

Project Design Specification

Physical 3D Larynx Model with Moving Components

October 9, 2008

Team Members: Rexxi Prasasya, Chou Mai, Karen Chen, Jason Tham

Problem Statement:

The goal of this project is to continue the development of a physical 3D laryngeal model with moving laryngeal cartilage, membranes and muscles. We would like to demonstrate nerve-muscle action and interaction in the larynx for voice production. The model is to be used as a patient educational tool for improved understanding of the laryngeal mechanism. It will also be used to plan treatment based on diagnosis of voice, airway and/or swallowing disorder. This semester, we will design a prototype that accurately demonstrates a healthy laryngeal muscle movements. In the subsequent semester, we would like to introduce several laryngeal disorders into the model.

Client Requirements:

1. The model must be three times the size of an adult human larynx
2. The model must contain the section of the larynx opening from the hyoid bone to the first two tracheal rings and show soft tissues, major muscles and cartilages.
3. Cartilage movements and associated muscles that need to be included are:
 - Abduction and adduction of the arytenoid cartilage
 - The rocking of the arytenoids cartilage
 - Flexion and extension of the thyroid cartilage
 - Oscillation of the thyroarytenoid muscle
4. The model must be presentable and functional
5. The model must be easily transportable

Design Requirements:

1. Physical and Operational Characteristics

- a. Performance Requirements-* The model must demonstrate the muscle and cartilage movements, as well as the proper anatomy of a healthy larynx. The model must be properly labeled to indicate components of the larynx.
- b. Safety-* The detachable part of the model must be designed to avoid choking hazard. All electrical components must be housed within proper insulator.
- c. Accuracy and Reliability-* The model should be 3 times the size of an adult human larynx. The model should create the correct muscle and cartilages movement (e.g. contraction, abduction, adduction, tension, etc.).
- d. Life in Service-* The model needs to operate for at least five years of constant usage. This may include sudden on and off switching, withstand short and long distance transportation.

- e. *Shelf Life*- 10 years with only minor repairs required.
- f. *Operating Environment*- The method must be compatible with hospital environment. Also, the device has to be operable by users who do not have full knowledge of the larynx.
- g. *Ergonomics*- N/A.
- h. *Size and Shape*- The model should represent the larynx at 3 times the actual size. The base dimensions should not be in excess of 25x25 cm and the height not exceeding 50 cm.
- i. *Weight*- Less than 2.0 kg
- j. *Materials*- The model must be prepared from a material that is widely accepted by the users, not rejected by the users' skin (e.g. allergic if made from latex). The material of the model needs to withstand transportation and wear from constant operation and articulation. The base of the model needs to be strong enough to support the model, as well as supporting the embedded circuits and motors.
- k. *Aesthetics*- The model should be presentable. Each component of the larynx needs to be uniquely color coded to ease patients' observation of movements within the larynx. The rest of the model should also be accurately colored in order to provide a good approximation of the physiology. The aesthetics should cater to an educational need.

2. Production Characteristics:

- a. *Quantity*- One working and well-tested prototype by the end of the semester.
- b. *Target production cost*- \$700 for the original prototype.
- c. *Testing procedure*- Testing will be done to test the patient's understanding on how the larynx works before and after demonstration of the prototype.

3. Miscellaneous:

- a. *Standards and Specifications*- The model can be used for educational purpose worldwide.
- b. *Customer*- LED lights and sound system maybe integrated into the functioning model if time allows
- c. *Patient-related concerns*- N/A
- d. *Competition*- Non-automated functional larynx models and Visual software programs.