LAB REPORT 1: DIGITAL LOGIC SYSTEM

GROUP 1

MCTA 3203

SEMESTER 1 2024/2025

MECHATRONICS SYSTEM INTEGRATION

NO	NAME	MATRIC NO
1.	ABDUL A'LIM BIN MOHD RAJIB	2119687
2.	AHMAD HAZAMI BIN MOHD RAZIP	2211203
3.	ABDUL HADI BIN ZAWAWI	2210739
4.	AIN MAISARA BINTI ABDULLAH	2217856
5.	ADIBAH BINTI MOHD AZILAN	2212670

DATE OF SUBMISSION: 23RD OCTOBER 2024

ABSTRACT

This experiment aimed to interface a common cathode 7-segment display with an Arduino Uno to display numbers sequentially from 0 to 9. The methodology involved setting up the circuit by connecting the display to the Arduino using digital pins and resistors, programming the microcontroller to control the display, and using push buttons for manual counting. After uploading the appropriate code, pressing the increment button increased the displayed count, while pressing the reset button returned it to zero.

Key findings showed successful number display through proper segment activation, demonstrating effective interfacing techniques. The experiment concluded that understanding the basic principles of digital logic and interfacing enhances practical skills in electronics, providing a solid foundation for more complex projects in the future.

TABLE OF CONTENTS

1. INTRODUCTION

In electronics, the 7-segment display can offer a simple method for displaying numerical data. The seven individual segments that are found in the component are used to represent digits from 0 to 9. The common cathode configuration means all cathodes are connected to ground, while each segment is activated by applying a high signal. When the display is put together with a pushbutton and used with an Arduino Uno microcontroller, a digital counter is set up, allowing users to provide commands through simple interaction. The purpose of the task was to understand the interfacing of a 7-segment display with Arduino, focusing on basic logic gates and electronic circuit interfacing principles. It was expected that by correctly wiring the components and programming the Arduino, the display would successfully show numbers from 0 to 9 upon pressing designated buttons. The following report will highlight the methodology used in the experiment, the obtained results and further discussions on the findings with the conclusion regarding the significance of this project in the field of electronics and programming.

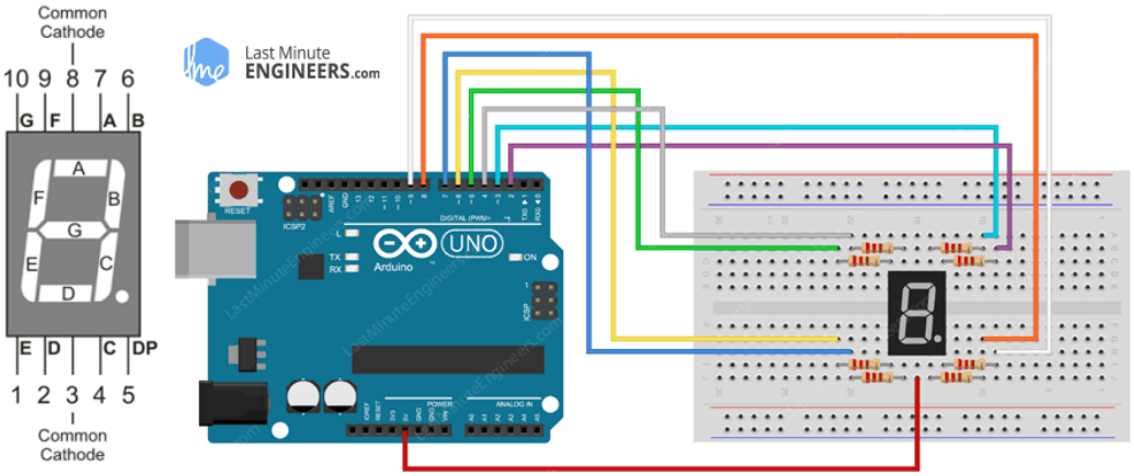
2. MATERIALS AND EQUIPMENT

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

3. EXPERIMENTAL SETUP

The circuit was set up on a breadboard as follows:

1. Each segment (a, b, c, d, e, f, g) of the 7-segment display was connected to separate digital pins (D0 to D6) on the Arduino.
2. The common cathode pin of the display was connected to one of the GND (ground) pins of the Arduino.
3. 220-ohm resistors were connected between the Arduino pins and the 7-segment segments to limit the current flowing to the LEDs.
4. Two pushbuttons were connected to digital pins D9 and D10 for incrementing the count and resetting it to 0.
5. 10K-ohm pull-up resistors were added to the pushbuttons by connecting one end of each resistor to the digital pin and the other end to the 5V output of the Arduino, to stabilize their inputs.



