KULLIYAH OF ENGINEERING
DEPARTMENT OF MECHATRONICS ENGINEERING

Lab Report

MCTA 3203
SECTION 1
GROUP E

EXPERIMENT 1

Digital Logic System:

Covering basic logic gates, electronic circuit interfacing, basic Arithmetic Logic Unit (ALU), 7-segment display, and applications involving IC-based interfacing

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Abstract

The experiment titled "Digital Logic Systems" aimed to provide a comprehensive understanding of fundamental digital electronic concepts. By exploring basic logic gates, electronic circuit interfacing, constructing an Arithmetic Logic Unit (ALU), integrating a 7-segment display, and applying interfacing techniques with integrated circuits, the study laid the foundation for practical digital systems.

Methodology involved hands-on exploration of logic gates, circuit connections, and ALU design. Key findings encompassed the functionality of these components, as well as 7-segment display operation. Moreover, the experiment showcased the practicality of integrated circuits in various applications.

In conclusion, this experiment offers essential insights into digital logic systems, benefiting fields like computer science and electronics. It provides the groundwork for the development of more complex digital systems, fostering a deeper understanding of their core elements.

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Introduction

This experiment explores the practical implementation of a seven-segment display with tactile switches, a fundamental component in digital electronics. The primary objective is to understand its operation and the methodology for incrementing and decrementing numerical values through tactile switches, skills critical in real-world applications.Seven-segment displays are widely used for numeric representation. They can illuminate or turn off individual segments to display digits and some alphanumeric characters. This experiment is grounded in binary-coded decimal (BCD) and multiplexing principles, core concepts in digital electronics.

The objective of this laboratory activity is to demonstrate the fundamental principles of establishing a connection between an Arduino microcontroller and a 7-segment display. In this section, we will discuss the connection of the 7-segment display to the Arduino board and the programming of the Arduino to control the display. This will encompass the configuration of the hardware as well as the implementation of the software. The objective of this project is to provide users with an opportunity to gain practical experience in multiplexing and controlling common-cathode 7-segment displays, thereby enhancing their understanding of their real-world functioning.

Our hypothesis is that by combining tactile switches with a seven-segment display, we can effectively increase and decrease displayed numbers. The expected outcome is a system where pressing "increase" raises the displayed number, and "decrease" lowers it, enhancing our understanding of digital component interfacing and binary representation.

By the end of the session, participants will comprehend the mechanics of the seven-segment display and have hands-on experience in building functional digital systems,

laying the foundation for more complex projects and a deeper understanding of digital electronics' practical applications.

Materials and Equipment

Materials:

1. Seven-segment display (common cathode)
2. Tactile switches (at least two, for increasing and decreasing)
3. Resistors (for limiting current to the display and switches)
4. Breadboard (to create the circuit)
5. Jumper wires (for making electrical connections)
6. Microcontroller or digital logic IC (Arduino Mega 2650) for controlling the display
7. Power supply (for providing voltage to the circuit)
8. Connecting cables (USB)

Equipment:

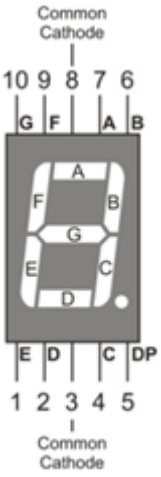
1. Computer with necessary software for programming and testing (Arduino IDE)
2. Screwdriver and pliers (for assembly and adjustments)

Experimental Setup

Equipment and Components Setup:

