UMONS
Université de Mons

Faculté Polytechnique

Interface MAX7219 ledMatrix SPI

Projet 2021

Readme file completed

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Année académique 2020-2021

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Sommaire

Introduction

Part 1 : Getting started with Quartus

Project creation

In this first part, we will see together how to understand the Quatus program in order to use the documentation found on Github. You have to work sequentially in the following way : First, start the Quartus program and wait for the welcome screen to appear. Second, create a project in which to include the Github files. To do this, go to : File - New Project Wizard. In the project creation window, make sure that the addressing is correct, that the processed files are in VHDL and that the simulation program is ModelSim Altera. In the project creation menu, it is also possible to include existing VHDL files. You must use the tool to include Github files, specifying the nature of the file (i.e. whether they are testbenches or not). In order to avoid a problem with the "Top-Level Entity" it is necessary to name the project by the name of the top-level entity.

Verify the driver

In order to be sure that the project can be operational. It is interesting to test the driver in advance. That is why we have provided a testbench to prove that the system is functional.

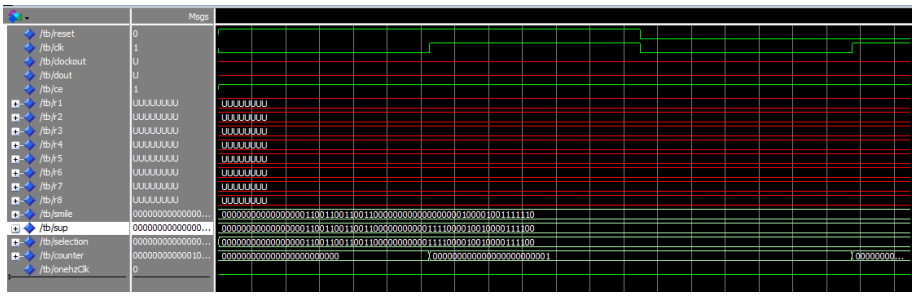


FIGURE 1 – Result of the testbench

First, we used a testbench using only a clocked counter to make the driver as simple as possible. This simulation was then run through Altera ModelSim. In the figure 15, we can see that at each rising edge of the clock, a counter is incremented. By passing through a counter, we can create a secondary clock which we have used for convenience at the rate of one second. We can also use the counter to adapt the clock from 500MHz to 400kHz to be compatible with the FPGA.

In the figure 15, a happy smiley and a surprised smiley are alternately displayed on the interface. First of all, we have defined a half-period time of 1250 ns (i.e. a frequency of 400kHz) and 64-bit signals for the smileys. Then, in the process, we define the clock and the reset. At each rising edge of the clock, the counter is incremented until it reaches 400000. This gives a clock signal of 1Hz. The smileys then alternate every second with this second clock. Note that the counter is a little oversized as 19 bits are needed and sufficient to count up to 400000.

```
process
   begin
      reset <= '1';
      wait for 2500 ns;
      reset <= '0';
      wait;
end process;
-- "Clock Pattern"
process
   begin
    clk <= '0' ;
    wait for halfperiod;
    clk <= '1' ;
    wait for halfperiod;
end process;

process(clk) begin

   if( rising_edge(clk) ) then

      if( counter >= 400000 ) then
         counter <= std_logic_vector(to_unsigned(0, 26));
         onehzclk <= not onehzclk;
      else
         counter <= counter + 1;
      end if;

   end if;

end process;

process(onehzclk) begin

   if( onehzclk = '1' ) then
      selection <= smile;
   else
      selection <= sup;
   end if;

end process;
```

FIGURE 2 – Testbench process

To run the testbench, follow these steps. First, compile the script to check that there are no syntax errors. To do this, click on the blue "play" button in the Quartus toolbar. Secondly, run a simulation by clicking on : Tool - Run Simulation Tool - RTL Simulation. Normally, the Altera ModelSim program should start. Thirdly, in ModelSim Altera, a new associated project must be created. To do this, click on : File - Create New Project. On the menu that just appeared, you must add the files you want to test by clicking on "Add existing files". Here we will test the testbench. Once the project is created, you can launch a compilation in : Compile - Compile All. After compiling successfully, you have to run the simulation with : Simulate - Start Simulation. In the window that has appeared, we select the entity to be tested in the "Work" area. Finally, add the waveform of the data by selecting : Add - Wave.
In order to clarify the procedure, you will find in the following figures the different steps to

follow to start the simulation.

