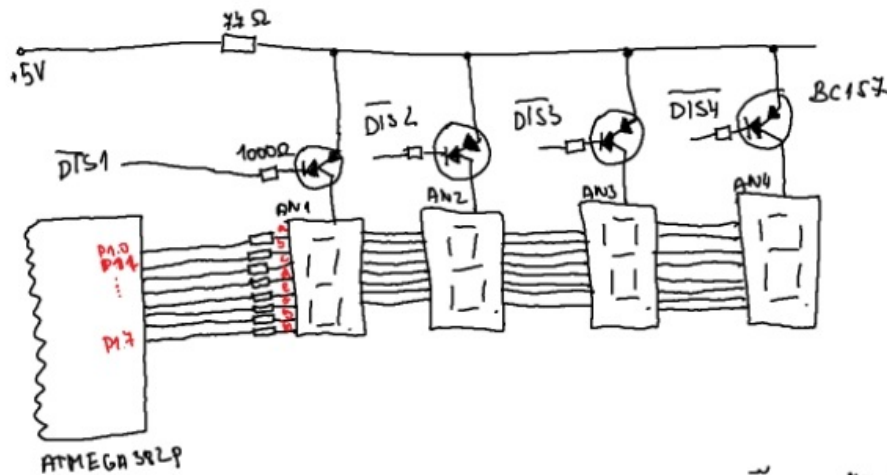


## Zadanie 4

### Úloha č. 1: Dynamické riadenie 4-miestneho LED displeja

a) Nakreslite schému zapojenia pre dynamické riadenie 4-miestneho LED displeja, pripojeného k vybraným portom jednočipového mikropočítača ATMEGA328. Napájacie napätie je + 5V. Jednotlivé anódy displejov budú riadené tranzistormi. Vyberte vhodný typ tranzistorov podľa požadovaného prúdového zaťaženia a vypočítajte hodnotu bázových odporov. Maximálny prúd cez jeden segment bude 10 mA.



$$U_{zdroj} = 5V$$
$$I_{max} = 10mA = 10^{-2}A$$
$$R = 2,5\Omega$$

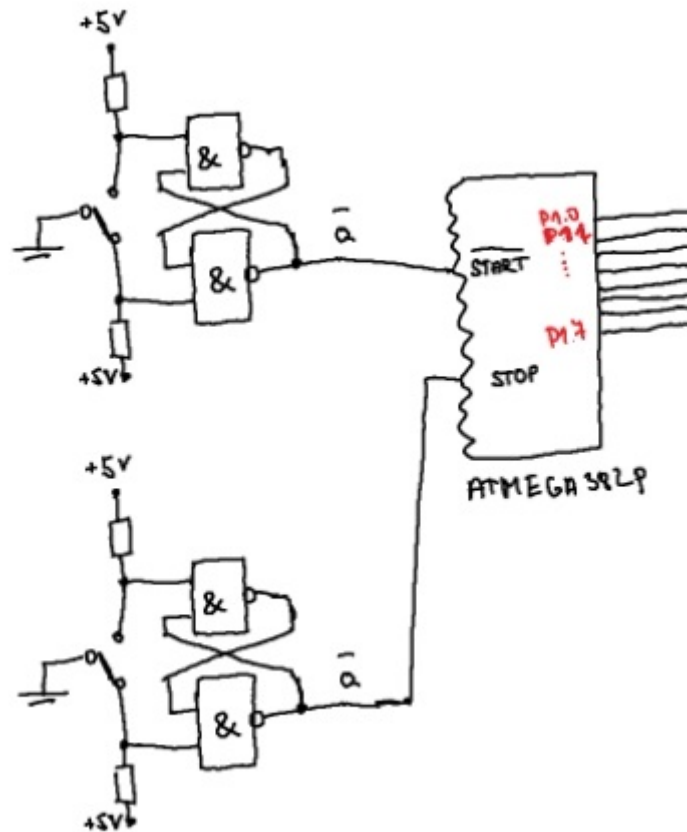
Do 7. segm. displeja potrebujeme dostať max. 70mA.  
Na bázu musíme riešiť max 5mA, čiže potrebujeme na bázu pridať odpor

$$R = \frac{U}{I} = \frac{5}{0,005} = 1000\Omega$$

$$I = x + 0,005$$
$$x = 0,07 - 0,005 = 0,065$$

$$R = \frac{5}{0,065} = 76,923 \approx 77\Omega$$

b) K mikropočítaču pripojte tlačidlá START a STOP, aktívna úroveň log. 0. Obidve tlačidlá budú ošetrené proti



zákmitom pomocou preklápacieho obvodu.