4. METHODOLOGY

PROCEDURES:

1. Circuit is built according to the instructions in the experimental setup.
2. Arduino code is uploaded to the Arduino Uno.
3. The Serial Monitor in the Arduino IDE is opened.
4. Increment button is pressed to increase the count. The 7-segment display should show the number from 0 to 9 sequentially.
5. The reset button is pressed to reset the count to 0.

5. DATA COLLECTION

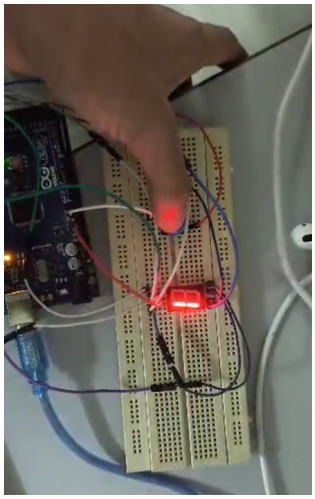
Observed outputs from the display when buttons were pressed consisted of the data collected:

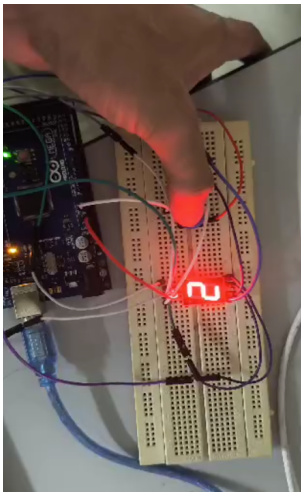
BUTTON PRESSED	DISPLAY OUTPUT
Increment	Sequentially counts from 0 to 9
Reset	Resets count back to 0

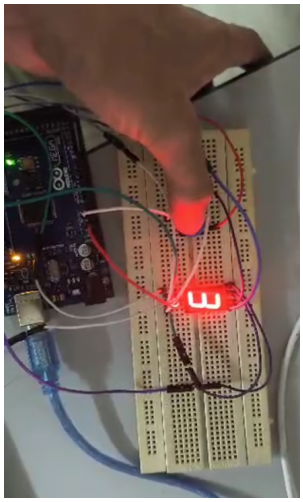
6. DATA ANALYSIS

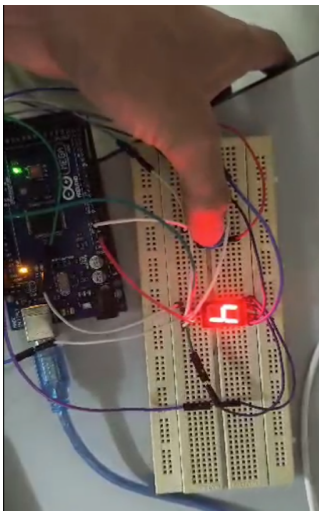
The data confirmed that each button press resulted in expected behaviour, which accurately incrementing the count or resetting the displayed number when required, as designed in the code logic.

