MECHATRONICS SYSTEM INTEGRATION

WEEK TWO: SEVEN-SEGMENT DISPLAY WITH A PUSH BUTTON

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DATE OF SUBMISSION: 17/3/2025

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Abstract

This experiment aimed to take a practical approach in applying basic digital logic design knowledge, by setting up a 7-segment display that counted from 0 to 5, when a push button was pressed. A 7-segment display was set up and connected to a push button, via an Arduino board, which acted as an interface between the 7-segment display and the push button. After interfacing the two components, it was observed that, while the 7-segment display did respond to the button being pushed, the numbers that appeared on the display weren't 0 to 5. Instead, the LEDs inside the display lit up in random order, before settling back to 0. While the wiring and code were correct, the display still failed to light up according to the code's instructions. This could indicate that the components were faulty.

Introduction

The experiment was conducted in order to apply basic digital logic design principles, through a practical approach. 7-segment displays have eight (including the decimal point) LEDs integrated into its circuit, 7 of which are used to display different numbers from 0 to 9. In order to achieve this, each LED lights up according to the structure of each number. The LEDs that light up have a logic of 1 or HIGH, while the LEDs that don't light up have a logic of 0 or LOW. From this, a truth table can be formed for the numbers 0 to 9, indicating which LEDs need to be lit up, in order to form the corresponding numbers. To allow this, a signal is sent from an external source, such as the push button used in this experiment.

What was expected from this experiment was for the 7-segment display to light up from 0 to 5, with a 500ms delay between each number, when the push button was pressed.

Equipment

- Arduino Uno board
- Common cathode 7-segment display
- 220-ohm resistors (7 of them)
- Pushbuttons (2 or more)
- Jumper wires
- Breadboard

Experiment Setup

1. Build the circuit according to the circuit setup instructions.
2. Upload the provided Arduino code to your Arduino Uno.
3. Open the Serial Monitor in the Arduino IDE.
4. Press the increment button to increase the count. The 7-segment display should show the numbers from 0 to 5 sequentially.
5. Press the reset button to reset the count to 0.

Circuit Set-Up

Connect the common cathode 7-segment display to the Arduino Uno as follows:
- Connect each of the 7 segments (a, b, c, d, e, f, g) of the display to separate digital pins on the Arduino (e.g., D0 to D6).
- Connect the common cathode pin of the display to one of the GND (ground) pins on the Arduino.
- Use 220-ohm resistors to connect each of the segment pins to the Arduino pins to limit the current.

Connect the pushbuttons to the Arduino:
- Connect one leg of each pushbutton to a separate digital pin (e.g., D9 and D10) and connect the other leg of each pushbutton to GND.
- Use 10K-ohm pull-up resistors for each pushbutton by connecting one end of each resistor to the digital pin and the other end to the 5V output of the Arduino

Methodology

a) Setup
Setup started with Arduino UNO being connected to the pin Number 6,pin 8 being connected with the Common Cathode while pin Number pin 9,pin7, pin 5, pin 4, pin 3 connected related to the resistor (1.2kOhm) and 5V being connected between resistor beneath the common Cathode.
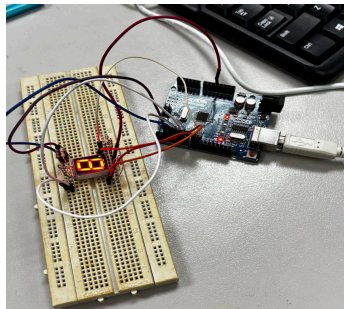
Results

When initiating the process, all 7 segments lit up, when only the first portion of the code was tested. However, when the button was pressed and the rest of the code was tested, the display responded accordingly. Yet, instead of showing the numbers 0 to 5, the LEDs lit up in random order, with no indication of the desired output.

Discussion

Analyzing the results, it was observed that the desired output was not achieved. The expected results were that the display would change from 0 to 5, with the corresponding LEDs lighting up accordingly, but the LEDs lit up in random order, not showcasing any of the numbers properly.

While there are many reasons for this, one of them could be that some of the components might have been damaged from prior use.

- <u>Question</u>

    1) In order to interface an I2C LCD board with an Arduino, the two interfacing pins of the I2C must be connected to two analog inputs.
    2) I2Cs have libraries, unlike 7-segment displays, which significantly simplifies the coding process
    3) In short, I2Cs use less code than 7-segment displays, as 7-segment displays need to have each LED's on/off state manually written into the code, depending on what number it needs to display, unlike I2Cs, which make use of predetermined code.
    4) As for matrix displays, their code is more complicated, as it requires bit manipulation.

Conclusion

The experiment on interfacing a 7-segment display with an Arduino successfully demonstrated how numerical values can be displayed sequentially, from 0 to 5. By properly connecting the display to the Arduino's digital output pins and writing a suitable program, the correct segments were activated to form each digit. This experiment provided a hands-on understanding of how 7-segment displays work, including their pin configurations, common anode/cathode types, and the importance of correctly managing digital signals to control each segment.

