TECHNOLOGICAL UNIVERSITY OF THE PHILIPPINES

Ayala Boulevard, Ermita, Manila

CIT-ELECTRONICS DEPARTMENT

CPET11L-M – Microprocessor and Microcontroller Systems, Lab

1st Semester, SY 2-24-2025

Name: Joseph C. Arenas	**Instructor:** Prof. Tristan Mopas
Course & Section: BET-CPET- 3A	**Date Submitted:** September 20, 2025

Activity 2

Topic 1: Arduino 7-Segment Display Counter Push Button

Topic 2: Segment Display Count Up Arduino

Topic 3: Arduino Push Button 2-Digit 7-Segment

Topic 4: Arduino Countdown Timer in Minutes & Seconds

I. OBJECTIVES

- To apply practical knowledge in using the Arduino Uno R3 and Mega
- To explain the functions and components of the related topics
- To implement the 7-Segment Display, Dual Digit 7-Segment Display, and 4-Digit 7-Segment Display using code and circuit diagrams
- To develop and enhance problem-solving skills related to the topics

II. EQUIPMENT AND MATERIALS

HARDWARE

- Arduino Uno or Arduino Mega 2560
- Breadboard
- Jumper Wires

- Push Button
- Laptop
- 7-Segment Display & 4-Digit 7-Segment Display
- Resistors 220Ω and 10KΩ
- Buzzer