c) Napište program v jazyku C vo vývojovom prostredí Arduino IDE, ktorý bude v nekonečnom cykle zobrazovať na jednotlivých LED displejoch hodnoty premenných MIN10, MIN1, SEC10, SEC1. Obnovovacia frekvencia displeja bude 50 Hz.

```
//On off values
int on = 0;
int off = 1;

// hodnoty premennych
int MIN10 = 0;
int MIN1 = 0;
int SEC10 = 0;
int SEC1 = 0;

// hodnoty LED segmentov
int LED7 = 8;
int LED6 = 2;
int LED5 = 3;
int LED4 = 4;
int LED3 = 5;
int LED2 = 6;
int LED1 = 7;

// hodnoty na kontrolu 7-seg displejov
int CTRL1 = 9;
int CTRL2 = 10;
```

```

int CTRL3 = 11;
int CTRL4 = 12;

// 1 perioda = 20ms => 1 seg = 20/4 = 5ms
int time_delay = 5;

void setup()
    // hodnoty pre 7 segment rezim vystup
    pinMode(LED7, OUTPUT);
    pinMode(LED6, OUTPUT);
    pinMode(LED5, OUTPUT);
    pinMode(LED4, OUTPUT);
    pinMode(LED3, OUTPUT);
    pinMode(LED2, OUTPUT);
    pinMode(LED1, OUTPUT);

    // hodnoty pre kontrolu displejov rezim vystup
    pinMode(CTRL1, OUTPUT);
    pinMode(CTRL2, OUTPUT);
    pinMode(CTRL3, OUTPUT);
    pinMode(CTRL4, OUTPUT);
}

void loop(){
    // 0 0:0 1
    number(SEC1);
    digitalWrite(CTRL4, 1);
    delay(5);
    digitalWrite(CTRL4, 0);

    // 0 0:1 0
    number(SEC10);
    digitalWrite(CTRL3, 1);
    delay(5);
    digitalWrite(CTRL3, 0);

    // 0 1:0 0
    number(MIN1);
    digitalWrite(CTRL2, 1);
    delay(5);
    digitalWrite(CTRL2, 0);

    // 1 0:0 0
    number(MIN10);
    digitalWrite(CTRL1, 1);
    delay(5);
    digitalWrite(CTRL1, 0);
}

void number(int num) {
    switch(num) {
        case 0:
            light_led(on, on, on, on, on, on, off); //zero
            break;

```

```

    case 1:
        light_led(off, on, on, off, off, off, off); //one
        break;
    case 2:
        light_led(on, on, off, on, on, off, on); //two
        break;
    case 3:
        light_led(on, on, on, on, off, on, on); //three
        break;
    case 4:
        light_led(on, on, on, on, on, off, on); //four
        break;
    case 5:
        light_led(on, off, on, on, off, on, on); //five
        break;
    case 6:
        light_led(on, off, on, on, on, on, on); //six
        break;
    case 7:
        light_led(on, on, on, off, off, off, off); //seven
        break;
    case 8:
        light_led(on, on, on, on, on, on, on); //eight
        break;
    case 9:
        light_led(on, on, on, on, off, on, on); //nine
        break;
    default:
        break;
}

}

void light_led(int V1, int V2, int V3, int V4, int V5, int V6, int V7)
{
    digitalWrite(LED1, V1);
    digitalWrite(LED2, V2);
    digitalWrite(LED3, V3);
    digitalWrite(LED4, V4);
    digitalWrite(LED5, V5);
    digitalWrite(LED6, V6);
    digitalWrite(LED7, V7);
}

