Procedural Programming Using C

MINI PROJECT REPORT

SUBMITTED BY,
NAME: VUNDELA SRAVAN SRI SIVA KUMAR REDDY
SEC: CSE_C
ROLL NO: NC.SC.U4CSE24237

SUBMITTED TO,
NAME: DR. SIVA RAJA P M (AP/CSE)
COURSE TITLE: PROCEDURAL PROGRAMMING USING C
COURSE CODE: 23CSE201

DATE: 10/12/2025

INDEX

1.Abstract:

→This project presents the development of a simple **cat-inspired robot** that reacts to human presence using an **Arduino UNO**, **ultrasonic sensor**, **servo motors**, and a **buzzer**. The main goal is to design an interactive system that detects nearby objects or people and imitates the behavior of a cat moving its legs and producing a "meow" sound. The robot uses an ultrasonic sensor for object detection, servo motors to simulate walking motion, and a buzzer to generate sound. The entire system is programmed in **C/C++ using the Arduino IDE**. The project demonstrates the potential of low-cost robotics in mimicking animal behavior for educational, entertainment, and experimental research purposes. The outcome is a semi-autonomous robot that responds interactively to its surroundings with realistic motion and sound.

2. INTRODUCTION

Overview

- This project is an **Arduino-based robotic cat** designed to imitate animal motion and interaction. It detects nearby humans or objects and responds by moving its legs and producing a meowing sound.

Relevance of Arduino and C Programming

- Arduino provides a simple interface to integrate sensors and actuators using **C/C++** programming. It is ideal for beginners and researchers to build real-world prototypes.

Real-world Applications

- Educational robotics projects
- Human-animal interaction studies
- Toy industry prototypes
- Home automation and pet simulation

Objectives

- To design a cat-like robot that detects humans using an ultrasonic sensor.
- To simulate cat movement using servo motors.
- To produce sound similar to a meow using a buzzer.
- To integrate and program all modules through Arduino.

3. LITERATURE REVIEW / BACKGROUND STUDY

Robotic Pets, Companion Robots & Social Robotics

1. Low-Cost Robotic Pets and Psychosocial Impact:
   Bradwell et al. (2022) examine the feasibility and impact of affordable robotic pets in care homes, particularly for dementia care. Their review highlights that interactive pet robots can help reduce agitation, improve mood, and increase social engagement. PMC
   Similarly, Koh et al. (2022) studied the usability and psychosocial effects of a low-cost robotic pet in older adults and found that users perceived emotional support and companionship from interacting with it. aging.jmir.org

2. Robotic Pets in Aging & Alzheimer's / Dementia Care:
   Robotic animals are used as therapeutic aids, especially for older adults suffering from loneliness or cognitive decline. The Paro robot (a baby harp seal) is a well-known therapeutic robot used in such settings. Wikipedia
   The ethics and challenges of deploying pet robots in dementia care have also been discussed, pointing out issues like anthropomorphism, attachment, and user expectations. Frontiers

3. User Perceptions & Design Challenges:
   Lazar et al. (2016) investigated how older adults perceive robotic pets. Their findings highlight tensions in expectations: participants wanted robot pets that feel alive but also predictable and controllable. thatlab.umd.edu
   A Miles's thesis (2022) reviews robotic animal use in therapeutic and social settings. It concludes that robotic pets can reduce restlessness, depression, and loneliness, but design, ethics, and acceptance are key challenges. mavmatrix.uta.edu+1

4. Biologically Inspired Robotic Cats & Quadrupeds:
   The project "Design and Development of a Biologically Inspired Robotic Cat for Research and Education" describes building a cat-like robot using off-the-shelf components, Arduino, and servos. Their aim: an affordable, educational platform for human–robot interaction studies. ResearchGate
   OpenCat is an open-source quadruped robotic cat designed for STEM education. It provides a modular, programmable platform with multiple sensors and uses a PWM servo driver (e.g., PCA9685) for managing many servos. Arduino Project Hub+1