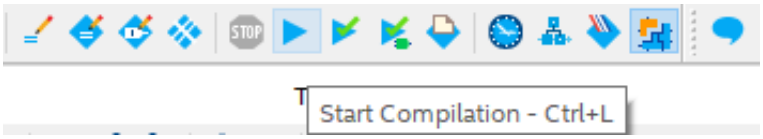


FIGURE 3 – Step 1 - Compile all the files in Quartus

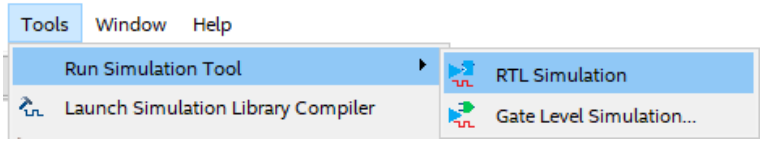


FIGURE 4 – Step 2 - Launch the simulation tool ModelSim Altera

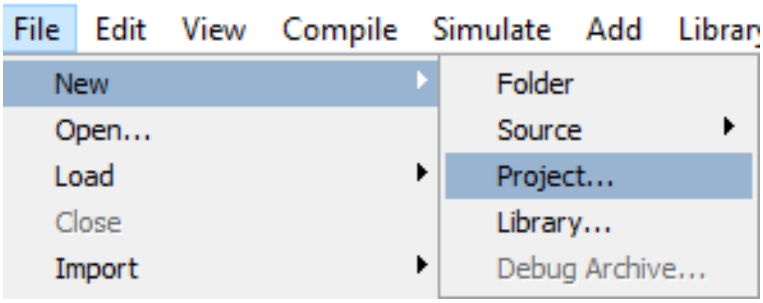


FIGURE 5 – Step 3 - Create a new project in ModelSim Altera

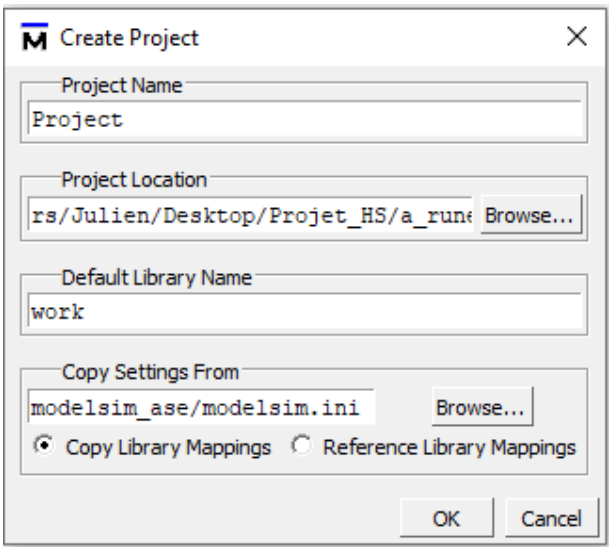


FIGURE 6 – Step 4 - Name the new project in ModelSim Altera

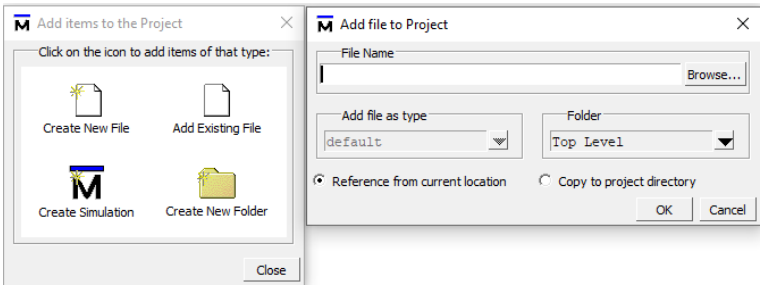


FIGURE 7 – Step 5 - Add existing files to the new project in ModelSim Altera

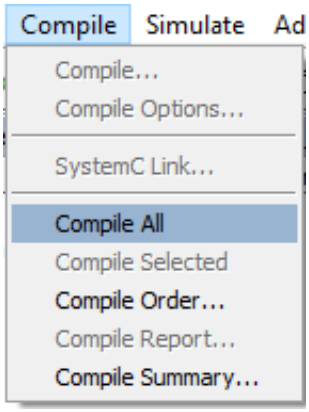


FIGURE 8 – Step 6 - Compile all files in ModelSim Altera

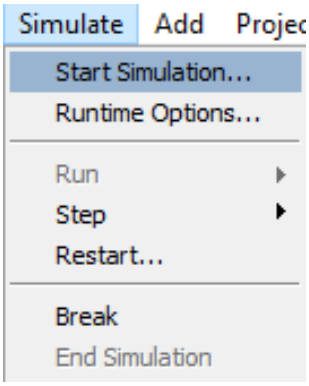


FIGURE 9 – Step 7 - Start the simulation in ModelSim Altera

Hardware

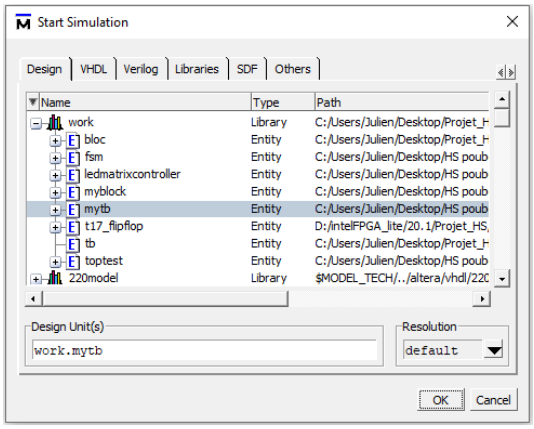


FIGURE 10 – Step 8 - Select the right entity for the simulation in ModelSim Altera