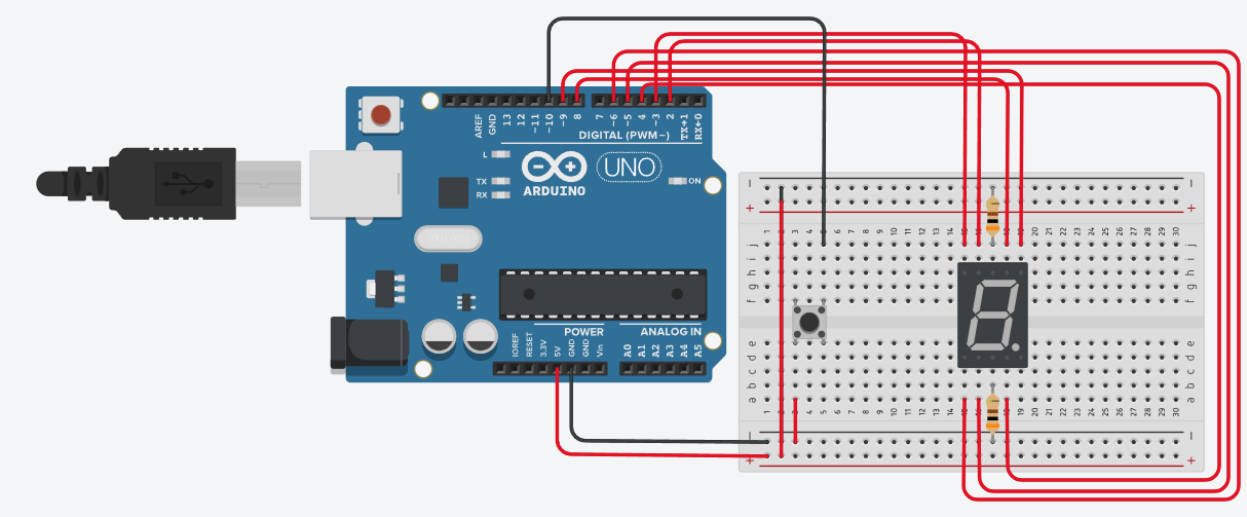
SOFTWARE

- Arduino IDE
- MS Word
- TinkerCad Simulator
- Wokwi Simulator

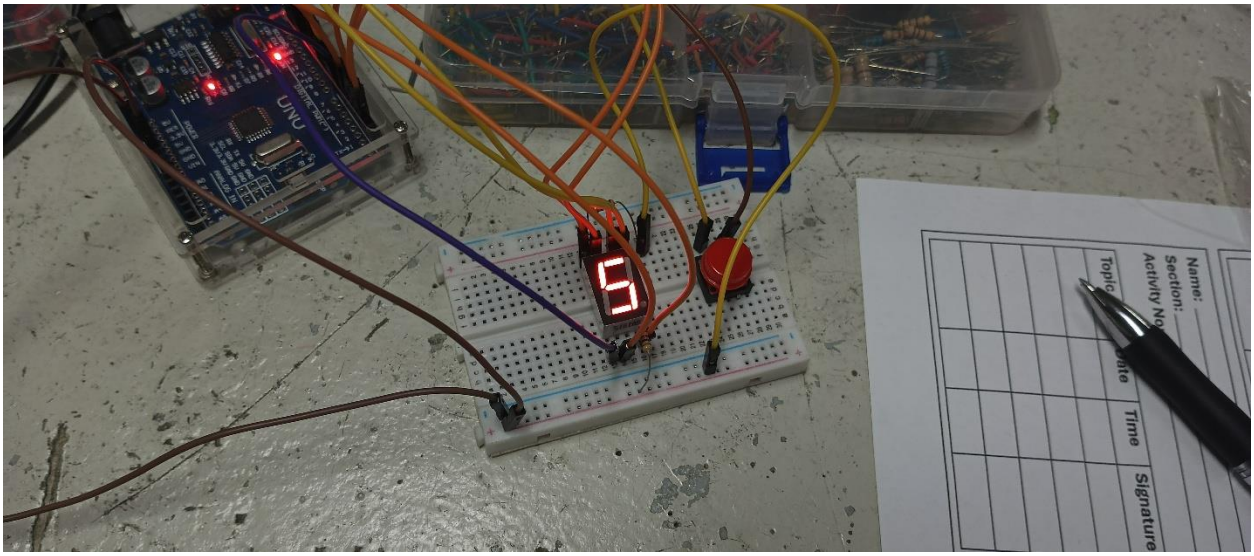
III. DIAGRAM

===== Topic 1: Arduino 7-Segment Display Counter Push Button =====

A. TinkerCad Simulation



B. Breadboard



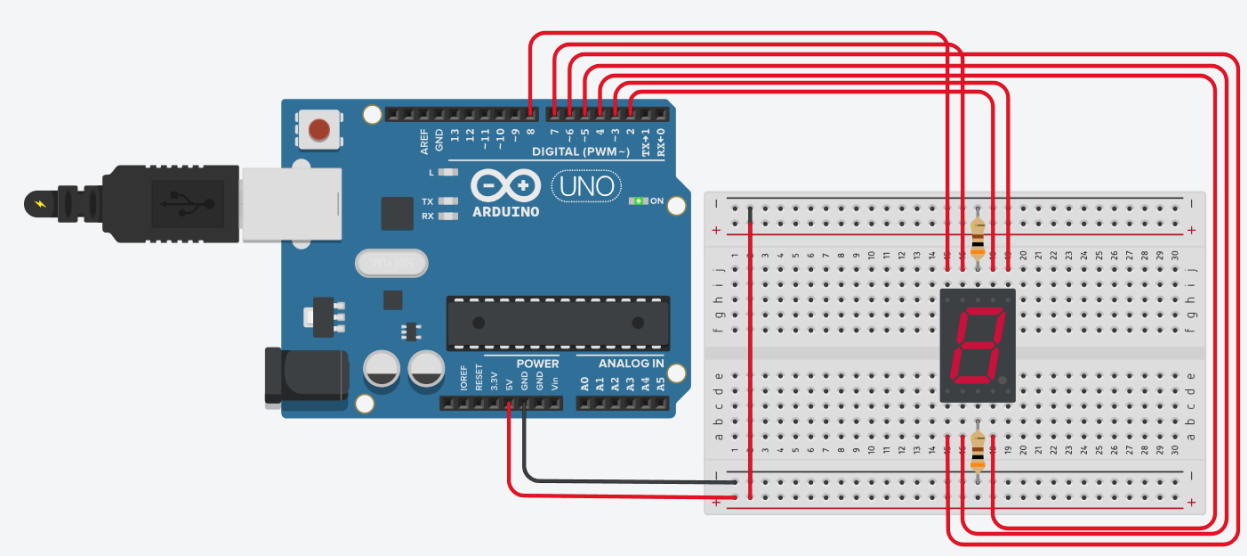
C. Source Code

```
const int a = 8;
const int b = 9;
const int c = 4;
const int d = 5;
const int e = 6;
const int f = 2;
const int g = 3;
bool bPress = false;
const int buttonPin = 10;
int buttonPushCounter = 0;
int buttonState = 0;
int lastButtonState = 0;
void setup() {
  pinMode(a, OUTPUT);  //A
  pinMode(b, OUTPUT);  //B
  pinMode(c, OUTPUT);  //C
  pinMode(d, OUTPUT);  //D
  pinMode(e, OUTPUT);  //E
  pinMode(f, OUTPUT);  //F
  pinMode(g, OUTPUT);  //G
  pinMode( buttonPin , INPUT_PULLUP );
  Serial.begin(9600);
  displayDigit(buttonPushCounter);
}

void displayDigit(int digit){
 if(digit!=1 && digit != 4)
 digitalWrite(a,HIGH);

if(digit != 5 && digit != 6)
 digitalWrite(b,HIGH);
```

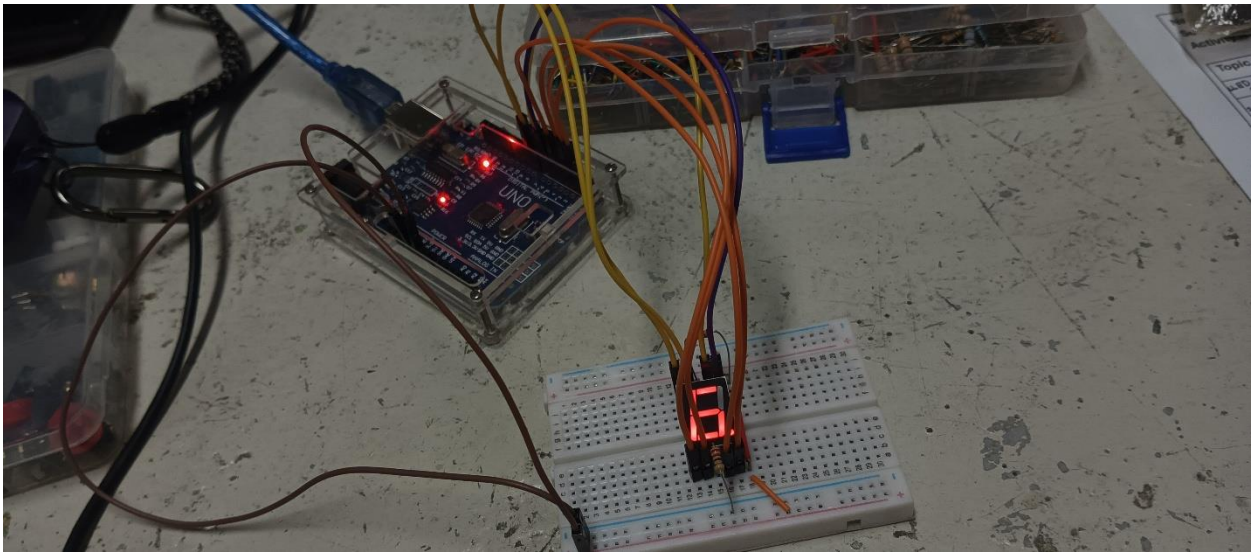
```
if(digit !=2)
 digitalWrite(c,HIGH);

 if(digit != 1 && digit !=4 && digit !=7)
 digitalWrite(d,HIGH);

 if(digit == 2 || digit ==6 || digit == 8 || digit==0)
 digitalWrite(e,HIGH);

 if(digit != 1 && digit !=2 && digit!=3 &&
digit !=7)
 digitalWrite(f,HIGH);

 if (digit!=0 && digit!=1 && digit !=7)
 digitalWrite(g,HIGH);
}
void turnOff(){
  digitalWrite(a,LOW);
  digitalWrite(b,LOW);
  digitalWrite(c,LOW);
  digitalWrite(d,LOW);
  digitalWrite(e,LOW);
  digitalWrite(f,LOW);
  digitalWrite(g,LOW);
}
```

