



The Lighthouse project (Level 4)

Worksheet for students

Team:.....

Aim: Study of the LED diode characteristics

What type of element is the LED diode?

Answer below

What is the difference between n-type and p-type semiconductors? What is the current carrier for n-type and p-type semiconductors?

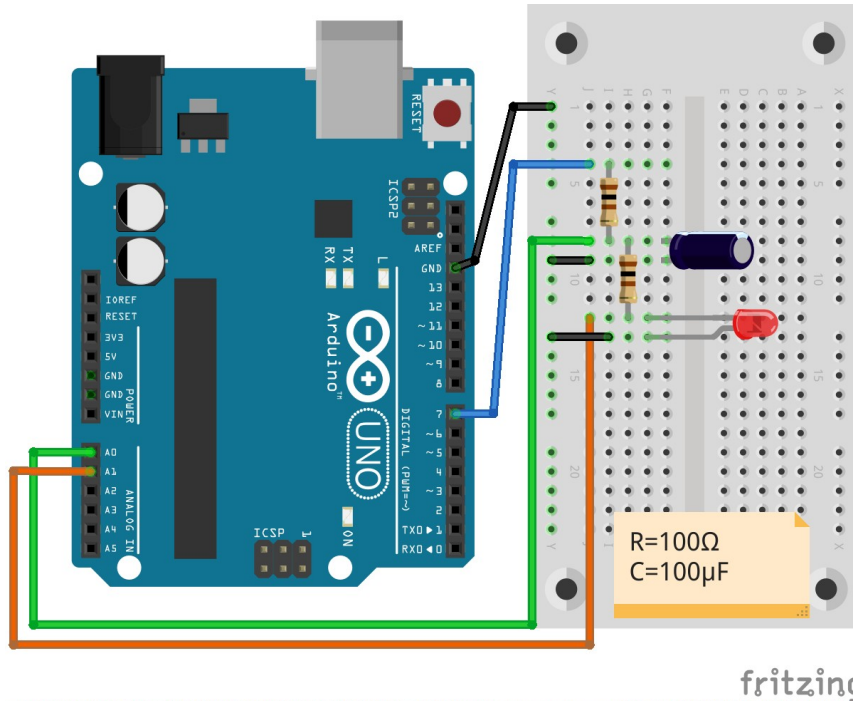
Answer below

Why can current flow only in one direction through the LED diode?

