MSP430 Family

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Lection 8. Communication.

Challenges

Motivation

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Interface examples

Protocol

Task in the class

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Hometask

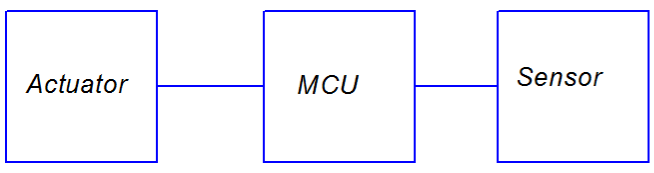
Challenges

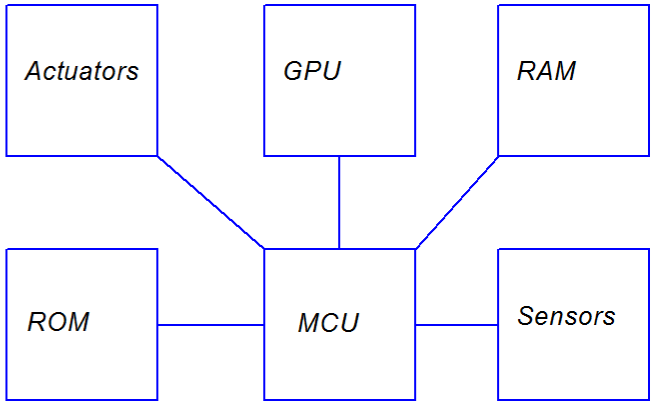
What you should know at the end of the day.

- Learn different communication interfaces
- Study ways to make communication reliable
- Study how construct the communication protocols

Motivation

Communication is one of the most important parts in the embedded system.
A lot of communications is covered from developer, but frequently you should implement additional functionality and communicate them.





Connection types

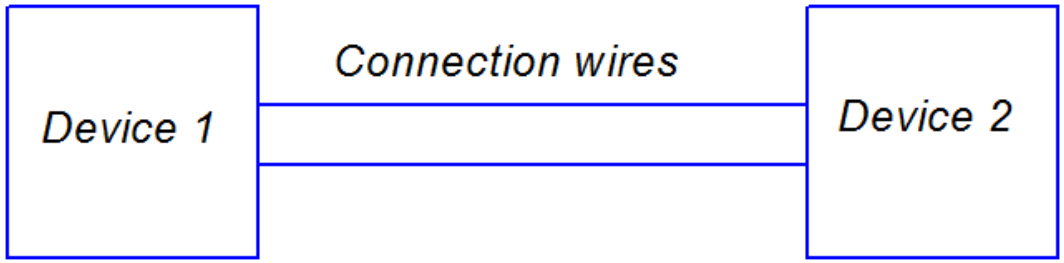
There are three main modes of connection:

- Point to point
- Master to slaves
- Bus mode

You should always choose communication structure before implementation.

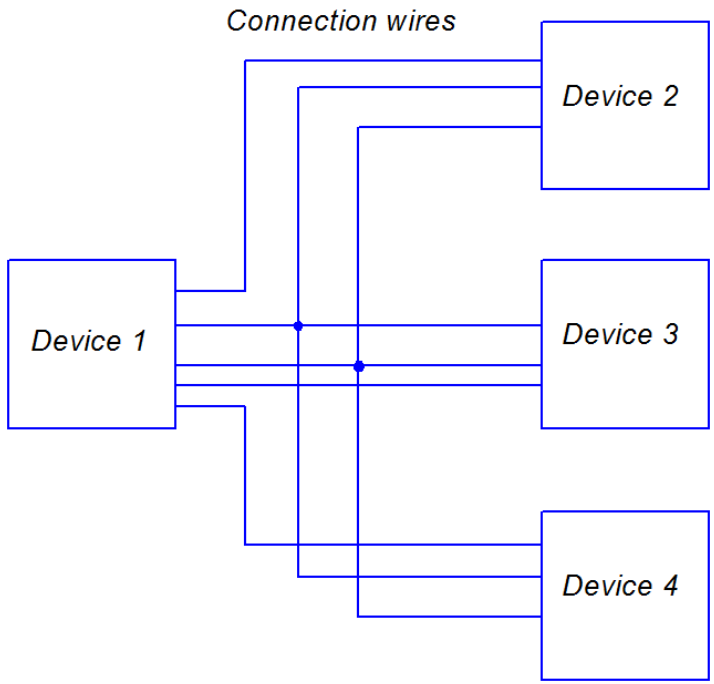
Point to point

Point to point connection allows to use maximally resources of the interface.
The disadvantages: dependency of the cable length, number of devices is bounded.



