REPORT 1 : DIGITAL LOGIC SYSTEM

GROUP 4

MCTA 3203

SEMESTER 1 2024/2025

MECHATRONICS SYSTEM INTEGRATION

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INTRODUCTION

This experiment was conducted to demonstrate how an Arduino Uno can be used to create a digital counter by connecting a common cathode 7-segment display and pushbuttons. This report outlines the methodology, procedure, results, discussion, and conclusion of the experiment. The objective of this experiment was to give participants hands-on experience with circuitry, Arduino programming, and component integration by examining the processes involved in hardware setup and software execution. Through this project, the efficiency of the Arduino platform in facilitating experiential learning in electronics was examined.

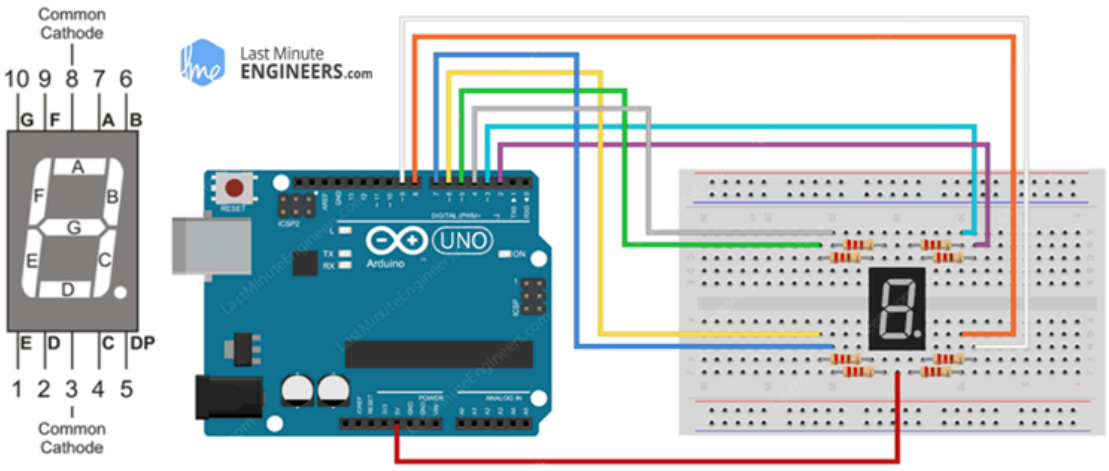
ABSTRACT

This experiment aims to demonstrate the interfacing of a common cathode 7-segment display with an Arduino Uno, allowing the display of numbers from 0 to 9 controlled by pushbuttons. The primary objective is to understand how to manually control a 7-segment display using basic input components. The methodology involves wiring each segment of the display to individual digital pins on the Arduino, using 220-ohm resistors to limit current, and connecting push buttons with pull-up resistors for input control. When the increment button is pressed, the display increases the count, and a reset button resets the count to zero. Key findings reveal that the display can be effectively controlled through simple input/output operations, providing insight into interfacing digital displays with microcontrollers. The experiment concludes with a successful demonstration of manual counting and reset functionality, offering a foundation for expanding to more complex projects.

MATERIALS AND EQUIPMENT

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

EXPERIMENTAL SETUP



1. Built the circuit according to the circuit setup instructions.
2. Upload the provided Arduino code to your Arduino Mega.
3. Open the Serial Monitor in the Arduino IDE.
4. Press the increment button to increase the count. The 7-segment display show the numbers from 0 to 9 sequentially.
5. Press the reset button to reset the count to 0.

METHODOLOGY

1. Hardware Setup:

- Connect the common cathode 7-segment display to the Arduino Uno:
- Each of the 7 segments (a, b, c, d, e, f, g) will be connected to individual digital pins on the Arduino (e.g., D0 to D6).
- Attach the common cathode pin to the GND (ground) pin of the Arduino.
- Use 220-ohm resistors to connect each segment pin to the Arduino to regulate current.
- Connect the pushbuttons to the Arduino:
- Connect one leg of each pushbutton to a separate digital pin (e.g., D9 and D10) and the other leg 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.

