SIT225 – Data Capture Technologies

Arduino Ultrasonic Distance Measurement System with LED Indicators

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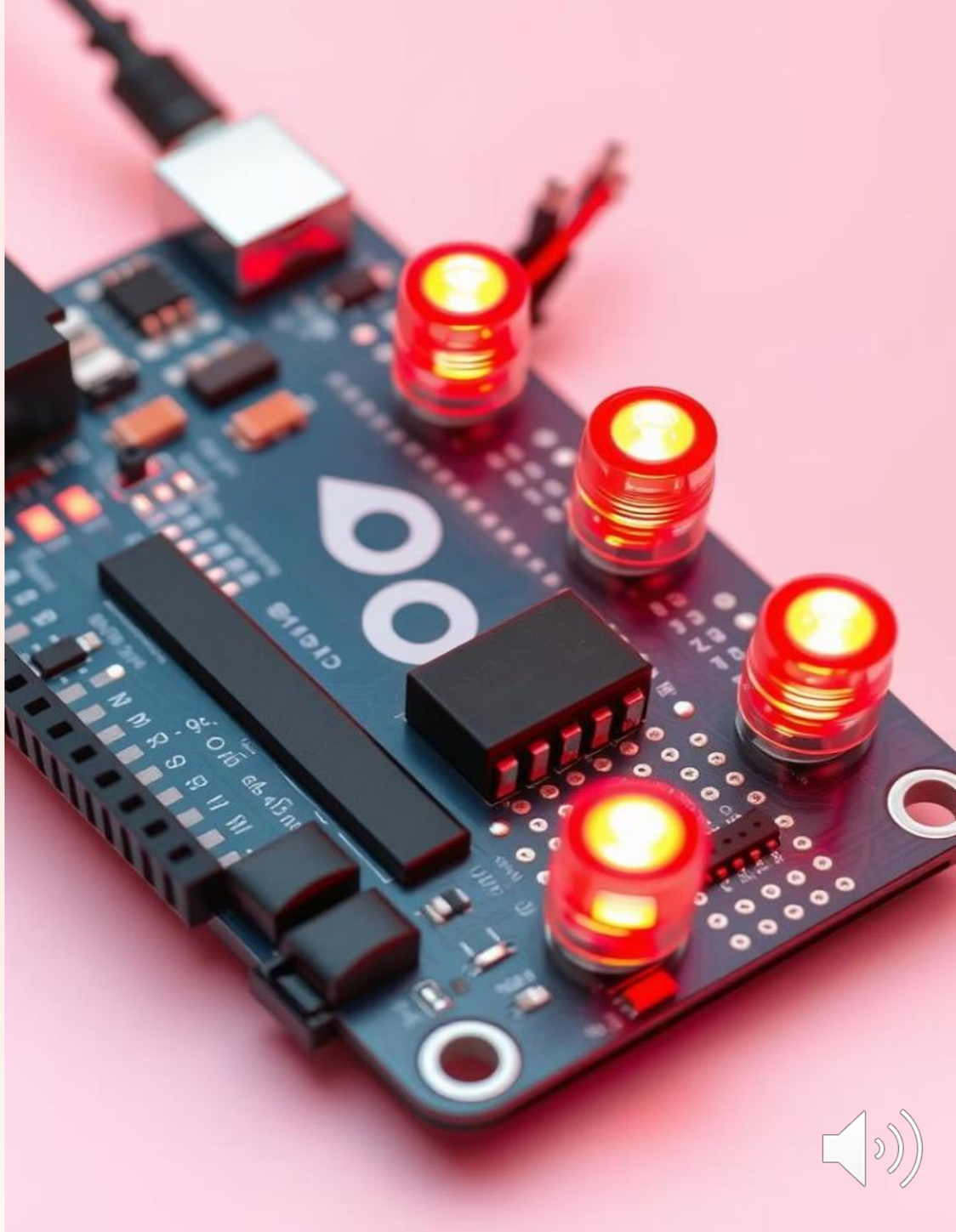


Problem Statement and Goal

Challenge

There is a need for a simple, visual distance measurement system for educational purposes. Teaching abstract concepts of distance sensing and IoT can be difficult, and there's a lack of hands-on, affordable tools for beginners.

Goal

Create an accessible tool for learning about sensors, Arduino, and IoT concepts. The system should provide real-time visual feedback and introduce cloud connectivity for data logging.

