Abstract

Title: - Design and evaluation of a miniaturized fluorescence sensor platform

Fluorescence sensors are widely used in many applications to measure different parameters such as oxygen, PH, carbon and protein. A fluorescence sensor consists of LEDs, mirror, sensor marker and photodiode. Most of the implemented systems depend on hardware circuits. The main idea behind this topic is to measure fluorescence response with a software approach to reduce dependency on hardware. The system is implemented to evaluate and analyse various algorithms to measure fluorescence response.

The branch “Micro-displays and sensorics” of Fraunhofer FEP already developed OLED-on-CMOS based sensor chip. This chip consists of two OLEDs, mirror and photodiode. The sensor marker is placed on a mirror to measure specific parameters. A sensor chip also consists of an optical filter to eliminate the crosstalk effect. Different algorithms are simulated and implemented during this work to check any possibility of eliminating the requirement of this optical filter because these optical filters are very costly. It is observed that the two frequency I-Q demodulation algorithm is capable of fluorescence measurement with crosstalk. All algorithms are simulated using Python scripts to find out the required specification of a hardware platform and then the microcontroller-based system is designed which can measure fluorescence response using two measurement principles such as time decay measurement and phase measurement.

The system is designed to have signal generation, signal acquisition and mathematical computation on a single chip. System validation shows the correct phase measurement which is compared with the reference system. The power consumption in various low power modes of a microcontroller is estimated and two application scenarios are analysed which indicates the feasibility of a system in the battery-powered application scenario.

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