

Advanced Robot Control

Embedded system design

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Presentation compiled for taking notes during lecture



Wrocław University
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- 1 **Embedded system**
 - What is it?
 - Features
- 2 **System architecture**
 - Software & Hardware
 - Sensors & Actuators
 - Communication
- 3 **Tools**
 - Data types
 - Code optimization
 - Computation acceleration
 - Parameters
 - Bootloader



Embedded system

What is an embedded system?



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Embedded system features (1/1)

- Feasibility
- Extendability
- Maintainability
- Longevity
- Repairable
- Modularity
- Power efficiency



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Software (1/1)

System architecture for an embedded solution can be divided into a few groups depending on the nature of the process.



Hardware (1/1)

Similarly to software requirements same can be applied to hardware ones. Depending on the system analysis in contrast to embedded system features. The most suitable platform should be selected.



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Sensors (1/1)

Each embedded system is connected with sensors and/or actuators. The purpose of the embedded solution is to collect data from the sensors, process them in some degree, and act accordingly through actuators.



Actuators (1/1)

Actuators are devices capable of influencing the environment when they are triggered with an external signal.



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Communication (1/1)

Communication between peripherals, sensors and actuators can be either wired or wireless. Depending on requirements for an embedded system one or the other type of communication can be selected.



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Data types in C language (1/1)

C language offers a variety of data types which differ in size and interpretation. Depending on the architecture the size of a variable can differ [3].



Floating point operations (1/1)

Some MCUs are equipped with a specialized block called Floating Point Unit (FPU). This block is responsible for hardware acceleration of mathematical operations on floating point variables.



Global variable initialization

If a global variable should be initialized with a zero value then there should be no initialization at all since it is done by the startup routine.



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Code optimization in GCC (1/1)

Code optimization can be controlled with `-O` flag passed to `gcc` compiler [2].



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Lookup table (LUT)

Lookup table is a technique commonly used to store pre calculated data in an array.



Direct Memory Access (DMA)

DMA is a peripheral available in most of MCUs. It's main purpose is to allow for data transfer between memory regions (program memory, peripheral registers) without direct use of the CPU.



CMSIS DSP Software Library

DSP library is a set of signal processing algorithms prepared for Cortex-M3 [1].



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Configuration parameters

Depending on the embedded solution a need of storing configuration parameters can emerge.



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Bootloader (1/1)

A bootloader is a piece of software which governs the process of loading target firmware. Also, it allows to **download**, **upload** and **verify** the integrity of the firmware. It is usually used to flash a new version of firmware through a common communication interface without a need of specialized hardware – a debugger/programmer.



Quiz for videoconference (1/1)

Prepare yourself for a short test. Select the host of the meeting as the chat receiver. Do not send answers to everyone. You will have 60 seconds for each question. When writing answer to the question. write down also the question number. Question 0. What is your favourite colour? Answer 0. My favourite colour is blue.



Quiz (1/1)

Calculate group number as the rest from dividing the Student ID number by 4.

Example

Student ID number is 123456, thus the group is 0.

Take last 2 digits from Student ID number (56) and calculate the rest from dividing by 4 ($56 \% 4 = 0$).

Write down your name, Student ID number and group.



Literature (1/1)



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