5. Robotics and Sensing Technologies in Animal Welfare / Behavior Simulation:
   Jukan et al.'s review (2016) surveys smart sensing and computing technologies applied to animal welfare and monitoring (e.g. in livestock, wild animals, pets). While not directly about robotic pets, it gives insights into sensor integration, actuation, and the role of feedback in animal-related systems. arXiv
   Projects that combine robotics with machine learning for navigation (e.g. using multiple ultrasonic sensors) also inform systems thinking about sensor-actuator coordination. For instance, Srivastava et al. (2021) propose a reactive navigation robot using ultrasonic sensors + ML to avoid obstacles, showing how simple sensors + logic can yield autonomous behavior. arXiv

4. PROBLEM STATEMENT:

Modern robotic pets are costly and inaccessible for educational use. This project aims to build a **low-cost, Arduino-based cat robot** that detects nearby objects and responds interactively, helping students understand robotics fundamentals and sensor-actuator integration.

5. SYSTEM REQUIREMENTS:

Hardware:

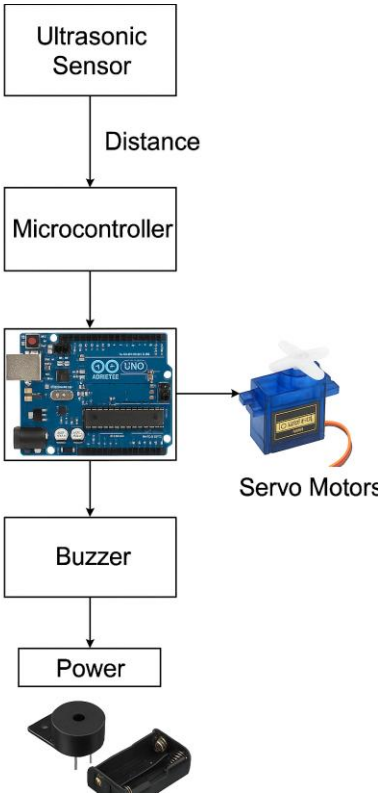
Component	Quantity	Purpose
Arduino UNO	1	Main controller
Ultrasonic Sensor (HC-SR04)	1	Object detection
Servo Motors (SG90)	4	Cat leg movement
Buzzer	1	Meow sound
Jumper Wires	Several	Connections
Breadboard	1	Prototyping
Battery Pack (4×3.7V Li-ion)	1	Power supply
Buck Converter	1	Step down voltage to 5V

Software:

- Arduino IDE
- C/C++ Language
- Tinkercad for simulation

6. SYSTEM DESIGN:

Block Diagram:



Pin Connections:

