MCTA 3203

MECHATRONIC SYSTEM INTEGRATION

SECTION 1

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LECTURER:

SIR WAHJU SEDIONO

SIR ZULKIFLI BIN ZAINAL

LAB REPORT 2:

INTERFACING 7 SEGMENT DISPLAY WITH ARDUINO

GROUP 2

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GROUP MEMBERS	MATRIC NUMBERS
AMIRUL IMAN BIN MAT KHIR	2316633
AHMAD IRFAN FAHMI BIN AHMAD USRI	2318631
MUHAMAD NUR HAFIZ BIN ROSLY	2317001
FAKHRULLAH BIN YUZAIRI	2220289

Abstract

This report describes how to connect and control a common cathode 7-segment display using an Arduino Uno. Each segment (a-g) of the display is connected to separate digital pins on the Arduino (e.g., D2-D8) with 220-ohm resistors to limit current. The common cathode pin is connected to the Arduino's ground (GND).. After uploading the code, the 7-segment display shows numbers 0-4 when the increment button is pressed. This experiment demonstrates basic interfacing and control of a 7-segment display with an Arduino. The report also explores how to interface an I2C LCD with an Arduino, comparing its coding principles with those of 7-segment displays and matrix LEDs, focusing on differences in communication protocols and control methods.

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INTRODUCTION

Digital logic circuits form the bedrock of electronics, used to create everything ranging from simple circuits to advanced computers. The basic building blocks of these circuits are simple logic gates like AND, OR, and NOT, which perform simple binary operations. Simple gates can be linked together in order to form more complex entities, like the Arithmetic Logic Units (ALUs), which the computer uses to perform calculations as well as logical operations.

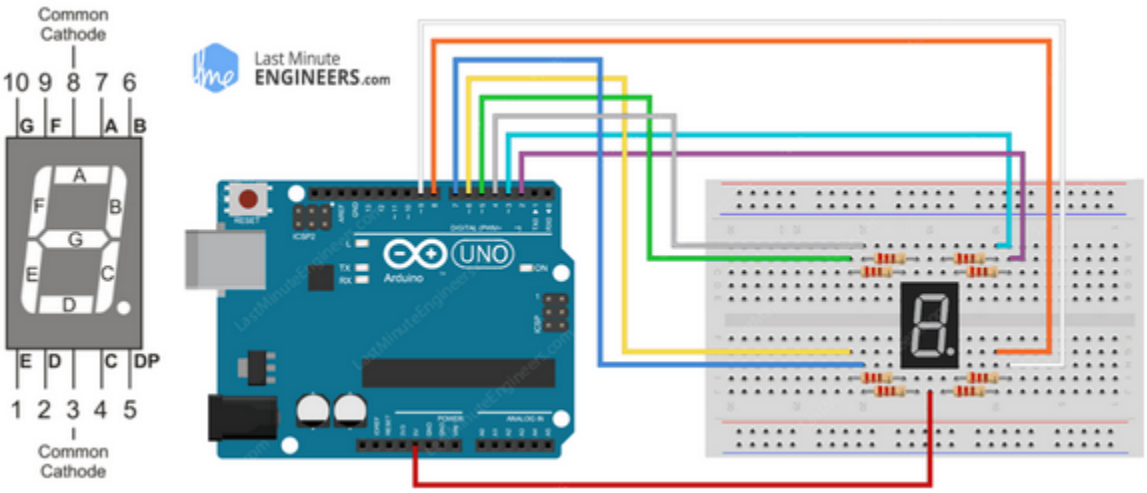
One of the key aspects of digital logic is interfacing, or connecting these systems with other devices like displays or sensors. One common example is with a 7-segment display, an LED display that shows numbers by lighting up individual segments. Using integrated circuits (ICs) and microcontrollers like Arduino, we can control these displays to show useful information, such as counting from 0 to 4.

In this experiment, we will learn how to interface a 7-segment display to an Arduino to create a counting sequence. This will help us understand how digital logic applies in real-world uses and how simple components can be combined to create functional systems.

MATERIALS AND EQUIPMENT

ITEM	AMOUNT
ARDUINO UNO MEGA	1
BREADBOARD	1
220 OHM RESISTANCE	7
JUMPER WIRES	9
COMMON CATHODE 7-SEGMENT DISPLAY	1

EXPERIMENTAL SETUP



1. insert the common cathode 7-segment display to the breadboard while making sure that each segment are not in contact with each other within the circuit of the board
2. Use 220-ohm resistors to connect each of the segment pins to the Arduino pins to limit the current.
3. Use jumper wires and connect the 7 segment display (a.b.c.d.e.f.g.) of the display to separate digital pins on the Arduino (D2 to D8)
4. Connect the common cathode pin of the display to one of the GND(ground)pins on the Arduino.

METHODOLOGY

1 . Setup for Arduino Board
*Build the circuit according to the circuit setup instructions.
*Connect the Arduino to the computer via a USB cable .

2. Software Programming in Arduino IDE
*Define The pins connected to the common cathode 7-segment display
*Make a void setup to initialize the pins as output
*make an infinite loop where each segment of the display will light up going from 0 until 4 sequentially
*Upload the code to Arduino

RESULT

Videos and Pictures can be found on our Github link

DISCUSSION

In this laboratory experiment, we learned about digital logic circuits that are the backbone of all modern electronic devices, making it possible to develop systems from basic circuits to sophisticated computing machines. The experiment was conducted in two parts. Initially, we learned about basic logic gates like AND, OR, and NOT, which carry out basic binary functions and act as the building blocks for developing more complicated digital circuits. The second involved the use of a 7-segment display with an Arduino microcontroller for showing numerical outputs from logical operations. Both methods demonstrated the application of digital logic in theory and also in practical life.

