

Nastavni predmet:	Ugradbeni računalni sustavi
Vježba: 02	Arduino – Sedam segmentni LED indikator 2
Cilj vježbe:	Naučiti ispisivati brojeve i slova na 4 X 7 segmentni LED zaslon

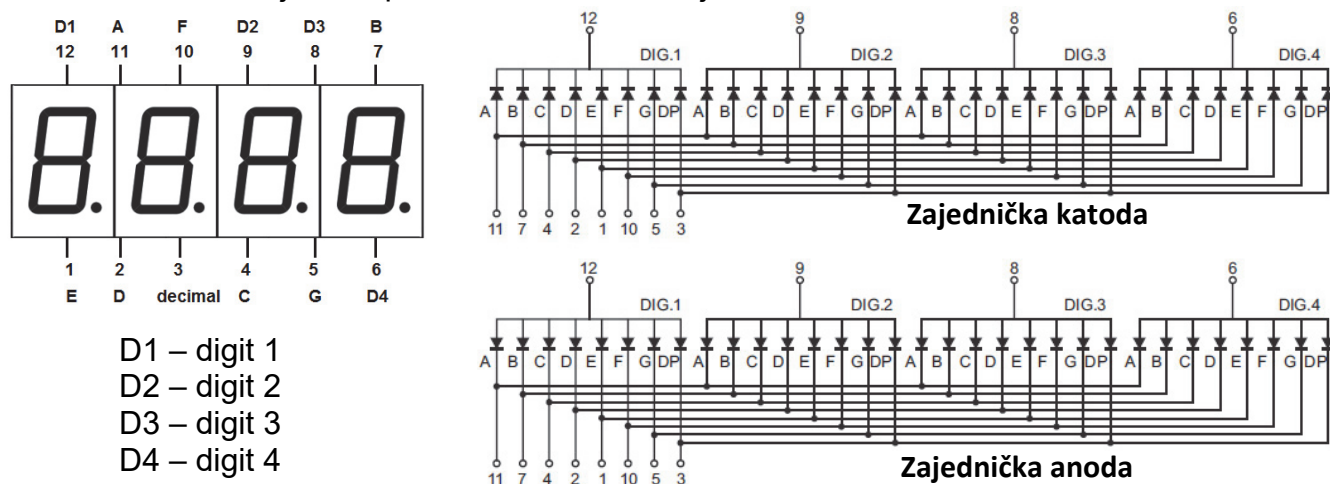
## Upute

Sve zadatke spremi na USB, a u bilježnici za sve zadatke napiši:

- postupak izrade programa
- objašnjenje korištenih naredbi
- dobivene rezultate po točkama
- odgovoriti u bilježnicu na postavljena pitanja vezana uz ovu vježbu
- Ukoliko u kodu postoji greška, korigiraj i objasni!

### 4 X 7 segmentni LED displej

U praksi je vrlo često potrebno prikazati više od jedne znamenke, pa se koristi 4 X 7 segmentni LED zaslon. Uobičajeni raspored izvoda i unutarnja električna shema dani su u nastavku.



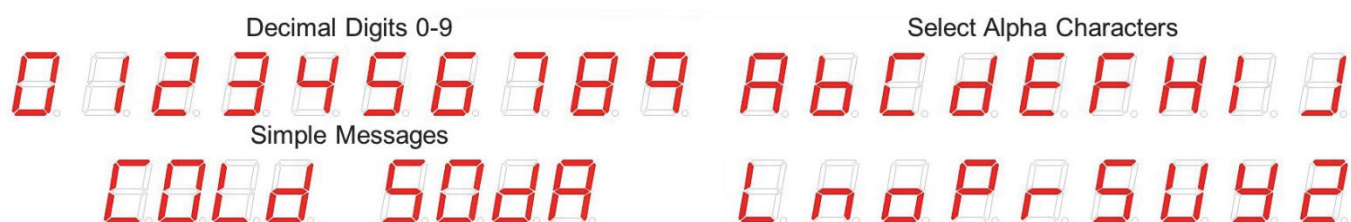
Kako bi se smanjio broj izvoda, 4 X 7 segmentni LED je multipleksiran, tj. za pojedinu znamenku treba uključiti zajedničku nožicu (katodu ili anodu) za tu znamenku.

