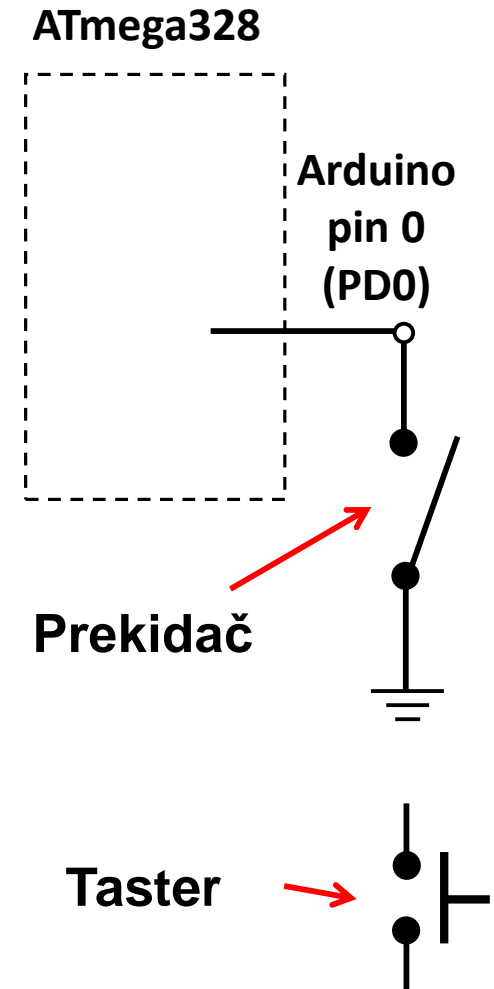


# ULAZNI DIGITALNI PORTOVI



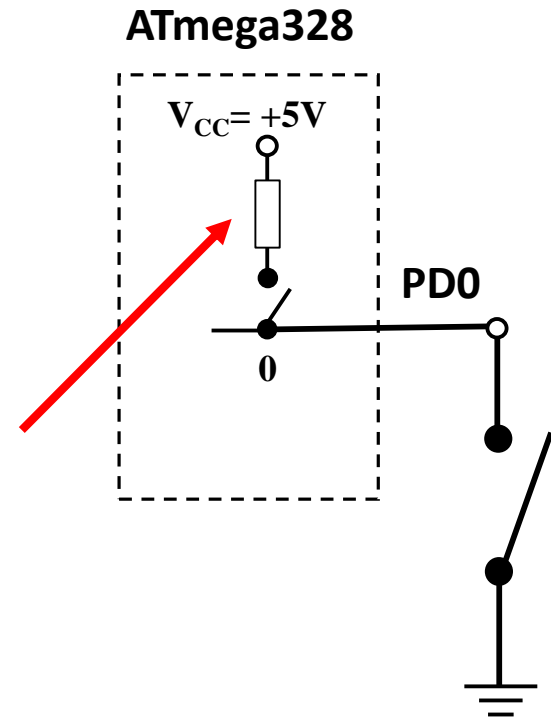
# Pin kao ulazni + Pull-up otpornik

- Prekidač kao senzor
  - Pr. Senzor pojasa za sjedište u autu
  - Detekcija **stanja prekidača**
    - Koji tok podataka treba biti za Arduino pin 0 (PD0)?
    - `pinMode(__0__, __INPUT__)` ;
    - Koji će biti napon na PD0 kada je prekidač zatvoren?
    - Koji će biti napon na PD0 kada je prekidač otvoren?



# Pin kao ulazni + Pull-up otpornik

- Prekidač kao senzor, nastavak.
  - Učinimo napon na pinu poznatim uključanjem pull-up otpornika za PD0
    - Neka je PD0 ulazni port:
      - `digitalWrite(0, HIGH);`  
uključenje “pull-up” otpornika
      - `pinMode(0, INPUT_PULLUP);`
    - Koji će napon biti na PD0 kada je prekidač otvoren?
    - Koji će napon biti na PD0 kada je prekidač zatvoren?

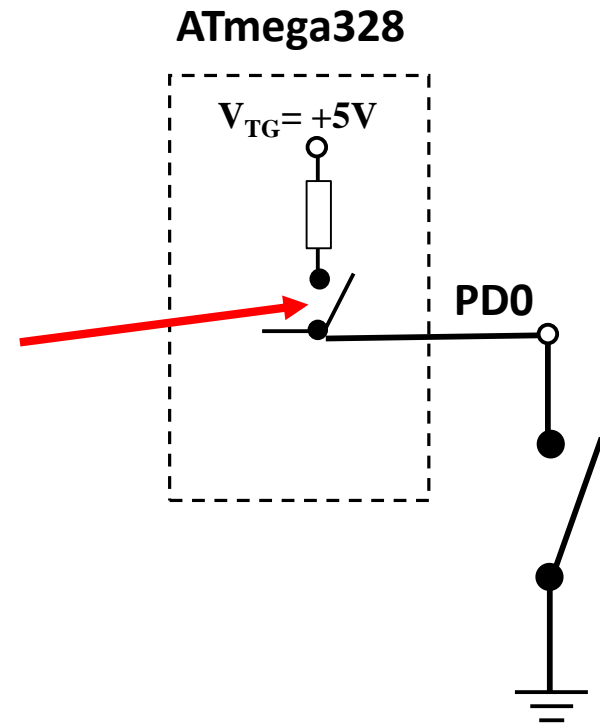


# Pin kao ulazni + Pull-up otpornik

- Prekidač kao senzor, nastavak.
  - Za isključenje pull-up otpornika
    - Neka je PD0 ulazni port:

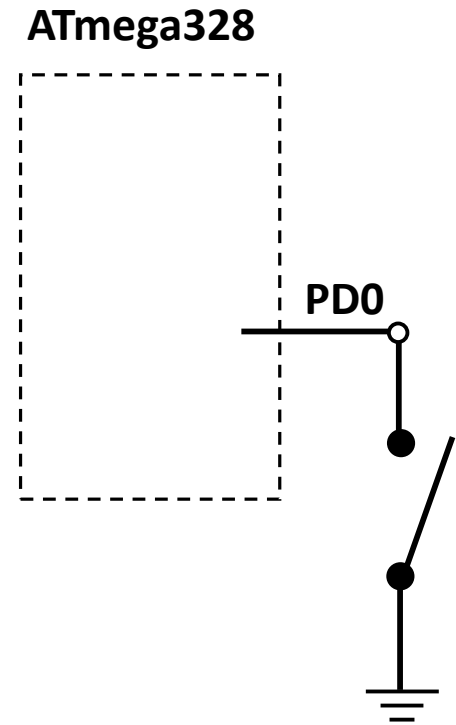
```
digitalWrite(0, LOW);
```

Isključuje "pull-up" otpornik



# Ulazni digitalni pin – Primjer 1

- ‘Očitavanje ulaznog pina’
  - Napisati ćemo nekoliko C linija koda za Arduino u cilju definisanja načina djelovanja kada je pojas vozača u autu vezan (prekidač zatvoren).
    - Ako je pojas vezan, omogućeno je uključenje auta kroz poziv funkcije `start_enable()`.
    - Ako pojas nije vezan omogućeno je uključenje auta kroz poziv funkcije `start_disable()`
  - Napisaćemo najprije psudokod!