1. Seven-Segment Display: Begin by connecting the seven-segment display to the breadboard, ensuring the correct identification and connection of common anode or common cathode pins. For common cathode displays, connect the common pin to the ground, while for common anode displays, connect it to the positive supply voltage.
2. Tactile Switches: Place two tactile switches on the breadboard. Connect one switch to increase the displayed number and the other to decrease it. Implement pull-up or pull-down resistors as needed, depending on your specific circuit design.
3. Microcontroller or Digital Logic IC: Integrate the microcontroller or digital logic IC (such as an Arduino or 74HC595) into the circuit. Connect it to the seven-segment display and the tactile switches, ensuring the appropriate establishment of input and output pin connections.
4. Power Supply: Connect the power supply to provide the necessary voltage for the circuit. Ensure that the voltage levels align with the operating requirements of the components and take into consideration the current demands of the seven-segment display and the switches.
5. Jumper Wires: Employ jumper wires to establish essential electrical connections between the components. Maintain an organised and clear wiring layout to prevent confusion or short circuits.
6. Programming: In case you are using a microcontroller, program it to interpret the signals from the tactile switches and manage the seven-segment display to increase or decrease the displayed number as described in the experiment steps. The specific programming details will depend on the microcontroller or IC in use.

7. Testing: Before proceeding with the experiment, verify that the circuit is correctly assembled and programmed. Test the tactile switches and the display to ensure that they function as intended.



Methodology

Experiment Steps:

1. Circuit has been constructed in accordance with the guidelines for circuit setup.
2. Arduino Uno was connected to the supplied Arduino code.
3. Code has been written using the Arduino IDE. Below is the code:
4. Arduino IDE's Serial Monitor was launched to examine the working of the circuit.
5. The count can be raised by using the increment button and the count can be reduced by hitting the down button. The numbers 0 through 9 should appear sequentially on the 7-segment display.
6. To reset the count to zero, press the reset button on the Arduino.

```
int num;
bool state;
void setup() {
  pinMode(2,OUTPUT);
  pinMode(3,OUTPUT);
  pinMode(4,OUTPUT);
  pinMode(5,OUTPUT);
  pinMode(6,OUTPUT);
  pinMode(7,OUTPUT);
  pinMode(8,OUTPUT);

  pinMode(9,INPUT_PULLUP);
  pinMode(10,INPUT_PULLUP);
}

void loop() {
  if(!digitalRead(9)&digitalRead(10)&!state){
    num++;

    if(num>9)num=9;
    state=1;}
    if(digitalRead(9)&!digitalRead(10)&!state){
    num--;
```

```
    if(num<0)num=0;
    state=1;}
  if(digitalRead(9)&digitalRead(10))state=0;



switch(num){
  case 0:
  digitalWrite(2,LOW);
  digitalWrite(3,LOW);
  digitalWrite(4,LOW);
  digitalWrite(5,LOW);
  digitalWrite(6,LOW);
  digitalWrite(7,LOW);
  digitalWrite(8,HIGH);
  break;
    case 1:
  digitalWrite(2,HIGH);
  digitalWrite(3,LOW);
  digitalWrite(4,LOW);
  digitalWrite(5,HIGH);
  digitalWrite(6,HIGH);
  digitalWrite(7,HIGH);
  digitalWrite(8,HIGH);
  break;
  case 2:
  digitalWrite(2,LOW);
  digitalWrite(3,LOW);
  digitalWrite(4,HIGH);
  digitalWrite(5,LOW);
  digitalWrite(6,LOW);
  digitalWrite(7,HIGH);
  digitalWrite(8,LOW);
  break;
    case 3:
  digitalWrite(2,LOW);
  digitalWrite(3,LOW);
  digitalWrite(4,LOW);
  digitalWrite(5,LOW);
  digitalWrite(6,HIGH);
  digitalWrite(7,HIGH);
  digitalWrite(8,LOW);
```

