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Trinkwasserqualitätsprüfung mit FPGA

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Water is an important resource, therefore the safety of the water supply must be guaranteed at all times. Today, our drinking water is checked for bacteria in many, mostly manual steps, which can take 48-72 hours. The time until contamination of the drinking water can be detected is correspondingly long.

With the flow cytometry method, bacteria can be detected within a few minutes and, as the method is automated, drinking water can be monitored around the clock.

Metanor manufactures such a fully automatic analyser. With the aid of pumps, the drinking water is mixed with a fluorescent chemical and the laser light scattered by fluorescence-labelled cells is detected with a photon multiplier (PMT).

The control of the pumps and the evaluation of the photon multipliers is done with complex electronics, which today consists of an industrial PC, analog-to-digital converters, several subordinate processors, programmable logic (FPGA) and user software created for Linux. The user software is distributed over several processors.

The progress in the field of embedded processors today should make it possible to unite the entire user software in one processor and thus significantly reduce the manufacturing costs of the analysis device. The task of this bachelor thesis was to provide this proof.

To reduce the complexity of the device, an existing multicore processor in the SoC-FPGA (Zync7000) was used to take over the entire control of the device. This proved that the expensive industrial PC and other subordinate processors could be saved.

For this, a Linux distribution for the multi-core processor had to be created with the help of Yocto and the entire PC application had to be ported to the new Linux distribution. The user interface should also be simplified with the help of a web interface. For this purpose, a WEB server with a currently still rudimentary web interface was implemented.

The tests possible in the context of this work show that the computing power of the SoC-FPGA is sufficient to operate the entire software. Software optimizations and an increase in computing power with a SoC-FPGA of the latest generation guarantee future performance increases.

Online-Bacteria-Analyzer with Flow-Cytometer, chemical tanks and user interface

Online-Bacteria-Analyzer with pump system