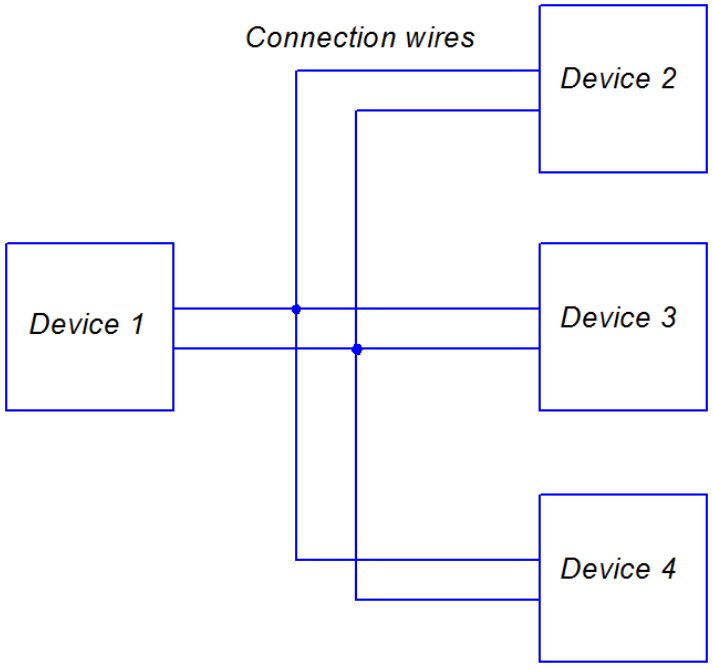
Master to slaves

Master to slaves mode implemented if one device is more powerful.
Advantages: number of devices is flexible, service data takes small resources.
The disadvantage: connection between slaves impossible.



Bus mode example

Bus connection allows connect high number of devices with different interconnections. Advantages: Flexible in connected devices, allows broadcast, multicast. Slave may start transmission. The disadvantage is high signalling and complex processing in the MCU device.



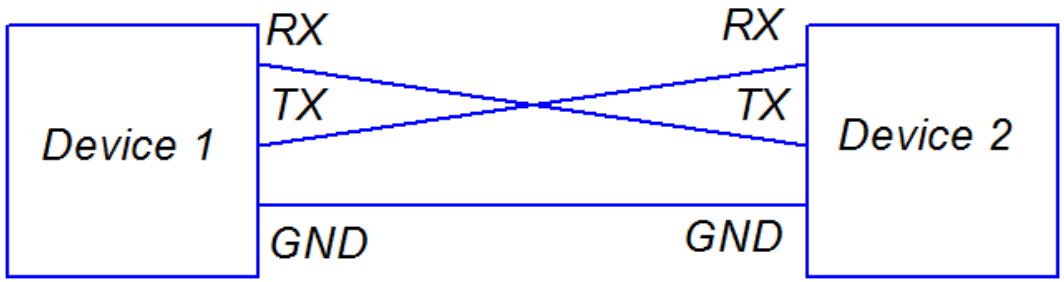
Examples

The most popular physicals interfaces:

- I2C (TWI)
- UART, USART
- SPI
- CAN
- One-wire
- ModBus
- USB

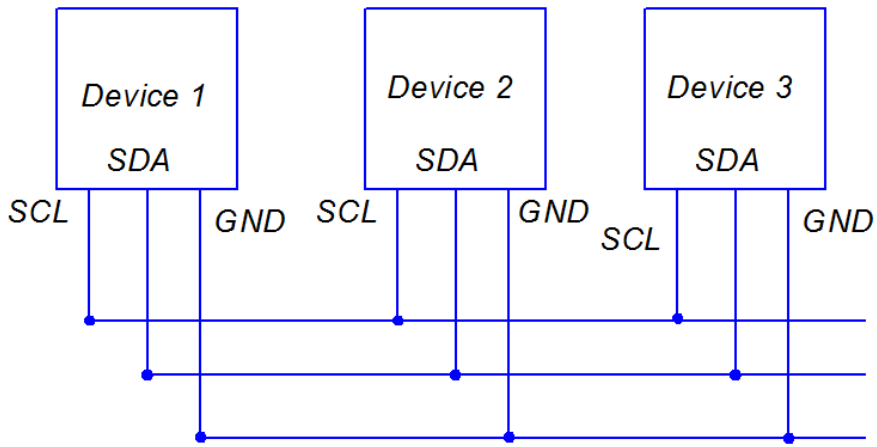
UART interface features

UART is example of the point to point communication.
3 wires are used : RX, TX, GND. The wires are connected as presented in the figure. Advantage of the interface is simplicity.



