

TED UNIVERSITY

2023 Fall

CMPE 453 Embedded Systems

LAB REPORT # 2

**Lab Name:** UART Communication between Host PC  
and Atmega328p microcontroller on ArduinoUno  
Board

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**Section:** 2

**Instructor's Name:** Prof. Saiful Islam

## I. Tasks

Firstly, a working physical circuit was established with Arduino Uno, a breadboard, a 7-segment display, resistors and jumper wires. Then, the ATMEGA328p microcontroller was programmed in C programming language with Arduino IDE to develop an embedded system which could accept a character between 0 and 9 from the serial monitor of host PC and display this on the seven segment display.

There were a few important conditions to consider:

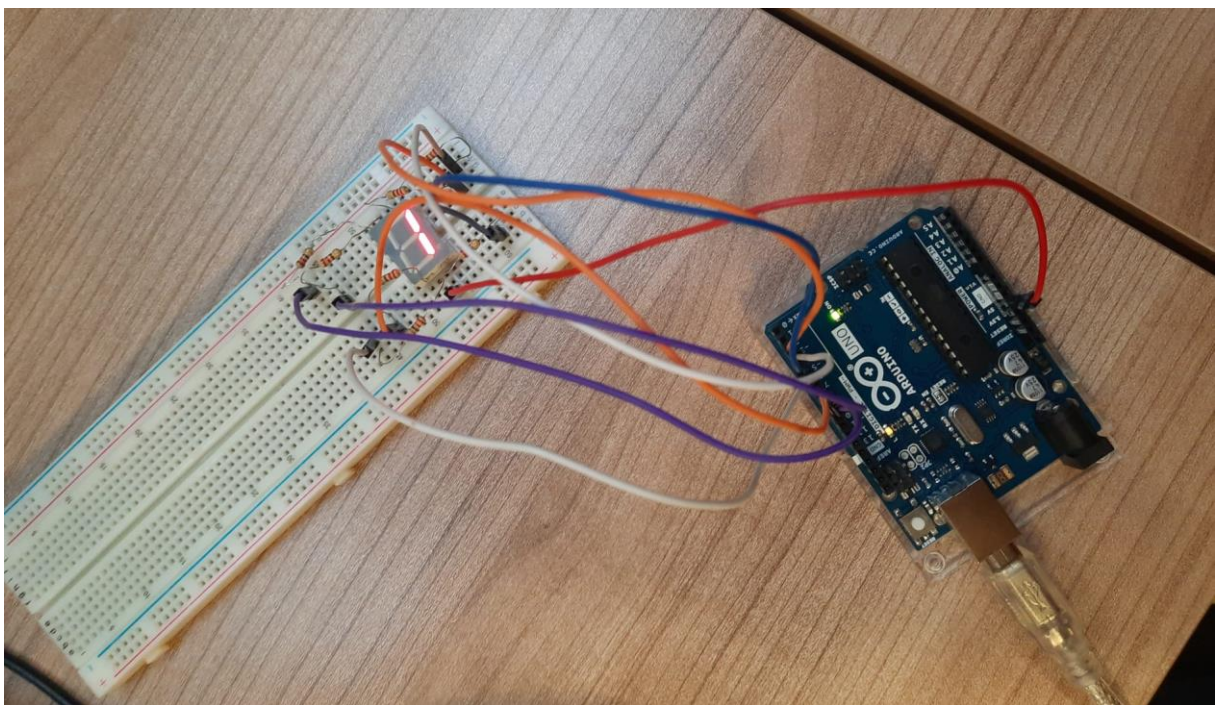
- UART settings:
  - Baud Rate 9600,
  - Normal asynchronous mode,
  - 8 data bits per UART frame,
  - 1 start , 1 stop and 1 parity bit.
- The microcontroller should send a prompt message “Connected: Please send a number between 0 and 9”.
- Then the microcontroller should wait for a character to be received from serial port. If character is received code should verify if it is between 0-9.
  - If valid: number should be displayed to the seven segment display with “You entered succesfully” message.
  - If invalid: transmit a message “Invalid Character: send again”
- When “3” entered 7-segment display should show 3,2,1,0 with delay(1000).

## II. Hardware Implementation

Connections were made as per the provided instructions. In the image below, it can be observed that 8 of the jumper wires with the  $220\Omega$  resistors were connected to the 7-segment display as specified.

Additionally, digital pins on the Arduino (PORTD and PORTB) were utilized to establish communication between the breadboard and the Arduino. These pins can have two distinct values: HIGH (1) or LOW (0). With these values, the 7-segment display and LEDs operated in accordance with the code.