# Ulazni digitalni pin – Primjer 1

- ‘Očitavanja pina’

- Pseudokod:

- Postaviti PD0 kao ulazni

- Uključiti PD0 pull-up otpornik

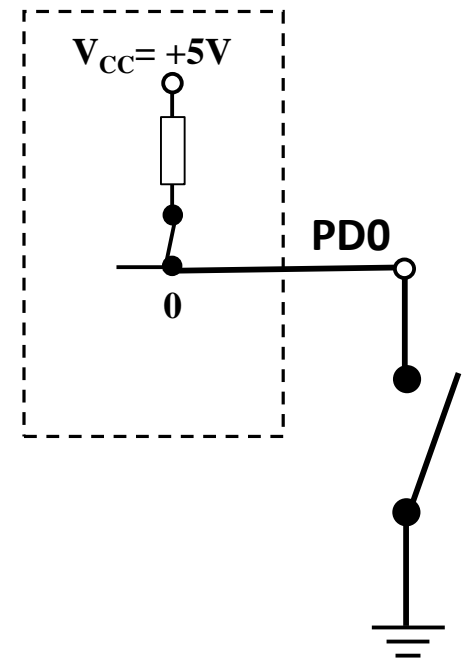
- Očitati napon sa Arduino pin 0 (PIN\_D0)

- IF PIN\_D0 napon je LOW (vezan), THEN  
pozovi funkciju start\_enable()

- ELSE

- pozovi start\_disable()

## ATmega328



# Primjer 2

- Postaviti Arduino pinove 0 i 1 (PD0 i PD1) kao ulazne, i uključiti pull-up otpornike

- Arduino pristup

```
pinMode(0, INPUT);  
pinMode(1, INPUT);  
digitalWrite(0, HIGH);  
digitalWrite(1, HIGH);
```

Ili ako je upotrijebljena me106.h:

```
pinMode(PIN_D0, INPUT);  
pinMode(PIN_D1, INPUT);  
digitalWrite(PIN_D0, HIGH);  
digitalWrite(PIN_D1, HIGH);
```

- Alternativni pristup

```
DDRD = 0; // all PORTD pins inputs  
PORTD = 0b00000011;  
ili  
PORTD = 0x03;
```

Ili još bolje:

```
DDRD &= ~(1<<PD1 | 1<<PD0);  
PORTD |= (1<<PD1 | 1<<PD0);
```

# Ulazni digitalni pin – Primjer 1

- ‘Očitavanja pina’

- Pseudokod:

- Postaviti PD0 kao ulazni

- Uključiti PD0 pull-up otpornik

- Očitati napon sa Arduino pin 3 (PIN\_D0)

- IF PIN\_D0 napon je LOW (vezan), THEN

- pozovi funkciju start\_enable()

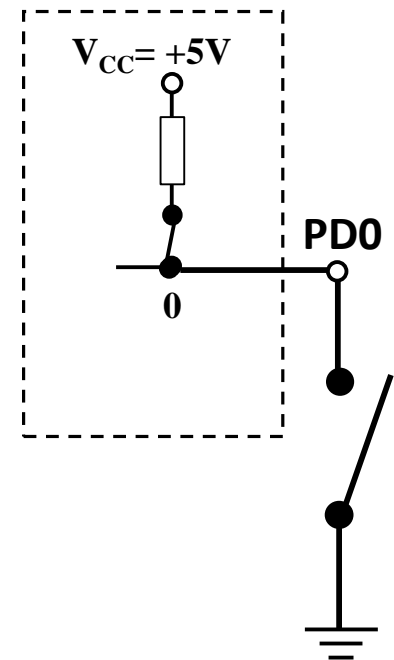
- ELSE

- pozovi start\_disable()

Fragment. Nije cijeli skeč.

```
#define PIN_SWITCH 0
#define LATCHED LOW
pinMode(PIN_SWITCH, INPUT_PULLUP);
belt_state = digitalRead(PIN_SWITCH);
if (belt_state == LATCHED)
{ ig_enable(); }
else
{ ig_disabled(); }
```

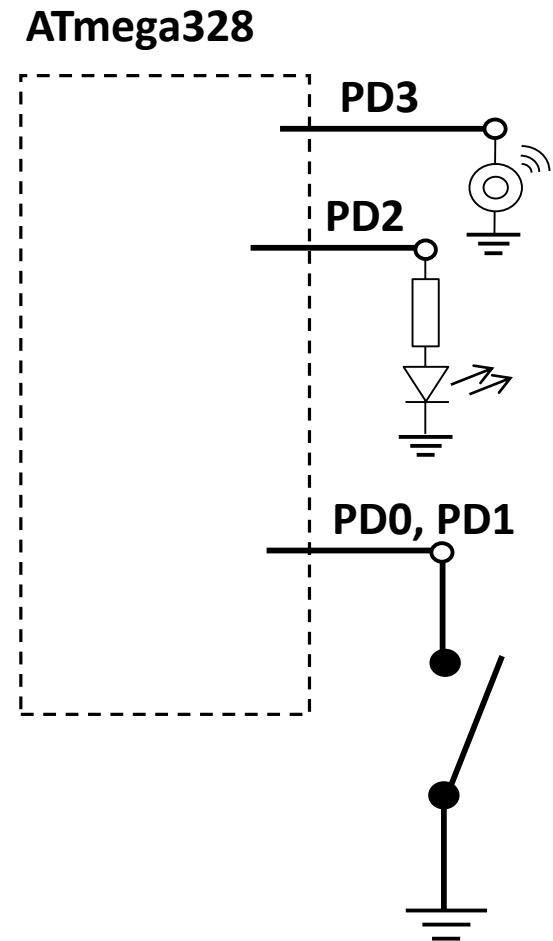
ATmega328





# Ulazni digitalni pin – Primjer 2

- Čitanje sa pina i upisivanje na pin
  - Napisaćemo nekoliko linija C koda za Arduino, s ciljem uključenja LED (PD2) i zvučnog signala (PD3) ako je ključ u bravi (PD0 zatvoren), ali pojas vozača nije vezan (PD1 otvoren)
  - Najprije pseudokod



