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

Microprocessor Lab

Laboratory Activity No. 3

Binary Representation of 8 LEDs in TinkerCad and Arduino Programming

Score

Submitted by:
De Guzman, April Yzabelle M.
S 7:00 am – 1:00 pm / CPE 0412

Date Submitted
10-07-2023

Submitted to:

Engr. Maria Rizette H. Sayo

I. Objectives

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

- To create Arduino circuit of Binary Representation (decimal 0-256 using 8 LEDs)
- To comprehend the concept of binary representation and how it relates to digital systems
- To navigate and utilize the TinkerCad platform for designing and simulating circuits
- To demonstrate the binary representation of numbers using the 8 LEDs
- To analyze the results of the binary representation using LEDs

II. Method/s

- Perform a task problem given in the presentation.
- Write a code and perform an Arduino circuit diagram of a binary representation (decimal 0-256 using 8 LEDs).
- Components Used:
  - Arduino
  - Breadboard
  - 8 LEDs
  - Resistors
  - Jumper wires

III. Results

TinkerCad Link:

https://www.tinkercad.com/things/atbBXUQJiyK-terrific-krunk/editel?tenant=circuits

Diagram:

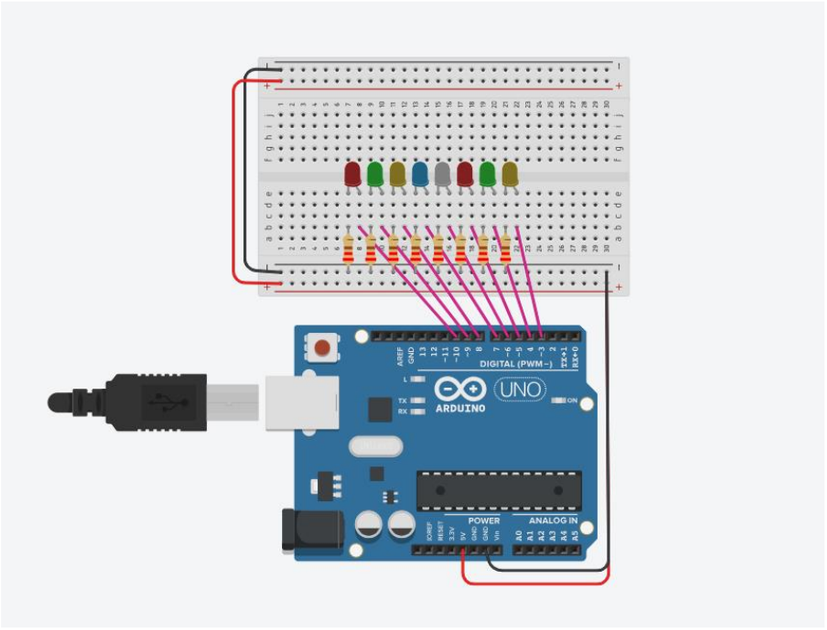

Figure No.1 Binary Representation Circuit Diagram

Code:

```
void setup() {
  // Set all LED pins as outputs
  pinMode(3, OUTPUT);
  pinMode(4, OUTPUT);
  pinMode(5, OUTPUT);
  pinMode(6, OUTPUT);
  pinMode(7, OUTPUT);
  pinMode(8, OUTPUT);
  pinMode(9, OUTPUT);
  pinMode(10, OUTPUT);
  Serial.begin(9600); // Initialize Serial Monitor
}

void loop() {
  for (int decimal = 0; decimal <= 256; decimal++) {
    displayBinary(decimal);
    Serial.println(decimal, BIN); // Print the binary representation to Serial Monitor
    delay(1000); // Delay for 1 second between numbers
  }
}

void displayBinary(int decimal) {
  digitalWrite(3, (decimal & 0x01) != 0);  // Set pin 3 based on the least significant bit
  digitalWrite(4, (decimal & 0x02) != 0);  // Set pin 4 based on the second least significant bit
  digitalWrite(5, (decimal & 0x04) != 0);  // Set pin 5 based on the third least significant bit
  digitalWrite(6, (decimal & 0x08) != 0);  // Set pin 6 based on the fourth least significant bit
  digitalWrite(7, (decimal & 0x10) != 0);  // Set pin 7 based on the fifth least significant bit
  digitalWrite(8, (decimal & 0x20) != 0);  // Set pin 8 based on the sixth least significant bit
  digitalWrite(9, (decimal & 0x40) != 0);  // Set pin 9 based on the seventh least significant bit
  digitalWrite(10, (decimal & 0x80) != 0); // Set pin 10 based on the most significant bit
}