- 7 ports for each segment (a, b, c, d, e, f, g)
- 1 port for the common anode ("COM") to 5V



*Figure 1 - Arduino and breadboard, with the necessary connections provided and working as desired. ( November 13, 2023 Lab-2)*

### III. Code

The Arduino code is designed to create an embedded system that communicates with a host computer via UART

**void setup() :** This function initializes the setup for the Arduino. It configures the ports as outputs, sets all initial states for PORTD and PORTB pins as HIGH (1), and initializes serial communication with **Serial.begin(9600)** ;while setting BAUD rate to 9600. Also Waits until serial communication is established with the **while (!Serial) ;**.

**void loop() :** This function continuously checks for available characters in the serial buffer. If a character is available, it checks if it is a valid digit between 0 and 9.

- If valid, it displays the digit on the seven-segment display.
- If an invalid character is entered, it prompts the user to send a valid one.
- If the digit is “3”, it displays 3, 2, 1, 0 sequentially with a delay of 1 second [delay(1000)].

Overall, this code aims to create a simple embedded system showcasing UART communication and seven-segment display functionality on an Arduino Uno.

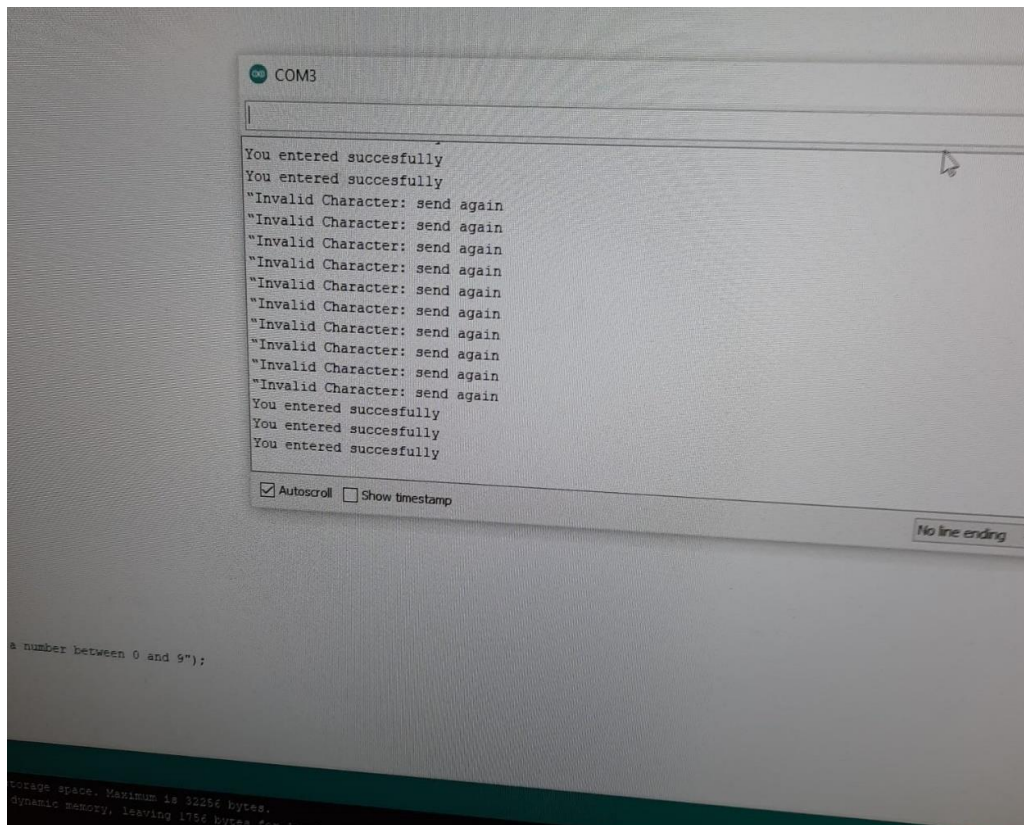


Figure 2 - Microcontroller transmits message to host computer accordingly to the input ( November 13, 2023 Lab-2)

#### **IV. Critical Analysis / Conclusion**

In conclusion, the UART communication and seven-segment display integration proved successful in the experiment. The microcontroller accurately processed input characters, displaying valid numbers on the seven-segment component and prompting for re-entry upon detecting invalid characters. The sequential display of “3, 2, 1, 0” in response to the input "3" demonstrated the microcontroller's capability to execute a specific sequence, adding a layer of dynamic behavior to the overall functionality.