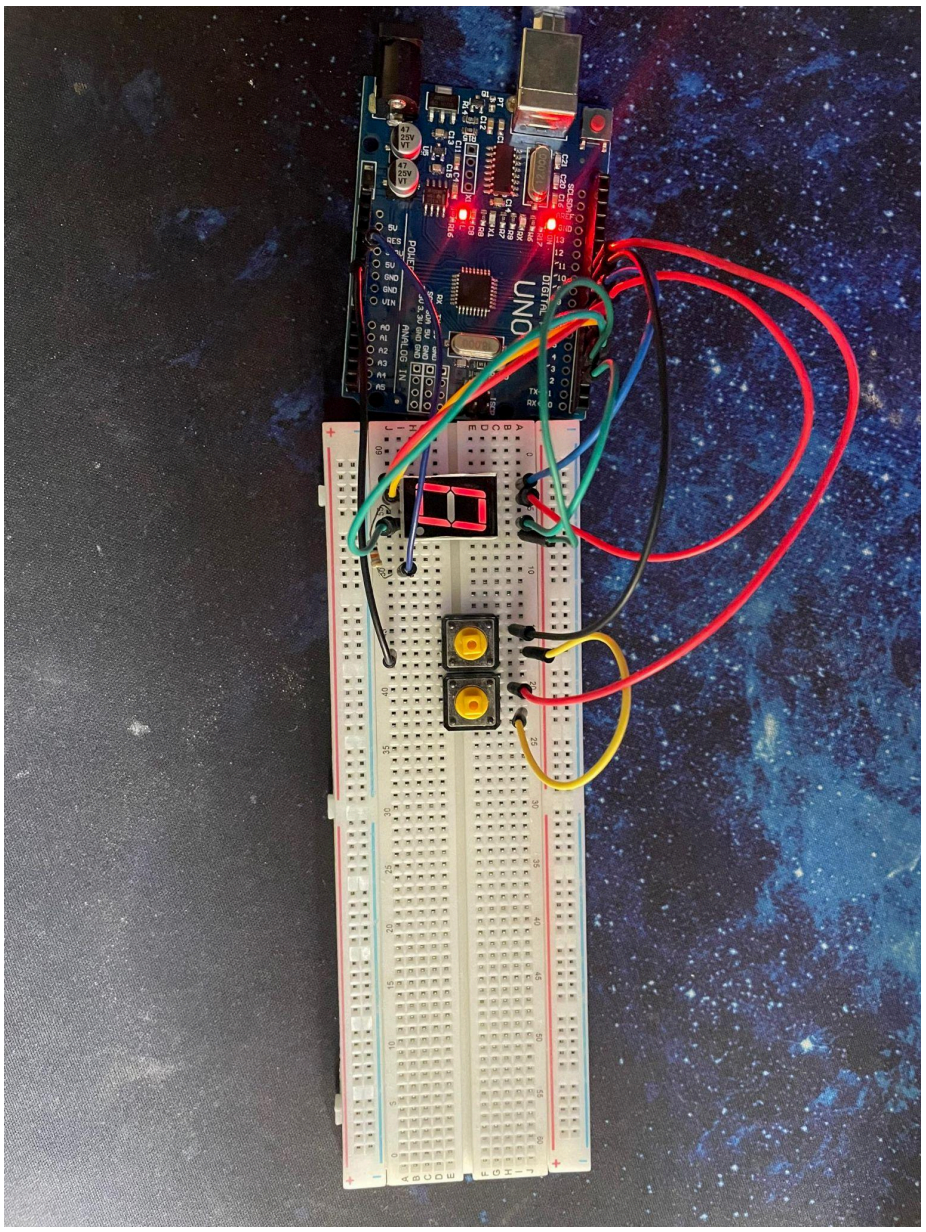
```
break;
  case 4:
digitalWrite(2,HIGH);
digitalWrite(3,LOW);
digitalWrite(4,LOW);
digitalWrite(5,HIGH);
digitalWrite(6,HIGH);
digitalWrite(7,LOW);
digitalWrite(8,LOW);
break;
  case 5:
digitalWrite(2,LOW);
digitalWrite(3,HIGH);
digitalWrite(4,LOW);
digitalWrite(5,LOW);
digitalWrite(6,HIGH);
digitalWrite(7,LOW);
digitalWrite(8,LOW);
break;
  case 6:
digitalWrite(2,LOW);
digitalWrite(3,HIGH);
digitalWrite(4,LOW);
digitalWrite(5,LOW);
digitalWrite(6,LOW);
digitalWrite(7,LOW);
digitalWrite(8,LOW);
break;
  case 7:
digitalWrite(2,LOW);
digitalWrite(3,LOW);
digitalWrite(4,LOW);
digitalWrite(5,HIGH);
digitalWrite(6,HIGH);
digitalWrite(7,HIGH);
digitalWrite(8,HIGH);
break;
case 8:
digitalWrite(2,LOW);
digitalWrite(3,LOW);
digitalWrite(4,LOW);
digitalWrite(5,LOW);
digitalWrite(6,LOW);
```

```
  digitalWrite(7,LOW);
  digitalWrite(8,LOW);
  break;
    case 9:
  digitalWrite(2,LOW);
  digitalWrite(3,LOW);
  digitalWrite(4,LOW);
  digitalWrite(5,LOW);
  digitalWrite(6,HIGH);
  digitalWrite(7,LOW);
  digitalWrite(8,LOW);
  break;
  }


}
```

