DISTANCE MEASUREMENT AND OBJECT DETECTION USING ULTRASONIC SENSORS WITH RASPBERRY PI

TEAM MEMBERS:

1. Subani Sundaram
2. Vaanmathi G
3. Srimathi R
4. Saambhavi K
5. Yuvalakshime S

AIM:

To design and implement a distance measurement and object detection system using ultrasonic sensors with a Raspberry Pi, capable of accurately measuring the distance between the sensor and nearby objects, detecting obstacles within a predefined range, and providing real-time output for applications such as smart parking, robotics, and collision avoidance systems.

COMPONENTS USED :

1. Raspberry pi poco w
2. Ultrasonic sensor
3. LED
4. LCD

1. Raspberry Pi Pico W

- Definition:
  A low-cost, high-performance microcontroller board based on the RP2040 chip with built-in Wi-Fi (in the "W" version). It is used to control and process input/output devices.
- Range / Specs:
  - Processor: Dual-core ARM Cortex-M0+
  - Clock Speed: Up to 133 MHz
  - RAM: 264 KB SRAM
  - Flash: 2 MB
  - Operating Voltage: 1.8 V to 3.3 V (I/O at 3.3 V)
- Applications:
  - IoT projects (Wi-Fi-based automation, sensors, actuators)
  - Robotics control
  - Environmental monitoring systems
  - Educational electronics & embedded systems projects

2. Ultrasonic Sensor (HC-SR04)

- Definition:
  A sensor that measures distance by transmitting ultrasonic sound waves (usually at 40 kHz) and detecting the echo reflected by an object.
- Range / Specs:
  - Measuring Range: ~2 cm to 400 cm
  - Accuracy: ±3 mm
  - Operating Voltage: 5 V
  - Frequency: 40 kHz
- Applications:
  - Object detection and avoidance in robots
  - Parking assistance systems
  - Level detection (e.g., in tanks)
  - Security and obstacle detection systems

3. LED (Light Emitting Diode)

- Definition:
  A semiconductor light source that emits visible light when current passes through it. Used as an indicator or alert.
- Range / Specs:
  - Forward Voltage: ~1.8 V to 3.3 V (depending on color)
  - Forward Current: ~10–20 mA
  - Pico W has an onboard LED at GPIO25 (green).
- Applications:
  - Visual indicators (status signals)
  - Alerts and notifications
  - Part of displays, illumination, communication (e.g., IR LEDs)

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4. LCD (Liquid Crystal Display, 16×2 with I2C module)