2. Software Programming:

- Write a program in Arduino IDE to:
- Initialize the pins connected to the 7-segment display as output pins.
- Use a counter logic that increases the count displayed on the 7-segment display when a pushbutton is pressed.
- Include a reset function to reset the count to zero with the press of a reset button.
- Upload the Arduino sketch to the Arduino Uno.

3. Execution:

- Build the circuit as per the connection instructions mentioned in the setup.
- Open the Serial Monitor in the Arduino IDE to monitor the execution.
- Press the increment button to display the numbers from 0 to 9 on the 7-segment display.

- Use the reset button to reset the displayed count to zero.

4. Testing and Troubleshooting:

- Verify that the 7-segment display correctly shows the numbers and increments.
- Check for proper wiring connections if the display or pushbuttons do not respond.
- Adjust code or hardware connections to resolve issues like debounce on the pushbutton.

RESULTS:

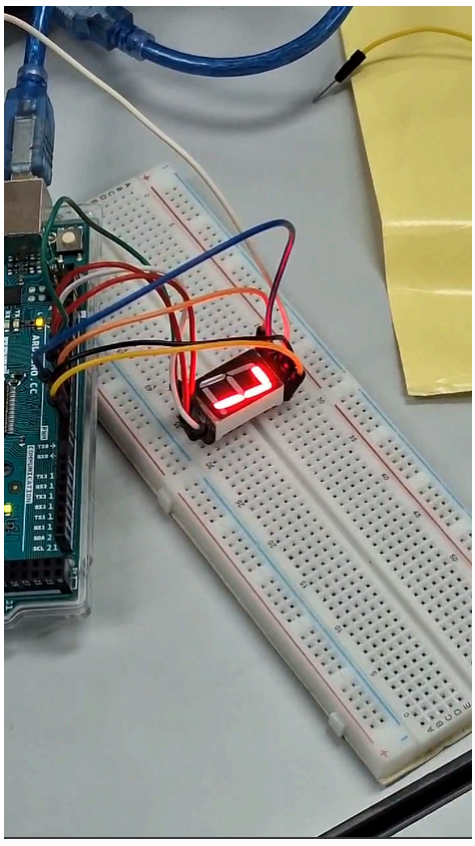


Figure 1: 7 Segment Display Without Button

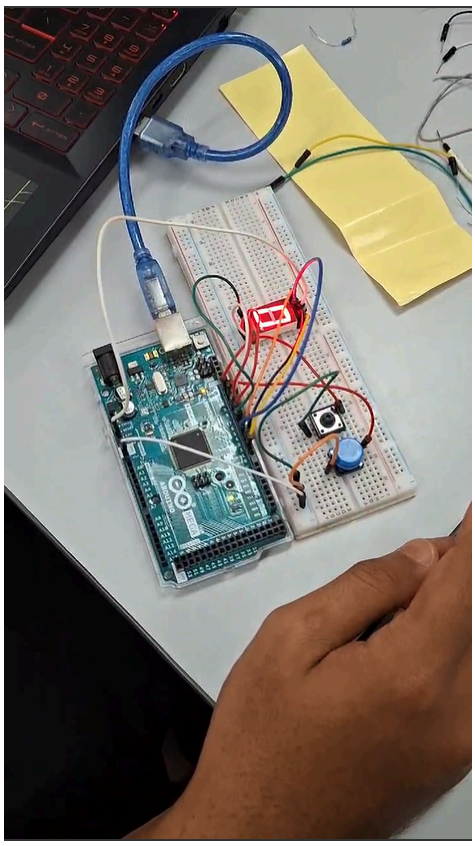


Figure 2: 7 Segment Display With Button

Video Link: https://github.com/nasrinazri/Group-4-lab-/tree/main/Week%202

QUESTION

- **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 12C LCD with arduino is only need 4 components which are Arduino Uno, I2C LCD Display, breadboard and Jumper Wires.