Result (observation)

The seven-segment display correctly counted up and down in response to button presses, as demonstrated by the results of our experiment. This feature shows how well the hardware configuration and related software work together. The experiment yielded successful outcomes, as it enabled the project to incorporate a mechanism for increasing the count through the utilisation of the plus button, while also facilitating count reduction via the down button. The numerical digits ranging from 0 to 9 are arranged in a sequential manner on the 7-segment display. However, as the display reaches the maximum and minimum numbers, specifically 9 and 0, it becomes fixed on these particular values. The main conclusion of this successful operation is that such a system can be used in many other industries where tracking or counting is required.



Link for recorded video:
https://drive.google.com/file/d/170XBs5hk7vw_tMNDnKepbzMDVtBaCx6K/view?usp=sharing

Discussion

There were no significant variations between the expected and observed results during the experiment. The counts were precisely reflected by the system as intended. It is important to note, though, that in real-world situations, disparities could occur as a result of things like component tolerance, electrical noise, or button debouncing. It is crucial to recognize that, although our experimental setup functioned well, more error-handling methods might be needed in practical implementations to guarantee precise counting.

The 7-segment display exhibits inflammability, particularly when it is directly linked to a 5V power source. Consequently, it is imperative to establish a connection between the 7-segment display and a resistor to prevent the occurrence of combustion.

Recommendations

For the recommendation, we would like to suggest that you also put the alphabet in a 7-segment display. Instead of the 7 segments that only show number output, it can also show alphabet output whenever necessary.

Next, we also think that it is a good idea to increase the number of 7-segment displays so that we can show a higher value or multiple outputs at the same time. For example, by using a four 7-segment display, we can create a clock.

Lastly, we may also add another switch on the breadboard as a reset button. So when we want to reset the system, we simply press the reset button, and there is no need to complete the full cycle just to get the output 'zero'.

Conclusion

The principal objective of this experiment was to link an Arduino microcontroller to a 7-segment display in order to explore display management and visualisation concepts. We believe that the knowledge we have acquired is highly instructive and useful.

Our main findings show that the Arduino may be a functional driver for a 7-segment display, enabling the presentation of numeric characters, provided it is outfitted with the appropriate hardware setup and skilled programming. The idea that the Arduino is a flexible tool for coordinating electronic components is supported by this experiment, which also highlights how useful it is for incorporating 7-segment displays into a variety of projects. To further optimise pin layouts, the experiment highlights the significance of understanding display kinds and multiplexing approaches.Furthermore, the experiment emphasises the importance of comprehending display types, pin layouts, and multiplexing techniques to optimise pin usage and elevate display performance.

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 contributor to the report.

We therefore, agreed unanimously that this report shall be submitted for marking and this final printed report have been verified by us

Signature: ***haziqiskandar*** Read✔️

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