# Ulazni digitalni pin – Primjer 2

- Pseudokod:

Postavljanje toka podataka za pinove

Postaviti PD0 i PD1 kao ulaze

Uključiti pull-up otpornike za PD0 i PD1

Postaviti PD2 i PD3 kao izlaze

Beskonačna petlja

IF je ključ u bravi THEN

IF ako je pojas vezan, THEN

Isključi zvučni signal

Isključi LED

ELSE

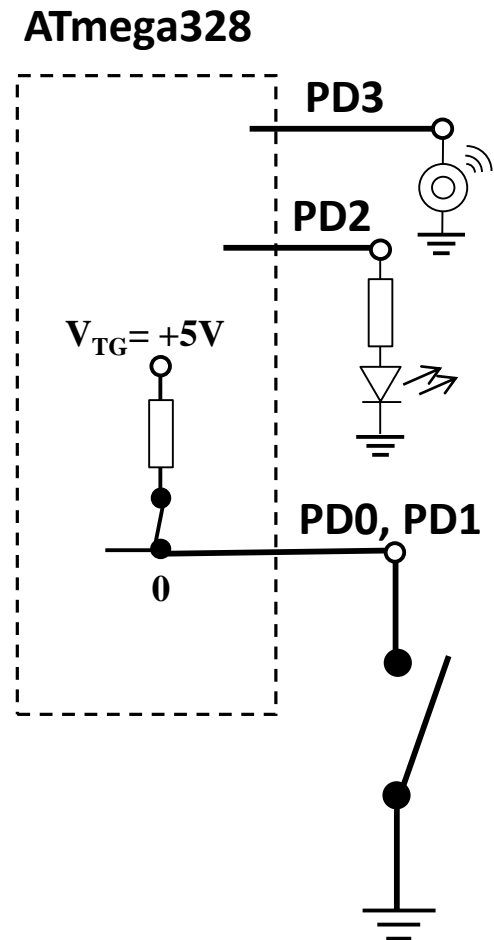
Uključi LED

Uključi zvučni signal

ELSE

Isključi zvučni signal

Isključi LED

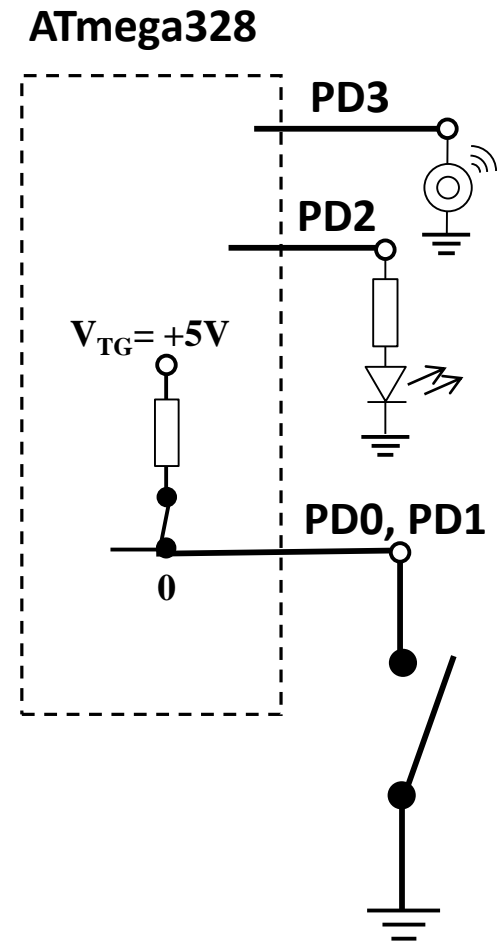


# Ulazni digitalni pin – Primjer 2 (Arduino kod)

```
#define PIN_IGNITION 0
#define PIN_SEATBELT 1
#define PIN_LED 2
#define PIN_BUZZER 3
#define SEATBELT_LATCHED LOW
#define KEY_IN_IGNITION LOW
#define LED_ON HIGH
#define LED_OFF LOW
#define BUZZER_ON HIGH
#define BUZZER_OFF LOW

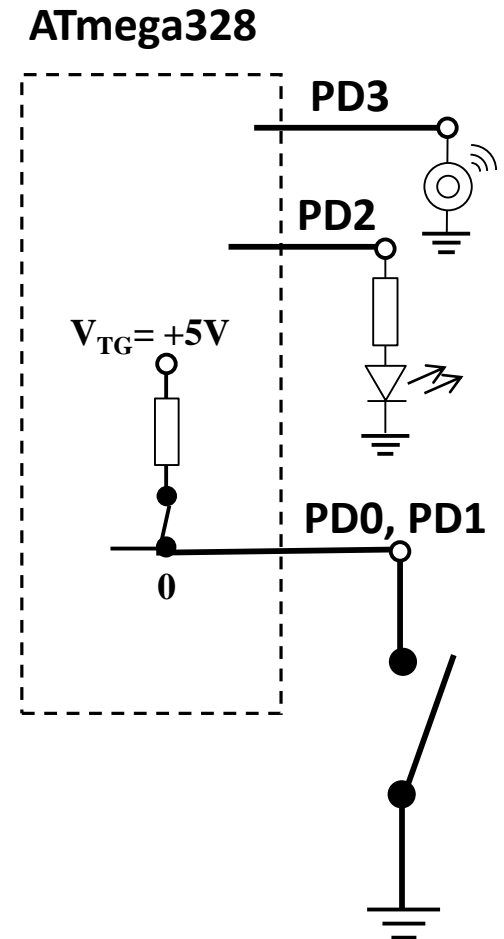
void setup()
{
  pinMode(PIN_IGNITION, INPUT_PULLUP); // key switch
  pinMode(PIN_SEATBELT, INPUT_PULLUP); // belt latch switch
  pinMode(PIN_LED, OUTPUT); // lamp
  pinMode(PIN_BUZZER, OUTPUT); // buzzer
}

/* see next page for code */
```



