

Lab 6 report

CSE121

Inhle Cele

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Lab 6 Overview

- **Objective:** The objective of this lab was to implement an ultrasonic range finder using the HC-SR04 sensor and adjust its distance measurements based on temperature readings from an SHTC3 temperature sensor. Accurate distance measurement is essential in various applications, including robotics and automation. This project utilized the ESP32-C3 microcontroller to integrate both sensors and calculate distances dynamically.

Lab 6.1: Ultrasonic Range Finder

1. Components and Setup

Hardware:

- ESP32-C3 Microcontroller
- HC-SR04 Ultrasonic Sensor
- SHTC3 Temperature Sensor
- Breadboard and Connecting Wires
- Power Supply (5V for HC-SR04)

Software:

- ESP-IDF
- esptool.py
- Serial Monitor

Circuit Setup:

- *HC-SR04:*
 - TRIG pin connected to GPIO 5
 - ECHO pin connected to GPIO 4
 - VCC connected to 5V
 - GND connected to GND
- *SHTC3:*
 - SDA connected to GPIO 10

- SCL connected to GPIO 8
- Pull-up resistors (4.7 kΩ) on SDA and SCL lines

2. Methodology

2.1. Ultrasonic Sensor Integration:

- Configured the TRIG pin (GPIO 5) as an output and the ECHO pin (GPIO 4) as an input.
- Sent a 10 μs pulse to the TRIG pin and measured the duration of the ECHO pulse to calculate distance.
- Adjusted the speed of sound based on the temperature using the formula:

$$\text{Speed of Sound} = 331.3 + 0.606 \cdot T \text{ (in m/s)}$$
 Converted to cm/μs for distance calculations.

2.2. Temperature Sensor Integration:

- Configured the SHTC3 sensor using the I2C protocol on GPIO 10 (SDA) and GPIO 8 (SCL).
- Read temperature data from the sensor and validated it using a CRC check.

2.3. Combined Implementation:

- Combined both sensors to output the temperature and distance every second.
- Handled edge cases such as sensor read failures and timeout errors.

3. ChatGPT chat export:

<https://chatgpt.com/share/674556cc-e7a4-8008-8fb8-7aa856e69a05>

Lab 6: Ultrasonic Range Finder - Chat Export

Lab 6: Ultrasonic Range Finder Chat Export

1. Discussion on integrating ultrasonic range finder and temperature sensor functionality.
2. Debugging assistance for CRC check failures and timeout issues.
3. Updated code snippets for GPIO configuration and combined implementation.
4. Troubleshooting guidance for wiring and software challenges.

Conclusion

This lab successfully demonstrated the integration of an ultrasonic range finder with a temperature sensor to dynamically adjust distance calculations. The project reinforced concepts of I2C

communication, GPIO configuration, and real-time data processing using the ESP32-C3. Future improvements could include implementing more advanced error handling and displaying results on an OLED screen.