SIT225 – Data Capture Technologies

Arduino Ultrasonic Distance Measurement System with LED Indicators

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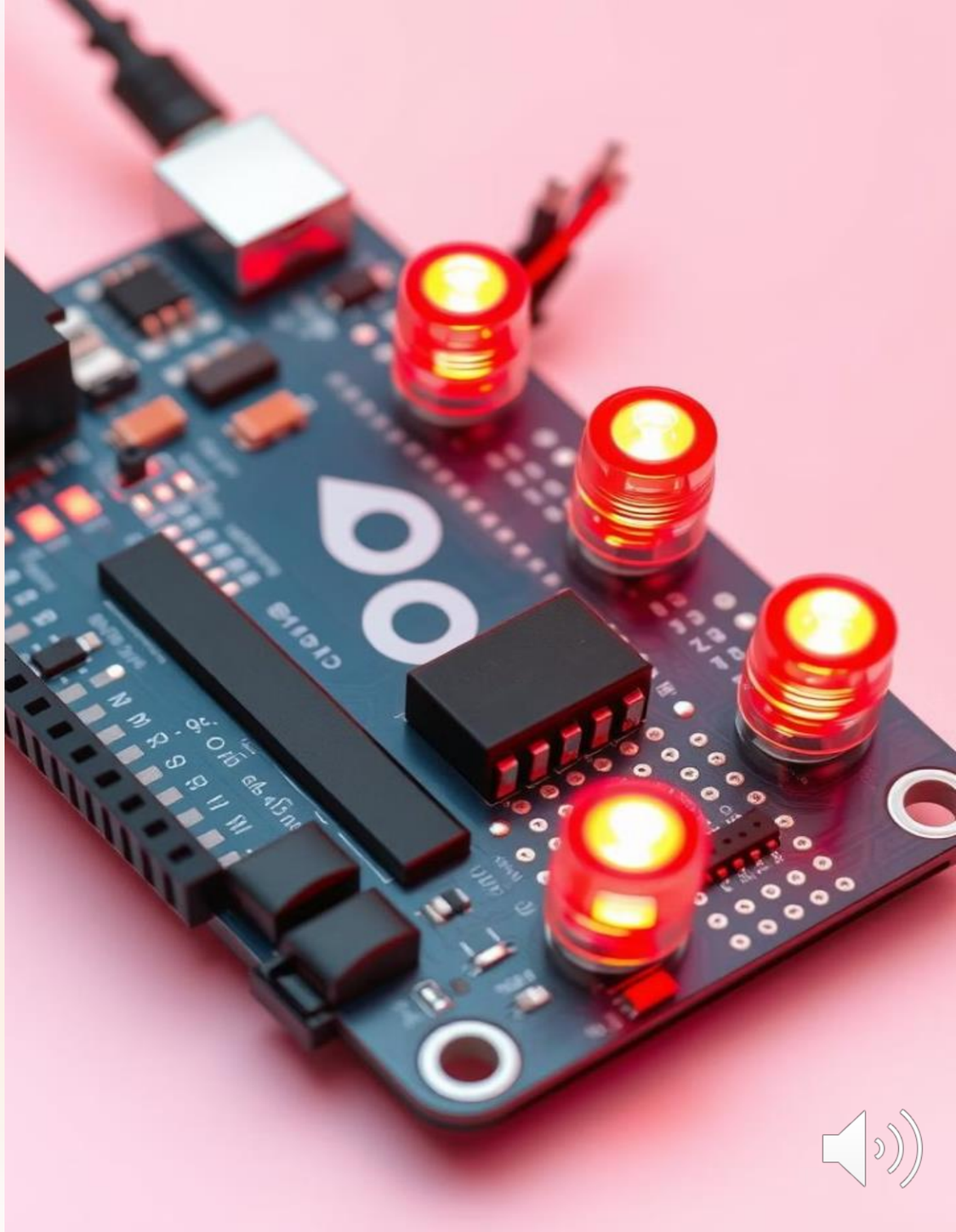


Problem Statement and Goal

Challenge

There is a need for an affordable, scalable, and real-time distance measurement system for industrial applications. Existing solutions often suffer from high costs, delayed data analysis, and limited scalability, which impede efficiency in sectors like manufacturing, warehouse management, and environmental monitoring.

Goal

Develop a cost-effective, data-driven system that delivers real-time proximity measurement and feedback using IoT technology. The system should provide continuous data collection, cloud-based logging, and advanced data analysis for predictive insights and improved operational decision-making.