Background & Existing Methods

Smart Parking Systems

Vehicle detection using HC-SR04 sensors (Rahul et al., 2023)

Waste Management Solutions

Bin fill-level monitoring (Anisha et al., 2022)

Water Level Monitoring

Combining ultrasonic sensors with other environmental sensors (Maheshwari et al., 2022)

Proposed Solution

1

Arduino-based System

Utilizes an HC-SR04 ultrasonic sensor, which is affordable and widely available.

2

Visual Feedback

Incorporates 5 LED indicators for intuitive, color-coded distance feedback.

3

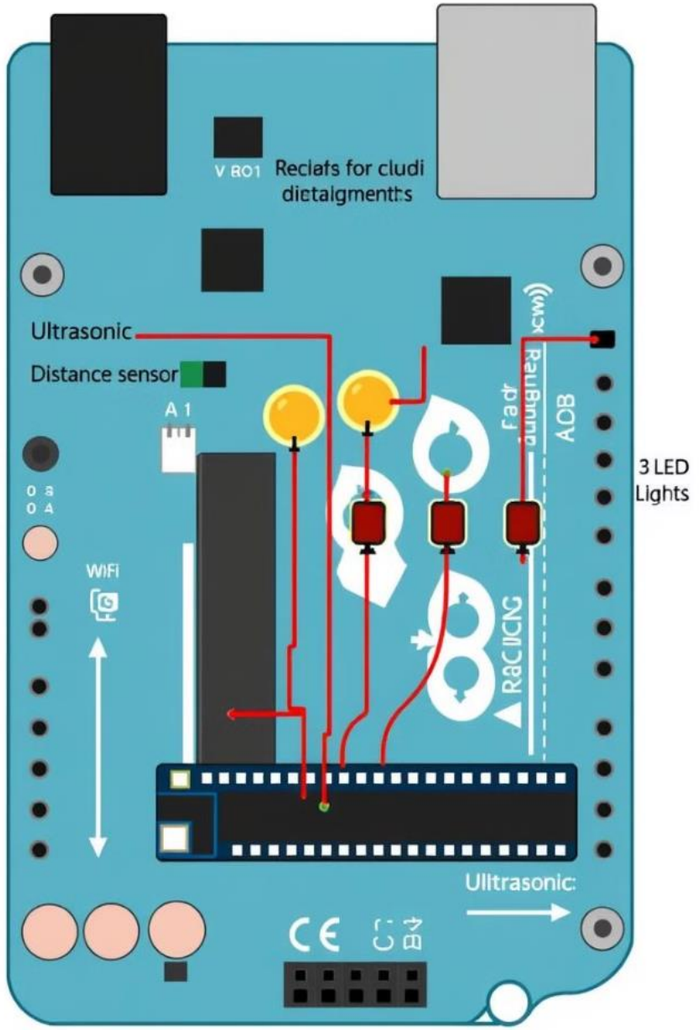
Cloud Integration

Integrates with Arduino Cloud for data logging and remote monitoring, enabling real-time data access and visualization.

4

Key Benefits

Low cost, easy to replicate, and introduces multiple learning concepts.



System Architecture and Methodology

1

Data Capture

Arduino sends trigger pulse to HC-SR04, which emits ultrasonic burst. Arduino measures echo time.

2

Distance Calculation

Distance = (Speed of Sound × Time) / 2

3

LED Activation

LEDs activate based on distance thresholds: Red (≤10cm), Yellow (10-20cm), Green (20-30cm), Blue (30-40cm), White (>40cm).

