

## Laboratory 1: Arduino

Objective: getting first contacts with Arduino and Hardware.

# 1 Basic working with Arduino IO, PWM and Serial

<https://www.arduino.cc/en/Guide/Introduction>

Look and do this getting started <https://www.arduino.cc/en/Guide/HomePage>

Also check the References <https://www.arduino.cc/reference/en/>

Give a sort overview about the IO of Arduino, what pins are and what kind of pins are there and how to use them. Write also how to initialize them and setting the different modes.

### 1.1 First Task LED Blink

Make an LED Blink and Fade. What is the difference between the two ways to realize it? Describe it in few words and give an example. You can use the tutorial as base. Don't forget to explain the difference concepts and ideas behind Blink and Fade. Give also a short use case for each of these concepts.

<https://www.arduino.cc/en/Tutorial/Blink>

<https://www.arduino.cc/en/Tutorial/BlinkWithoutDelay>

### 1.2 Second Task Buzzer Program

Make a Buzzer Program. Describe it in few words and give an example how it works. What is needed to make it Buzz. Implement your own melody and describe how to create a melody or how to implement a song. Give also a short use case for each of these concepts.

You can use the tutorial as guideline.

<https://www.arduino.cc/en/Tutorial/toneMelody>

### 1.3 Third Task timer, Buzzer and LED Program

Expand the Blink Task with a button or a timer and a Buzzer. Create a Program that uses the knowledge of the last exercises. Describe it in few words how the program works. Describe the idea behind the program.

## 1.4 Third Task Communication

Communication between different modules: Understand the Serial communication

<https://www.arduino.cc/en/Tutorial/DigitalReadSerial>

Read and understand what Serial communication is. What other kind of communication exist for Arduino? What are their advantages and disadvantages? Describe at least two additional communication possibilities additionally to Serial communication.

## 1.5 Third Task Communicate and interact with Arduino

Combine task 1.1 to 1.4. Be creative. Describe, imagine a useful application with Arduino

Be creative. Create a program that uses LED, Buzzer, timer and serial communication. Describe what is your idea and how do you realize it.

## 2 LED Matrix

Understand the function of Libraries and how to use them. Alternatively use a Display.

<https://www.arduino.cc/en/Reference/Libraries>

### 2.1 First Task connect the hardware and count

Given the Hardware (Arduino + LED Matrix 16X8 LED or Display) implement a counter and a small application. Read the documentation of the module and apply. Explain how the matrix or display works and what is necessary to get started. Also describe witch parameters are important.

### 2.2 Second Task count to 128 and how to fit

Count with the LED from 0 to 128. Does the number fit in the Matrix? What can you do to make the numbers fit If you are using the display does how to make the numbers beiger and readable?

As Tipp use the function "matrix.drawPixel(X, Y, COLOR)"

How does this function work? What are the parameters. How do you make the content fit better?

### 2.3 Second Task Draw easy Bitmap

Draw easy Bitmap on the LED Matrix or Display. How does this function work? What else is necessary? How is the Bitmap be stored?

As Tipp use the function "matrix.drawBitmap(0, 8, om\_bmp, 8, 8, HT16K33\_BLINK\_CMD);"

## **2.4 Third Task Print on Matrix**

Print some Text in the LED Matrix. How does this work? What options are available? How does the example behave with longer text? How does it work? What happens with the memory?

As Tip use `"matrix.print("Hello");"` and `"matrix.setCursor(x,0);"`

## **2.5 Third Task short overview**

Give a short overview and explain the most important functions and how does the Board work.

# **3 LED Matrix as Terminal Output**

Combine the knowledge of the two previous Tasks and write a LED-Banner that plots the data that is sent to the Arduino via Terminal. The data should be typed in a serial console and be displayed on the Arduino.

Describe how your program works and what is your concept. Do some sort of planning before you start programming.