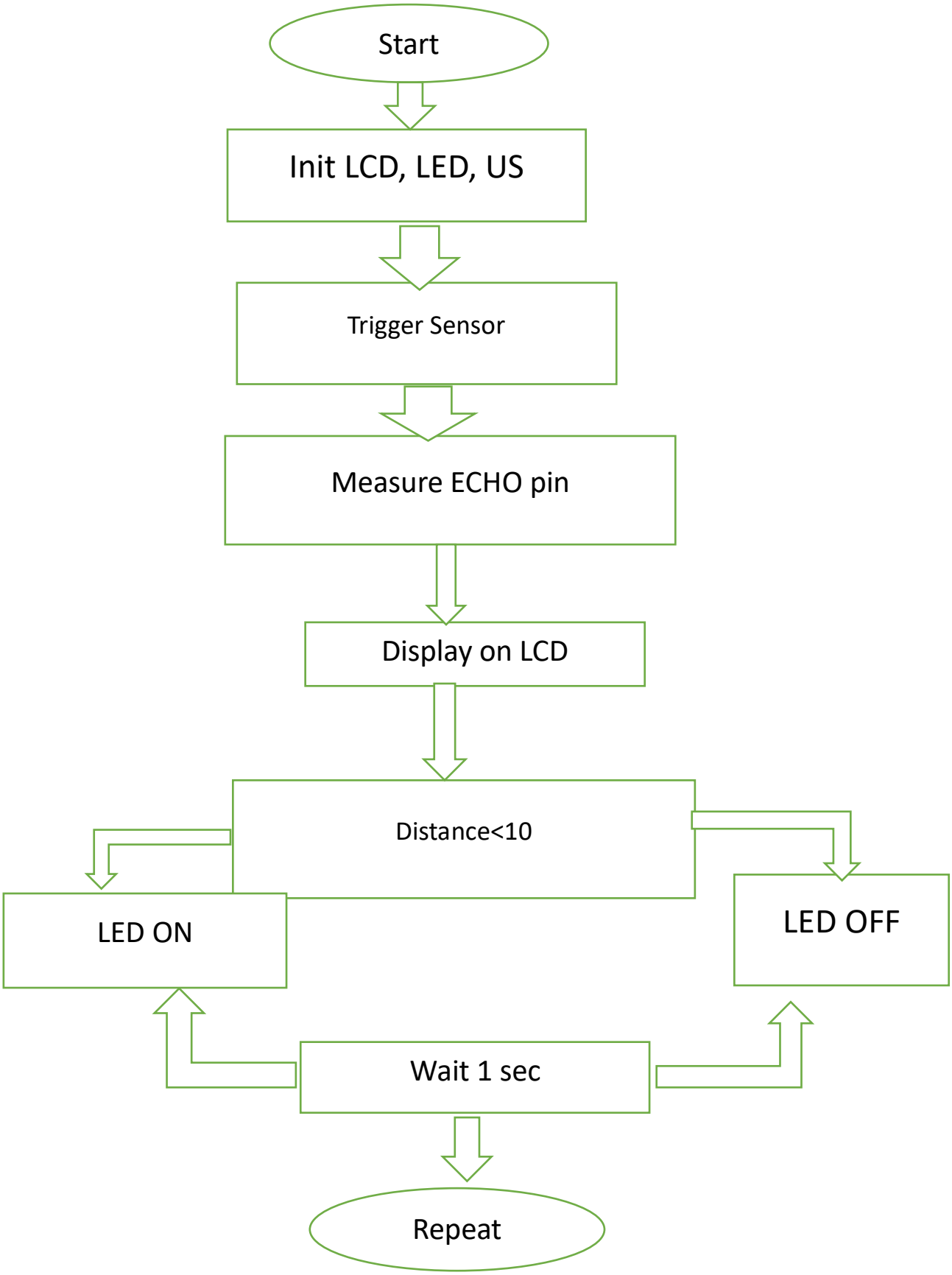
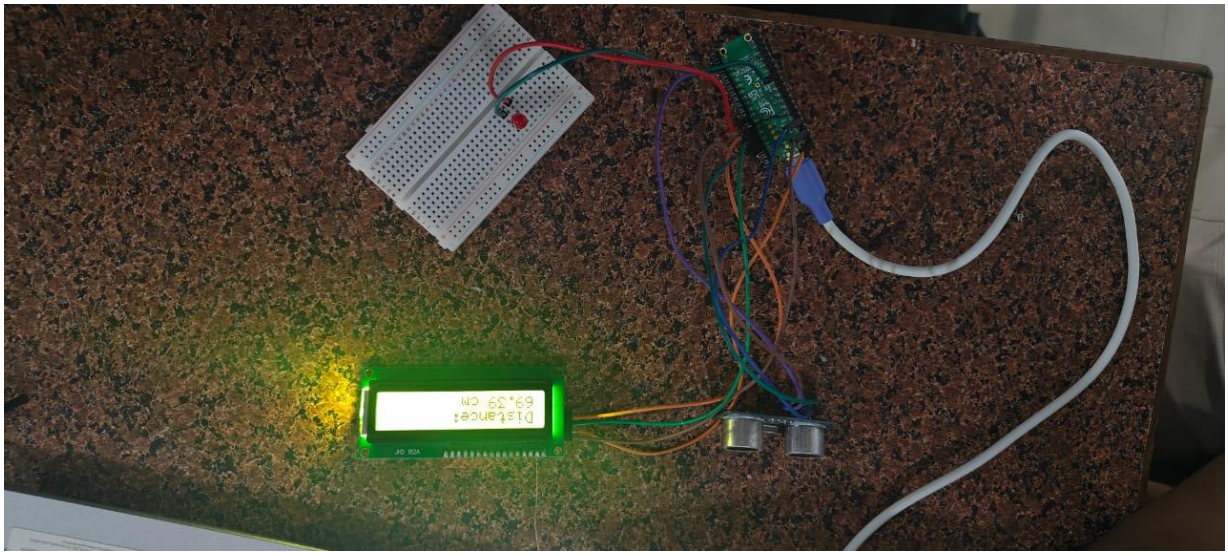
- Definition:
  A character-based display used to show text output. The 16×2 LCD can display 16 characters per line across 2 lines. With the I2C adapter, it communicates using only two data pins (SDA & SCL).
- Range / Specs:
  - Characters: 16 per line × 2 lines
  - Supply Voltage: 5 V (some modules support 3.3 V)
  - Communication: I2C (2 wires) or parallel (8/4-bit)
- Applications:
  - Displaying sensor readings
  - User interfaces in embedded systems
  - Menu navigation and status indication

PIN TABLE :

COMPONENTS	PIN TO CONNECT	CONNECT TO
Ultrasonic Sensor	ECHO PIN	GP2
	Trigger PIN	GP3

LED	Anode	GP25
	Cathode	GND
LCD	VCC	3.3V
	GND	GND
	SDA	GP4
	SCL	GP5

FLOWCHART:


Start
Init LCD, LED, US
Trigger Sensor
Measure ECHO pin
Display on LCD
Distance<10
LED ON
LED OFF
Wait 1 sec
Repeat

EXECUTION :