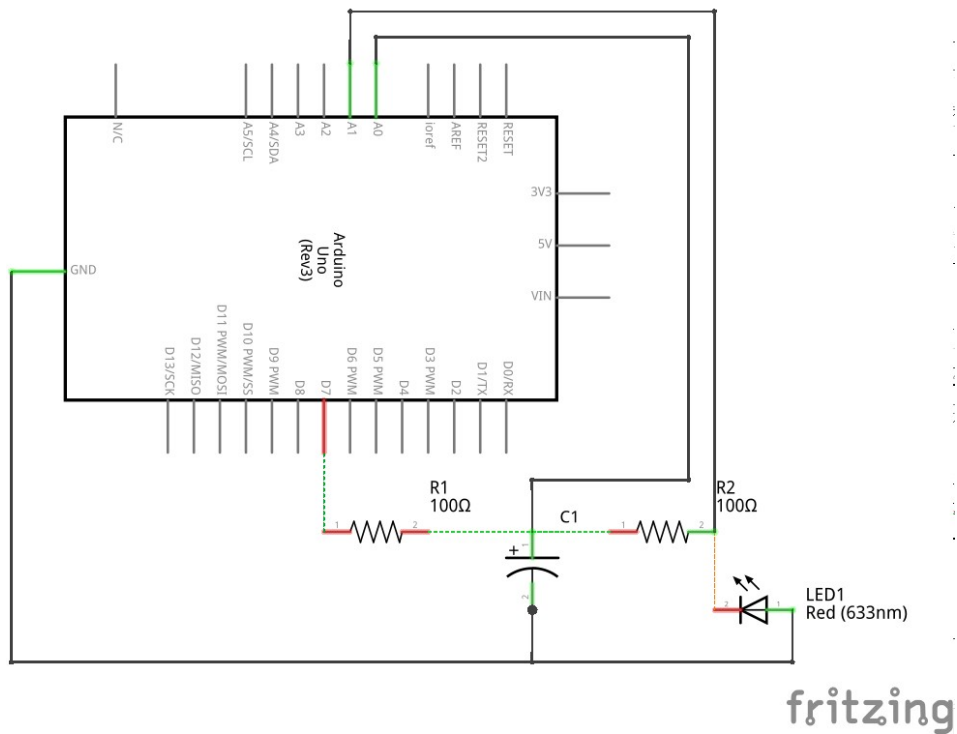
Answer below

Time for circuit making!

The circuit consists of a low-pass filter and the LED diode. Try to connect elements according with the scheme.



Part1



What does the low-pass filter do?

Answer below

What kind of information do you receive from A0 and A1 pins?

Answer below

Time for programming!

The LED characteristics is done by measuring current for different voltage values. In fact, the current is not measured directly but calculated based on difference of voltages measurement in A0 and A1 pins. The different values of voltage is obtained by changing PWM signal with different duty cycle to analog signal using the low-pass filter. The output voltage from filter is measured in A0 pin.

The algorithm of code for studying the LED characteristics:

1. Declaration, which pins should be inputs and outputs.

Tip: `pinMode`(pin number, INPUT/OUTPUT) is a function to declare, which pin will be used as input or output. When you measure the values from pin, the pin is used as input. If you generate the value, the pin is used as output.

2. Changing the duty of PWM signal from 0 to 190. The maximum value is limited to 190 because the higher values can destroy some type of LED diodes.

Tip: `analogWrite`(pin number, duty) is function, which can be used to generate the PWM signal with chosen duty. If you need to repeat the measurement for different duty cycle, you can use the `for` loop.

3. Reading the voltages from A0 and A1 pins. The difference between them is voltage on measurement resistor.

Tip: `analogRead`(pin number) is function, which return voltage from pin. The voltage is a number between (0;1023). The 1023 value corresponds to 5V (this is a reference voltage on Arduino Board). If you would like to change the value to voltage you can do it in two ways. First is using the function `map`(value, minimum value in old range, maximum value in old range, minimum value in new range, maximum value in new range). Second is using equation: $\text{value} * 5.0 / 1024$.

4. Repeat the measurement of voltage 100 times to receive precise value of voltages.

5. Calculating the average value of voltages from A0 and A1 pins.

6. Calculating the voltage on measurement resistor, which is difference between voltages from A0 and A1.

7. Calculating the current according to the Ohm's law. Remember that measurement resistor has value 100Ω

Remember: The Ohm's law is: $I = U/R$

8. Printing values of voltage (U) from A1 (voltage drop on a LED) and current (I) in serial monitor to easy copy it to spreadsheet and prepare the plot: $I=f(U)$.

Tip: The serial monitor should be initialized in setup by using function `Serial.begin`(baud) e.g. `Serial.begin(9600)` . The values can be printed in serial monitor using two similar functions: `Serial.print`(value or string) or `Serial.println`(value or string). Second option will add enter to end of value or string.

Time for measuring!

Please measure the current and voltage for three different LED diodes e.g. red, green and blue.

What is the shape of I-U characteristics? How does the current behave during increasing the voltage?

Answer below

What is the difference between I-U characteristic for three different LED diodes?

Answer below

How can you improve the quality of I-U characteristics?

Answer below

ROBOSCIENTISTS PROJECT

Motivating secondary school students towards STEM careers through robotic artefact making

Erasmus+ KA2 2018-1PL01-KA201-051129

Creator

Angelika Tefelska (Warsaw University of Technology)

Declaration

This report has been prepared in the context of the ROBOSCIENTISTS project. Where other published and unpublished source materials have been used, these have been acknowledged.

Copyright

© Copyright 2018 - 2021 the Roboscientists Consortium
All rights reserved.



This document is licensed to the public under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

Funding Disclaimer

This project has been funded with support from the European Commission. This communication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.