EGU2020-3032
https://doi.org/10.5194/egusphere-egu2020-3032
EGU General Assembly 2020

Microcontrollers beyond Arduino: a stationary and a mobile environmental monitoring system

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In the course of the Helmholtz MOSES initiative two monitoring systems are being developed which consist of the same key components and thus functionality but with very different scopes of application. One is a stationary data logger with a classic measurement routine (on/off duty cycle) and support for various hardware interfaces (2xSDI12, 1xRS485, 2xUART, amongst others). The other is a drifting data logger that stays idle until a flood event activates the logger and carries it downstream. On-board are turbidity, EC and temperature sensors, a GPS and an inertial measurement unit (IMU) monitoring turbulence.

Advancements in electronics driven by automotive, mobile and IoT applications led to the development of very powerful, small and low power microcontrollers. This is why we decided to leave the realms of ATMega 8-bit systems (such as Arduino) and move towards ARM Cortex 32-bit systems. More precisely we used the Teensy 3.5 microcontroller development system as the core for the two systems. It is superior to Arduino in terms of performance while its developing team tries to maintain compatibility to Arduino in terms of programming vocabulary. This allows easier migration but comes also with restrictions regarding the capabilities of the hardware.
The other key component is the FiPy which supports five different wireless network types (WiFi, Bluetooth, LoRa, Sigfox, LTE-M) in one module. In comparison to most other hardware it runs MicroPython which adds more complexity to the project. Even though it is a microcontroller and features also several hardware interfaces, power consumption is far from low power, which is why it is used here only for remote communication and data transmission. In addition, several design decisions were made regarding power path routing and jumper configuration to improve the systems' overall versatility, debugging capabilities and low power functionality, which are often key to the feasibility of a remote monitoring system.