# Ulazni digitalni pin – Primjer 2 (Arduino kod)

```
/* see previous page for code before loop() */  
void loop()  
{  
  int key_state = digitalRead(PIN_IGNITION);  
  int belt_state = digitalRead(PIN_SEATBELT);  
  if (key_state == KEY_IN_IGNITION)  
  {  
    if (belt_state == SEATBELT_LATCHED)  
    {  
      digitalWrite(PIN_BUZZER, BUZZER_OFF);  
      digitalWrite(PIN_LED, LED_OFF);  
    }  
    else // key is in ignition, but seatbelt NOT latched  
    {  
      digitalWrite(PIN_BUZZER, BUZZER_ON);  
      digitalWrite(PIN_LED, LED_ON);  
    }  
  }  
  else // key is NOT in ignition  
  {  
    digitalWrite(PIN_BUZZER, BUZZER_OFF);  
    digitalWrite(PIN_LED, LED_OFF);  
  }  
}
```



# Ulazni digitalni pin – Primjer 2 (Alternativni kod)

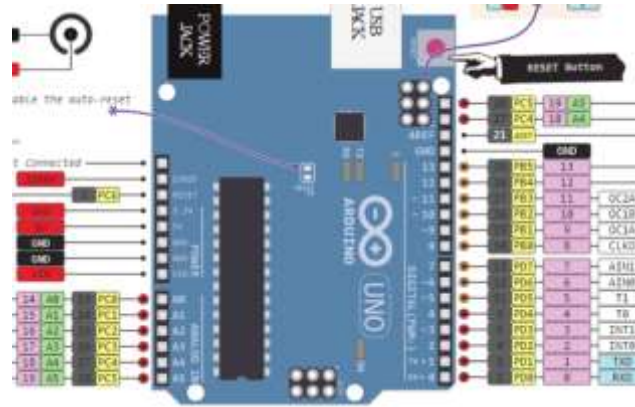
/\* NOTE: #defines use predefined PORT pin numbers for ATmega328 \*/

```
#define PIN_IGNITION PD0
#define PIN_SEATBELT PD1
#define PIN_LED PD2
#define PIN_BUZZER PD3
#define SEATBELT_LATCHED LOW
#define KEY_IN_IGNITION LOW
#define LED_ON HIGH
#define LED_OFF LOW
#define BUZZER_ON HIGH
#define BUZZER_OFF LOW
#define _BIT_MASK( bit ) ( 1 << (bit) ) // same as _BV( bit)
```

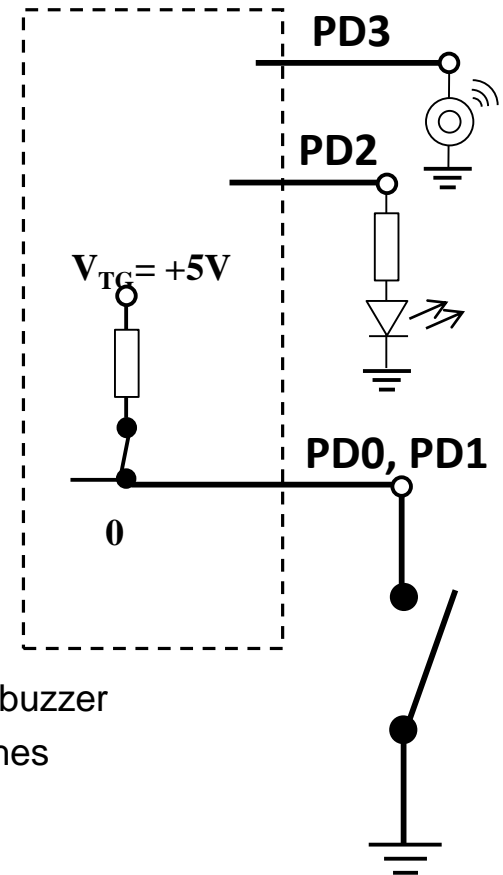
void setup()

```
{
  PORTD = 0; // all PORTD pullups off
  DDRD = _BIT_MASK(PIN_LED) | _BIT_MASK(PIN_BUZZER); // LED and buzzer
  PORTD |= _BV(PIN_IGNITION) | _BV(PIN_SEATBELT); // pullups for switches
}
```

/\* See next page for loop() code \*/

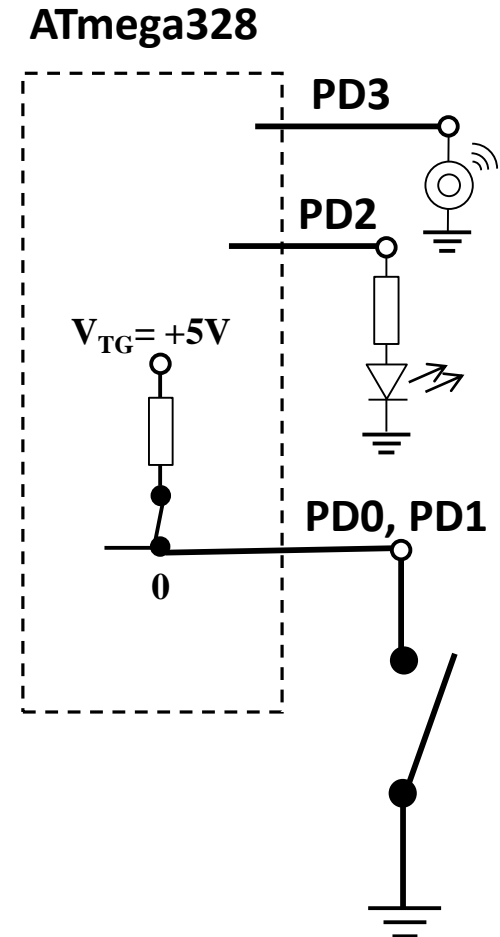


ATmega328



# Ulazni digitalni pin – Primjer 2 (Alternativni kod)

```
/* see previous page for setup() code */
void loop()
{
  uint8_t current_PORTD_state, key_state, belt_state;
  current_PORTD_state = PIND; // snapshot of PORTD pins
  key_state = current_PORTD_state & _BV(PIN_IGNITION);
  belt_state = current_PORTD_state & _BV(PIN_SEATBELT);
  if (key_state == KEY_IN_IGNITION)
  {
    if (belt_state == SEATBELT_LATCHED)
    {
      PORTD &= ~(_BV(PIN_LED) | _BV(PIN_BUZZER) );
    }
    else
    {
      PORTD |= ( _BV(PIN_LED) | _BV(PIN_BUZZER) );
    }
  }
  else
  {
    PORTD &= ~(_BV(PIN_LED) | _BV(PIN_BUZZER) );
  }
}
```