Additionally, the implementation of a counting sequence helped reinforce the concept of timing delays and loop structures in Arduino programming. The experiment also highlighted practical challenges, such as ensuring proper wiring connections and debugging potential display errors. Overall, this project serves as a fundamental step toward more advanced display applications, such as multi-digit displays, alphanumeric outputs, and real-world applications like electronic counters, digital clocks, and temperature displays.

Recommendations

a)Improvement
 - Optimising power consumed by adjusting resistor values to balance brightness and the efficiency of the 7- segment .
-Making a display on 7 segment continuous after the first click and stop after the second click that might offer a stopwatch concept.

b) Insight
- The shortcut of how looping in a coding can offer help in reducing commands and making the array looks cleaner

Reference

-https://projecthub.arduino.cc/stannano/one-digit-7-segment-led-display-819bcd
-https://www.instructables.com/Using-a-4-digit-7-segment-display-with-arduino/

Appendix

Code

```
// Define the pins for each segment (D0 to D6)
const int segmentA = 2; // D0

const int segmentB = 3; // D1

const int segmentC = 4; // D2

const int segmentD = 5; // D3

const int segmentE = 6; // D4

const int segmentF = 7; // D5

const int segmentG = 8; // D6

const int PB = 10; //push button

void setup() {
 // Initialize the digital pins as OUTPUTs
 pinMode(PB, INPUT);
 pinMode(segmentA, OUTPUT);
 pinMode(segmentB, OUTPUT);
 pinMode(segmentC, OUTPUT);
 pinMode(segmentD, OUTPUT);
```

```arduino
  pinMode(segmentE, OUTPUT);
  pinMode(segmentF, OUTPUT);
  pinMode(segmentG, OUTPUT);
}


// 0 = A,B,C,D,E,F
// 1 = B,C
// 2 = A,B,G,E,D
// 3 = A,B,C,D,G
// 4 = A,F,G,C,D


void loop() {

  int x = digitalRead(PB);

  if(x==1){
  // Turn on each segment one by one
  digitalWrite(segmentA, HIGH);
  digitalWrite(segmentB, HIGH);
  digitalWrite(segmentC, HIGH);
  digitalWrite(segmentD, HIGH);
  digitalWrite(segmentE, HIGH);
  digitalWrite(segmentF, HIGH);
  delay(500);
  digitalWrite(segmentA, LOW);
  digitalWrite(segmentB, LOW);
  digitalWrite(segmentC, LOW);
  digitalWrite(segmentD, LOW);
  digitalWrite(segmentE, LOW);
  digitalWrite(segmentF, LOW);


  delay(500);
  digitalWrite(segmentB, HIGH);
  digitalWrite(segmentC, HIGH);
  delay(500);
```

```
digitalWrite(segmentB, LOW);
digitalWrite(segmentC, LOW);


delay(500);
digitalWrite(segmentA, HIGH);
digitalWrite(segmentB, HIGH);
digitalWrite(segmentG, HIGH);
digitalWrite(segmentE, HIGH);
digitalWrite(segmentD, HIGH);
delay(500);
digitalWrite(segmentA, LOW);
digitalWrite(segmentB, LOW);
digitalWrite(segmentG, LOW);
digitalWrite(segmentE, LOW);
digitalWrite(segmentD, LOW);


delay(500);
digitalWrite(segmentA, HIGH);
digitalWrite(segmentB, HIGH);
digitalWrite(segmentC, HIGH);
digitalWrite(segmentD, HIGH);
digitalWrite(segmentG, HIGH);
delay(500);
digitalWrite(segmentA, LOW);
digitalWrite(segmentB, LOW);
digitalWrite(segmentC, LOW);
digitalWrite(segmentD, LOW);
digitalWrite(segmentG, LOW);


 delay(500);
digitalWrite(segmentA, HIGH);
digitalWrite(segmentF, HIGH);
digitalWrite(segmentG, HIGH);
digitalWrite(segmentC, HIGH);
digitalWrite(segmentD, HIGH);
```

```
delay(500);
digitalWrite(segmentA, LOW);
digitalWrite(segmentF, LOW);
digitalWrite(segmentG, LOW);
digitalWrite(segmentC, LOW);
digitalWrite(segmentD, LOW);


delay(500);
}// Delay for 1/2 second before repeating
}
```

Student Declaration Form

STUDENT'S DECLARATION

Certificate of Originality and Authenticity

This is to certify that we are responsible for the work submitted in this report, that **the original work** is our own except as specified in the references and acknowledgement, and that the original work contained herein have not been untaken or done by unspecified sources or persons.

We hereby certify that this report has **not been done by only one individual** and **all of us have contributed to the report**. The length of contribution to the reports by each individual is noted within this certificate.

We also hereby certify that we have **read** and **understand** the content of the total report and that no further improvement on the reports is needed from any of the individual contributors to the report.

We therefore, agree unanimously that this report shall be submitted for **marking** and this **final printed report** has been **verified by us**.

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