====== Topic 2: Segment Display Count Up Arduino ======

A. TinkerCad Simulation



B. Breadboard



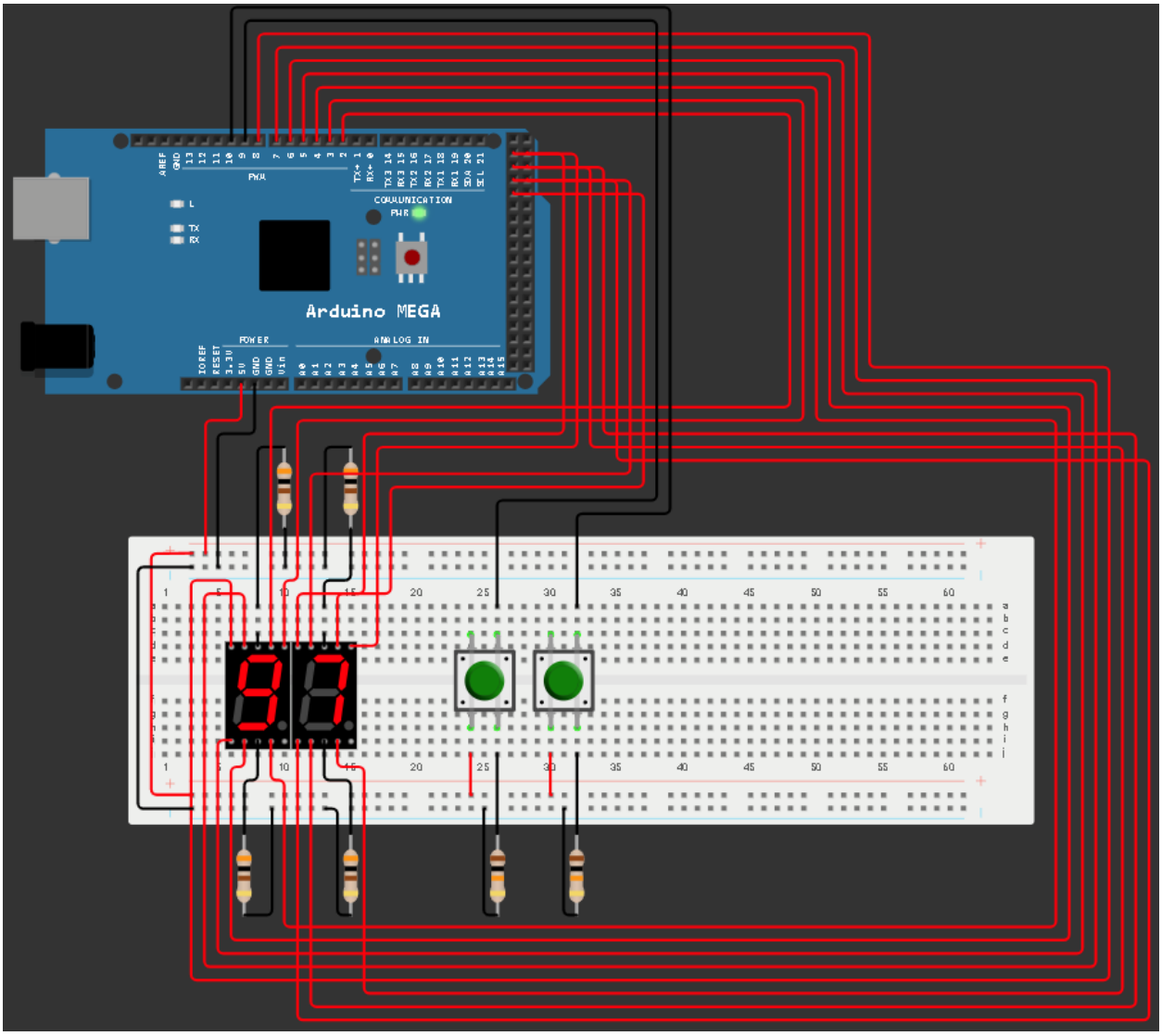
C. Source Code

```
byte pin[] = {2, 3, 4, 5, 6, 7, 8, 9};


int number[9][8] = {
  {1, 1, 0, 0, 0, 1, 1, 1},
  {0, 0, 1, 0, 0, 0, 1, 0},
  {1, 0, 0, 0, 0, 0, 1, 0},
  {1, 1, 0, 0, 0, 1, 0, 0},
  {1, 0, 0, 0, 1, 0, 0, 0},
  {0, 0, 0, 0, 1, 0, 0, 0},
  {1, 1, 0, 0, 0, 0, 0, 1},
  {0, 0, 0, 0, 0, 0, 0, 0},
  {1, 1, 0, 0, 0, 0, 0, 0},
};
```

