EMBEDDED SYSTEMS

DIGITAL ASSIGNMENT - 1

WINTER SEMESTER 2023 - 2024

COURSE CODE : BCSE305L
SLOT : A2 + TA2

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PROBLEM STATEMENT :

Find whether the obstacle is present or not. If it exists then calculate the distance between the sensor and the object using Ultrasonic sensor.

OBJECTIVE :

Calculate the distance using Ultrasonic sensor and display it using Liquid Crystal Display (LCD).

HARDWARE REQUIREMENTS :

1. **Arduino Uno Board -** It is used to integrate the hardware components with software. Mainly it focus on reading the input from the sensor and doing some actions based on our input through the software.
2. **Ultrasonic Sensor -** It is used to calculate the distance between the object and the sensor by sending and receiving the ultrasonic sound waves.

   Pin Configuration of Ultrasonic ,
   1 - Vcc - The Vcc pin powers the sensor, typically with +5V
   2 - Trigger - Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.
   3 - Echo - Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
   4 - Ground - This pin is connected to the Ground of the system.

   Features of Ultrasonic :

   Operating voltage: +5V
   Theoretical Measuring Distance: 2cm to 450cm
   Practical Measuring Distance: 2cm to 80cm
   Measuring angle covered: <15°
   Operating Current: <15mA
   Operating Frequency: 40Hz

3. **LCD -** To display the output Visually Through the Liquid Crystal Display.

   Pin Configuration of LCD ,
   Pin1 (Ground/Source Pin): This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.
   Pin2 (VCC/Source Pin): This is the voltage supply pin of the display, used to connect the supply pin of the power source.

Pin3 (V0/VEE/Control Pin): This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.

Pin4 (Register Select/Control Pin): This pin toggles among command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).

Pin5 (Read/Write/Control Pin): This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).

Pin 6 (Enable/Control Pin): This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit & constantly held high.

Pins 7-14 (Data Pins): These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller unit like 0 to 7.

Pin15 (+ve pin of the LED): This pin is connected to +5V

Pin 16 (-ve pin of the LED): This pin is connected to GND.

Features of LCD:

The operating voltage of this LCD is 4.7V-5.3V

It includes two rows where each row can produce 16-characters.

The utilization of current is 1mA with no backlight

Every character can be built with a 5×8 pixel box

The alphanumeric LCDs alphabets & numbers

4. **Wires -** To connect the components as per our requirements.
5. **LEDs -** (Optional) To display the variation of outputs by make the LEDs blinking in different ways.
6. **Resistors -** It is for connecting the LEDs.
7. **BreadBoard -** It is used to connect all the components without interfere each other and for easy understanding of the connection.
8. **USB Cable -** It is used to connect the Arduino board with the computer.

SOFTWARE REQUIREMENTS :

1. **Laptop/PC -** To download the Arduino software.
2. **Arduino -** Download the Arduino software according to your computer requirements from the web. After downloading, install the same by double clicking the downloaded file. Once installed, open the software, where you can write your code. If you are connect your Laptop/PC with Arduino board then you need to select the board and port. To select the board go to the tools -> board -> Arduino Uno. To select the port go to the tools -> port -> Select the port number which is shown in that pop-up. After that your work is to type the code as per your need then click the compile and upload option one by one.

WORKING PRINCIPLE OF ULTRASONIC :

Ultrasonic sensors operate by emitting sound waves at frequencies that are too high for humans to hear. The sensor's transducer serves as a microphone to receive and transmit ultrasonic sound. They also use a single transducer to send and receive pulses. Further, the sensor measures the total time taken to deliver and receive an ultrasonic pulse and calculates the target's distance.

The working principle of an ultrasonic sensor revolves around the emission and reception of high-frequency sound waves. These waves range from 20 kHz which is beyond the range of human hearing.

1. **Emitting Sound Waves:** The ultrasonic sensor generates a burst of ultrasonic sound waves, usually in the range of 20 kHz to 65 kHz. These sound waves travel through the air towards the target object.
2. **Bouncing Off Objects:** When the sound waves encounter an object in their path, they bounce off the surface of the object.
3. **Measuring the Return Time:** The sensor measures the time it takes for the emitted sound waves to bounce back after hitting the object. This time interval is extremely short, typically measured in microseconds.
4. **Calculating Distance:** The sensor figures out how far an object is by using the speed of sound in the air. It does this by multiplying the time it takes for sound waves to go to the object and then coming back by the speed of sound.
5. **Output Data:** Last, the sensor provides this distance information as an output, which can be used in various applications, such as obstacle detection, object positioning, or navigation.