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Ball Throwing Device for Animals

Design with Microprocessors

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Chapter 1

Introduction

1.1 Purpose and Motivation

The primary purpose of this project is to strengthen the bond between pets and their human companions by providing a technologically advanced and interactive playtime experience.

1.2 Rationale

Pet owners often find themselves balancing their busy schedules with the well-being and happiness of their cherished animals. When a pet and their human companion are together, there's an opportunity for shared activities and playtime. However, it's not always possible for the human to engage in play with their pet due to work commitments or other responsibilities.

1.3 Scope

The primary scope of this project includes the development of a fully functional ball throwing device that provides engaging play for animals when initiated by a human operator.

Chapter 2

Proposed Solution and Implmentation

2.1 Overview of the Solution

The Ball Throwing Device for Animals integrates various hardware components, including an Arduino UNO R3 board, a breadboard, a MG995 servo motor, two LEDs for visual feedback, a buzzer for audio feedback, resistors, a button and an HC-SR04 ultrasonic sensor for distance measurement.

2.2 Hardware Implementation

The hardware components are interconnected, as depicted in the following diagram.

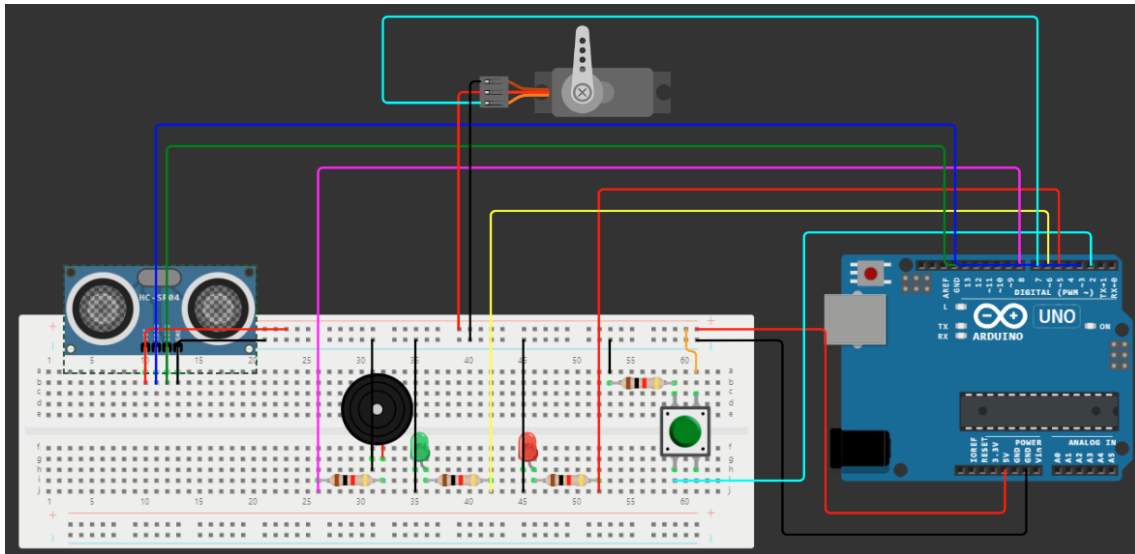


Figure 2.1: Hardware Circuit Diagram

2.3 Software Implementation

The code reads the state of a button connected to buttonPin and prints its state to the Serial Monitor.

The ultrasound sensor is used to measure distance by triggering a pulse and calculating the duration it takes for the echo to return. The distance is then calculated based on the speed of sound using the formula: $\text{distance} = \text{duration} \times 0.034/2$

The distance measurement is checked, and if the distance is greater than or equal to 10 cm, the green LED is turned on, and the red LED is turned off. Otherwise, if the distance is too short, a message is printed to the Serial Monitor, and the red LED is turned on.

The code checks if the button is pressed (**buttonState** == **HIGH**) and if the distance is greater than or equal to 10 cm. If both conditions are met, it performs the following actions:

- Rotates the servo motor to 90 degrees in order to activate the catapult.
- Activates a buzzer to emit a sound at a frequency of 1000 Hz for 0.5 seconds.
- Returns the servo motor to its initial position (defined as `initialPosition`).

Chapter 3

Testing and Validation

3.1 Challenges in Implementation

While implementing the Ball Throwing Device for Animals, I faced numerous challenges, highlighting the iterative nature of hardware projects. Here are some significant challenges and the corresponding adjustments made:

- **Servo Motor Alignment:** - Issue: The initial servo motor positioning resulted in the servo motor being initialized at an incorrect angle. - Solution: We fine-tuned the servo motor's range and positioning parameters to ensure the scoop of the catapult could sustain a small object and throw it at a proper angle.
- **Ultrasonic Sensor Precision:** - Issue: The accuracy of distance measurements from the ultrasonic sensor fluctuated due to environmental factors. - Solution: Through iterative testing, I refined the sensor's position and orientation, leading to enhanced accuracy in distance measurements.

3.2 Project Evolution

1. **Initial Stage:** Began by monitoring button states for user interaction.
2. **Enhanced Distance Measurement:** Incorporated an ultrasonic sensor, enabling precise distance calculations using the formula **distance = duration × 0.034/2**.
3. **Visual Feedback:** Introduced LEDs for visual cues:
 - Green LED indicates distances greater than 10 cm.
 - Red LED signifies distances too short.
4. **Interactive Actions:** When specific conditions are met:
 - The servo motor rotates precisely to 90 degrees.
 - A buzzer emits a 1000 Hz sound for 0.5 seconds.
 - The servo motor returns to its defined initialPosition.

This phased development approach significantly enhances user engagement and overall functionality.

Chapter 4

Conclusion

In summary, this documentation covers the purpose, motivation, rationale, and scope of the ball throwing device for animals. By addressing the needs of pet owners and the well-being of animals, this project aims to provide an innovative and customizable solution to keep animals engaged and active.

4.1 Adaptations and Future Improvements

- **Mobile App Control:** integrating mobile app control for remote operation, providing convenience and accessibility.
- **Voice Commands:** implement voice recognition for hands-free control, enhancing user experience.
- **Camera Integration:** include a camera module for visual monitoring during play sessions.
- **Energy Efficiency:** optimize power usage for prolonged operation.
- **Internet Connectivity:** adding Wi-Fi or Bluetooth connectivity would enable remote monitoring and control.

Chapter 5

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