

## Hands-Free Electrolarynx Device

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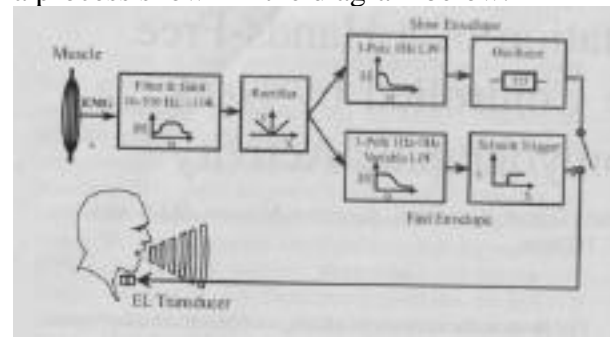
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Every year many people go through a laryngectomy, or the surgical removal of the larynx. This is many times due to cancer and other instances related to a trauma incident. If the larynx is removed it costs you the ability to produce regular speech along with having to breathe through a stoma, or hole, in the neck. Speech is still possible through alaryngeal speech. The three types of voice rehabilitation are esophageal, tracheo-esophageal (TE) and electromechanical or electro-laryngeal (EL) speech.

Esophageal speech is based on the method in which the patient transports a small amount of air into the esophagus and then forces it back past the pharyngo-esophageal (PE) segment causing it to resonate. This produces a "belch-like voice." TE speech involves a one-way valve that directs air into the esophagus instead of the trachea. This causes the PE tissue to produce phonation. The traditional EL is a hand-held battery operated transducer. When it is held up it emits a buzzing sound that travels through the neck tissue or the oral cavity and into the vocal tract. Various problems and complaints with these methods are they are difficult to learn, some occupy your hands, and they produce a monotonic sound.

This study investigated the design of a hands-free Electrolarynx device that was controlled by the Electromyographic (EMG) Activity in your neck. Electromyography is a test that measures muscle response to nervous stimulation. The unit consists of a DelSys surface electrode, the EMG-EL processor and an EL transducer. The electrode and transducer are worn against the neck by an inconspicuous neck brace.

The system operates by detecting the electrical activity of the infra-hyoid neck strap muscles from a bipolar electrode. The Electromyographic signal received is in the tens of microvolts with most energy in the frequency range of 10 to 500 Hz. The signal goes through a process shown in the diagram below.



The fast envelope controls the on/off function of the transducer, while the slow envelope is used to control the fundamental frequency of the EL voice by directly modifying the frequency of the oscillator driving the EL transducer.

The performance of this system was assessed by comparing it to normal voice, manual EL voice and TE voice in a number of reaction time tests. The EMG-EL performed well enough to deem it a useful device in the initiation and termination of an electrolarynx controlled by electromyographic signals.

E. Goldstein, J. Heaton, J. Kobler, G. Stanley, R. Hilton, *Design and Implementation of a Hands-Free Electrolarynx Device Controlled by Neck Strap Muscle Electromyographic Activity*. IEEE Transactions on Biomedical Engineering, Vol. 51, No.2, February 2004.