PAMANTASAN NG LUNGSOD NG MAYNILA
(University of the City of Manila)
Intramuros, Manila

Microprocessor Lab

Laboratory Activity No. 2
Arduino and Tinkercad Interface

Score

Submitted by:
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S 1:00-7:00 / CPE 0412-2

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Submitted to:

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I. Objectives

This laboratory activity aims to implement the principles and techniques of hardware programming using Arduino through:

- creating an Arduino programming and circuit diagram.

II. Method/s

- Perform a task problem given in the presentation.
- Write a code and perform an Arduino circuit diagram of a ring counter that display eight (8) LEDs starting from left.

III. Results

Exercise 1: Write a code that does a ring counter display for eight (8) LEDs starting from left.

Tinkercad:

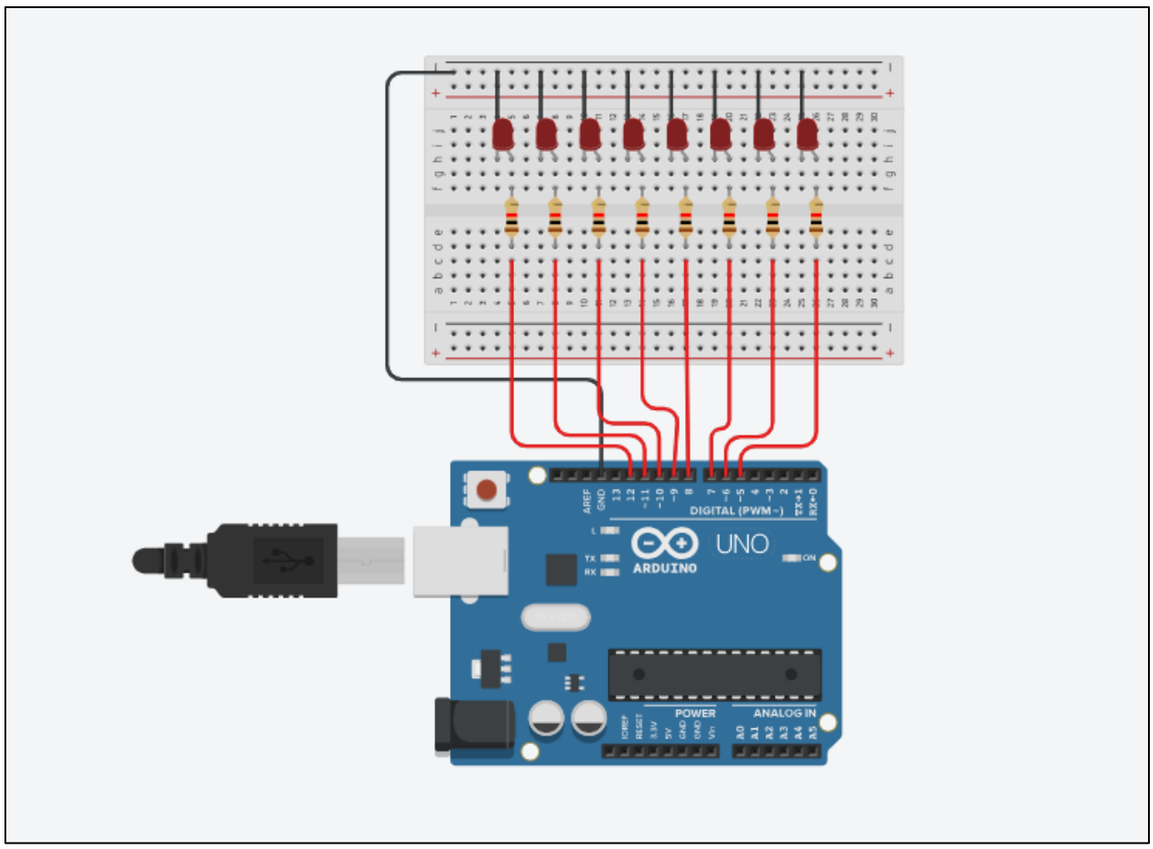

Figure No.1 Ring Counter Display Circuit Diagram

To simulate, please refer to this link: https://www.tinkercad.com/things/anbHw72p4wI-lab-2/editel?sharecode=cc-i-cIMwGSToh90Z6_1Wn5Wra38EkrSobixyZ0VqOQ