4

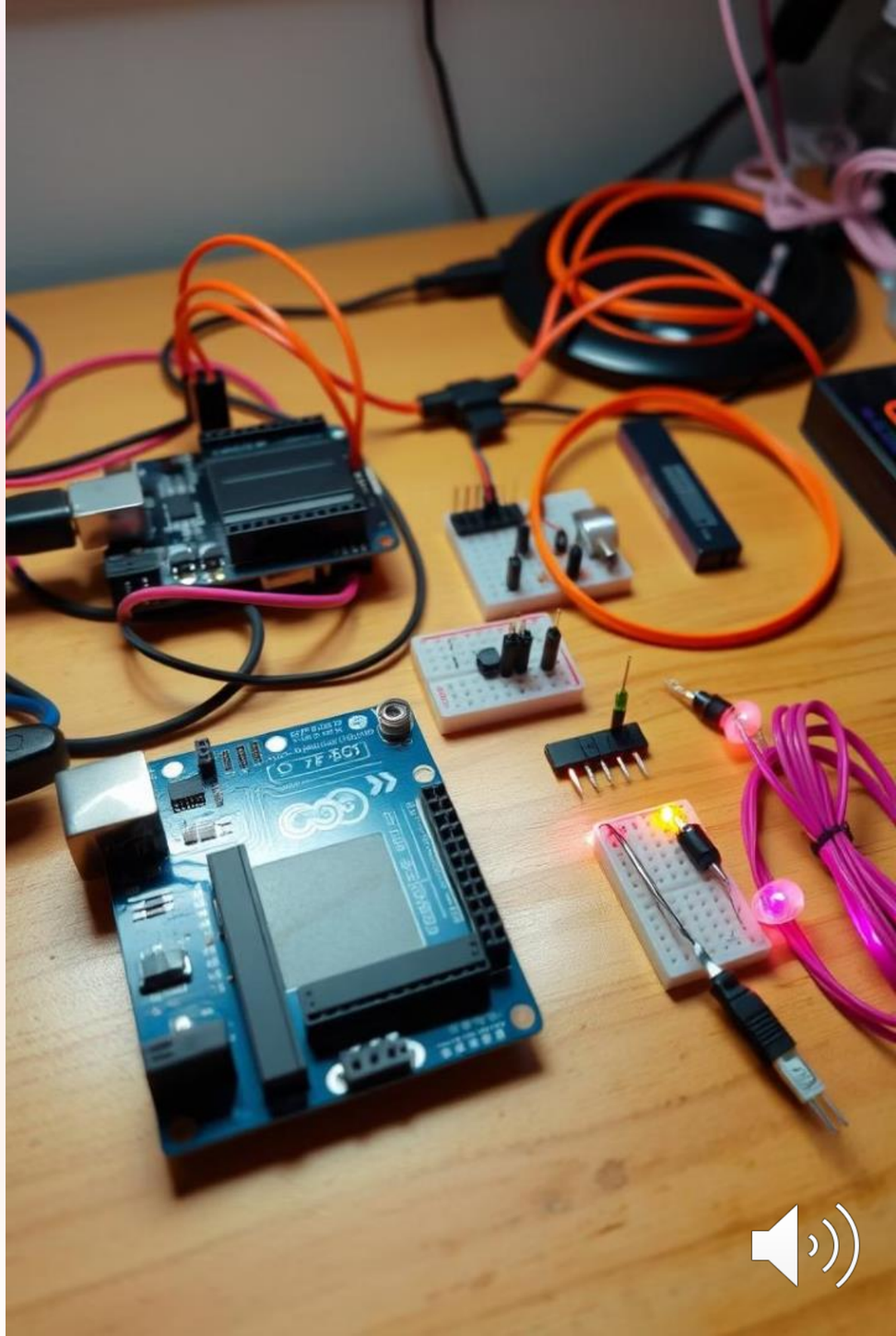
Cloud Transmission

Data (distance and LED status) sent to Arduino Cloud every 5 seconds.

Hardware & Software Requirements

Component	Cost
Arduino Uno R3	$23.00
HC-SR04 Ultrasonic Sensor	$3.95
LEDs (5 colors)	$1.00
Resistors (220Ω) x5	$0.25
Breadboard	$5.00
Jumper wires	$3.00
Total Hardware Cost	$36.20

Software tools required: Arduino IDE (Free) and Arduino Cloud (Free tier)



Development Timeline and Ethical Considerations

3-Day Development Plan

Day 1: Hardware Setup (2h), Basic Sensor Reading (2h), LED Control Implementation (2h)

Day 2: Arduino Cloud Setup (2h), Cloud Integration (2h)

Day 3: Testing and Refinement (2h), Documentation & Showcase (3h)

Total development time: **15 hours**

Ethical Considerations

- Privacy: Ensure no unauthorized monitoring
- Safety: Proper electrical isolation
- Environmental: Use of recyclable materials

Conclusion and Future Work

1

Project Benefits

Hands-on learning tool for distance sensing, introduction to IoT and cloud connectivity, affordable and easily replicable design.

2

Educational Value

Teaches programming, electronics, and data analysis. Encourages further exploration in IoT.

3

Future Work

Additional sensors, advanced data analysis using machine learning, mobile app for remote control, integration with home automation systems.