Instituto Superior Técnico

Master's Degree in Information Systems and Computer Engineering

Software for Embedded Systems

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1st Lab work: Building an embedded system [1]

Group: Grupo 6		
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Goal:

The goal of this work is to put students for the first time in touch with the Arduino environment to drive simple actuators (in the case LEDs).

Description:

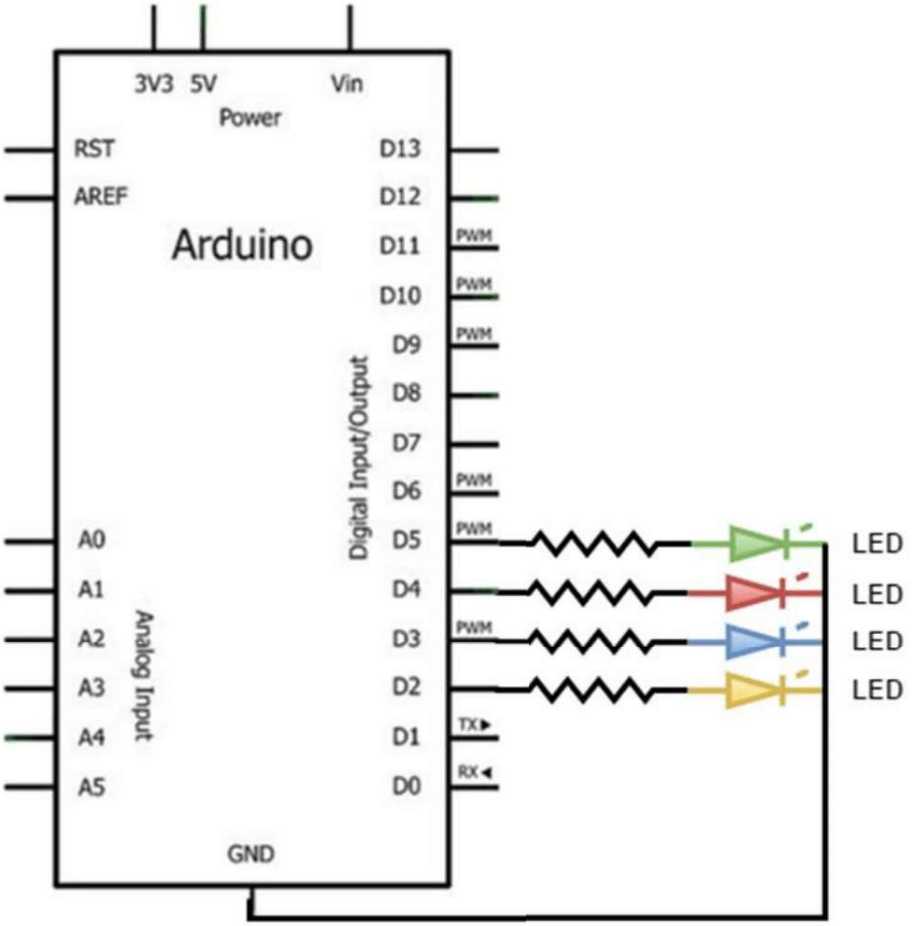
Build an embedded system using the Arduino UNO board to control 4 LEDs with different colors. In normal operation, in each 5 seconds period with the following pattern of activity, only one LED shall be active at a time (1 second slots):

1 – Red LED ON
2 – Green LED ON
3 – Blue LED ON
4 – Yellow LED ON
5 – All LEDs OFF

This behavior is then repeated.

The figure represents the circuit to drive the LEDs to be assembled.

[1] V1.1, Oct. 2017.



References:

1. https://www.arduino.cc/en/Reference/digitalWrite
2. https://www.arduino.cc/en/Reference/Delay

Recommendations:

In order to develop your work with security, and to avoid damaging the hardware involved, remember to carry out the recommendations below. As you are working fill the boxes to be certain that you fulfill all security measures.