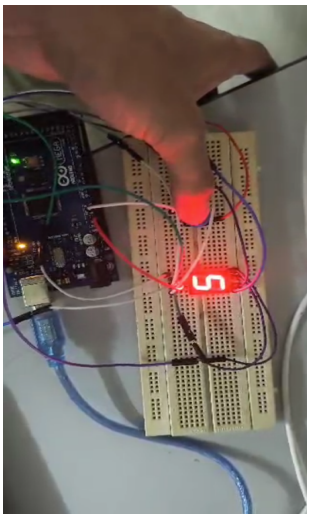
7. RESULTS

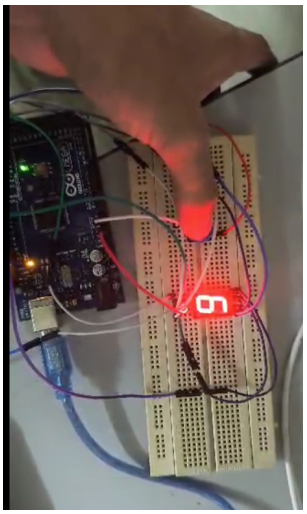


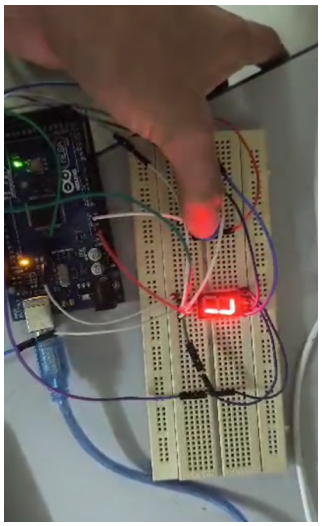


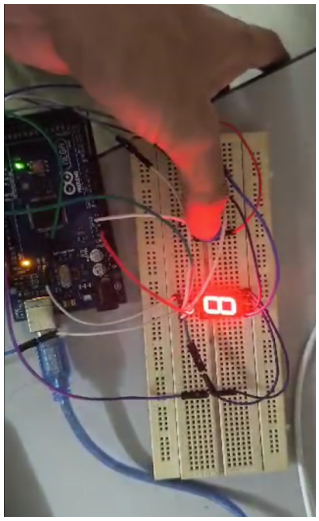


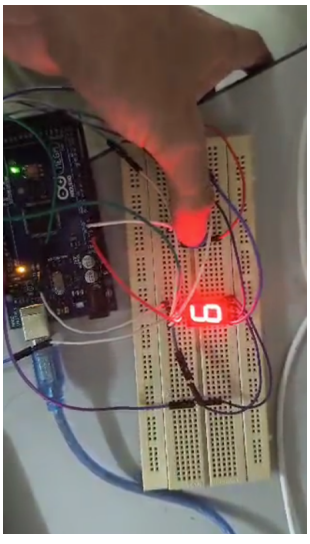


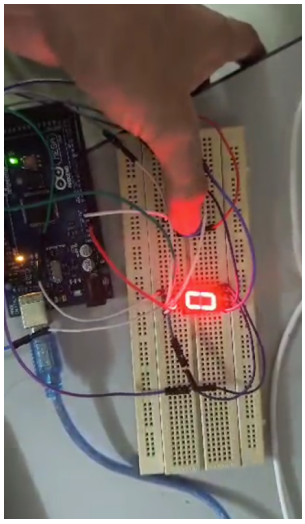












The experiment successfully showed that the Arduino could control a common cathode 7-segment display through manual input via push buttons. After uploading the code to the Arduino, the buttons were pressed to verify correct operation of the counting sequence.

8. DISCUSSION

Questions: How to interface an I2C LCD with Arduino? Explain the coding principle behind it compared with 7 segments display and matrix LED.

To interface an I2C LCD with an Arduino, connect the LCD's VCC and GND pins to the Arduino's 5V and GND, and link the SDA pin of the LCD to A4 and the SCL pin to A5 on the Arduino. After wiring, install the LiquidCrystal_I2C library in the Arduino IDE. The code involves initializing the LCD and using commands like lcd.print() to display text.

Compared to a 7-segment display or matrix LED, the I2C LCD is simpler to use. It requires only two data lines (SDA and SCL), allowing for easier management of multiple devices. In contrast, a 7-segment display uses several pins for each segment and requires manual control with digitalWrite commands. Generally, the I2C LCD simplifies both wiring and coding, making it a convenient choice for projects.

The results matched expectations that a 7-segment display could be interfaced with Arduino and controlled through digital logic. The primary goal was to control the display using a pushbutton, allowing for manual counting from 0 to 9. By using pushbuttons to control the display, we learned how user input can affect digital outputs. Each time we pressed the increment button, the counter increased, and the display updated to show the new number. This process demonstrated the practical use of digital logic, where we saw how simple inputs (the button presses) can lead to meaningful outputs (the displayed numbers). The hypothesis that proper wiring and coding would allow for effective control of the display was confirmed through successful operation. However, discrepancies occurred due to uncertain factors such as incorrect or loose wiring connections, faulty components, or errors in coding, which could lead to inaccurate display readings in the beginning, before getting the desired outcomes at the end. These considerations emphasize the importance of careful circuit assembly and thorough testing. It also highlighted how programming logic directly influences hardware behaviour, offering a practical application of theoretical concepts in digital electronics.

