

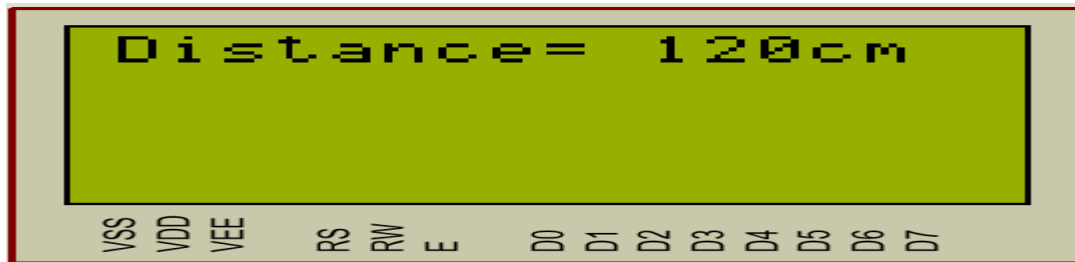
## Mini Project 4

### System Requirements

Implement the following system to measure the distance using ultrasonic sensor

HC-SR04 with the specifications listed below:

1. Use **ATmega32** Microcontroller with frequency **8Mhz**.
2. Measure the distance using the Ultrasonic sensor HC-SR04. Check the “**HC-SR04 Ultrasonic MT Student Tutorial**” pdf file to understand how to interface with this sensor.
3. The LCD should display the distance value like that:



4. The project should be design and implemented based on the layered architecture model as follow:



## GPIO Driver Requirements

1. Use the Same GPIO driver implemented in the course.

## ICU Driver Requirements

1. Use the Same ICU driver implemented in the course.
2. The ICU should be configured with frequency  **$F_{CPU}/8$**  and to detect the **raising edge** as the first edge.
3. **ICU\_init** and **ICU\_setCallBack** functions should be called inside the **Ultrasonic\_init** function.

## LCD Driver Requirements

1. Use 4x16 LCD.
2. Use the Same LCD driver implemented in the course with 8-bits data mode.
3. Connect the LCD control pins and 8-bits data pins as follow:
  - **RS → PB0**
  - **RW → PB1**
  - **E → PB2**
  - **Data Bus → all PORTA pins.**

## Ultrasonic Driver Requirements

1. Implement a full ultrasonic Driver using ATmega32 ICU driver.
2. The ultrasonic driver has 3 functions:
  - a. **void Ultrasonic\_init(void)**
    - **Description**
      - Initialize the ICU driver as required.
      - Setup the ICU call back function.
      - Setup the direction for the trigger pin as output pin through the GPIO driver.
    - **Inputs:** None
    - **Return:** None

**b. void Ultrasonic\_Trigger(void)**

- **Description**
  - Send the Trigger pulse to the ultrasonic.
- **Inputs: None**
- **Return: None**

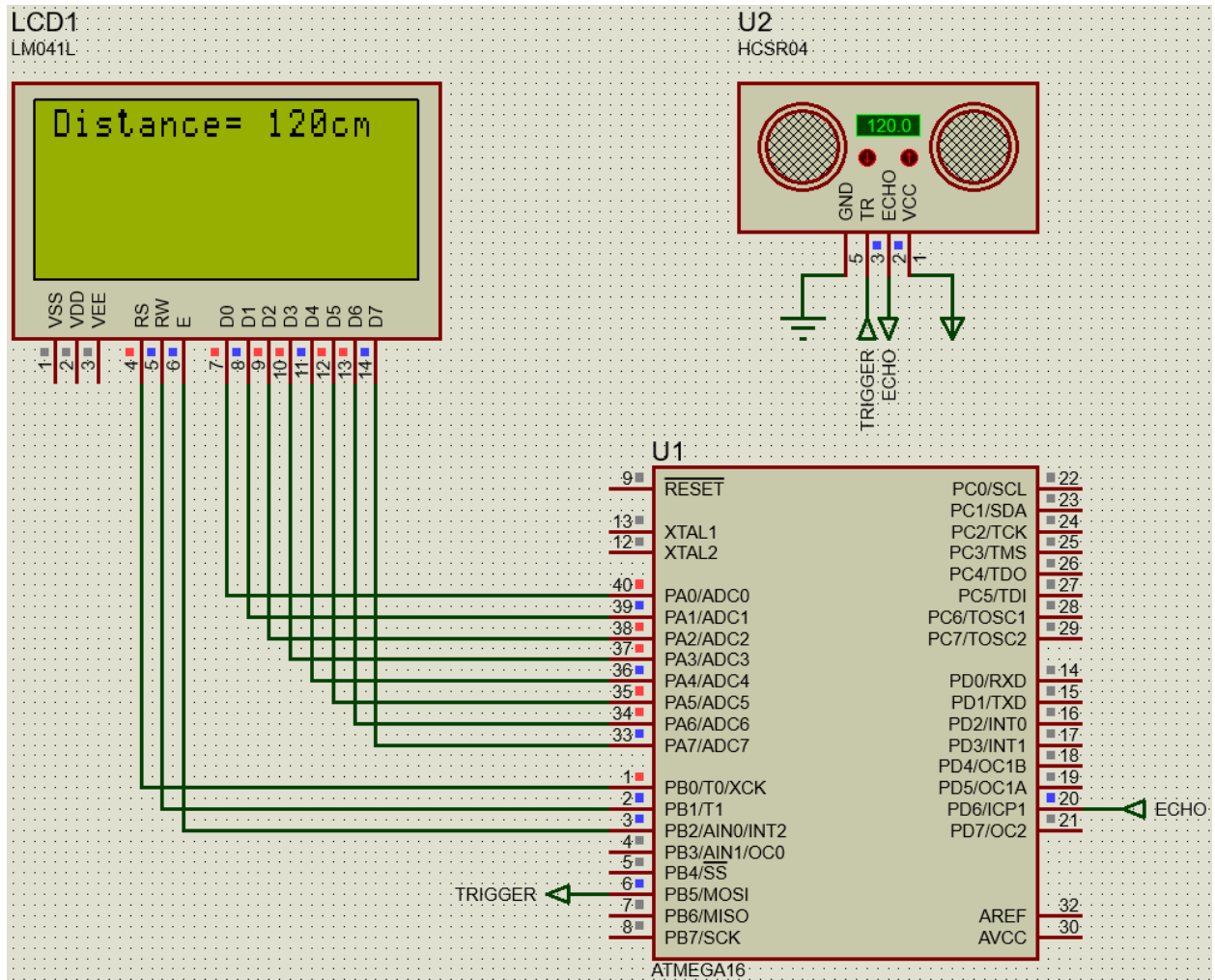
**c. uint16 Ultrasonic\_readDistance(void)**

- **Description**
  - Send the trigger pulse by using **Ultrasonic\_Trigger** function.
  - Start the measurements by the ICU from this moment.
- **Inputs: None**
- **Return:** The measured distance in Centimeter.

**d. void Ultrasonic\_edgeProcessing(void)**

- **Description**
  - This is the call back function called by the ICU driver.
  - This is used to calculate the high time (pulse time) generated by the ultrasonic sensor.
- **Inputs: None**
- **Return: None**

## The Project Hardware Connections



*Thanks and Good Luck*  
*Eng / Mohamed Tarek*