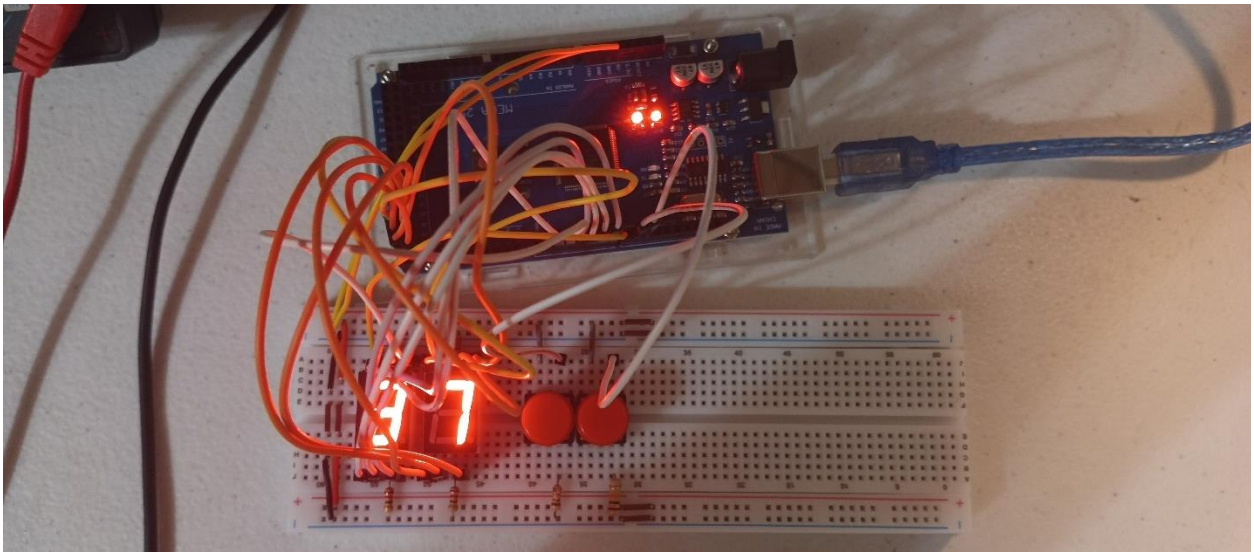
```
void setup() {
  for (byte a = 0; a < 8; a++) {
    pinMode(pin[a], OUTPUT);
  }
}


void loop() {
  for (int a = 0; a < 9; a++) {
    for (int b = 0; b < 8; b++) {
      digitalWrite(pin[b], number[a][b]);
    }
    delay(500);
  }
}
```

=== TOPIC 3: Arduino Push Button 2-Digit 7-Segment ===

A. Wokwi Simulation



B. Breadboard



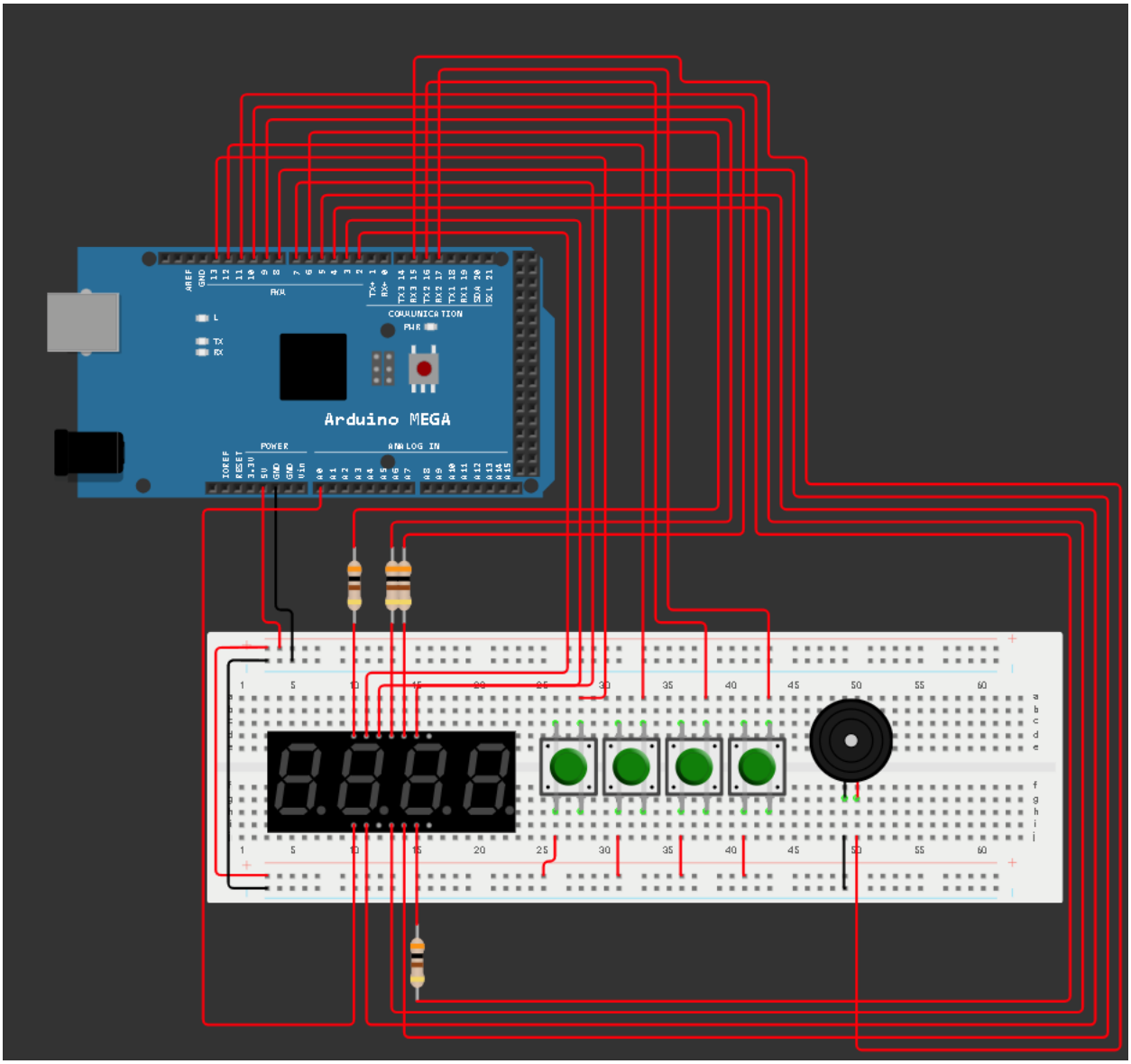
C. Source Code

```
int leds_Uno[] = {2, 3, 4, 5, 6, 7, 8};
int leds_Dos[] = {22, 23, 24, 25, 26, 27, 28};
int button_Uno = 9;
int button_Dos = 10;
int numbers = 0;
int digit_Array[10][7] = {
  {1, 1, 1, 1, 1, 1, 0},
  {0, 1, 1, 0, 0, 0, 0},
  {1, 1, 0, 1, 1, 0, 1},
  {1, 1, 1, 1, 0, 0, 1},
  {0, 1, 1, 0, 0, 1, 1},
  {1, 0, 1, 1, 0, 1, 1},
  {1, 0, 1, 1, 1, 1, 1},
  {1, 1, 1, 0, 0, 0, 0},
  {1, 1, 1, 1, 1, 1, 1},
  {1, 1, 1, 1, 0, 1, 1},
};
void setup(){
  for(int i = 0 ; i < 7 ; i++){
    pinMode(leds_Uno[i], OUTPUT);
    pinMode(leds_Dos[i], OUTPUT);
  }
  pinMode(button_Uno, INPUT);
  pinMode(button_Dos, INPUT);
}
void segmentOutput(int pins[], int digit){
  for(int i = 0 ; i < 7 ; i++){
    digitalWrite(pins[i], digit_Array[digit][i]);
}
}
```