# Serijska komunikacija

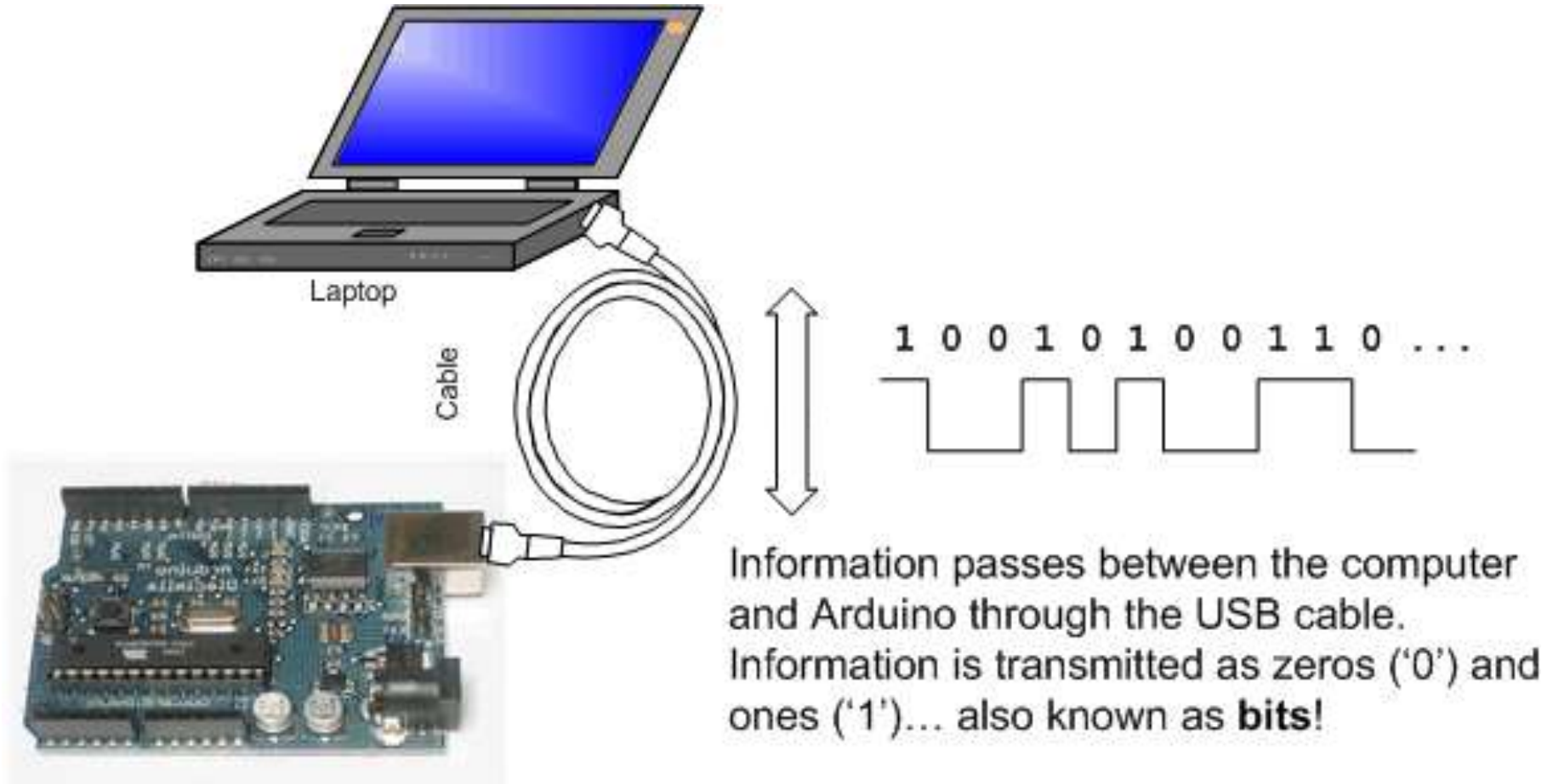
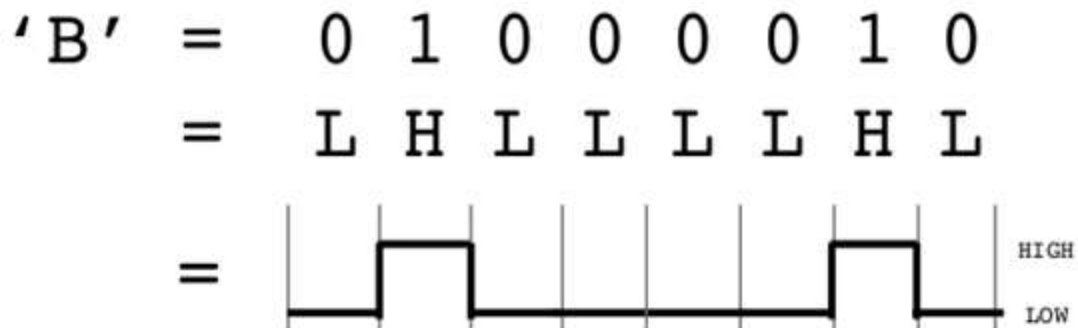


Image from <http://www.ladyada.net/learn/arduino/lesson4.html>

# Serijska komunikacija

Serijska- jer su podaci razbijeni na bitove. Svaki bit se šalje jedan za drugim preko jedne žice

Primjer: ASCII karakter 'B' se šalje kao:

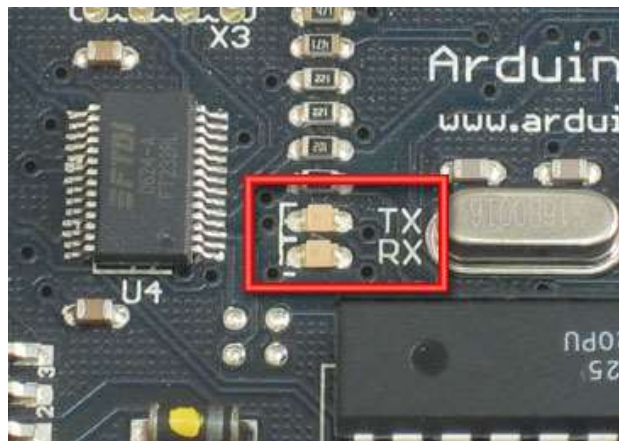


Mijenja se stanje na pinu baš kao kada se upravlja treperenjem LED.

