Miniaturized EEG System and Seizure Detector for Wearable and Subdermal Application

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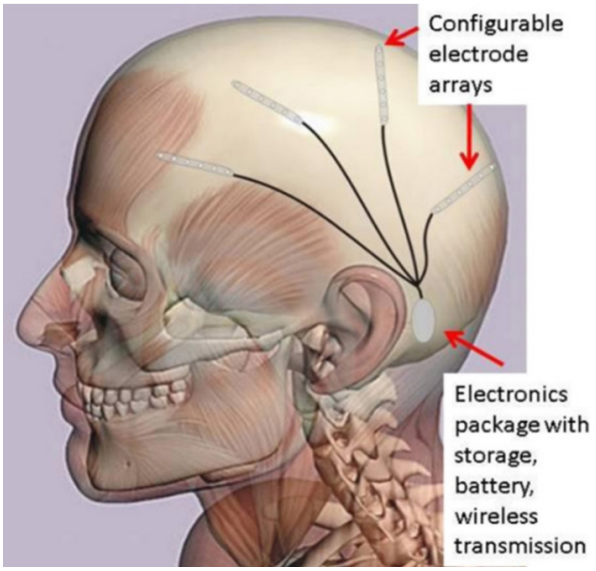
Electroencephalograms (EEGs) are used to diagnose and treat a wide range of neurological related topics by providing insight into a patient's brain activity. Their applications range from diagnosing epilepsy and sleep disorders to assisting doctors to administer anesthetic drugs and more.

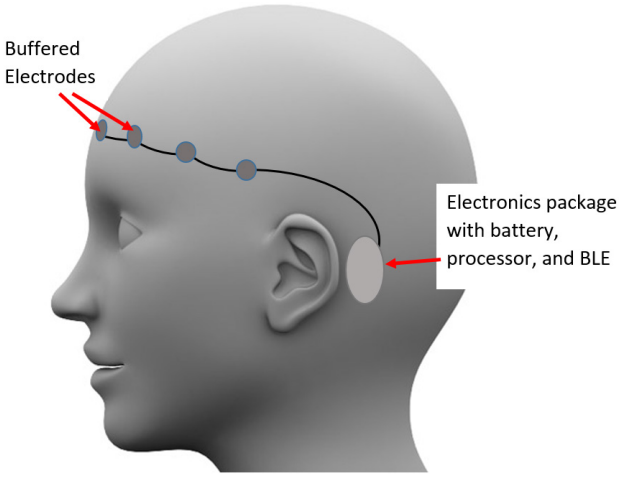
Achieving long-term continuous EEG data in a wearable form has been a long-standing problem. In a conventional EEG, the patient must go to the hospital and be connected to bulky equipment. This is prohibitively expensive in the long run and prevents the patient from going about their daily lives, thereby reducing patient compliance in certain situations.

This work extends previous investigations on miniaturization of EEG by providing system-level improvements to expand the use-cases of the device. With optimized packaging of an EEG system-on-a chip (SoC) die, form-factors more suitable for implantation as well as wearable designs are realized. For the subdermal implanted design, an eight-channel EEG recorder with a seizure detector is implanted behind a patient's ear. Electrodes are threaded underneath the patient's scalp to the location of interest. EEG data is then sent wirelessly to a wearable external device that processes the data and provides power to the implant. This implantable system has the ability to continuously record EEG for more than 30 days with minimal maintenance.

For the wearable form factor, the miniaturized EEG SoC and wireless microprocessor are attached near the mastoid behind the patient's ear. Eight buffered electrodes are placed across the head at the location of interest. EEG data is collected and transmitted via BLE to a computer or smartphone for further processing.



▲ Figure 1: Implanted EEG system showing location of the SoC and electrodes.



▲ Figure 2: Wearable EEG system showing locations of electronics package and electrodes.