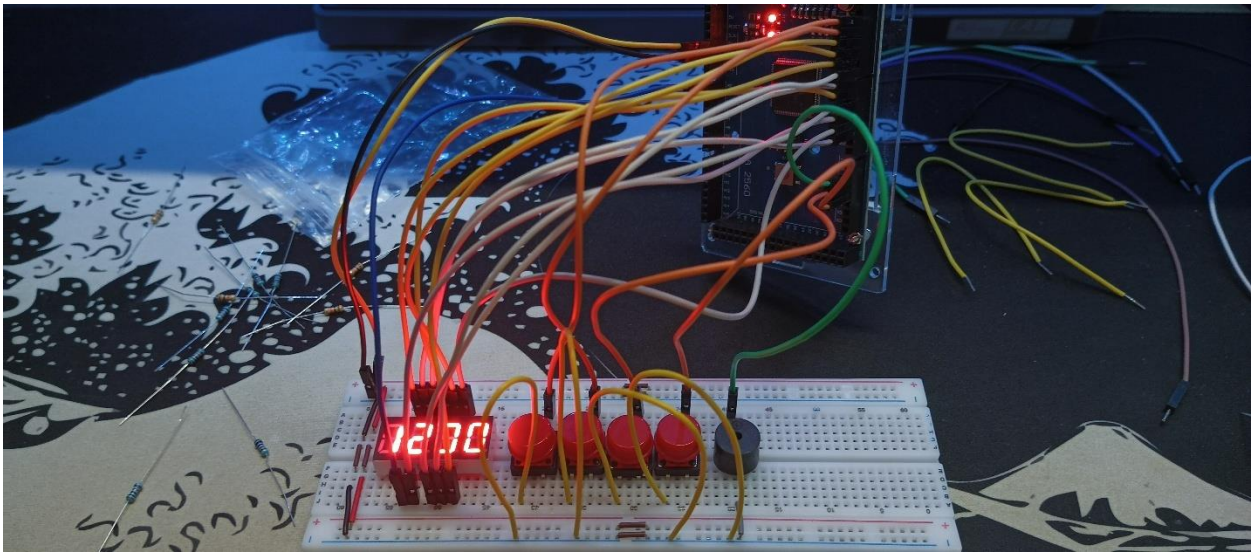
```
void loop(){
  if (digitalRead(button_Uno) == HIGH){
    numbers--;
    if (numbers < 0) numbers = 99;
    delay(150);
  }

  if (digitalRead(button_Dos) == HIGH){
    numbers++;
    if (numbers > 99) numbers = 0;
    delay(150);
  }

  int tens = numbers / 10;
  int ones = numbers % 10;

  segmentOutput(leds_Uno, tens);
  segmentOutput(leds_Dos, ones);
}
```