```

## Úloha č. 2: Stopky v rozsahu 00:00 až 59:59

a) Doplňte program z Úlohy č. 1 tak, aby sa po stlačení tlačidla START displej vynuloval a začal počítat sekundy. Postupne sa budú upravovať hodnoty jednotlivých premenných SEC1 až MIN10, zobrazovaných na 4-miestnom displeji.

```

//btns
int button_start = 13;

//On off values
int on = 0;
int off = 1;

//Stop help bool
int stopped = 0;

// hodnoty premennych
int MIN10 = 0;
int MIN1  = 0;
int SEC10 = 0;
int SEC1  = 0;

// hodnoty LED segmentov
int LED7  = 8;
int LED6  = 2;
int LED5  = 3;
int LED4  = 4;
int LED3  = 5;
int LED2  = 6;
int LED1  = 7;

// hodnoty na kontrolu 7-seg displejov
int CTRL1 = 9;
int CTRL2 = 10;
int CTRL3 = 11;
int CTRL4 = 12;

// 1 perioda = 20ms => 1 seg = 20/4 = 5ms
int time_delay = 5;

void setup() {
    // start tlacidlo
    pinMode(button_start, INPUT_PULLUP);

    // hodnoty pre 7 segment rezim vystup
    pinMode(LED7, OUTPUT);
    pinMode(LED6, OUTPUT);
    pinMode(LED5, OUTPUT);
    pinMode(LED4, OUTPUT);
    pinMode(LED3, OUTPUT);
    pinMode(LED2, OUTPUT);
    pinMode(LED1, OUTPUT);

    // hodnoty pre kontrolu displejov rezim vystup
    pinMode(CTRL1, OUTPUT);
    pinMode(CTRL2, OUTPUT);
    pinMode(CTRL3, OUTPUT);
    pinMode(CTRL4, OUTPUT);
}

```

```

}

void loop(){
    if(digitalRead (button_start) == 0){
        secs = 0;
        mins = 0;
    }

    MIN10 = mins/10;
    MIN1  = mins%10;
    SEC10 = secs/10;
    SEC1  = secs%10;

    // 0 0:0 1
    number(SEC1);
    digitalWrite(CTRL4, 1);
    delay(5);
    digitalWrite(CTRL4, 0);

    // 0 0:1 0
    number(SEC10);
    digitalWrite(CTRL3, 1);
    delay(5);
    digitalWrite(CTRL3, 0);

    // 0 1:0 0
    number(MIN1);
    digitalWrite(CTRL2, 1);
    delay(5);
    digitalWrite(CTRL2, 0);

    // 1 0:0 0
    number(MIN10);
    digitalWrite(CTRL1, 1);
    delay(5);
    digitalWrite(CTRL1, 0);

    secs += 1;
    if (secs > 59) {
        secs = 0;
        mins += 1;
    }

    if (mins > 59) {
        secs = 0;
        mins = 0;
    }
}

void number(int num) {
    switch(num) {
        case 0:
            light_led(on, on, on, on, on, on, off);//zero
            break;

```

```

        case 1:
            light_led(off, on, on, off, off, off, off); //one
            break;
        case 2:
            light_led(on, on, off, on, on, off, on); //two
            break;
        case 3:
            light_led(on, on, on, on, off, on, on); //three
            break;
        case 4:
            light_led(on, on, on, on, on, off, on); //four
            break;
        case 5:
            light_led(on, off, on, on, off, on, on); //five
            break;
        case 6:
            light_led(on, off, on, on, on, on, on); //six
            break;
        case 7:
            light_led(on, on, on, off, off, off, off); //seven
            break;
        case 8:
            light_led(on, on, on, on, on, on, on); //eight
            break;
        case 9:
            light_led(on, on, on, on, off, on, on); //nine
            break;
        default:
            break;
    }

}

void light_led(int V1, int V2, int V3, int V4, int V5, int V6, int V7)
{
    digitalWrite(LED1, V1);
    digitalWrite(LED2, V2);
    digitalWrite(LED3, V3);
    digitalWrite(LED4, V4);
    digitalWrite(LED5, V5);
    digitalWrite(LED6, V6);
    digitalWrite(LED7, V7);
}

