Senior Design / BS Project
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Olfactory Sensory Evoked Potentials

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Abstract

Approximately 15% of the population reports loss of sense of smell. There is a demand for a device that is capable of emitting an odor and objectively measuring olfactory function so doctors can screen for olfactory dysfunction and develop new treatments. This device was built and tested with acceptable design specifications to gather objective measurements for evaluation of the brain's response to odors. Alternating emission of a neutral and robust odor were delivered to a patient. Electrodes measured these responses and we were able to see a spike in amplitude of signals responding to robust odors. Research using this device will reveal mechanisms of the olfactory sensory system.

Introduction

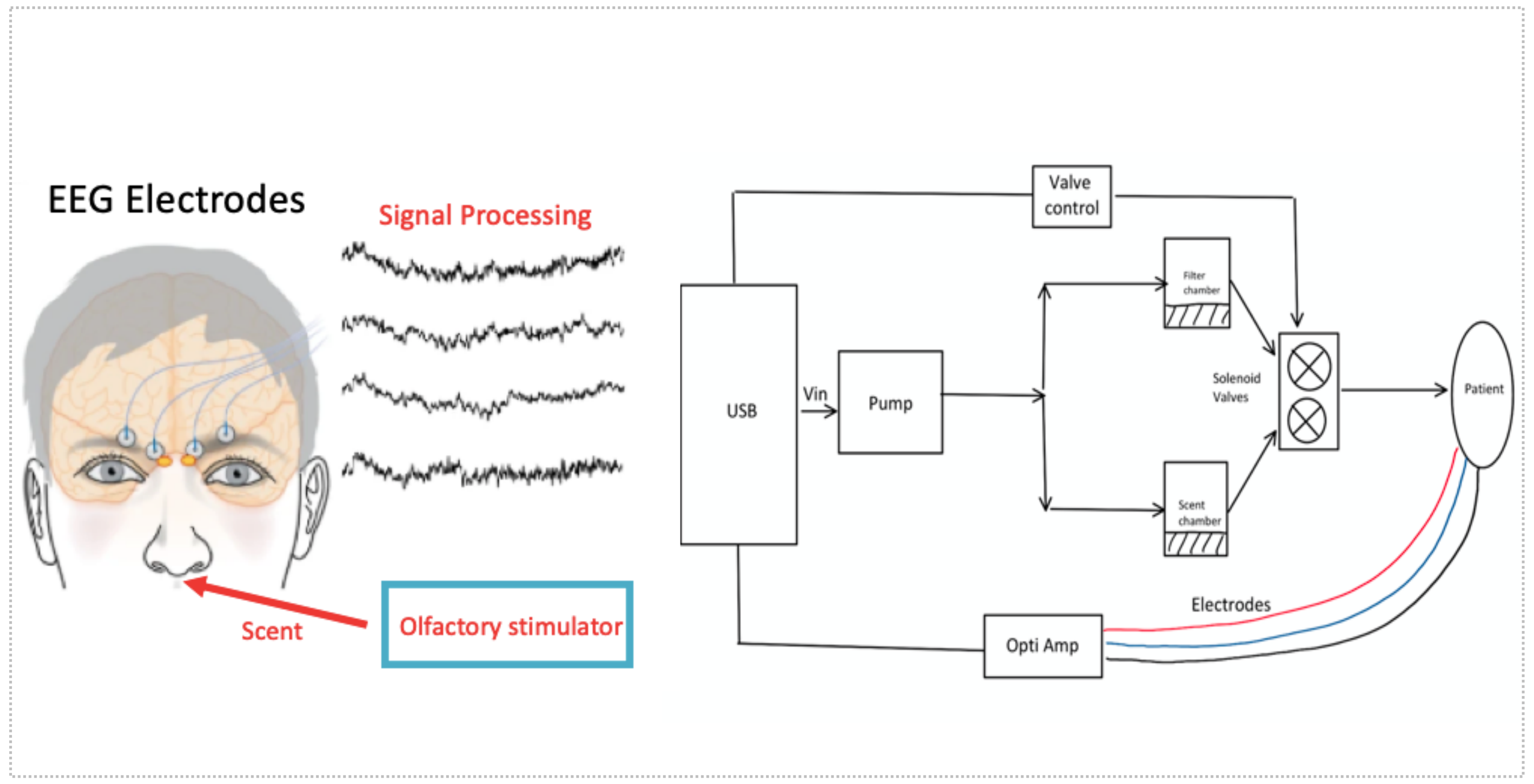
The inability to sense odors is called anosmia and can result from trauma, illness, aging, and other factors. Various other types of smell disorders include parosmia which is the experience of distorted smells, and phantosmia, hallucinations of the olfactory system. More recently, olfactory dysfunction has been suggested to be a side effect of the novel coronavirus. The causation is still unclear due to the unknown behaviors of the virus, however, post-viral olfactory dysfunction (PVOD) is common. Some studies show that PVOD is caused by mechanisms other than nasal obstruction evaluated by acoustic rhinometry, thus making the need for the olfactory sensory evoked potential device even more critical for evaluation brain activity during olfaction.