As an example of how digital logic is interfaced with external devices, we built a system where an Arduino was utilized to power a 7-segment display.From the microcontroller programming, numerical value display was achieved through enabling certain segments depending on binary inputs. This study demonstrated how external inputs from microcontrollers can be used to influence display components, hence accurate and programmable graphical displays. Establishing stable connections between the Arduino and the display became paramount, where proper wiring and coding logic were essential in ensuring a continuous and accurate display of numerical values. The second half of the experiment was based on the idea of automation through the application of digital logic along with real-time output regulation. We programmed a sequence and allowed the 7-segment display to count from 0 to 4 on its own, thus illustrating the principles of automated logic circuits. This method emphasized the application of sequential logic for everyday uses, including digital clocks and counters.

Additionally, this experiment highlights the importance of proper wiring, coding, and logical sequencing in digital electronics. Ensuring that the Arduino correctly interprets and transmits binary data to the display requires precise circuit connections and well-structured programming.

This process not only reinforces theoretical knowledge but also provides hands-on experience with hardware integration and debugging. By successfully implementing a digital counting sequence, we gain valuable insights into how electronic systems process and display information, forming the basis for more sophisticated applications in embedded systems and automation.

QUESTION

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

Interfacing an I2C LCD with Arduino

An I2C LCD is a type of display that uses the I2C communication protocol to connect to an Arduino. It only needs two wires (SDA and SCL) to work, making it much simpler to wire compared to other displays. You also need a library like `LiquidCrystal_I2C` to control the LCD. With this library, you can easily display text or numbers on the screen without worrying about the low-level details. For example, you can write a simple program to show "Hello, World!" on the LCD with just a few lines of code.

Coding Principle:

The I2C LCD uses the I2C communication protocol, which requires only two wires (SDA and SCL) for communication. The Arduino communicates with the LCD using the `Wire` library, and the `LiquidCrystal_I2C` library simplifies the process of sending data to the LCD.

Example Code:

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

// Initialize the I2C LCD (address, columns, rows)
LiquidCrystal_I2C lcd(0x27, 16, 2); // Address 0x27, 16 columns, 2 rows

void setup() {
  // Initialize the LCD
  lcd.begin();
  lcd.backlight(); // Turn on the backlight
  lcd.print("Hello, World!"); // Display text
}

void loop() {
  // Nothing to do here
}
```

Comparison with 7-Segment Display

A 7-segment display is a simple way to show numbers and some basic symbols. Each segment (a-g) is controlled by a separate pin on the Arduino, so you need at least 7 pins to use it. You also need resistors to protect the LEDs. To display a number, you manually turn on or off the segments. For example, to show the number "3," you turn on segments A, B, C, D, and G. This method is straightforward but limited because it can only show numbers and a few symbols.

Comparison with Matrix LED

A matrix LED is a grid of LEDs (like an 8x8 grid) that can display more complex patterns, including graphics and animations. However, it requires more pins and often uses additional components like shift registers or driver chips to control the LEDs. Coding for a matrix LED is more complex because you need to manage rows and columns to light up specific LEDs. Libraries like `LedControl` can help simplify this process, but it's still more complicated than using a 7-segment display or an I2C LCD.

CONCLUSION

This experiment yielded valuable understanding of digital logic circuits and their real-world applications. Through the fundamental logic gates and an Arduino-controlled 7-segment display,

we explored the fundamental principles of digital electronics and their use in contemporary systems. The hands-on process underscored the value of precise wiring, programming, and logical organization in enabling precise data transmission and display functionality.

The automation of the count from 0 through 4 showed the use of sequential logic for everyday applications such as digital clocks and counters. Through the imposition of a specified sequence, we illustrated the use of digital logic circuits to implement automation without subjecting it to ongoing human management. This method was, nevertheless, characterized by limited flexibility compared to sensor-oriented systems and thus was more suited to predetermined automation compared to real-time dynamic tasks.

Besides, the experiment stressed the pivotal role of microcontrollers in digital systems. The accurate interpretation and transmission of binary information to the 7-segment display by the Arduino demanded meticulous circuit connections and well-drafted programming. This activity facilitated theoretical knowledge and practical experience in hardware integration and debugging. In general, this experiment explained the mechanism by which microcontrollers convey information to display devices and reaffirmed the place of digital logic in the design of automated and embedded systems. This can be a solid foundation for higher-level applications in electronics, computing, and automation.

REFERENCES

https://drive.google.com/drive/folders/1rq0wLF6mA7jEoNsPWyAbWR9n0X3SQsQz

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STUDENT'S DECLARATION

We hereby declare that the work presented in this report is entirely our own, except where explicitly acknowledged. All sources of information and references have been properly cited, and we have adhered to the principles of academic integrity throughout the completion of this project.

Name:Amirul Iman Bin Mat Khir	Read [/]
Matric Number: 2316633	Understand [/]
Signature:	Agree [/]
Name:Ahmad Irfan Fahmi Bin Ahmad Usri	Read [/]
Matric Number: 2319531	Understand [/]
Signature:	Agree [/]
Name:Muhamad Nur Hafiz Bin Rosly	Read [/]
Matric Number: 2317001	Understand [/]
Signature:	Agree [/]
Name: Fakrulah Bin Yuzairi	Read [/]
Matric Number: 2220289	Understand [/]
Signature:	Agree [/]