

THE DISTANCE DETECTOR

INTERNET OF THINGS

Time: 60 mins

Introduction

In this class, the student/s will learn how to create a distance detector using ultrasonic sensor and glow LEDs to indicate proximity of the sensor.

New Commands Introduced

- `pinMode(TRIG_PIN, OUTPUT);` Mentions the trigger pin as output pin with HIGH state
- `pinMode(ECHO_PIN, INPUT);` Mentions the echo pin as output pin
- `int duration = pulseIn(ECHO_PIN, HIGH);` Calculates the duration for pulse in HIGH state
- `int distance = duration * 0.034 / 2;` Calculates the distance covered one way

Vocabulary

- **Ultrasonic sensors** emit ultrasonic sound waves and measure the time it takes for the waves to travel to an object and back.
- **Trig (Trigger) pin** is used to trigger the ultrasonic sound pulses.
- **Echo pin** produces a pulse when the reflected signal is received.
- **Speed of sound** depends on the properties of the medium through which it travels. The speed of ultrasonic sound in air is 340m/s.

Learning Objectives

Student/s should be able to:

- **Recall** how different components can be connected to the input-output pins of ESP32.
- **Demonstrate** how to create a distance detector using an ultrasonic sensor.
- **Explain** how to glow red and green LED to indicate the proximity of the sensor.

Activities

Class Narrative: (3 mins)

- Brief the student/s that Alex and friends have landed to a go-karting game arena and have to reach the next door without damaging the kart.

Concept Introduction Activity: (4 mins)

- Let the student/s observe that the red LED glows on the object being too near else glows the green signal.
- Explain how different components can be connected to create a distance detector. Explain an ultrasonic sensor.
- Using the slides, explain that the student/s will learn:
 - to connect the components
 - To calculate the distance
 - to switch on the LED

Activity 1: Connect the Components(16 mins)

Teacher Activity: (8 mins)

- Explain the different pins of the ultrasonic sensor, how the trigger sends the sound waves while the echo pin receives the sound waves.
- Explain how distance can be calculated using the speed of sound and time taken by the sound waves to travel between the sensor and the object.
- Introduce and explain connecting the components to create a distance detector using the ultrasonic sensor.

Student Activity: (8 mins)

- Guide the student/s to connect the components to create a distance detector.

Activity 2: Calculate the Distance (10 mins)

- Explain how we will calculate the time period for the return of sound wave.
- Explain how we will measure the distance between the ultrasonic sensor and the object.

Student Activity: (10 mins)

- Guide the student/s to measure the duration of the pulse for which it travels from the ultrasonic sensor to the object and returns back and calculate the distance.

Activity 3: Switch on the LED(12 mins)

- Explain how LEDs can be used as distance indicators for proximity to an object.
- Demonstrate how we can use the if-else statement to glow the LEDs as per the distance between the sensor and the object.

Student Activity: (6 mins)

- Guide the students to turn the LEDs as per the distance between the sensor and the object.

Introduce the Post class project: (2 min)

- Open the dustbin when distance is less than 200 cm, otherwise keep it closed using a servo motor.

Test and Summarize the class learnings: (5 mins)

- Check for understanding through quizzes and summarize learning after respective activities.
- Summarize the overall class learning towards the end of the class.

Additional activities:

- Encourage the student/s to turn the green LED on when distance is greater than 200cm otherwise add blink effect to the red LED.
- Encourage the student/s to control LED color and blinking for multiple sensors in a circuit.

State the Next Class Objective: (1 min)

- In the next class, student/s will create a parking assistant for the cars.

U.S. Standards:

CSTA: 2-AP-11, 2-AP-12, 2-AP-13, 2-AP-14, 2-AP-19

Links Table		
Activity	Activity Name	Link
Class Presentation	THE DISTANCE DETECTOR	https://s3-whjr-curriculum-uploads.whj

		r.online/6f045ec7-164c-49cd-bff0-b93ee3e1fe5f.html
Explore Activity	THE DISTANCE DETECTOR	https://wokwi.com/projects/385248202145518593
Student Activity 1	Connect the Components	https://wokwi.com/projects/385247313455201281
Teacher Reference: Student Activity 1 Solution	Connect the Components	https://wokwi.com/projects/385247268693577729
Teacher Activity 2	Calculate the Distance	https://wokwi.com/projects/385247849404508161
Teacher Reference: Teacher Activity 2 Solution	Calculate the Distance	https://wokwi.com/projects/385247363412518913
Student Activity 2	Calculate the Distance	https://wokwi.com/projects/385247849404508161
Teacher Reference: Student Activity 2 Solution	Calculate the Distance	https://wokwi.com/projects/385247363412518913
Student Activity 3	Turn on the LEDS	https://wokwi.com/projects/385248619172615169
Teacher Reference: Student Activity 3 Solution	Turn on the LEDS	https://wokwi.com/projects/385248202145518593
Student's Additional Activity 1	Change the Sensor Range	https://wokwi.com/projects/385249370664035329
Teacher Reference: Student's Additional Activity 1 Solution	Change the Sensor Range	https://wokwi.com/projects/385248821529976833
Student's Additional Activity 2	Connect Multiple Sensors	https://wokwi.com/projects/386061280649594881
Teacher Reference: Student's Additional Activity 2 Solution	Connect Multiple Sensors	https://wokwi.com/projects/386060419958439937
Post Class Project	Create an Automatic Dustbin	https://wokwi.com/projects/386534639755860993
Teacher Reference: Post Class Project Solution	Create an Automatic Dustbin	https://wokwi.com/projects/386533164492164097