

## Wireless communication for sensors of a pipetting robot

In this bachelor thesis, initiated by the firm Tecan Schweiz AG as a proof of concept, a pipetting robot was equipped with a new measurement procedure for the detection of pipetting needles diving into or emerging out of a fluid. This provides the groundwork for a wireless communication between the pipetting arms and the body of the system.

The starting point of the thesis was a functioning pipetting robot that should be equipped with wireless communication for measurement results and a wireless measurement synchronization mechanism. In order to detect dive and emerge events, the pipetting arms are fitted with a sensor technology based on capacitive measurements. A crucial point regarding the system design is that the capacitive measurements need to fulfil very high synchronicity requirements in order to avoid interference between the pipetting needles. The fact that the pipetting arms are connected to a central main board through cables plays a significant role in the fulfilment of the rigid synchronicity requirements.

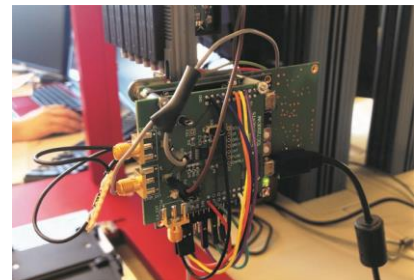
It was examined whether it is possible to meet the synchronization requirements with a wireless technology. Upon first negative results, attempts were made to lower the requirements on several levels. On one hand the measurement electronics were moved down to the pipetting arms. Thereby the signal paths are greatly reduced with the intention to gain stronger and clearer measurement signals. On the other hand the existing analog measurement electronics were studied regarding their functionality and were, in an iterative working process, partly replaced with a digital alternative. Simultaneously a software was written for the processing of the measurements, that paves the way for a wireless synchronization mechanism. Additionally a specific wireless technology (IEEE 802.15.4 standard) was examined in order to find out whether it poses a suitable solution.

As a main result it was possible to develop a procedure that enables staggered measurements which greatly simplifies the synchronisation problem. Together with the mentioned measures a good basis for a wireless connection has been provided. The new measurement procedure consists of self made hardware as well as software including a fast algorithm for signal analysis. The findings and achievements were composed into an anticipatory overall concept, that includes wireless communication and synchronization.



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Hardware for capacitive measurements developed during the project



The basis of the project was a pipetting robot