

## Final Assignments

For most assignments, sensors need to be connected to the DE1-SoC board. Be careful, use ESD precautions, check voltage-levels and have the interface checked by a teacher!

The final assignment is somewhat larger than the practice assignments. You may choose one of the following final assignments as long as it is not picked by too many other students. You therefore have to choose an assignment in consultation with your teachers. It is also possible to define your own assignment in consultation with your teachers.

Please note: the assignments below (except for assignment 14.) are basic assignments. You can score a 6 with these assignments. If you want to score higher, you have to add extra functionality to the assignment. This extra functionality is not specified here. You have to come up with this yourself.

1. Read the temperature from a [T175Q1 temperature sensor](#) and display it on the 7-segment displays.
2. Read the temperature from a [MCP9808 temperature sensor](#) and display it on the 7-segment displays.
3. Read the temperature from a [DHT22 sensor and display it on the 7-segment displays](#).
4. Read the humidity from a [DHT22 humidity sensor](#) and display it on the 7-segment displays.
5. Read the Temperature from a [DS18B20 temperature sensor](#) and display it on the 7-segment displays.
6. Use a [LED-strip](#)<sup>1</sup> and turn this into a reaction-meter. Every LED should correspond with a number of milliseconds. The number of milli-seconds should also be displayed on the 7-segment displays. See [Footnote 1](#).
7. Use a [LED-strip](#) and turn this into a running-light. See [Footnote 1](#).
8. Use a [LED-strip](#) and turn this into a [KIT-scanner](#). See [Footnote 1](#).
9. Use a Neopixel ring<sup>2</sup> to build a kind of clock that displays seconds, minutes and hours. See [Footnote 2](#).
10. Use a Neopixel ring and turn this into a reaction-meter. Every LED should correspond with a number of milliseconds. The number of milliseconds should also be displayed on the 7-segment displays. See [Footnote 2](#).
11. Use a Neopixel ring and turn this into a running-light. See [Footnote 2](#).

12. This is an assignment for two students! Student 1 uses an [IR-transmitter](#) to send a number set by some switches. Student 2 uses an [IR-receiver](#) to receive these numbers and store it on the 7-segment displays.
13. Read the code (button name) from a IR remote control received by an [IR-receiver](#) and display it on the 7-segment displays.
14. This is an assignment for two students! Create a PONG game on a VGA-monitor and make a hardware interface for two rotary encoders and use this to control the game.
15. Read a PS2-keyboard and display the key pressed on the 7-segment displays.
16. Read a PS2-mouse and display the coordinates on the 7-segment displays.
17. Use an [8x8 LED-display with a MAX7219](#) to display some fancy moving pattern. You may be creative here.
18. Use an [8x 7-segment display with a MAX7219](#) to display the output of a counter on the displays.
19. Use a [Parallax 28015 ultrasonic sensor](#) to measure distance and display it on the 7-segment displays.
20. Use a [DS2413 GPIO extension-board](#) to blink a LED for two seconds if a switch is pressed. The switch should be debounced.
21. Read the temperature from a [BMP280 temperature and pressure sensor](#) and display it on the 7-segment displays.
22. Read the barometric pressure from a [BMP280 temperature and pressure sensor](#) and display it on the 7-segment displays.

## Resources

You may use any sources you can find as long as you refer to them properly in your report. We prefer the [IEEE reference style](#). You are also allowed to [use ChatGPT](#) or any other language model to help you with this assignment, but you are obliged to mention this in your report on a case-by-case basis.

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<sup>1</sup> For final assignment 6. to 8., you have to use a separate 12V power-supply for the LEDs! You also need a level-shifter, since the DE1-SoC IO is 3.3V and LEDs are 12V. The level-shifters are available when you pick up your LED-strip.

<sup>2</sup> For final assignment 9. to 11., you have to use a separate 5V power-supply for the LEDs! You also need a level-shifter, since the DE1-SoC IO is 3.3V and the [WS2812](#) LEDs are 5V. The level-shifters are available when you pick up your Neopixel ring.

## Report

To conclude this final assignment a report will have to be written. This document can be written in English or in Dutch. The relevant and modified source code should be attached using color coding.

This report should include the following:

- A block diagram of the designed system. Also include a state diagram for every finite state machine you designed.
- The testbench(es) you wrote or used to test your design with a brief explanation about the choices that you have made when developing these testbench(es).
- The VHDL code you wrote or used to implement your design with a brief explanation about the choices that you have made when implementing your design.
- An indication of where you used sequential and combinational VHDL code with a clear motivation.
- The results of running the testbench(es).
- The results of running the design on the DE1-SoC board. You can include photographs or link to a short movie.
- The results from the RTL Viewer and State Machine Viewer given by Quartus. Compare these to your original design.

## Delivery

The report shall be delivered as a single PDF document. The file name has the following convention: studentnumber\_surname.pdf. For example: 1012345\_Wozniak.pdf

This file must be uploaded into the the assignment in the Brightspace course.