Displej ima 8 nožica za 8 standardnih segmenata + 4 nožice za odabir pojedine znamenke. Znamenke se naizmjenice uključuju i ispisuju se odgovarajući segmenti za tu znamenku.

Ako se znamenka za znamenkom ispisuju dovoljno velikom brzinom, ljudsko oko će prepoznati kao da sve 4 znamenke svijetle istovremeno.

Osim decimalne točke, ovi indikatori mogu imati i dvotočku pomoću kojih se može realizirati sat.

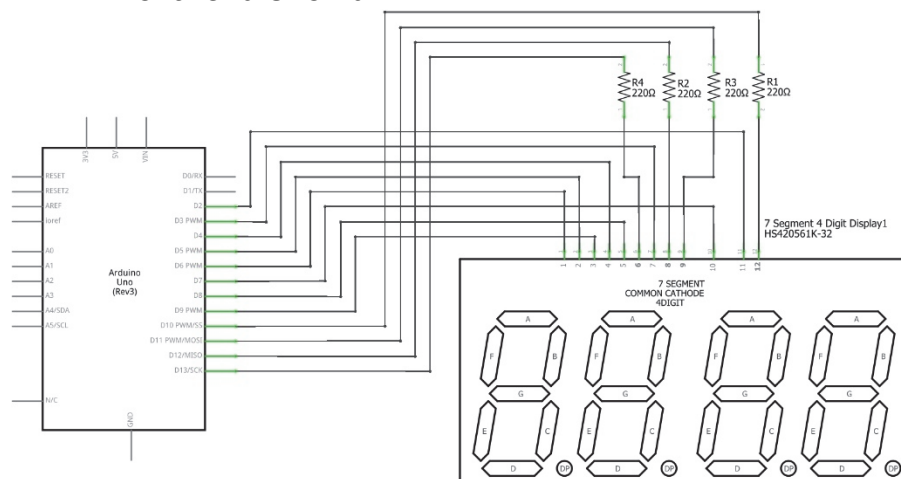
Znakovi koji se mogu prikazati pomoću 7 segmentnog LED displeja:



**Zadatak 1.** Spoji 4 X 7 segmentni LED displej prema priloženoj shemi. Napiši program tako da na njemu piše „PULA“.

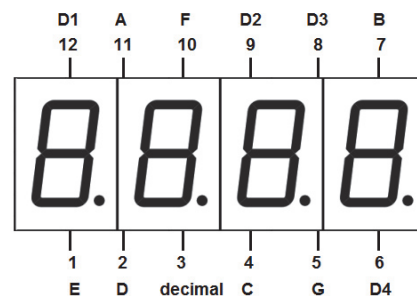
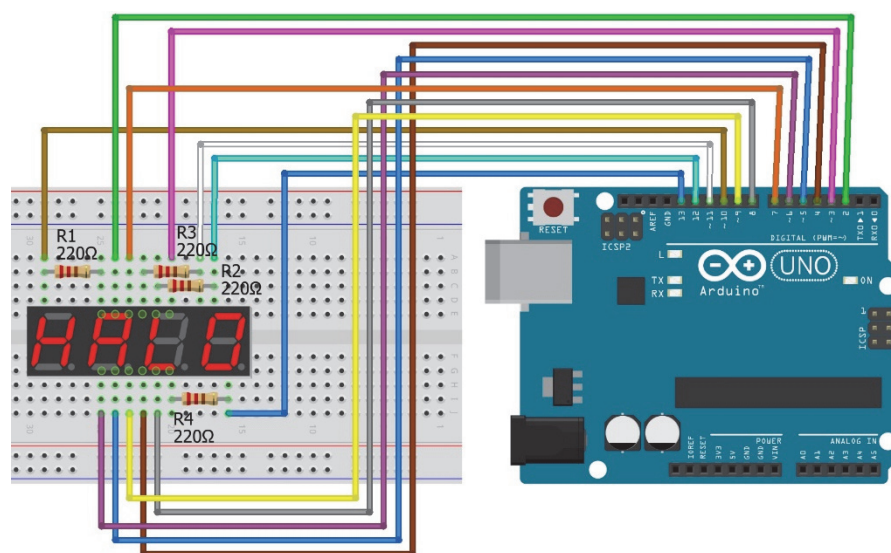
**NAPOMENA:** Između pinova D1 (12), D2 (8), D3 (9) i D4(6) LED displeja i odgovarajućih pinova Arduina treba spojiti otpornik oko 220 ohma.