Always work with the circuit disconnect from the source.	☒
Call the teacher, or the responsible for the laboratory, before you connect the circuit to the source.	☒
Make sure the circuit is well connected (resistors, capacitors, etc.) to prevent a short circuit, or damage the hardware.	☒

Design the interface:

R_red 560 Ω

R_green 560 Ω

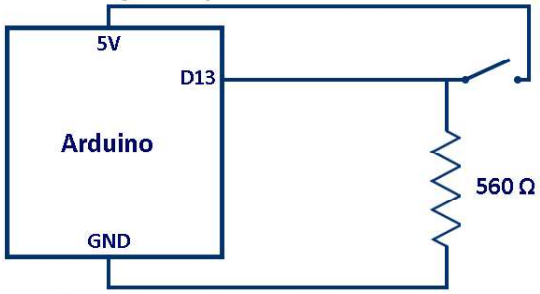
R_blue 560 Ω

R_yellow 560 Ω

Interface the circuit to a press button.

Whenever the button is pressed the activated LED must remain ON making it easier to read the voltage drop on the LED. When the button is depressed the system continues its normal operation sequence.

Draw and design the press button interface to the controller.



Measure the voltage drops of the LEDs:

V_red 1.79 V

V_green 1.96 V

V_blue 2.80 V

V_yellow 1.88 V

Estimate the power consumption of the interface (the circuit with resistors and LEDs in the figure) in normal operation.

Intensidade da corrente:	**Potência em cada um dos LED'S:**	**Potência das Resistências (x4):**
I_Red: 8.51 mA	P_Red: 1.79 x 0.00851 ≈ 0.015 W	P_Resist: 5^2 / 560 ≈ 0.045 W
I_Green: 8.50 mA	P_Green: 1.96 x 0.00850 ≈ 0.017 W	
I_Blue: 8.52 mA	P_Blue: 2.8 x 0.00852 ≈ 0.024 W	
I_Yellow: 8.45 mA	P_Yellow: 1.88 x 0.00845 ≈ 0.016 W	

Potência Consumida: $\frac{0.015 + 0.045 + 0.017 + 0.045 + 0.024 + 0.045 + 0.016 + 0.045 + 0 + 0}{5} \approx 0.05$ W/s

```
const int redLedPin = 4;
const int greenLedPin = 5;
const int blueLedPin = 3;
const int yellowLedPin = 2;
const int buttonPin = 13;

int lightLed = 0;
int buttonRead = 0;

void setup() {
  pinMode(redLedPin, OUTPUT);
  pinMode(greenLedPin, OUTPUT);
  pinMode(blueLedPin, OUTPUT);
  pinMode(yellowLedPin, OUTPUT);

  pinMode(buttonPin, INPUT);
}

void loop() {
  // Read Button State
  buttonRead = digitalRead(buttonPin);

  if(buttonRead != HIGH) {
    // Increment Led On
    if(lightLed == 4) {
      lightLed = 0;
    } else {
      lightLed += 1;
    }
  }

   // Set all leds to off
   digitalWrite(redLedPin, LOW);
   digitalWrite(greenLedPin, LOW);
   digitalWrite(blueLedPin, LOW);
   digitalWrite(yellowLedPin, LOW);

  switch (lightLed) {
    case 0: // ALL LEDS OFF
      break;
    case 1: // RED LED ON
      digitalWrite(redLedPin, HIGH);
      break;
    case 2: // GREEN LED ON
      digitalWrite(greenLedPin, HIGH);
      break;
    case 3: // BLUE LED ON
      digitalWrite(blueLedPin, HIGH);
      break;
```

```
   case 4: // YELLOW LED ON
     digitalWrite(yellowLedPin, HIGH);
      break;
   default: // ALL LEDS ON - ERROR NOT EXPECTED BEHAVIOUR
     digitalWrite(redLedPin, HIGH);
     digitalWrite(greenLedPin, HIGH);
     digitalWrite(blueLedPin, HIGH);
     digitalWrite(yellowLedPin, HIGH);
      break;
   }

   delay(1000); // Wait 1 Second
}
```