```

Serial Monitor

Figure No.2 Code for Binary Representation

Code using for loop:

```

void setup() {
  for (int i = 3; i <= 10; i++) {
    pinMode(i, OUTPUT); // Set all LED pins as outputs
  }
  Serial.begin(9600); // Initialize Serial Monitor
}

void loop() {
  for (int decimal = 0; decimal <= 256; decimal++) {
    displayBinary(decimal);
    Serial.println(decimal, BIN); // Print the binary representation to Serial Monitor
    delay(1000); // Delay for 1 second between numbers
  }
}

void displayBinary(int decimal) {
  for (int i = 3; i <= 10; i++) {
    int bit = (decimal >> (i - 3)) & 0x01; // Extract the i-th bit from the right
    digitalWrite(i, bit);
  }
}

```

Figure No.3 Code for Binary Representation using for loop

Serial Monitor Output:

Serial Monitor

```
0
1
10
11
100
101
110
111
1000
1001
1010
1011
1100
1101
1110
1111
```

Figure No.4 Serial Monitor Output

Sample Output:

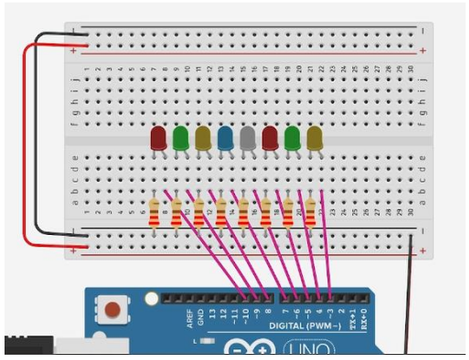

Figure No. 5 Binary 0 (0)

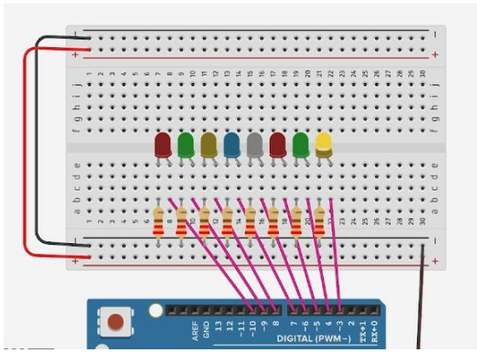

Figure No. 6 Binary 1 (1)

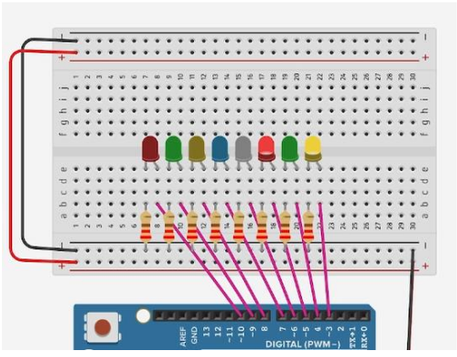

Figure No. 7 Binary 101 (5)

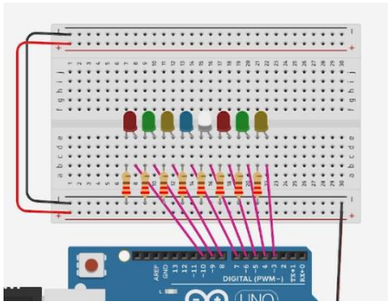

Figure No. 8 Binary 1000n(8)

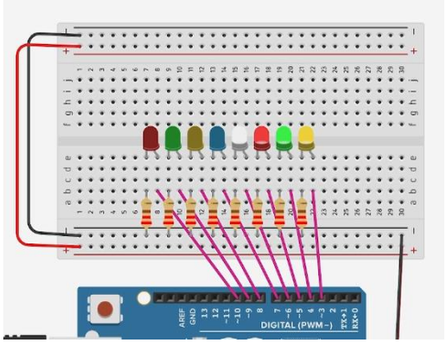

Figure No. 9 Binary 1111 (15)