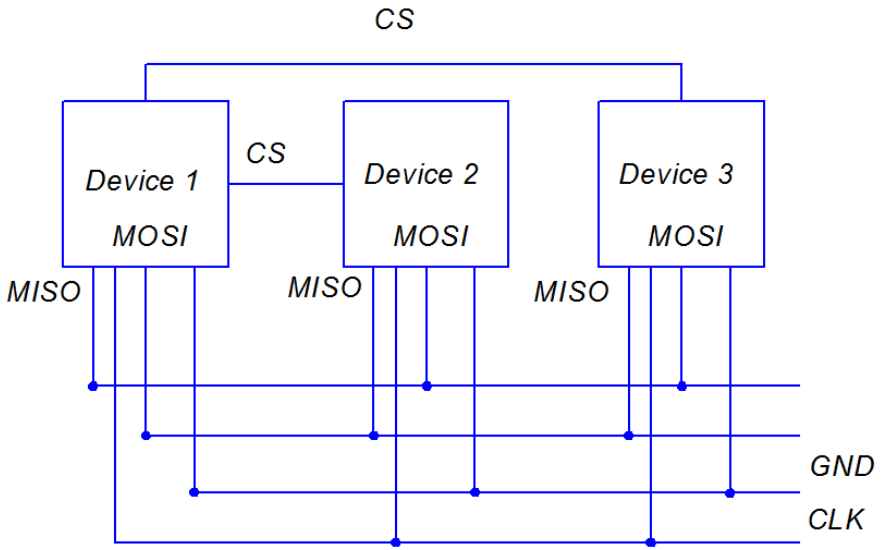
I2C interface features

I2C is example of the bus interface.
3 wires are used: SCL, SDA and GND
Advantages: flexibility. One bus can do everything. Implemented address, ACK.
Disadvantages: very complex processing, possible to fail with hardware implementation.



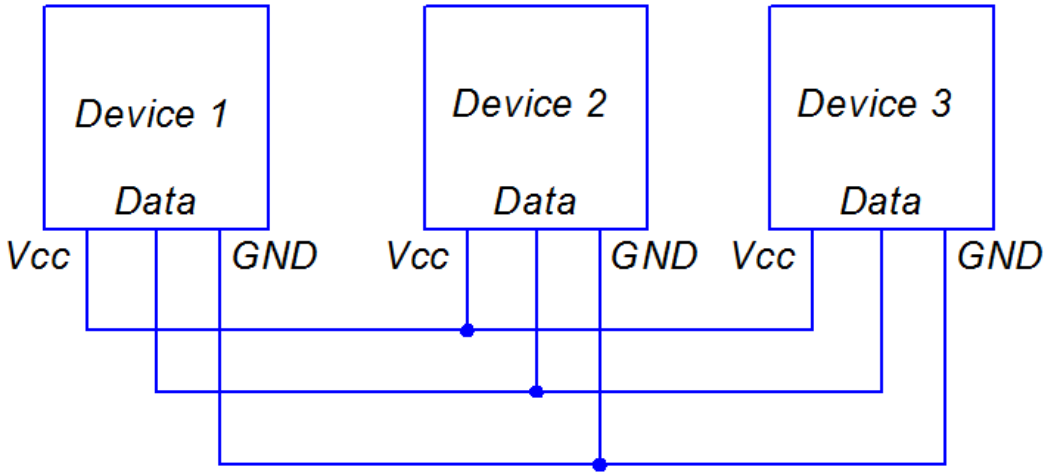
SPI interface features

SPI interface is example of the master to slaves mode. Number of used wires is flexible: SCL, MOSI, MISO,GND and number of CS pins equal to slave devices.
Advantages: similar to the UART interface signalling, flexible number of devices. Disadvantages: Number of used pins changes. Slaves doesn't interconnect



One-wire interface features

One-wire interface used for the sensor connection.
It allows to make high number connected devices only with 2-3 wires.
Advantages: Low number of pins, unique addressing, number of pins doesn't changes, allow powering via interface.
Disadvantages: High complexity, no peripheral implementation



Protocol construction

Data transmission is only half of the communication.
Receiver and transmitter should use certain rules to understand what and where was transmitted.
Example: Length of the packet, tags for different parameters, CRC check, dialogue mode.

Signalling and data

With protocol choose we come to the trade-off between flexibility and amount of information which we will send.
We can make protocol inflexible and transmit data without any tags, but with increasing of the amount of data protocol will be rewritten each time.

Task in the class

Implement I2C interface in the MSP430. Use USCI prebuilded interface to change mode.
Use each device as the slave, with possibility to transmit the data.
Introduce the interrupts for the received and transmitted data. Switch structure is the best case to handle all wide variabilities of the interface.

Result

Hometask

Write protocol which will transmit data from ADC to the neighbour device, receive data from another neighbour and turn on led if the received value is higher than bound.

Select addresses for each device at first.

Thanks for your attention