=== Topic 4: Arduino Countdown Timer in Minutes & Seconds ===

A. Wokwi Simulation



B. Breadboard



C. Source Code

```
#include <math.h>


 int digit_pin[] = {6, 9, 10, 11}; // PWM
Display  digit pins from left to right


 int speakerPin = 15;


 #define DIGIT_ON  LOW

 #define DIGIT_OFF  HIGH


 int segA = 2;

 int segB = 3;

 int  segC = 4;

 int segD = 5;

 int segE = A0; //pin 6 is used bij display 1 for
its pwm function

 int segF = 7;

 int segG = 8;

 //int segPD = ;



 int  button1=13;

 int button2=12;

 int button3=16;

 int button4=17;


 int  countdown_time = 60;


 struct struct_digits {

    int digit[4];

  };
```

```
void  setup() {

   pinMode(segA, OUTPUT);

   pinMode(segB, OUTPUT);

   pinMode(segC, OUTPUT);

   pinMode(segD, OUTPUT);

   pinMode(segE, OUTPUT);

   pinMode(segF, OUTPUT);

   pinMode(segG, OUTPUT);


   for (int i=0; i<4;  i++) {

    pinMode(digit_pin[i], OUTPUT);

   }


   pinMode(speakerPin,  OUTPUT);


   pinMode(button1,INPUT_PULLUP);

   pinMode(button2,INPUT_PULLUP);

   pinMode(button3,INPUT_PULLUP);

   pinMode(button4,INPUT_PULLUP);

 }



 void  playTone(int tone, int duration) {

   for (long k = 0; k < duration * 1000L; k  +=
tone * 2) {

    digitalWrite(speakerPin, HIGH);

    delayMicroseconds(tone);

    digitalWrite(speakerPin, LOW);

    delayMicroseconds(tone);

  }

 }
```

```
void  lightNumber(int numberToDisplay) {

 #define SEGMENT_ON  HIGH
 #define SEGMENT_OFF  LOW

  switch (numberToDisplay){

  case 0:
    digitalWrite(segA,  SEGMENT_ON);
    digitalWrite(segB, SEGMENT_ON);
    digitalWrite(segC, SEGMENT_ON);
    digitalWrite(segD, SEGMENT_ON);
    digitalWrite(segE, SEGMENT_ON);
    digitalWrite(segF,  SEGMENT_ON);
    digitalWrite(segG, SEGMENT_OFF);
    break;

  case  1:
    digitalWrite(segA, SEGMENT_OFF);
    digitalWrite(segB, SEGMENT_ON);
    digitalWrite(segC, SEGMENT_ON);
    digitalWrite(segD, SEGMENT_OFF);
    digitalWrite(segE, SEGMENT_OFF);
    digitalWrite(segF, SEGMENT_OFF);
    digitalWrite(segG, SEGMENT_OFF);
    break;

  case 2:
    digitalWrite(segA,  SEGMENT_ON);
    digitalWrite(segB, SEGMENT_ON);
    digitalWrite(segC, SEGMENT_OFF);
    digitalWrite(segD, SEGMENT_ON);
    digitalWrite(segE, SEGMENT_ON);
```

```
case  3:
    digitalWrite(segA, SEGMENT_ON);
    digitalWrite(segB, SEGMENT_ON);
    digitalWrite(segC, SEGMENT_ON);
    digitalWrite(segD, SEGMENT_ON);
    digitalWrite(segE,  SEGMENT_OFF);
    digitalWrite(segF, SEGMENT_OFF);
    digitalWrite(segG,  SEGMENT_ON);
    break;

  case 4:
    digitalWrite(segA, SEGMENT_OFF);
    digitalWrite(segB, SEGMENT_ON);
    digitalWrite(segC, SEGMENT_ON);
    digitalWrite(segD,  SEGMENT_OFF);
    digitalWrite(segE, SEGMENT_OFF);
    digitalWrite(segF,  SEGMENT_ON);
    digitalWrite(segG, SEGMENT_ON);
    break;

  case  5:
    digitalWrite(segA, SEGMENT_ON);
    digitalWrite(segB, SEGMENT_OFF);
    digitalWrite(segC, SEGMENT_ON);
    digitalWrite(segD, SEGMENT_ON);
    digitalWrite(segE,  SEGMENT_OFF);
    digitalWrite(segF, SEGMENT_ON);
    digitalWrite(segG, SEGMENT_ON);
    break;
```

```
case 6:
    digitalWrite(segA, SEGMENT_ON);
    digitalWrite(segB,  SEGMENT_OFF);
    digitalWrite(segC, SEGMENT_ON);
    digitalWrite(segD, SEGMENT_ON);
    digitalWrite(segE, SEGMENT_ON);
    digitalWrite(segF, SEGMENT_ON);
    digitalWrite(segG,  SEGMENT_ON);
    break;

  case 7:
    digitalWrite(segA, SEGMENT_ON);
    digitalWrite(segB, SEGMENT_ON);
    digitalWrite(segC, SEGMENT_ON);
    digitalWrite(segD,  SEGMENT_OFF);
    digitalWrite(segE, SEGMENT_OFF);
    digitalWrite(segF,  SEGMENT_OFF);
    digitalWrite(segG, SEGMENT_OFF);
    break;

  case  8:
    digitalWrite(segA, SEGMENT_ON);
    digitalWrite(segB, SEGMENT_ON);
    digitalWrite(segC, SEGMENT_ON);
    digitalWrite(segD, SEGMENT_ON);
    digitalWrite(segE,  SEGMENT_ON);
    digitalWrite(segF, SEGMENT_ON);
    digitalWrite(segG, SEGMENT_ON);
    break;
```

```
case 9:
    digitalWrite(segA, SEGMENT_ON);
    digitalWrite(segB,  SEGMENT_ON);
    digitalWrite(segC, SEGMENT_ON);
    digitalWrite(segD, SEGMENT_ON);
    digitalWrite(segE, SEGMENT_OFF);
    digitalWrite(segF, SEGMENT_ON);
    digitalWrite(segG, SEGMENT_ON);
    break;

  case 10:
    digitalWrite(segA,  SEGMENT_OFF);
    digitalWrite(segB, SEGMENT_OFF);
    digitalWrite(segC,  SEGMENT_OFF);
    digitalWrite(segD, SEGMENT_OFF);
    digitalWrite(segE,  SEGMENT_OFF);
    digitalWrite(segF, SEGMENT_OFF);
    digitalWrite(segG,  SEGMENT_OFF);
    break;
  }

}

void SwitchDigit(int  digit) {
  for (int i=0; i<4; i++) {
    if (i == digit) {
      digitalWrite(digit_pin[i],  DIGIT_ON);
    } else {
      digitalWrite(digit_pin[i], DIGIT_OFF);
    }
  }
}
```

```
struct struct_digits IntToDigits(int n){
  struct struct_digits  dig;
  int zeros=0;
  int d;
  for (int i=0; i<4; i++) {
    d=n/pow(10,3-i);
    zeros += d;
    n = n - d*pow(10,3-i);
    if (zeros!=0 || i==3) {
      dig.digit[i]=d;
    } else {
      dig.digit[i]=10;
    }
  }
  return dig;
}

 void PrintNumber(int n, int time) {
  struct struct_digits  dig;

  dig = IntToDigits(n);

  for (int i=0; i<= time/20; i++) {
    if (digitalRead(button2)==LOW) {
      return;
    }
    for (int j=0;  j<4; j++) {
      SwitchDigit(j);
      lightNumber(dig.digit[j]);
      delay(5);
    }
  }
 }
```

```
bool Countdown(int n, int del){
  int minutes = n / 100;
  int seconds = n % 100;

  while (minutes > 0 || seconds > 0) {
    // Combine back into MMSS format for
display
    int displayTime = minutes * 100 + seconds;
    PrintNumber(displayTime, del);

    if (digitalRead(button2) == LOW) {
      return false; // stop pressed
    }

    // countdown logic like a real clock
    if (seconds == 0) {
      if (minutes > 0) {
        minutes--;
        seconds = 59;
      }
    } else {
      seconds--;
    }
  }

  // Final 00:00
  PrintNumber(0,0);
  playTone(1519,1000);
  return true;
}
```

```
void reset() {
  int m, zeros, d, pressed3  = 0, pressed4 = 0;
  countdown_time = 1200;
  struct struct_digits dig;
  dig = IntToDigits(countdown_time);

  while (digitalRead(button1)==HIGH)  {
   for (int j=0; j<4; j++) {
    SwitchDigit(j);
    lightNumber(dig.digit[j]);
    delay(5);
   }
   // Decrement (one second, borrow to minutes when needed)
   if (digitalRead(button3)==LOW) {
    if (pressed3 == 0 || pressed3 > 30) {
     int minutes = countdown_time / 100;
     int seconds = countdown_time % 100;

     if (minutes > 0 || seconds > 0) {
      if (seconds == 0) {
       if (minutes > 0) { minutes--; seconds = 59; }
      } else {
       seconds--;
      }
      countdown_time = minutes * 100 + seconds;
      dig = IntToDigits(countdown_time);
     }
    }
    pressed3 += 1;
   }
```

```
else if (digitalRead(button4)==LOW) {
    if (pressed4 == 0 || pressed4 > 30) {
     int minutes = countdown_time / 100;
     int seconds = countdown_time % 100;

     // cap at 99:59 to stay within 4 digits
     if (!(minutes == 99 && seconds == 59)) {
      if (seconds == 59) {
       if (minutes < 99) { minutes++; seconds = 0; }
      } else {
       seconds++;
      }
      countdown_time = minutes * 100 + seconds;
      dig = IntToDigits(countdown_time);
     }
    }
    pressed4 += 1;
   }

   if (digitalRead(button3)==HIGH)  pressed3 = 0;
   if (digitalRead(button4)==HIGH)  pressed4 = 0;
  }
}
```

```
void loop(){
   reset();
   while (!Countdown(countdown_time,962))  {
     reset();
   }
   while (digitalRead(button2)==1){};
 }
```