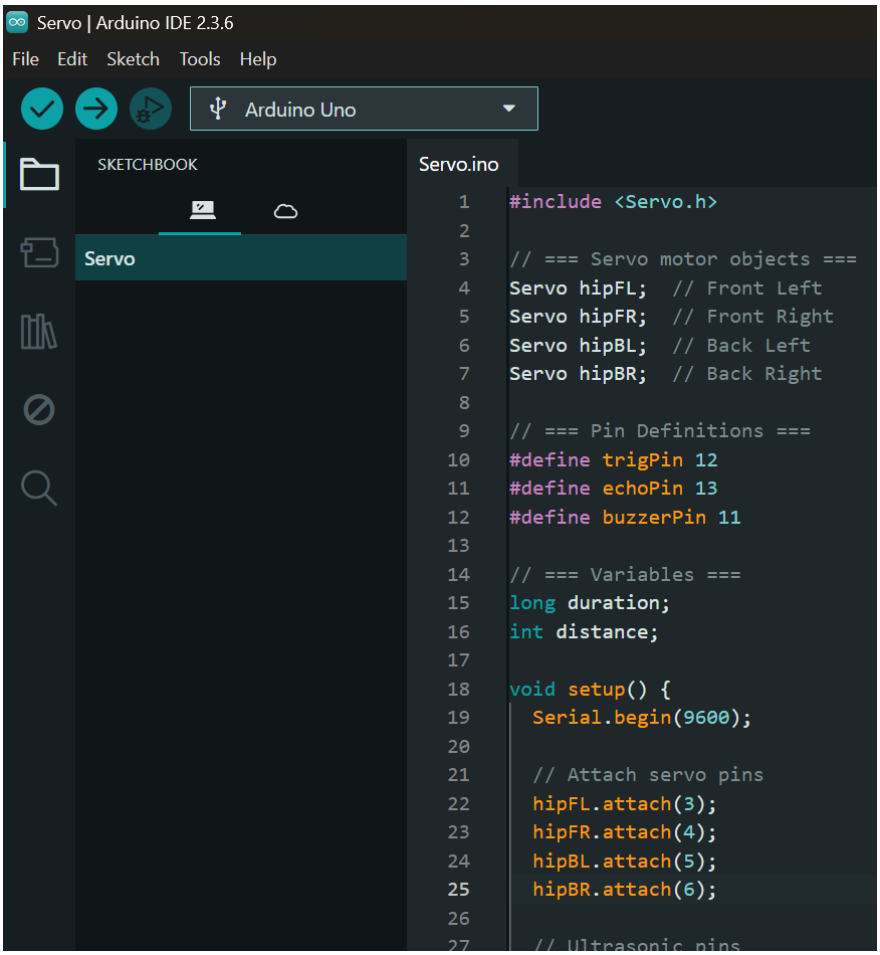
Component	Pin on Arduino	Type
Front Left Servo	D3	PWM
Front Right Servo	D5	PWM
Back Left Servo	D6	PWM
Back Right Servo	D9	PWM
Buzzer	D11	Digital Output
Ultrasonic Trigger	D12	Output
Ultrasonic Echo	D13	Input
Power (All components)	5V, GND	Power

7. IMPLEMENTATION:

Algorithm / Flow:

1. Start system and initialize components.
2. Continuously measure distance using ultrasonic sensor.
3. If object < 20 cm →
   → Move legs (servos)
   → Sound buzzer (meow)
4. Else → Stay in neutral pose.

Code:



Servo.ino

```
27    // Ultrasonic pins
28    pinMode(trigPin, OUTPUT);
29    pinMode(echoPin, INPUT);
30
31    // Buzzer pin
32    pinMode(buzzerPin, OUTPUT);
33
34    // Initial neutral position
35    neutralPose();
36    delay(500);
37    Serial.println("System Ready!");
38  }
39
40  void loop() {
41    distance = getDistance();
42
43    Serial.print("Distance: ");
44    Serial.print(distance);
45    Serial.println(" cm");
46
47    if (distance > 2 && distance < 20) {
48      // Object detected within 20 cm
49      Serial.println("Object Detected!");
50      meow();
51      moveCatFast();
52    } else {
53      neutralPose();  // No object
```

Servo.ino

```
54    }
55
56    delay(100);
57  }
58
59  // === Measure Distance ===
60  int getDistance() {
61    digitalWrite(trigPin, LOW);
62    delayMicroseconds(2);
63    digitalWrite(trigPin, HIGH);
64    delayMicroseconds(10);
65    digitalWrite(trigPin, LOW);
66
67    duration = pulseIn(echoPin, HIGH, 30000); // Timeout 30ms
68    if (duration == 0) return 999; // No reading (too far)
69
70    int dist = duration * 0.034 / 2;
71    return dist;
72  }
73
74  // === Neutral Pose ===
75  void neutralPose() {
76    hipFL.write(90);
77    hipFR.write(90);
78    hipBL.write(90);
79    hipBR.write(90);
80  }
81
```