# **4 Wire layout for temperature measurement(Arduino)**

Wire layout for temperature measurement

(Arduino/Genuino)

In the first part of the laboratory we will connect the digital thermometer (DS18B20) and the Arduino Uno, in order to get data from the digital sensor and to measure the temperature.

You need the following:

- 1 or more digital thermometer (DS18B20)
- 1 Arduino Uno or similar board.
- 1 resistor (4,7K  $\Omega$ )
- Cables (Vcc = red GND = black)
- 1 Breadboard (grey element in the figure)

Figure 1 shows two different operation modes for the digital thermometer, use the one you prefer.

Read the datasheet to know the different characteristics of each mode.

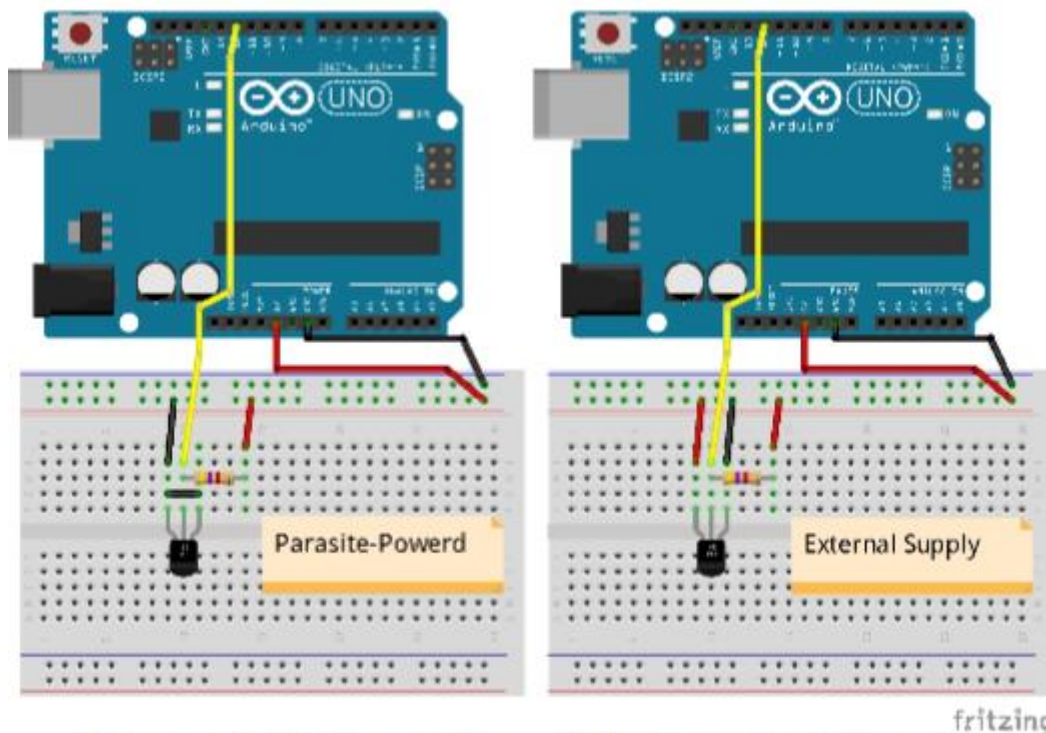


Figure 1: HW layout with two different operation modes

### 4.1 Implementation

The digital thermometer uses a one-wire protocol for communication. Fortunately the Arduino IDE already provides an implementation for the protocol (one-wire library). For this exercise we will use the already existing library. Just download it (<http://playground.arduino.cc/Learning/OneWire>) and integrated it into the Arduino IDE.

### 4.2 : Temperature reading

Using the Arduino implement get the data from sensor and plotted at the Serial console.

### 4.3 : LED scale

Expand the circuit with LED Matix and Print the Temperature.

Helpful TOOLS

Sketching Tool

<http://fritzing.org/download/>

Arduino IDE

<https://www.arduino.cc/en/Main/Software>