Components Used

1. 8 LEDs
2. Resistor
3. Breadboard

Code:

```
// C++ code
//
/*
Ring counter display for eight (8) LEDs starting from left.
*/

void setup()
{
  Serial.begin(9600);
  pinMode(5, OUTPUT);
  pinMode(6, OUTPUT);
  pinMode(7, OUTPUT);
  pinMode(8, OUTPUT);
  pinMode(9, OUTPUT);
  pinMode(10, OUTPUT);
  pinMode(11, OUTPUT);
  pinMode(12, OUTPUT);
}

void loop()
{
  digitalWrite(12, HIGH);
  delay(500);
  Serial.println("The LED1 is HIGH");
  digitalWrite(12, LOW);
  delay(500);
  Serial.println("The LED1 is LOW");

  digitalWrite(11, HIGH);
  delay(500);
  Serial.println("The LED2 is HIGH");
  digitalWrite(11, LOW);
  delay(500);
  Serial.println("The LED2 is LOW");

  digitalWrite(10, HIGH);
  delay(500);
  Serial.println("The LED3 is HIGH");
  digitalWrite(10, LOW);
  delay(500);
  Serial.println("The LED3 is LOW");

  digitalWrite(9, HIGH);
  delay (500);
  Serial.println("The LED4 is HIGH");
  digitalWrite(9, LOW);
  delay(500);
  Serial.println("The LED4 is LOW");

  digitalWrite(8, HIGH);
  delay(500);
  Serial.println("The LED5 is HIGH");
  digitalWrite(8, LOW);
  delay(500);
  Serial.println("The LED5 is LOW");

  digitalWrite(7, HIGH);
  delay (500);
  Serial.println("The LED6 is HIGH");
  digitalWrite(7, LOW);
  delay(500);
  Serial.println("The LED6 is LOW");
```

```
  digitalWrite(6, HIGH);
  delay (500);
  Serial.println("The LED7 is HIGH");
  digitalWrite(6, LOW);
  delay(500);
  Serial.println("The LED7 is LOW");

  digitalWrite(5, HIGH);
  delay (500);
  Serial.println("The LED8 is HIGH");
  digitalWrite(5, LOW);
  delay(500);
  Serial.println("The LED8 is LOW");
}
```

IV. Conclusion

This experiment focused on constructing a ring counter that sequentially lights 8 LEDs from left to right. In digital logic circuits, ring counters have an output of the flip-flop connected to the input of the flip-flop. They are assembled using shift registers, similar to shift counters [2]. Ring counters are categorized into two types: straight ring type and twisted ring counter. The straight ring type counter's result from the concluding flip-flop is looped back as input to the initial flip-flop. In contrast, the twisted ring counter's inverted result from the concluding flip-flop is provided as input to the initial flip-flop in a feedback loop [3].

The experiment followed the working principle of a straight ring type. Eight LEDs were lined up side by side, and each cathode leg was connected to the ground. In contrast, each anode leg was connected to a corresponding digital pin in the Arduino Uno R3, regulated by a 1kΩ resistor. Complementing the circuit is a code where pinModes are initialized in the setup function. Meanwhile, the code in the loop function dictates when an LED will turn on or off and the delay between each operation. In addition, the serial monitor is also functional to verify which LED is in high or low states. The output shows a sequential blinking of LEDs from left to right, similar to a ring counter. It also has a constant delay of 500 ms per change of state. In general, ring counters have many use cases, including digital clocks, traffic light control, industrial automation, LED displays, scrolling text displays, address decoders, control logic, etc., which require sequencing, pattern generation, decoding, and frequency division. However, constant sequence lengths and glitches may occur during shifting [4].

References

[1] D.J.D. Sayo. “University of the City of Manila Computer Engineering Department Honor Code,” PLM-CpE Departmental Policies, 2020.
[2] GeeksforGeeks, “Ring counter in digital logic,” *GeeksforGeeks*, Jan. 2023. https://www.geeksforgeeks.org/ring-counter-in-digital-logic/
[3] T. Agarwal, “Ring Counter : Working, Classification and its Applications,” *ElProCus - Electronic Projects for Engineering Students*, Mar. 07, 2020. https://www.elprocus.com/ring-counter-in-process/
[4] M. Dham, “Ring counter in digital logic,” *PrepBytes Blog*, Aug. 30, 2023. https://www.prepbytes.com/blog/digital-electronics/ring-counter-in-digital-logic/
[5] “Blink,” *Arduino*. https://www.arduino.cc/en/Tutorial/BuiltInExamples/Blink