Servo.ino

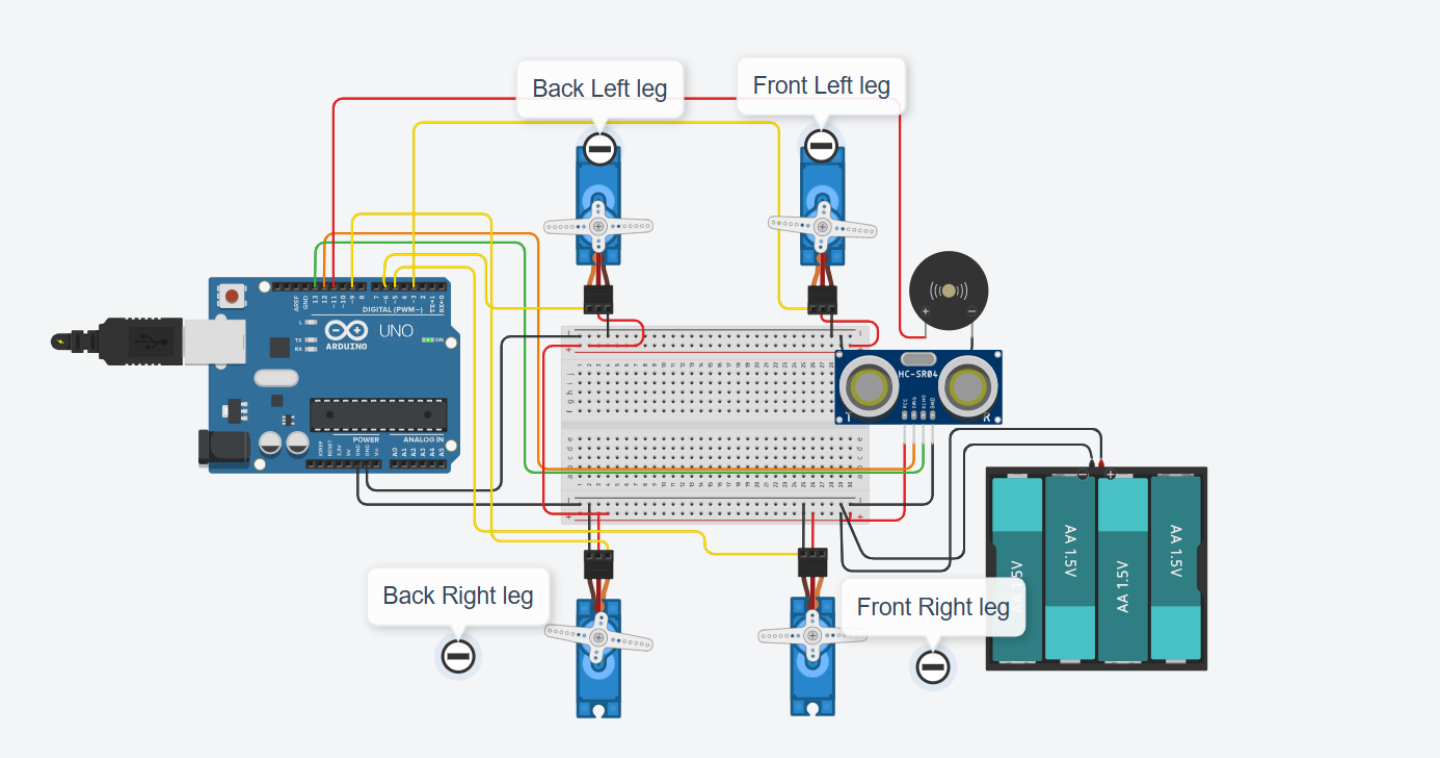
```
// === Cat Movement ===
void moveCatFast() {
  hipFL.write(65);
  hipBR.write(65);
  hipFR.write(115);
  hipBL.write(115);
  delay(200);

  neutralPose();
  delay(100);

  hipFR.write(65);
  hipBL.write(65);
  hipFL.write(115);
  hipBR.write(115);
  delay(200);

  neutralPose();
}

// === Meow Sound ===
void meow() {
  digitalWrite(buzzerPin, HIGH);
  delay(100);
  digitalWrite(buzzerPin, LOW);
  delay(80);
  digitalWrite(buzzerPin, HIGH);
  delay(80);
  digitalWrite(buzzerPin, LOW);
}
```