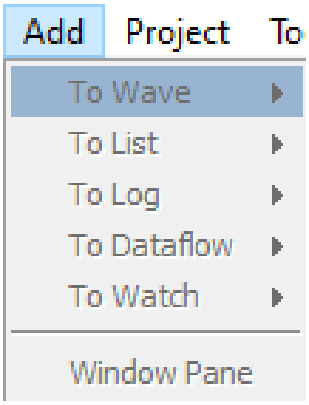


FIGURE 11 – Step 9 - Add waves to the simulation in ModelSim Altera

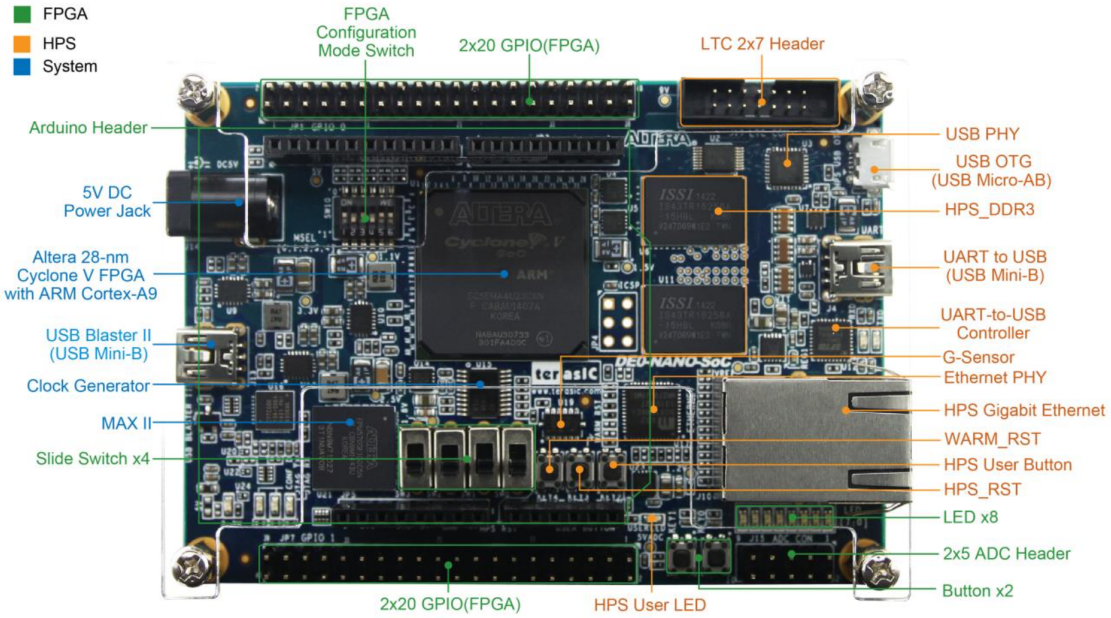
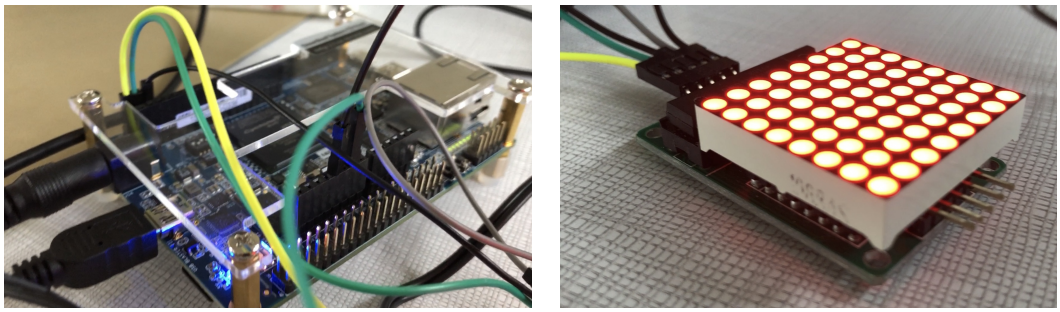


FIGURE 12 – DE0-Nano-SoC Board



(a) DE0 nano SoC golden (b) Ledmatrix

FIGURE 13 – DE0 nano SoC golden and Interface MAX7219 ledMatrix SPI connected together

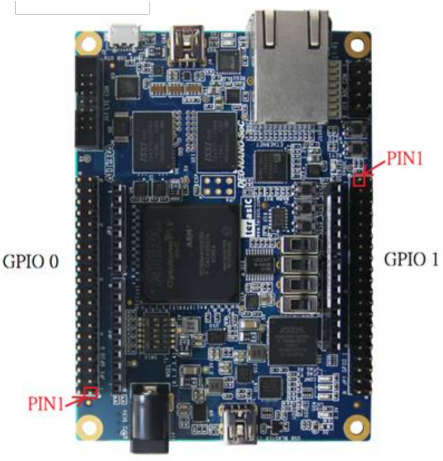


FIGURE 14 – DE0-Nano-SoC Board focus on the GPIO connector

FIGURE 15 – I/O distribution of the GPIO connector

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