System Architecture Design (Block Diagrams)

Today's complex digital systems are comprised of many different components, such as processing cores, memories, and various I/O peripherals. These main building blocks are together arranged into an architecture, which defines how the single components are connected and interact.

Hand-in instructions: Prepare a small report with your solutions (detailed). Submit your report as a PDF through the lecture moodle per the moodle submission deadline.

Information Boxes

Throughout the class, we use different types of information boxes (as shown below) to help indicate important information, teach you some aspects of circuit design, and give you recommendations on the software you can use.

Important information

To highlight important things you need to have done or remember to check during the exercises and labs we use these **Important information** boxes.

Circuit designer's toolbox

To expand your toolbox as circuit designers and engineers we add these **Circuit designer's toolbox** information boxes. New content is shown to match the current problem sets.

Software

Recommendations for software are given in **Software** information boxes.

Hints and common errors

Hints and common errors information boxes help get you going or fix common problems.

Task Description

The goal of this exercise is to design two different systems, by drawing high-level architectural block diagrams of these systems. **The two systems to design are:**

- System 1: A portable sensor node
- System 2: A digital oscilloscope

The system descriptions and the component list are given at the end of this exercise manual.

You should **proceed as follows for each system:**

1. Define the necessary general components that make up System 1 or System 2, as well as their structure and desired properties based on the system descriptions.

2. Decide which specific components to use from the component list by inspecting the data-sheets. The components should be selected according to the specifications given in the respective system descriptions.
3. Draw a block diagram for each system, using the previously selected components.

For both systems the main components to decide on are:

- Processing core
- Memory: volatile, non-volatile
- I/O peripherals: data converter (e.g. an ADC), communication (e.g. a radio), user interface (e.g. a display)

Always indicate all of the main components (processing core, memory, and I/O) in your block-diagram, even if some of them happen to be integrated together in a single physical device. Not all devices/components of the provided list have to be used, and there are multiple feasible configurations (solutions) for each system.

Software

Drawing circuit schematics and diagrams can be done in many different ways and with various tools that you may already be familiar with but did not consider for drawing schematics:

- **Hand drawing:** Often it is best to just draw the schematic on paper or a tablet.
- **app.diagrams.net:** (formerly draw.io): Free online drawing tool with the option of saving your work to Google drive, OneDrive, and other places. Under *More Shapes* you will find *Electrical* which contains logic gates, Flip-flops, multiplexers, and adders.
- **PowerPoint:** We provide the template dsd_template.ppt on the moodle for making drawings in PowerPoint.
- **Microsoft Visio:** Dedicated diagramming tool from Microsoft. You can use Visio if you have access to the VM called STI-WINDOWS10 at vdi.epfl.ch. Visio already has support for various standard digital electronics components.

What is important when selecting a tool (or just doing hand drawings) is that your diagrams are clear and you are productive! **Please remember to label all wires/busses with names, the same applies for the digital circuits you draw in Exercise 1b.**

System 1: Sensor Node

System specification:

- Portable, battery-driven, low-power sensor node
- Tailored to monitoring of multi-lead bio-signals (e.g. a heart rate)
- Supports very basic on-node signal processing
- Wireless communication with a master device (e.g. a smartphone)

System 2: Digital Oscilloscope

System specification:

- 2 channels with 500M samples/sec acquisition speed each
- Total buffer size of 256M samples
- Persistent user configuration profiles

- Gigabit ethernet connection
- Medium-resolution, color LCD display

Component List

Here is a list of the components along with links to download the data-sheets. You can also find all of the device data-sheets together on the moodle. Not all devices/components of the provided list have to be used, and there are multiple feasible configurations (solutions) for each system.

- Atmel AT28C256
- Atmel ATtiny28
- Epson S1D13706
- ISSI IS43-46DR81280A
- Marvell 88E1111
- Microchip PIC24F16KL402
- TI ADC08D500
- TI ADS1198
- TI CC2420
- TI CC3000
- TI MSP430F149
- Xilinx CoolRunner-II
- Xilinx XC6VLX240T