Abstract
This project was carried out as the final assignment for the Instrumentation course (Semester 7). The objective was to design, implement, and evaluate an ultrasonic distance measurement system using the HC-SR04 sensor. The system measures distance based on the time-of-flight principle, where the travel time of ultrasonic pulses is used to calculate the distance to a target.

To ensure reliability, experiments were conducted under three distinct scenarios:
1. Normal environmental conditions (room temperature and standard humidity).
2. Extreme environmental conditions with unusual temperature and humidity variations.
3. A compensated system in which additional measurements from the DHT22 sensor (temperature and humidity) were integrated to adjust the speed of sound dynamically.

The hardware platform was an Arduino UNO, connected to the HC-SR04 ultrasonic sensor and, in the compensated scenario, the DHT22 environmental sensor. Data was collected at reference distances of 5 cm, 15 cm, and 30 cm. Results were recorded and analyzed to evaluate error and accuracy levels across all scenarios.

Findings show that environmental conditions significantly affect ultrasonic sensor accuracy. In extreme conditions, deviations and errors increased, while compensation using DHT22-based speed of sound adjustments notably improved performance, reducing error margins and providing more stable readings. This project not only deepened my understanding of instrumentation and digital measurement techniques but also provided hands-on experience with embedded systems design, sensor fusion, data logging, and error analysis.

Overall, the project demonstrated the importance of environmental compensation in sensor-based measurement systems and highlighted the practical applications of combining multiple sensors to enhance accuracy and reliability in real-world conditions.