Wireless Optodes for Brain Imaging Applications

Students

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Introduction: The incidence of neurological disorders, particularly strokes, which affect one in four people worldwide, underlines the urgent need for effective neurorehabilitation techniques. Current treatments often approach the brain as a 'black box', lacking regular clinical evaluation to directly measure recovery. Addressing this gap, Optohive has developed an innovative brain monitoring solution tailored for neurological disorders. This solution uses near-infrared imaging combined with AI-based algorithms to provide personalized patient care focused on restoring specific brain networks. The current wired system is bulky and time-consuming to install, making it inconvenient. Shifting towards a wireless setup, as illustrated in Fig. 3, is essential for enhancing the practicality and effectiveness of brain imaging in clinical rehabilitation.

Approach: Various wireless protocols are analysed in line with high requirements for synchronisation, data throughput and scalability. Specifically, the system aims for a synchronisation error of under 200µs, ensuring precise timing across the network. The initial proof of concept targets a network of 20 devices with minimum throughput of 560Bytes/s per device. The existing Optohive sytem is based on the EFR32MG24 chip, which already supports OpenThread, Zigbee, Bluetooth Low Energy, and Bluetooth Mesh. To determine the optimal protocol, these protocols are examined, compared, implemented, and evaluated as in Fig. 1.

Conclusion: Preliminary a theoretical evaluation of the different communication protocols, put the focus on BLE and OpenThread for a more detailed exploration. OpenThread offered a more advantageous approach for applications with such stringent requirements, especially in the aspect of synchronization, as shown in Fig. 2. OpenThread's synchronisation schemes were found to be less complex, yet equally effective, compared to those in BLE. This ease of implementation and efficiency in meeting synchronization requirements make OpenThread a more suitable choice for applications demanding high precision and reliability in the Optohive project.

Fig. 1 Illustration of the setup used to measure different concepts of the system.
Own presentment

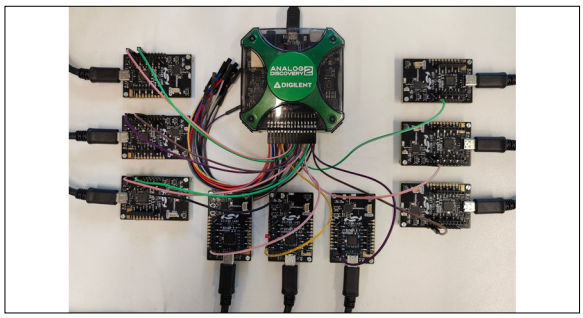


Fig. 2 The plot displays the time synchronisation error, with a synchronisation concept implemented in OpenThread.
Own presentment

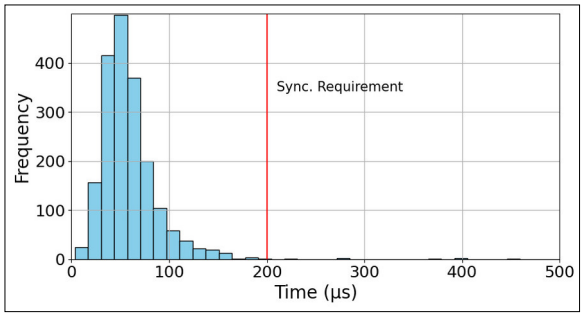
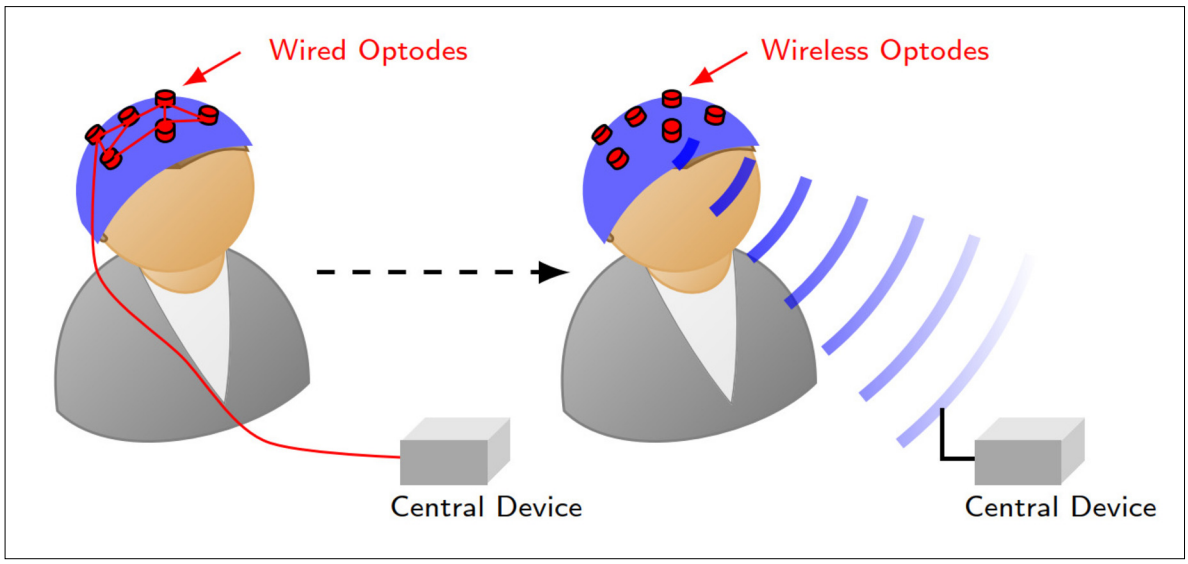


Fig. 3 Shift from existing Optohive System to a fully wireless system.
Own presentment



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