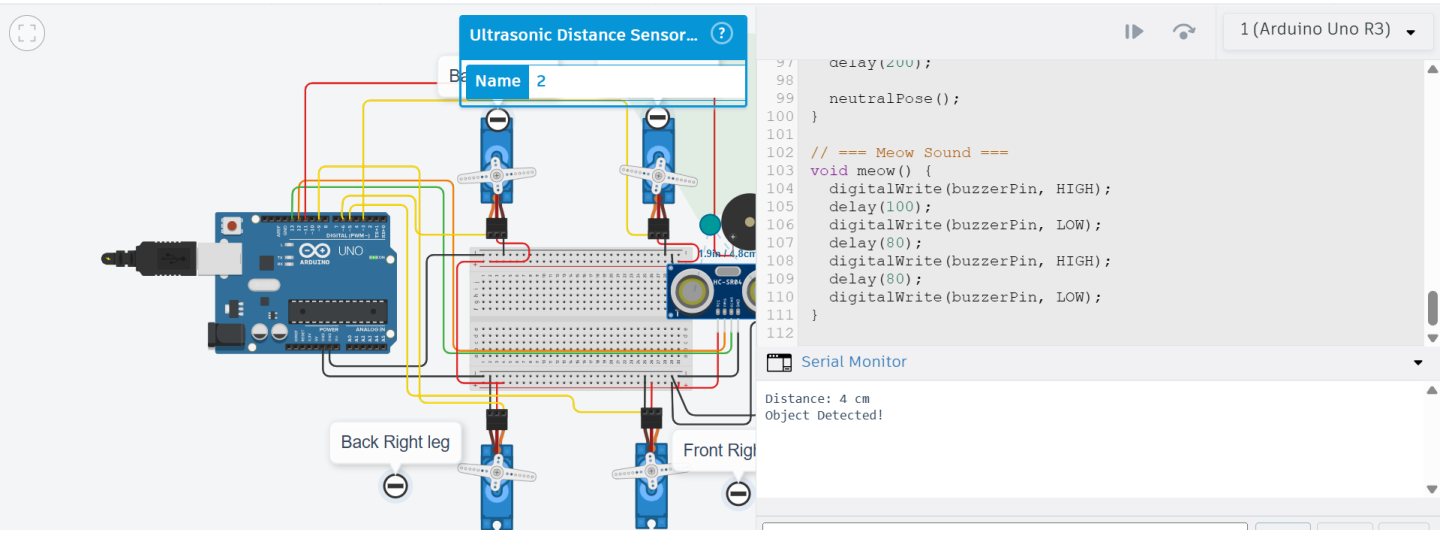
8. RESULTS AND OUTPUT:

- When an object is detected within 20 cm:
  → The robot **moves** like a cat.
  → The **buzzer sounds** "meow".
- Serial Monitor output example:

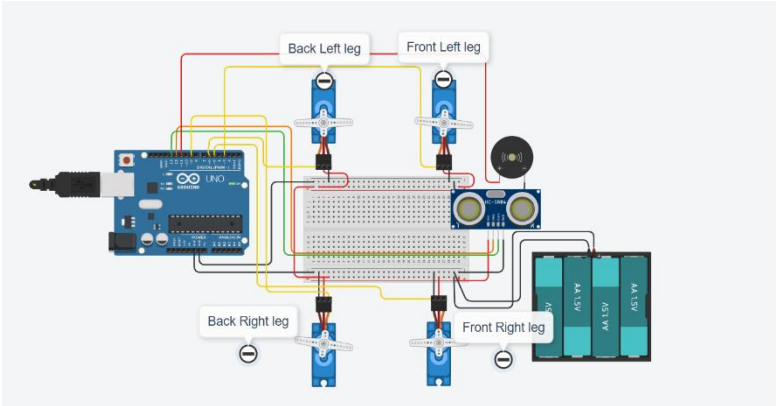
  Distance: 15 cm

  Object Detected!
- System goes back to neutral state when object moves away.

