, there are opportunities for improvement. Future versions could include louder sound emitters, additional visual deterrents, improved weather protection, and adjustable sensor settings to reduce false triggers. These improvements would increase reliability and effectiveness in real-world conditions.

References

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