**Električna shema:**



Arduino Pin	4x7 segment. LED display Pin
2	11 (A)
3	7 (B)
4	4 (C)
5	2 (D)
6	1 (E)
7	10 (F)
8	5 (G)
9	3 (DP)
10	12 (D1)
11	8 (D2)
12	9 (D3)
13	6 (D4)

**Grafička shema:**



**Kòd zadatka**

```
int intDelay = 500; // vrijeme čekanja između ispisa dviju znamenki

void setup() {
  // put your setup code here, to run once:
  pinMode(2, OUTPUT); // segment A
  pinMode(3, OUTPUT); // segment B
  pinMode(4, OUTPUT); // segment C
  pinMode(5, OUTPUT); // segment D
  pinMode(6, OUTPUT); // segment E
  pinMode(7, OUTPUT); // segment F
  pinMode(8, OUTPUT); // segment G
  pinMode(9, OUTPUT); // decimalna točka
}
```

```

digitalWrite(9, 0);      // isključujemo decimalnu točku

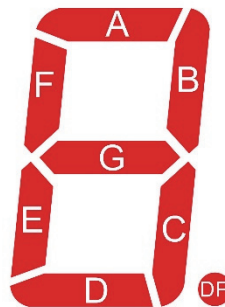
pinMode(10, OUTPUT);    // Pin za katodu prve znamenke D1
pinMode(11, OUTPUT);    // Pin za katodu druge znamenke D2
pinMode(12, OUTPUT);    // Pin za katodu treće znamenke D3
pinMode(13, OUTPUT);    // Pin za katodu četvrte znamenke D4
}

```

```

void loop() {
  // piši 'P'
  digitalWrite(2, 1);
  digitalWrite(3, 1);
  digitalWrite(4, 0);
  digitalWrite(5, 0);
  digitalWrite(6, 1);
  digitalWrite(7, 1);
  digitalWrite(8, 1);

```



```

digitalWrite(10, 0);    // Aktivna samo prva znamenka D1
digitalWrite(11, 1);
digitalWrite(12, 1);
digitalWrite(13, 1);
delay(intDelay);

```

```

// piši 'U'
digitalWrite(2, 0);
digitalWrite(3, 1);
digitalWrite(4, 1);
digitalWrite(5, 1);
digitalWrite(6, 1);
digitalWrite(7, 1);
digitalWrite(8, 0);

```

```

digitalWrite(10, 1);
digitalWrite(11, 0);    // Aktivna samo druga znamenka D2
digitalWrite(12, 1);
digitalWrite(13, 1);
delay(intDelay);

```

```

// piši 'L'
digitalWrite(2, 0);
digitalWrite(3, 0);
digitalWrite(4, 0);
digitalWrite(5, 1);
digitalWrite(6, 1);
digitalWrite(7, 1);
digitalWrite(8, 0);

```

```

digitalWrite(10, 1);
digitalWrite(11, 1);
digitalWrite(12, 0);    // Aktivna samo treća znamenka D3

```

```

digitalWrite(13, 1);
delay(intDelay);

// piši 'A'
digitalWrite(2, 1);
digitalWrite(3, 1);
digitalWrite(4, 1);
digitalWrite(5, 0);
digitalWrite(6, 1);
digitalWrite(7, 1);
digitalWrite(8, 1);

digitalWrite(10, 1);
digitalWrite(11, 1);
digitalWrite(12, 1);
digitalWrite(13, 0);    // Aktivna samo četvrta znamenka D4
delay(intDelay);
}

```

**Zadatak 2.** Prethodni zadatak modificiraj tako da dodaš potencijometar na ulaz A0 Arduina pomoću kojeg ćeš regulirati brzinu ispisa slova. Brzinu ispisa treba regulirati u granicama 1 ms do 250 ms.

1. Koje modifikacije u kodu treba napraviti da se dobije čist i stabilan prikaz znamenki?

**Zadatak 3.** Modificiraj program iz prethodnog zadatka tako da na 4 X 7 segmentnom zaslonu ispisuješ očitanu A/D vrijednost potencijometra priključenog na A0 ulaz. Prati stanje znamenki na Serial monitoru.