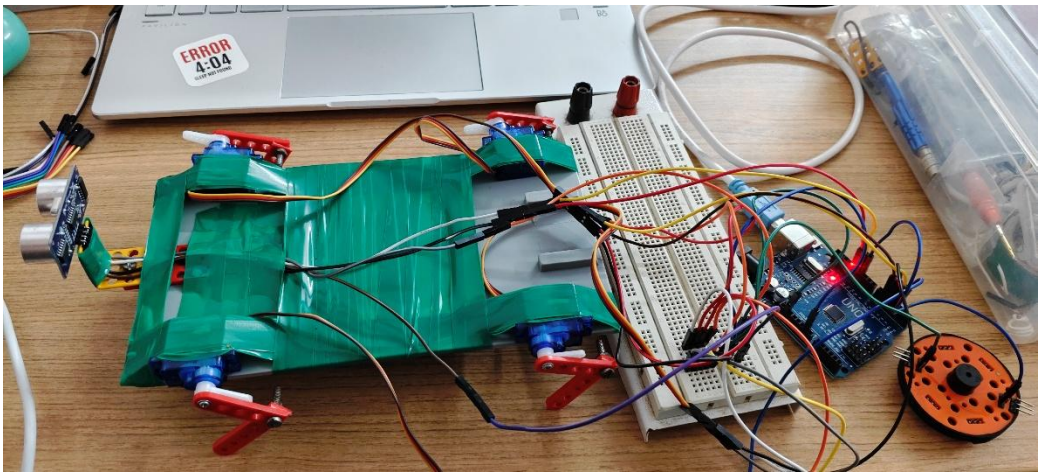




Videos Of Output: Ctrl + Click on the below images to view Videos



2.video:



9. DISCUSSION AND ANALYSIS:

- The system successfully detects nearby objects.
- Servo synchronization gives realistic motion.
- Low-cost components achieved intended behavior.
- Challenge: servo power draw — solved using external battery + buck converter.

10. APPLICATIONS AND FUTURE SCOPE:

Applications:

- Educational robotics model.
- Pet simulation toy.
- Interactive display bot.

Future Scope:

- Add **voice module** for realistic sounds.
- Use **AI (OpenCV)** for face recognition.
- Add **Bluetooth or Wi-Fi control**.

11. CONCLUSION:

This project successfully demonstrated the integration of sensors, actuators, and microcontrollers to mimic animal-like behavior. Using Arduino and basic electronic components, a reactive robotic cat was built that detects objects and produces a meowing sound. The project enhanced understanding of embedded systems, servo control, and sensor interfacing.

12. REFERENCES:

1. Arduino Official Documentation – https://www.arduino.cc
2. HC-SR04 Datasheet
3. Servo Motor SG90 Datasheet
4. TutorialsPoint: Arduino Projects
5. Tinkercad Circuits Simulation Tutorials
6. Murad Mehrab Abrar, Raian Islam, "Design and Development of a Biologically Inspired Robotic Cat for Research and Education." ResearchGate
7. "OpenCat — affordable quadruped robot for STEM," Arduino Project Hub. Arduino Project Hub
8. "Implementing Affordable Socially Assistive Pet Robots in Care Homes," Bradwell et al. (PMC). PMC
9. "The Usability and Impact of a Low-Cost Pet Robot," Koh et al. aging.jmir.org
10. Lazar et al., "Rethinking the Design of Robotic Pets for Older Adults." thatlab.umd.edu
11. A Miles, "What is the state of the literature about robotic animal use …" mavmatrix.uta.edu+1
12. Jukan, Masip-Bruin, Amla, "Smart Computing and Sensing Technologies for Animal Welfare: A Systematic Review." arXiv
13. Srivastava, Singh, Syed Ibrahim, "Autonomous bot with ML-based reactive navigation for indoor environment." arXiv

13.GitHub Link:

Sravan9116/C_Mini_Project