9. CONCLUSION

To conclude, this experiment successfully achieved its objective of interfacing a 7-segment display with an Arduino Uno, and using pushbuttons to control the display's counting sequence to create a simple counting system. The experiment also highlighted the importance of proper circuit design, including the use of resistors to protect components and ensure stable operation. It showed how different electronic components can function well together. One of the important lessons from this experience is the need to understand electronic interfacing. Through this hands-on experiment, we gained practical skills in circuit design and Arduino programming, which are essential for future projects involving microcontrollers. The knowledge gained can be

applied to more complex projects, like creating digital clocks or scoreboards that use multiple displays or additional input methods. Overall, this task was successful and provided a strengthened understanding of the principles of digital logic systems. It has not only improved our technical skills, but also sparked our interest in taking on more advanced projects in electronics and programming.

10. RECOMMENDATIONS

For future experiments involving the interfacing of displays and microcontrollers, several improvements and modifications could enhance the learning experience. Using an I2C LCD for comparison could be beneficial, as it would allow us to explore the differences in wiring, coding complexity, and output capabilities between the I2C LCD and traditional displays. We could set up experiments to display text messages or dynamic data on the LCD while simultaneously using a 7-segment display for numerical output.

Another interesting experiment could involve adding extra functionalities to the existing setup. For example, we could try displaying letters or symbols on the 7-segment display or matrix LED. This would require modifying the code to control which segments light up for each character, giving us a deeper understanding of how these displays work.

11. REFERENCES

[1] Electronics Tutorials. (2018, February 16). 7-segment Display and Driving a 7-segment Display. Basic Electronics Tutorials.
https://www.electronics-tutorials.ws/blog/7-segment-display-tutorial.html

[2] Last Minute Engineers. (2020, November 8). Interface an I2C LCD with Arduino. Last Minute Engineers; Last Minute Engineers. https://lastminuteengineers.com/i2c-lcd-arduino-tutorial/

[3] 7-Segment display Pinout, codes, working, interfacing. (2023, August 29). Electronics For You. https://www.electronicsforu.com/resources/7-segment-display-pinout-understanding

APPENDICES

The following Arduino code was written and uploaded to the board:

```
// Define the pins for each segment (D0 to D6)
const int segmentA = 0; // D0
const int segmentB = 1; // D1
const int segmentC = 2; // D2
const int segmentD = 3; // D3
const int segmentE = 4; // D4
const int segmentF = 5; // D5
const int segmentG = 6; // D6

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


ACKNOWLEDGEMENTS

We would like to express our sincere gratitude to our lecturers, Dr. Wahju Sediono and Dr. Zulkifli bin Zainal Abidin for their invaluable guidance in this experiment. Their expertise in the mechatronics field and encouragement have been a big support in the successful integration of our system. Not forgetting our teaching assistants in the lab for helping us indirectly.

To add, we also wish to extend a special thank you to our fellow team members for their collaboration and hard work during the course of this project. Their contributions were pivotal in driving our efforts forward and enhancing the overall quality of our work.

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

Signature: **A'LIM**	**Read**	/
Name: ABDUL A'LIM BIN MOHD RAJIB	**Understand**	/
Matric No: 2119687	**Agree**	/

Signature: 	**Read**	/
Name: AHMAD HAZAMI BIN MOHD RAZIP	**Understand**	/
Matric No: 2211203	**Agree**	/

Signature: 	**Read**	/
Name: ABDUL HADI BIN ZAWAWI	**Understand**	/
Matric No: 2210739	**Agree**	/

Signature: 	**Read**	/
Name: AIN MAISARA BT. ABDULLAH	**Understand**	/
Matric No: 2217856	**Agree**	/

Signature: 	**Read**	/
Name: ADIBAH BINTI MOHD AZILAN	**Understand**	/
Matric No: 2212670	**Agree**	/