IV. PROCEDURE

A. Preparation

- Gather the required components as stated in Chapter 2
- Prepare the Arduino IDE on your preferred device.
- Review the problem for each topic and formulate or search for a circuit diagram given the problem of each topic.
- Simulate your circuit diagram to a circuit simulator such as TinkerCADor Wokwi.

B. Actual

- For topic 1, connect each segment of the 7 segment display to their respective digital pins as per the circuit diagram. Connect the common segments of the 7-segment display to ground as it is a common anode configurated component. Attach the tactile/push button on the breadboard and connect digital pin 10 to it while connecting its adjacent pin to VCC. Connect the common segments of the 7-segment display to ground as it is a common anode configurated component using a 220Ω resistor. Connect the 5v VCC and GND pin of the microcontroller to the "+" and "-" of the breadboard. Connect the USBVCC to the Arduino Uno R3 / Arduino Mega 2560 then verify and upload the code.
- For topic 2, connect each segment of the 7 segment display to their respective digital pins as per the circuit diagram. Connect the common segments of the 7-segment display to ground as it is a common anode configurated component using a 220Ω resistor. Connect the 5v VCC and GND pin of the microcontroller to the "+" and "-" of the breadboard. Connect the USBVCC to the Arduino Uno R3 / Arduino Mega 2560 then verify and upload the code.
- For topic 3, connect the first 7-segment display's segments to digital pins 2-8. Connect the second 7-segment display's segments to digital pins 22-28. Connect the common segments of all the 7-segment displays to ground as it is a common anode configurated component using a 220Ω resistor. Place the two push buttons on the bread board. Connect digital pin 9 on the first button then direct it to ground for a normally low, active high button. Connect the adjacent pin of the first button to VCC. Repeat for the second button but connect it to digital pin 10.