#### Kòd zadatka

```

int a = 2;
int b = 3;
int c = 4;
int d = 5;
int e = 6;
int f = 7;
int g = 8;
int p = 9;

int d1 = 10;
int d2 = 11;
int d3 = 12;
int d4 = 13;

int nDelayMicroseconds = 200;

int data;
void setup()
{
    pinMode(A0, INPUT);
}

```

```

pinMode(d1, OUTPUT);
pinMode(d2, OUTPUT);
pinMode(d3, OUTPUT);
pinMode(d4, OUTPUT);

pinMode(a, OUTPUT); //DDRD.2
pinMode(b, OUTPUT); //DDRD.3
pinMode(c, OUTPUT); //DDRD.4
pinMode(d, OUTPUT); //DDRD.5
pinMode(e, OUTPUT); //DDRD.6
pinMode(f, OUTPUT); //DDRD.7

pinMode(g, OUTPUT);
pinMode(p, OUTPUT);

//DDRD = B11111110;
//DDRB = B00111111;

Serial.begin(9600);
}

void loop()
{
    int d1, d2, d3, d4;

    data = analogRead(A0);

    d1 = data / 1000 % 10;    // Znamenska tisućice
    d2 = data / 100 % 10;    // Znamenska stotice
    d3 = data / 10 % 10;     // Znamenska desetice
    d4 = data % 10;          // Znamenska jedinice

    Serial.print(data);
    Serial.print("\t");
    Serial.print(d1);
    Serial.print("\t");
    Serial.print(d2);
    Serial.print("\t");
    Serial.print(d3);
    Serial.print("\t");
    Serial.print(d4);
    Serial.print("\n");

    for (int m = 0; m<80; m++) {
        clearLEDs();        //Turn off all LED lights
        pickDigit(1);        //Selection of a digital display
        pickNumber(d1);      //Display digital d1
        delayMicroseconds(nDelayMicroseconds);

        clearLEDs();        //Turn off all LED lights
        pickDigit(2);        //Select the first two digital display
        pickNumber(d2);      //Display digital d2
    }
}

```

```

        delayMicroseconds(nDelayMicroseconds);

        clearLEDs();           //Turn off all LED lights
        pickDigit(3);          //Select the first three digital display
        pickNumber(d3);        //Display digital d3
        delayMicroseconds(nDelayMicroseconds);

        clearLEDs();           //Turn off all LED lights
        pickDigit(4);          //Select the first four digital display
        pickNumber(d4);        //Display digital d4
        delayMicroseconds(nDelayMicroseconds);
    }
}

void pickDigit(int x) //Defined pickDigit (x), whose role is to open the
port dx
{
    digitalWrite(d1, HIGH);
    digitalWrite(d2, HIGH);
    digitalWrite(d3, HIGH);
    digitalWrite(d4, HIGH);
    switch (x)
    {
    case 1:
        digitalWrite(d1, LOW);
        break;
    case 2:
        digitalWrite(d2, LOW);
        break;
    case 3:
        digitalWrite(d3, LOW);
        break;
    default:
        digitalWrite(d4, LOW);
        break;
    }
}

void pickNumber(int x) //Defined pickNumber (x), whose role is to display
digital x
{
    switch (x)
    {
    case 1:
        one();
        break;
    case 2:
        two();
        break;
    case 3:
        three();
        break;
    }
}

```

```

    case 4:
        four();
        break;
    case 5:
        five();
        break;
    case 6:
        six();
        break;
    case 7:
        seven();
        break;
    case 8:
        eight();
        break;
    case 9:
        nine();
        break;
    default:
        zero();
        break;
}

}

void dispDec(int x) //Decimal point setting Open
{
    digitalWrite(p, HIGH);
}

void clearLEDs() //Clear screen
{
    digitalWrite(a, LOW);
    digitalWrite(b, LOW);
    digitalWrite(c, LOW);
    digitalWrite(d, LOW);
    digitalWrite(e, LOW);
    digitalWrite(f, LOW);
    digitalWrite(g, LOW);
    digitalWrite(p, LOW);
}

void zero() //Define those figures 0 cathode pin switch
{
    digitalWrite(a, HIGH);
    digitalWrite(b, HIGH);
    digitalWrite(c, HIGH);
    digitalWrite(d, HIGH);
    digitalWrite(e, HIGH);
    digitalWrite(f, HIGH);
    digitalWrite(g, LOW);
}