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**

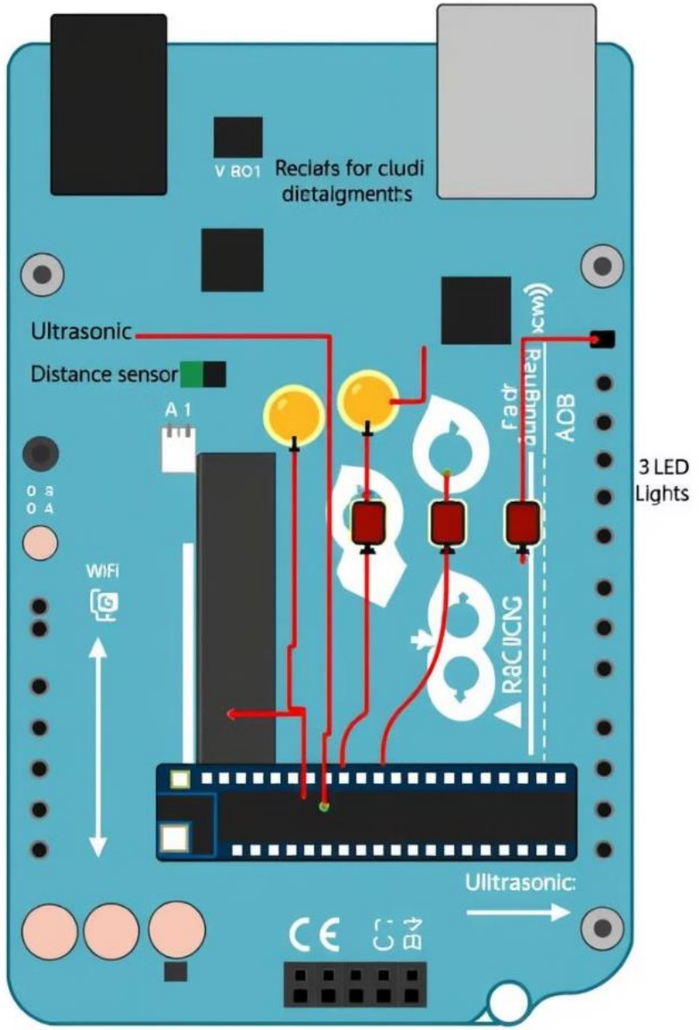
Incorporates 5 LED indicators for intuitive, color-coded distance feedback.

3 **Cloud Integration**

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

4 **Key Benefits**

Affordable, scalable, real-time data collection, enabling predictive insights and optimization in industrial applications.



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

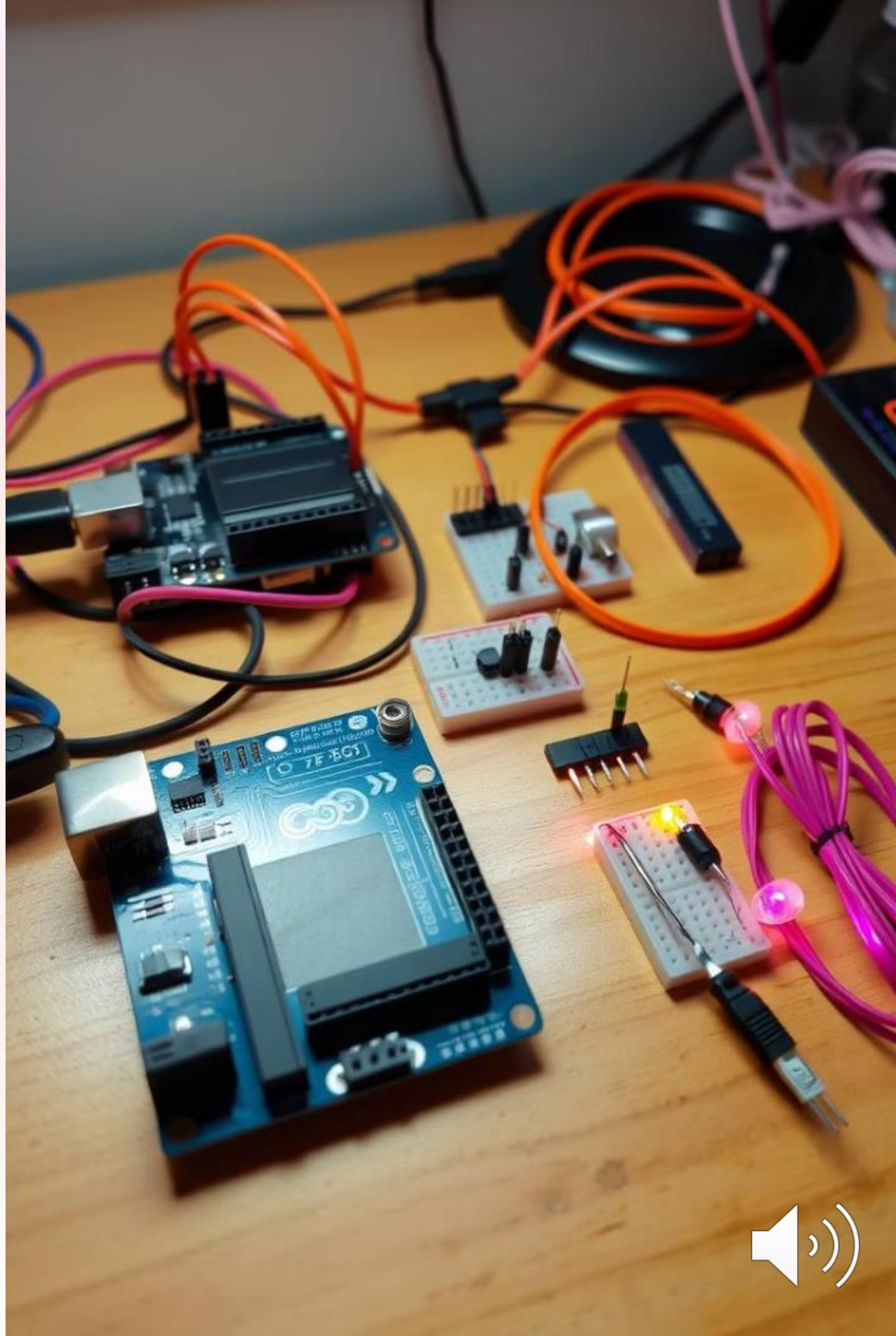
Cloud Transmission

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

Affordable, scalable solution for real-time distance sensing and data analysis, suited for industrial applications like manufacturing and warehouse management.

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.