Jedna linija se koristi za slanje i jedna za prijem podataka.



# Serijska komunikacija



- ***Kompajliranje*** prevodi program u binarne podatke (jedinice i nule)
- ***Uploading (upisivanje)*** šalje bitove kroz USB kabl do Arduina.
- Dvije LED diode blizu USB konektora trepere dok se podaci prenose
  - **RX** treperi kada Arduino prima podatke
  - **TX** treperi kada Arduino šalje

# Serijski monitor

The screenshot shows the Arduino IDE interface with the Serial Monitor window open. The sketch in the background is as follows:

```
YourDuinoStarter_SerialMonitor_SEND_RCVE | Arduino 1.0.3
File Edit Sketch Tools Help
Serial Monitor
YourDuinoStarter_SerialMonitor_SEND_RCVE
Serial.print(" ");
Serial.print(ByteReceived, HEX);
Serial.print(" ");
Serial.print(char(ByteReceived));

if(char(ByteReceived) == '1')
{
digitalWrite(led,HIGH);
Serial.print(" LED ON ");
}

if(char(ByteReceived) == '0')
{
digitalWrite(led,LOW);
Serial.print(" LED OFF");
}

Serial.println(); // End the line

} // END Serial Available
```

The Serial Monitor window (COM20) displays the following output:

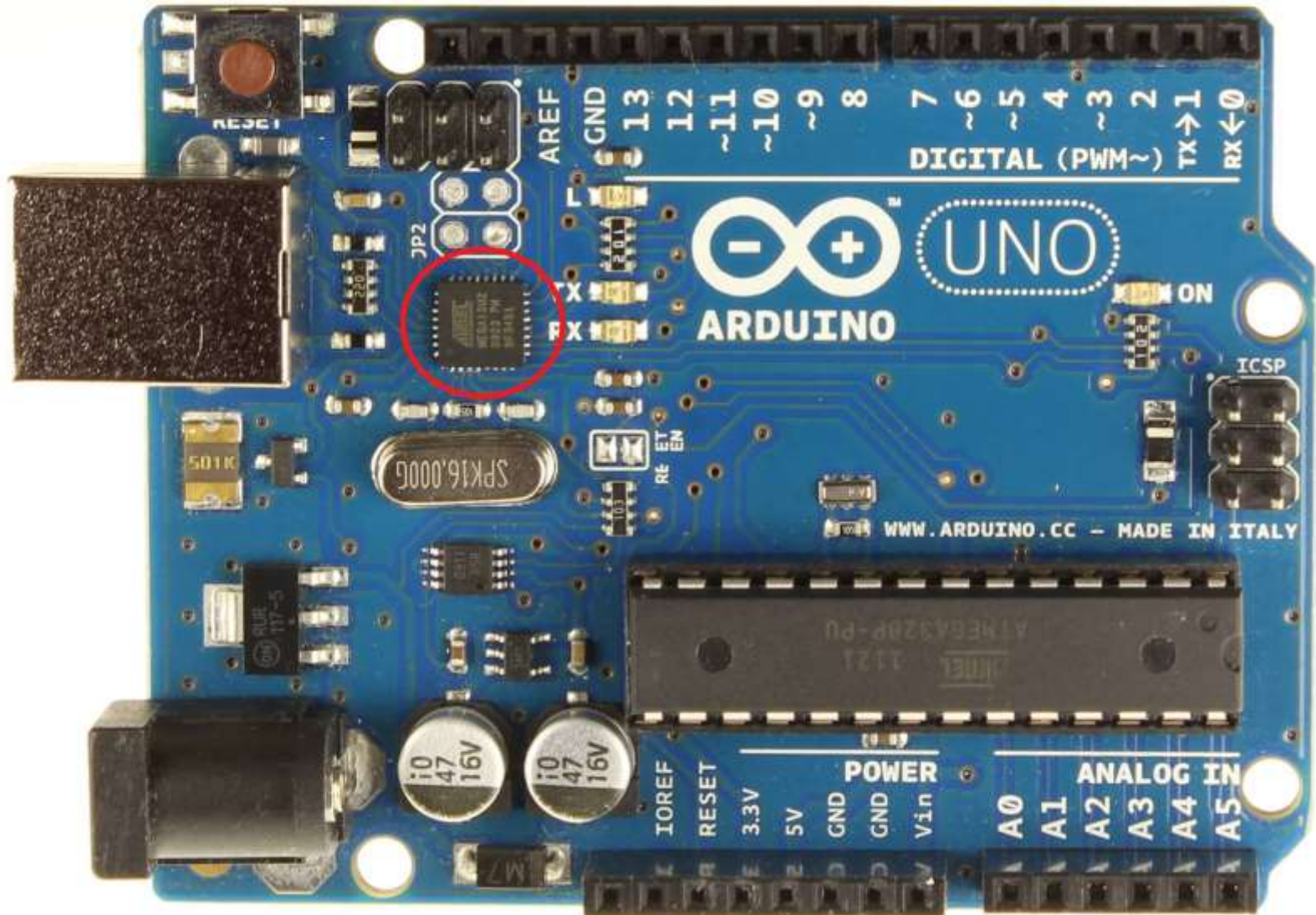
```
--- Start Serial Monitor SEND_RCVE ---
(Decimal) (Hex) (Character)
65      41      A
66      42      B
67      43      C
49      31      1 LED ON
48      30      0 LED OFF
68      44      D
69      45      E
70      46      F
```

The Serial Monitor settings are: Autoscroll checked, No line ending selected, and 9600 baud selected. The status bar at the bottom indicates: Done uploading, Binary sketch size: 2,912 bytes (of a 30,720 byte maximum), and Arduino Duemilanove w/ ATmega328 on COM20.