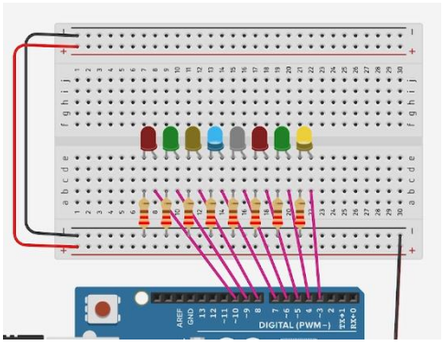

Figure No. 10 Binary 10001 (17)

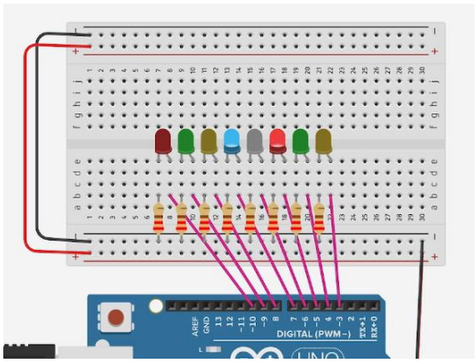

Figure No. 11 Binary 10100 (20)

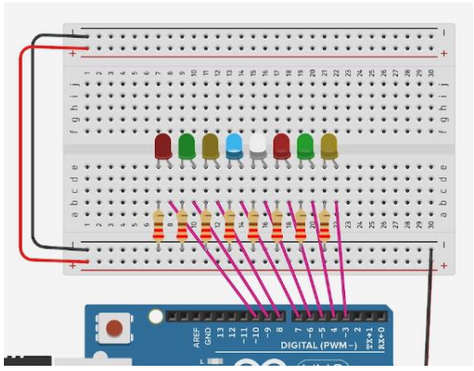

Figure No. 12 Binary 11000 (24)

IV. Conclusion

In conclusion, this laboratory activity has accomplished its main goals by giving a thorough and practical introduction to Arduino hardware programming. Using an Arduino circuit and a set of 8 LEDs, we successfully represented binary integers from 0 to 256. Through this hands-on activity, we could comprehend how hardware programming ideas are applied in the real world.

The laboratory experiment has effectively illustrated the principle of binary counting through the utilization of an Arduino Uno microcontroller. This experiment leverages light-emitting diodes (LEDs) to symbolize individual bits within a binary number, offering a tangible and visual representation of how binary counting functions. In this setup, the state of each LED, whether it is illuminated (on) or not (off), corresponds to a particular binary bit, with 1 representing an illuminated LED and 0 representing a non-illuminated one. As the binary counter increments, the pattern of lit LEDs dynamically changes to mirror the binary representation of the current numerical value. This transformation in the LED arrangement provides a clear and intuitive way to understand how binary numbers progress and evolve with each count.

Moreover, this experiment also serves as a practical demonstration of the application of bitwise operations in programming. It showcases how these operations can be used to manipulate and extract specific bits from a numerical value, a crucial skill in various programming tasks and digital systems. In essence, it not only teaches binary counting but also underscores the practical relevance of bitwise operations in real-world programming scenarios. This hands-on approach makes the concept more engaging and accessible for learners, enhancing their understanding of both binary counting and bitwise operations.

In conclusion, the laboratory exercise helped us better understand the fundamental ideas behind digital systems while also imparting technical abilities in hardware programming. It gave us useful skills and information that would help with future programming and electronics projects and allow us to work efficiently with digital systems and circuits.

References

[1] D.J.D. Sayo. “University of the City of Manila Computer Engineering Department Honor Code,” PLM-CpE Departmental Policies, 2020.

[2] Binary Representations in Digital Logic. (2022). Retrieved from https://www.geeksforgeeks.org/binary-representations-in-digital-logic/

[3] Pauli, S. (n.d.). MAT 112 Integers and Modern Applications for the Uninitiated. Retrieved from https://mathstats.uncg.edu/sites/pauli/112/HTML/secbinary.html

[4] Marian, P. (2022). Arduino 8 bit Binary LED Counter. Retrieved from https://www.electroschematics.com/arduino-8-bit-binary-led/