Connect the 5v VCC and GND pin of the microcontroller to the “+” and “-“ of the breadboard. Connect the USBVCC to the Arduino Uno R3 / Arduino Mega 2560 then verify and upload the code.

- For topic 4, connect the segments of the 4-digit 7-segment display to their respective digital pins. Connect the digit segments to digital pins 6, 9, 10, and 11 with a 220Ω resistor. Attach four push buttons on the breadboard with their pins connected to 13, 12, 16 and 17 respectively. Connect each adjacent pin of the 4 push buttons to VCC. Attach the buzzer to the breadboard. Connect its anode to digital pin 15. Connect its cathode to ground. Connect the 5v VCC and GND pin of the microcontroller to the “+” and “-“ of the breadboard. Connect the USBVCC to the Arduino Uno R3 / Arduino Mega 2560 then verify and upload the code.

C. Checking

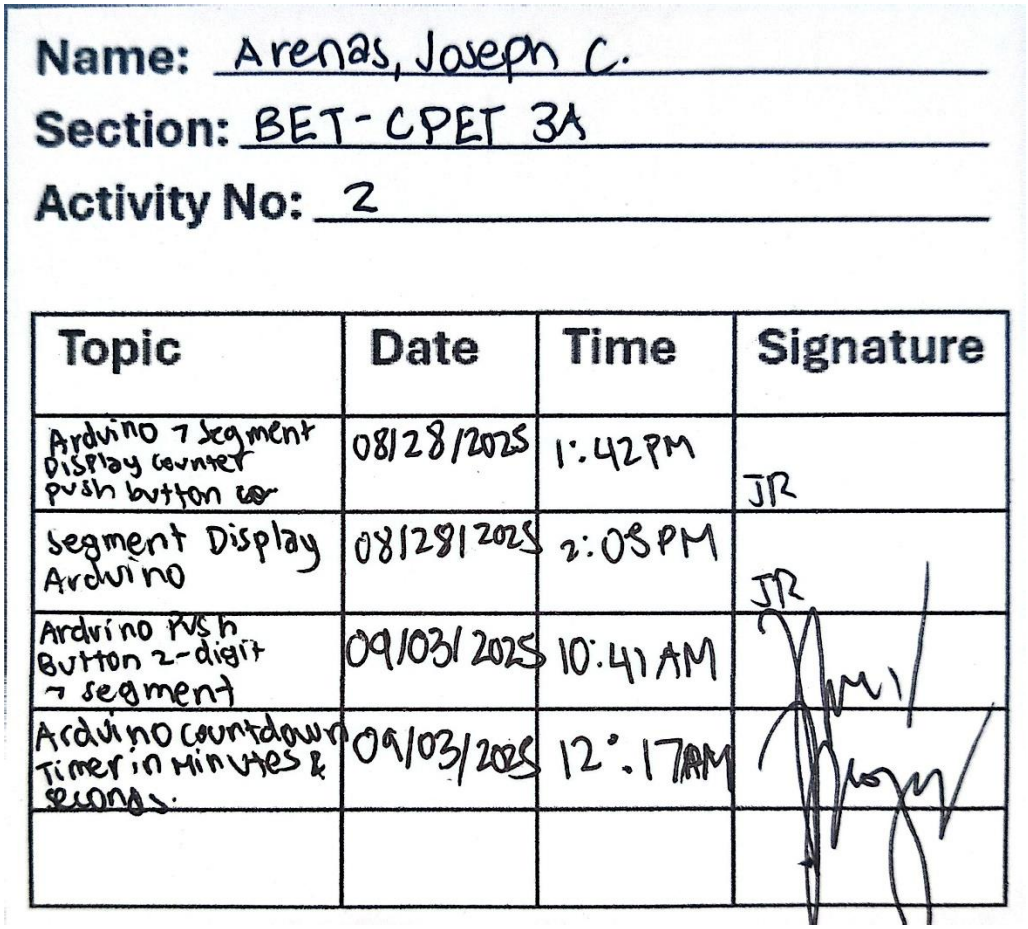
- For topic 1, ensure that at each press of the button, 7-segment display number increments by 1 from numbers 0-9 then back to 0.
- For topic 2, ensure that the 7-segment display shows the numbers 0-9 then back to 0 incrementing automatically.
- For topic 3, ensure that numbers of 1 digit and two digits increment when button 2 is pressed and decrements when button 1 is pressed. Numbers displayed should be from 0-99.
- For topic 4, ensure that proper time formatting is followed. Ensure that button 1 starts the timer, button 2 resets the timer back to 12:00, button 3 decrements the timer alarm and button 4 increments the timer alarm. Make sure that when the timer reaches 00:00, the buzzer goes HIGH.
- Adjust values or fix errors if the output is not working as expected.

D. Uploading

- Upload the final and corrected code to the Arduino Uno R3/Arduino Mega 2560
- Ensure that all four topics properly work.

V. CONCLUSION

The activities highlighted the practical integration of hardware and software using Arduino, particularly with 7-segment displays and LEDs. They demonstrated how digital logic, coding, and circuit design work together to produce functional outputs. Overall, the tasks strengthened both technical understanding and problem-solving skills in microcontroller applications.



Name: Arenas, Joseph C.

Section: BET-CPET 3A

Activity No: 2

Topic	Date	Time	Signature
Arduino 7 segment display counter push button co	08/28/2025	1:42PM	JR
Segment Display Arduino	08/28/2025	2:05PM	JR
Arduino Push Button 2-digit 7 segment	09/03/2025	10:41AM	
Arduino countdown Timer in minutes & seconds.	09/03/2025	12:17AM	