# Osnovne komande

- `Serial.begin()`
  - pr., `Serial.begin(9600)`
- `Serial.print()` or `Serial.println()`,  
`Serial.write()`

# Serial-to-USB chip



# Dva različita komunikaciona protokola

## Serijski (TTL):

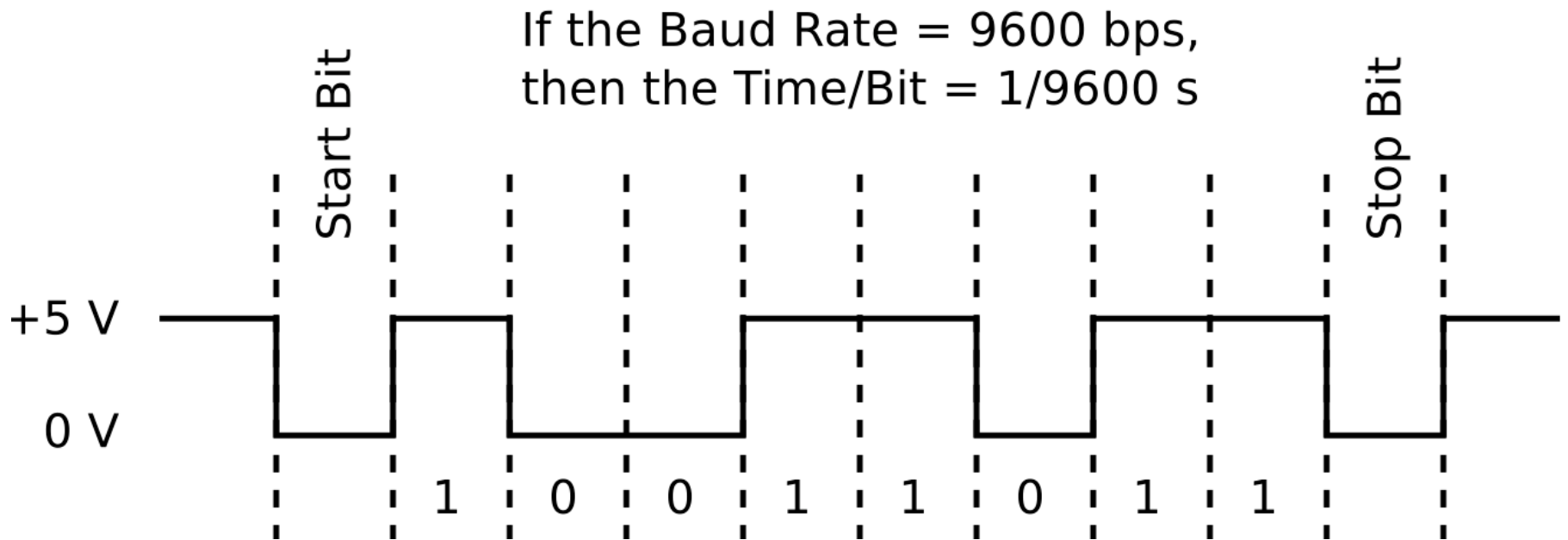


Image from <http://www.fiz-ix.com/2013/02/introduction-to-arduino-serial-communication/>