Current diagnostic methods include sniff tests, nasal endoscopies, and Imaging techniques. The problems with using sniff tests are that there is room for bias and it does not allow any physiological or anatomical explanation for your sensory dysfunction. Nasal endoscopies are limited to only viewing the nasal cavity to see if there is physical damage, contamination, or infection
Imaging techniques are not deemed necessary for patients coming in with complaints of smell loss. Because they are timely, costly, and overall not very effective.

Unlike sense of sight and sound which travel to a relay center in the brain, smell goes directly to different locations in the brain which can trigger fight or flight, memory, hunger, and other sensations. Due to the variability of brain activation, there is a lack of understanding of olfactory function within the brain.
A device that emits an odor and objectively measures the event related evoked potential will reveal mechanisms of the olfactory complex.

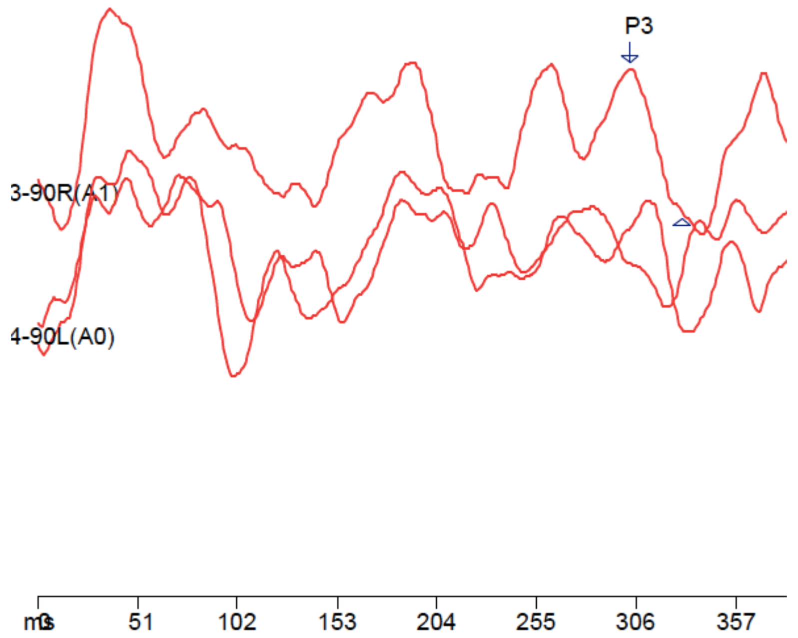
Methods I Design I Analysis

The device is built using an air pump to provide constant air flow into the system. Two scent chambers contain a neutral and a robust odor to yield objective measurements. The solenoid valves alternate opening to release the odors at controlled durations and frequencies. At each odor emission, an electroencephalogram device is programmed to measure responses detected by the electrodes, which are dermally placed on the patient's head. The system then performs signal processing to filter, sum, and average the measurements.



Results

We were able to measure a response that coincides with the P300 event related potential phenomena. When comparing the neutral odor response to the robust odor response, the robust evoked potential was greater in amplitude than the EP response to the neutral odor. The signal labeled "P3" is the evoked potential responding to the odor stimulus.



Conclusion

The experiments conducted with this device thus far represent a healthy patient with functional olfaction. We intend to create a baseline for how the signals should behave in a healthy patient by performing more tests on a larger healthy population. In the future, we will be able to use this device to monitor patients who report smell loss and compare their measurements to the baseline. This device will allow doctors properly diagnose patients with olfactory dysfunction and reveal mechanisms of the olfactory system within the brain.

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