```

```

void one() //Define those figures 1 cathode pin switch
{
    digitalWrite(a, LOW);
    digitalWrite(b, HIGH);
    digitalWrite(c, HIGH);
    digitalWrite(d, LOW);
    digitalWrite(e, LOW);
    digitalWrite(f, LOW);
    digitalWrite(g, LOW);
}

void two() //Define those figures 2 cathode pin switch
{
    digitalWrite(a, HIGH);
    digitalWrite(b, HIGH);
    digitalWrite(c, LOW);
    digitalWrite(d, HIGH);
    digitalWrite(e, HIGH);
    digitalWrite(f, LOW);
    digitalWrite(g, HIGH);
}

void three() //Define those figures 3 cathode pin switch
{
    digitalWrite(a, HIGH);
    digitalWrite(b, HIGH);
    digitalWrite(c, HIGH);
    digitalWrite(d, HIGH);
    digitalWrite(e, LOW);
    digitalWrite(f, LOW);
    digitalWrite(g, HIGH);
}

void four() //Define those figures 4 cathode pin switch
{
    digitalWrite(a, LOW);
    digitalWrite(b, HIGH);
    digitalWrite(c, HIGH);
    digitalWrite(d, LOW);
    digitalWrite(e, LOW);
    digitalWrite(f, HIGH);
    digitalWrite(g, HIGH);
}

void five() //Define those figures 5 cathode pin switch
{
    digitalWrite(a, HIGH);
    digitalWrite(b, LOW);
    digitalWrite(c, HIGH);
    digitalWrite(d, HIGH);
    digitalWrite(e, LOW);
}

```



```

    digitalWrite(f, HIGH);
    digitalWrite(g, HIGH);
}

void six() //Define those figures 6 cathode pin switch
{
    digitalWrite(a, HIGH);
    digitalWrite(b, LOW);
    digitalWrite(c, HIGH);
    digitalWrite(d, HIGH);
    digitalWrite(e, HIGH);
    digitalWrite(f, HIGH);
    digitalWrite(g, HIGH);
}

void seven() //Define those figures 7 cathode pin switch
{
    digitalWrite(a, HIGH);
    digitalWrite(b, HIGH);
    digitalWrite(c, HIGH);
    digitalWrite(d, LOW);
    digitalWrite(e, LOW);
    digitalWrite(f, LOW);
    digitalWrite(g, LOW);
}

void eight() //Define those figures 8 cathode pin switch
{
    digitalWrite(a, HIGH);
    digitalWrite(b, HIGH);
    digitalWrite(c, HIGH);
    digitalWrite(d, HIGH);
    digitalWrite(e, HIGH);
    digitalWrite(f, HIGH);
    digitalWrite(g, HIGH);
}

void nine() //Define those figures 9 cathode pin switch
{
    digitalWrite(a, HIGH);
    digitalWrite(b, HIGH);
    digitalWrite(c, HIGH);
    digitalWrite(d, HIGH);
    digitalWrite(e, LOW);
    digitalWrite(f, HIGH);
    digitalWrite(g, HIGH);
}

```

**Zadatak 4.** Modificiraj spoj iz prethodnog zadatka tako da dodaš dva tipkala. Modificiraj program tako da pritiskom na jednu tipku povećavaš broj prikazan na 4 X 7 segmentnom zaslonu, a pritiskom na drugu tipku smanjuješ broj na zaslonu. Inicijalno, na zaslonu treba napisati broj 500. Da li svakim pritiskom broj povećavaš samo za 1?

**Zadatak 5.** Modificiraj kod iz prethodnog zadatka tako da napraviš digitalni sat. Početno vrijeme podešavati pomoću dva tipkala. Pritiskom na jedno tipkalo povećavaš znamenku sati, a pritiskom na drugo povećavaš znamenku minuta. Za brojanje koristiti Timer1 koji treba pokrenuti prekidni potprogram svakih 1000 ms. Funkcioniranje Timer1 pogledati u prošlogodišnjoj vježbi: Timeri i njihov prekid. Izvadak koda u nastavku modificirati i primijeniti za rješavanje zadatka.

```
timerISR()
{
    seconds++;

    if(seconds == 60)
    {
        seconds = 0;
        minutes++;
    }
    if(minutes == 60)
    {
        minutes = 0;
        hours++;
    }
    if(hours > 23)
        hours = 0;
}
```