

Final Assignments

The final assignment for HWP1 may be completed individually or in pairs. You can partner with the student you worked with during weeks 1 to 5, or choose another student. You must register your group in Brightspace as an “Eindopdracht groep”. If you work in pairs, both students will receive the same grade.

The final assignment is somewhat larger than those from weeks 1 to 5. You may choose one of the following assignments, provided it is not selected by too many other students. Therefore, you must choose your assignment in consultation with your teachers. Alternatively, you may define your own assignment in consultation with your teachers.

Please note: the assignments listed below are basic assignments. Completing one of these will earn you a grade of 7. If you wish to achieve a higher grade, you must add extra functionality to your assignment. For assignments 1. to 4., some suggestions for additional functionality are provided. For all other assignments, you must come up with your own enhancements.

The implementation of the extra functionality must:

- at least contain one self-written state machine with at least four states;
- at least consist of three components of which at least one is self-written;

And each self-written component must:

- have a testbench which can test the component automatically;
- use generics to make the component as flexible as possible;

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

A small tutorial on how to use the GPIO pins of the DE1-SoC board can be found [here](#).

Basic final assignments

1. Implement an alarm clock. There is a separate [document](#) which describes this assignment.
2. Implement a stopwatch. There is a separate [document](#) which describes this assignment.
3. Implement a dimmer for an LED. There is a separate [document](#) which describes this assignment.

4. Implement a game on 7-segment displays. There is a separate [document](#) which describes this assignment.
5. Read a [matrix membrane keypad](#) and display the pressed key on the 7-segment displays. You may display an E when key * is pressed and an F when key # is pressed.
6. Read a [SBC ButtonMatrix](#) and display the number of the pressed key on the 7-segment displays.
7. Read the temperature from a [T175Q1 temperature sensor](#) and display it on the 7-segment displays.
8. Read the temperature from a [MCP9808 temperature sensor](#) and display it on the 7-segment displays.
9. Read the temperature from a [DHT22 temperature and humidity sensor](#) and display it on the 7-segment displays.
10. Read the humidity from a [DHT22 temperature and humidity sensor](#) and display it on the 7-segment displays.
11. Read the Temperature from a [DS18B20 temperature sensor](#) and display it on the 7-segment displays.
12. Read the temperature from a [BMP280 temperature and pressure sensor](#) using I²C and display it on the 7-segment displays.
13. Read the temperature from a [BMP280 temperature and pressure sensor](#) using SPI and display it on the 7-segment displays.
14. Use a Neopixel ring¹ and turn this into a running-light.
15. Use an [8x8 LED-display with a MAX7219](#)² to display some fancy patterns. You may be creative here.
16. Use an [8x 7-segment display with a MAX7219](#)³ to display the output of a counter on the displays.

¹ For this final assignment, you have to use a separate 5 V power-supply for the LEDs! You also need a level-shifter, since the DE1-SoC IO is 3.3 V and the [WS2812](#) LEDs are 5 V. The level-shifters are available when you pick up your Neopixel ring.

² For this final assignment, you have to use a separate 5 V power-supply for the LEDs! You also need a level-shifter, since the DE1-SoC IO is 3.3 V and the [MAX7219](#) LEDs are 5 V. The level-shifters are available when you pick up your LED-display.

³ For this final assignment, you have to use a separate 5 V power-supply for the 7-segment displays! You also need a level-shifter, since the DE1-SoC IO is 3.3 V and the [MAX7219](#) 7-segment displays are 5 V. The level-shifters are available when you pick up your 7-segment displays.

17. Use a [HC-SR04 ultrasonic sensor](#)⁴ to measure distance and display it on the 7-segment displays.
18. Use a [LSM9DS1 Accelerometer + Gyro + Magnetometer 9-DOF](#) to read out the acceleration in the Z-direction and display it on the 7-segment displays.

Resources

You may use any sources you find, as long as you cite them properly in your report. We recommend using the [IEEE reference style](#). You are also permitted to use Copilot, ChatGPT, or any other large language model to assist you with this assignment, but you must mention this in your report for each case⁵.

Report

To complete this final assignment, you must write a report. The report may be written in either English or Dutch. Be sure to include all relevant and modified source code, using color coding for clarity.

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 concurrent 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 a link to a short movie.
- The results from the RTL Viewer and State Machine Viewer given by Quartus. Compare these to your original design.

⁴ For this final assignment, you need a level-shifter, since the DE1-SoC IO is 3.3 V and the HC-SR04 ultrasonic sensor uses 5 V. The level-shifters are available when you pick up your sensor.

⁵ See: https://hrelektrotechniek.bitbucket.io/LLM/llm_ebook.pdf.

Delivery

The report shall be delivered as a single PDF document. The file name has the following convention: studentnumber1_surname1_studentnumber2_surname2.pdf. For example: 1012345_Wozniak_1098765_Jobs.pdf

This file must be uploaded into the assignment “Eindopdracht” in Brightspace.