  For the setup, 12C LCD interfere only need 4 connections which are VCC connect with 5v, connection of the ground pin, and SDA and SCl connect to output pins. Before start to code, you need to install the “liquidCrystal.12C” library in the Arduino IDE.It provides a function to control the display easily. Here is the simple code as you can refer below:

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27, 16, 2); // Set the LCD address to 0x27 for a
16x2 display

void setup() {
    lcd.begin(); // Initialize the LCD
    lcd.backlight(); // Turn on the backlight
    lcd.setCursor(0, 0); // Set cursor to first row, first column
    lcd.print("Hello World!"); // Print message
}

void loop() {
    // Code can be added here for continuous operations
}
```

Comparison

1. **7- segment Display**
    - Complex wiring connection which required at least 7 pins to control each segment
    - Long coding paragraphs which need to code each segment individually to display the output
2. **Matrix LED**
    - Complex wiring connections which required more pins compare to 12C LCD and it be address by its row column coordinate.
    - It can display characters, numbers and patterns but need more advanced control logic.
3. **12C LCD**
    - Fewer connection which only required 4 connections which are VCC,GND, SDA and SCl pins.
    - Simple coding as the ‘liquidCrystal_12C’ library been installed it can take care of the low-level code.
    - It’s also have versatility on display that capable for both text and simple graphic without needing complex code.

DISCUSSION

In this experiment, we were able to connect a 7 segment display with an Arduino and display numeric data. The outcomes revealed that the LED screen was capable of displaying the desired digits when operated by the Arduino; thus authenticated cable connections and meaningful coding.

As a shortcoming one can point to occasional flashes in the display. This issue was attributed to poor connections and correcting all the loose connections helped fix the problem. Also, some adjustments were made on the timing in the arduino code which helped to improve the display of the microcontroller.

From this experiment one can gain a lot of practical experience since a 7-segment display is used in virtually all devices with numbers on their displays, such as clocks and calculators. Here learned skills can be used with more complex tasks such as using multiple display interfaces or other types of sensors or actuators.

This means that future experiments may consider testing other types of displays, like the LCD ones or other types and compare how hard it is to interface them. It is also possible to advance the project to new levels starting with more complex data visualization or user input, which would also contribute to the result.

CONCLUSION

In conclusion, this experiment provided the basic understanding required for the interfacing of the 7-segment display with the microcontroller. The project can further be enhanced in some complex functionalities like changing characters to display or inclusion of a timer. Further, multiple displays can also be interfaced to expand into more complexity projects.

The project helped us learn much-needed knowledge on some of the most important electronic pieces necessary to properly function circuits. Working with Arduino allowed us to learn more about how software communicates with hardware to create an embedded system; thus, programming plays an important role in such systems.

The following basic experiment enables us to present more experimental work and added complexity for future projects. Overall, the exercise reinforced the main concepts concerning the technology of microcontrollers and created interest in more complex electronic designs.

RECOMMENDATION

Several recommendations would add further reliability and effectiveness to this experiment. First, the connections must be checked twice before powering the circuit, as incorrect wiring tends to provide either faulty operation or damage. Next, the lab must provide a multimeter to check voltage levels at various points and might also find the origin of problems in the power supply or incorrect resistor values. It is important to confirm that the resistor values are correct or incorrect values will make either a dim display or damage it.

Once the basic functionality is established, testing varied scenarios can discover any potential problems much earlier. By following these guidelines, error occurrence is much more minimal, allowing for an easier, more productive experimental experience and leading to successful outcomes and valuable learning experiences.

ACKNOWLEDGEMENTS

A special thanks goes out to Dr. Wahju Sediono and Dr. Zulkifli Bin Zainal Abidin, my teaching assistant, and my peers for their invaluable help and support in finishing this report. Their advice, feedback, and experience have greatly influenced the level of quality and understanding of this work. Their time, patience, and commitment to supporting my academic success are greatly appreciated.

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 no further improvement on the reports is needed from any of the individual's 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**.

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Read ☑
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