```

b) Po stlačení tlačidla STOP sa počítanie zastaví a na displeji zostane svietiť posledná hodnota.

```

//btns
int button_start = 13;
int button_stop  = 14;

//On off values

```

```

int on = 0;
int off = 1;

//Stop help bool
int stopped = 0;

// hodnoty premennych
int MIN10 = 0;
int MIN1  = 0;
int SEC10 = 0;
int SEC1  = 0;

// hodnoty LED segmentov
int LED7  = 8;
int LED6  = 2;
int LED5  = 3;
int LED4  = 4;
int LED3  = 5;
int LED2  = 6;
int LED1  = 7;

// hodnoty na kontrolu 7-seg displejov
int CTRL1 = 9;
int CTRL2 = 10;
int CTRL3 = 11;
int CTRL4 = 12;

// 1 perioda = 20ms => 1 seg = 20/4 = 5ms
int time_delay = 5;

void setup() {
    // tlacidla
    pinMode(button_start, INPUT_PULLUP);
    pinMode(button_stop, INPUT_PULLUP);

    // hodnoty pre 7 segment rezim vystup
    pinMode(LED7, OUTPUT);
    pinMode(LED6, OUTPUT);
    pinMode(LED5, OUTPUT);
    pinMode(LED4, OUTPUT);
    pinMode(LED3, OUTPUT);
    pinMode(LED2, OUTPUT);
    pinMode(LED1, OUTPUT);

    // hodnoty pre kontrolu displejov rezim vystup
    pinMode(CTRL1, OUTPUT);
    pinMode(CTRL2, OUTPUT);
    pinMode(CTRL3, OUTPUT);
    pinMode(CTRL4, OUTPUT);
}

void loop(){
    if(digitalRead (button_start) == 0){
        secs = 0;
    }
}

```



```

    mins = 0;
}

if(digitalRead (button_stop) == 0){
    stopped = 1;
}

if(stopped == 0){
    MIN10 = mins/10;
    MIN1  = mins%10;
    SEC10 = secs/10;
    SEC1  = secs%10;

    // 0 0:0 1
    number(SEC1);
    digitalWrite(CTRL4, 1);
    delay(5);
    digitalWrite(CTRL4, 0);

    // 0 0:1 0
    number(SEC10);
    digitalWrite(CTRL3, 1);
    delay(5);
    digitalWrite(CTRL3, 0);

    // 0 1:0 0
    number(MIN1);
    digitalWrite(CTRL2, 1);
    delay(5);
    digitalWrite(CTRL2, 0);

    // 1 0:0 0
    number(MIN10);
    digitalWrite(CTRL1, 1);
    delay(5);
    digitalWrite(CTRL1, 0);

    secs += 1;
    if (secs > 59) {
        secs = 0;
        mins += 1;
    }

    if (mins > 59) {
        secs = 0;
        mins = 0;
    }
}

}

void number(int num) {
    switch(num) {
        case 0:
            light_led(on, on, on, on, on, on, off); //zero

```

```

        break;
    case 1:
        light_led(off, on, on, off, off, off, off); //one
        break;
    case 2:
        light_led(on, on, off, on, on, off, on); //two
        break;
    case 3:
        light_led(on, on, on, on, off, on, on); //three
        break;
    case 4:
        light_led(on, on, on, on, on, off, on); //four
        break;
    case 5:
        light_led(on, off, on, on, off, on, on); //five
        break;
    case 6:
        light_led(on, off, on, on, on, on, on); //six
        break;
    case 7:
        light_led(on, on, on, off, off, off, off); //seven
        break;
    case 8:
        light_led(on, on, on, on, on, on, on); //eight
        break;
    case 9:
        light_led(on, on, on, on, off, on, on); //nine
        break;
    default:
        break;
}

}

void light_led(int V1, int V2, int V3, int V4, int V5, int V6, int V7)
{
    digitalWrite(LED1, V1);
    digitalWrite(LED2, V2);
    digitalWrite(LED3, V3);
    digitalWrite(LED4, V4);
    digitalWrite(LED5, V5);
    digitalWrite(LED6, V6);
    digitalWrite(LED7, V7);
}

```