# USB protokol

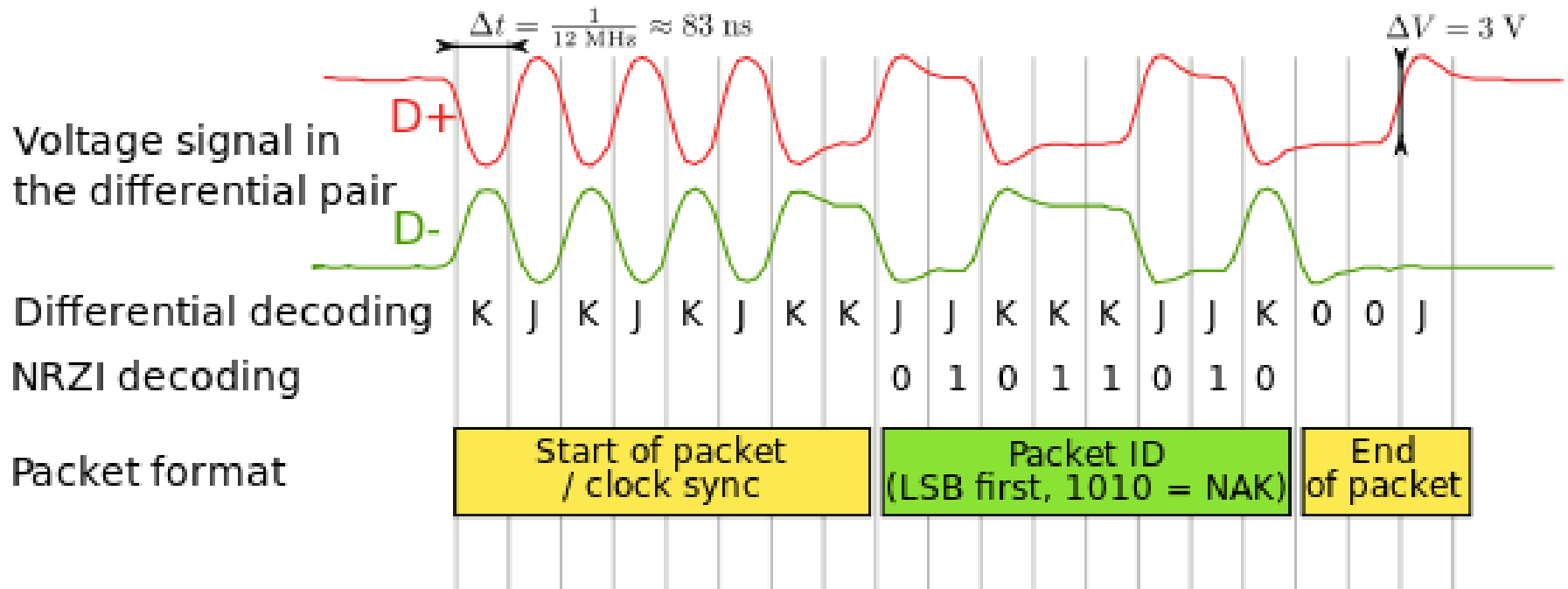


Image from <http://en.wikipedia.org/wiki/USB>

- Puno komplikovaniji

# Brojanje koliko puta je pritisnut taster.



```
#define TASTER 6
#define LED 2
#define TST_CHECK_PERIOD 5

int brojPritisaka;
boolean Taster, pTaster;
unsigned long nextTstCheck;

void setup() {
  pinMode(TASTER, INPUT_PULLUP);
  pinMode(LED, OUTPUT);
  Serial.begin(115200);

  Taster = digitalRead(TASTER);
  pTaster = Taster;
}

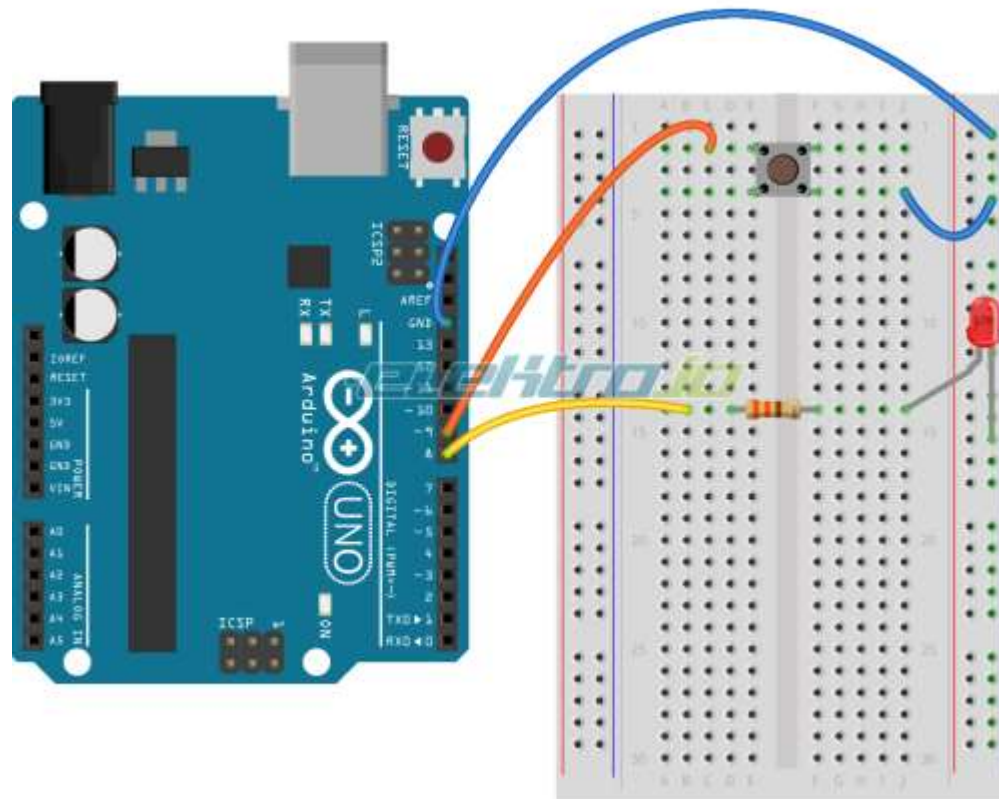
void loop() {
  if (millis() - nextTstCheck > TST_CHECK_PERIOD) {
    Taster = digitalRead(TASTER);
    if (!Taster && pTaster) {
      brojPritisaka++;
      Serial.println(brojPritisaka);
    }
    pTaster=Taster;
    nextTstCheck=millis();
  }

  if (Taster) digitalWrite(LED, LOW);
  else digitalWrite(LED, HIGH);
}
```



# Zadaci za vježbu

**Z1.** Upotrijebiti taster za uključenje i isključenje LED. Svaki pritisak tastera duži od tri sekunde uključuje LED. Pritisak tastera kraći od jedne sekunde isključuje LED. Pritisci tastera trajanja između sekunde i tri sekunde ne mijenjaju stanje LED. **(2-1 poen)**





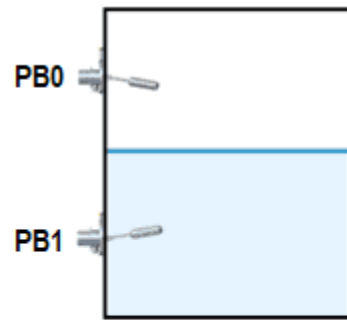
**Z2.** Trčeće svjetlo sa 4 LED. Smjer se određuje prekidačem. Prekidač otvoren - jedan smjer, prekidač zatvoren - drugi smjer. Zaustavlja se pritiskom na taster. Trčeće svjetlo treba reagovati neposredno po promjeni stanja tastera i/ili prekidača (ne treba otrčati do kraja niza, pa tek onda reagovati). **(3-2 poen)**



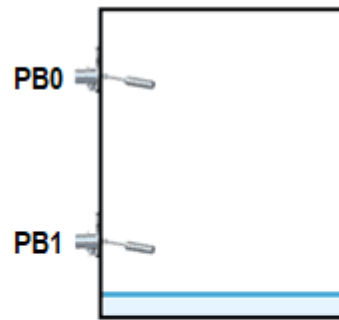
**Z3.** Nivo tečnosti u bazenu. Kao gornji i donji senzor nivoa upotrijebiti obične kratkospojnike, a kao bazen čašu i nešto vode u njoj. Informaciju o nivou tečnosti indicirati na jednocifarkom sedmo-segmentnom displeju, LED diodama i zvučno, na sljedeći način:

- OK nivo - slovo 'O' i uključena zelena LED,
- nizak nivo - slovo 'L' i uključena žuta LED,
- visok nivo - slovo 'H' i uključena crvena LED,
- neispravnost - slovo 'E', isključene sve LED i isprekidani zvučni signal.

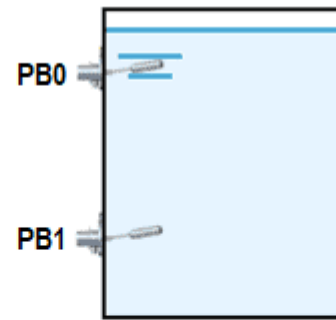
**(5-4-3 poena)**



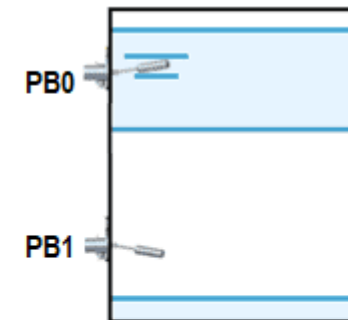
OK nivo  
slovo O  
Zelena LED



Nizak nivo  
slovo L  
Žuta LED



Visok nivo  
slovo H  
Crvena LED



Neispravnost  
slovo E  
isprekidan zvučni signal  
Crvena LED treperi