



# The Larynx Team

Ken Roggow  
Kevin Hanson  
Nick Ladwig  
Jonathan Meyer

# An Overview



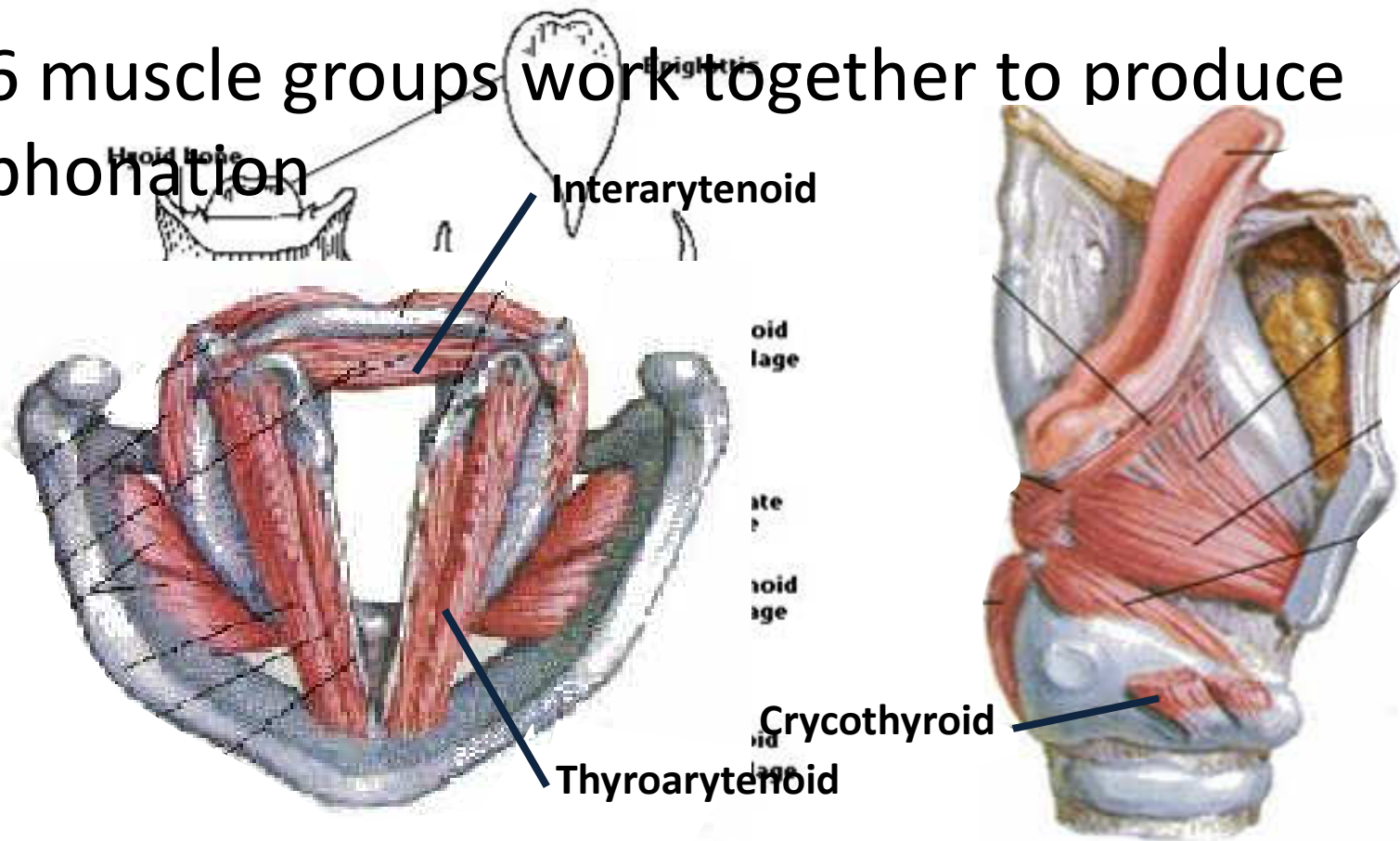
- Motivation
- Background
- Specifications
- Design options
- Design matrix

# Why build a larynx model?

- Our client is a speech pathologist at the UW-Health Voice and Swallowing Clinic
- She sees about 500 patients/month
- She wants a functioning laryngeal model
  - +Patient education
  - +Treatment plans

# Complexity you take for granted

- The larynx is composed of muscle, cartilage, and soft tissues
- 6 muscle groups work together to produce phonation



# Existing Models



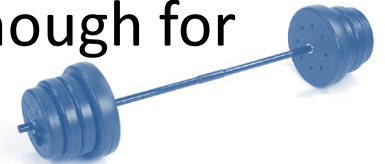
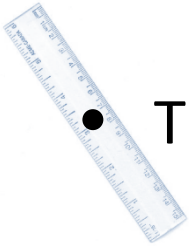
Existing movable designs use drawstrings to make motion.

They don't show how muscles work together in common motions



# Client Specifications:

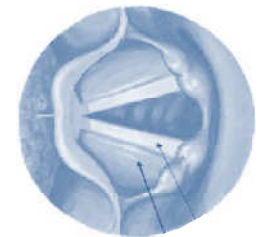
- The model must be 3x scale or greater
- The model needs to be light enough and small enough for one person to easily move it



- The model must span from the hyoid bone to the second tracheal ring, and show tissue, major muscles, and bone



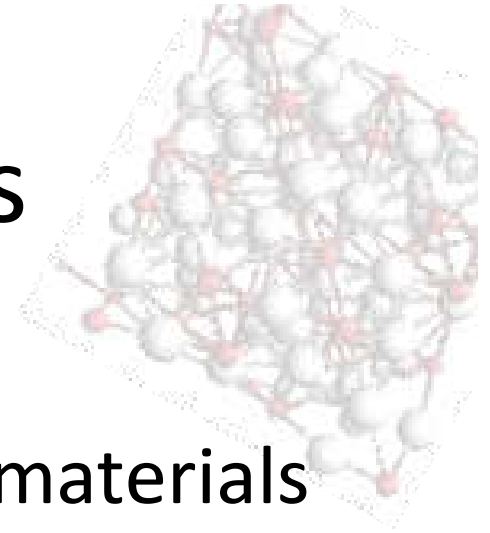
- It must show the vocal folds opening, closing, and stretching.



- The movements must take at least 2 seconds



# Three Design Options

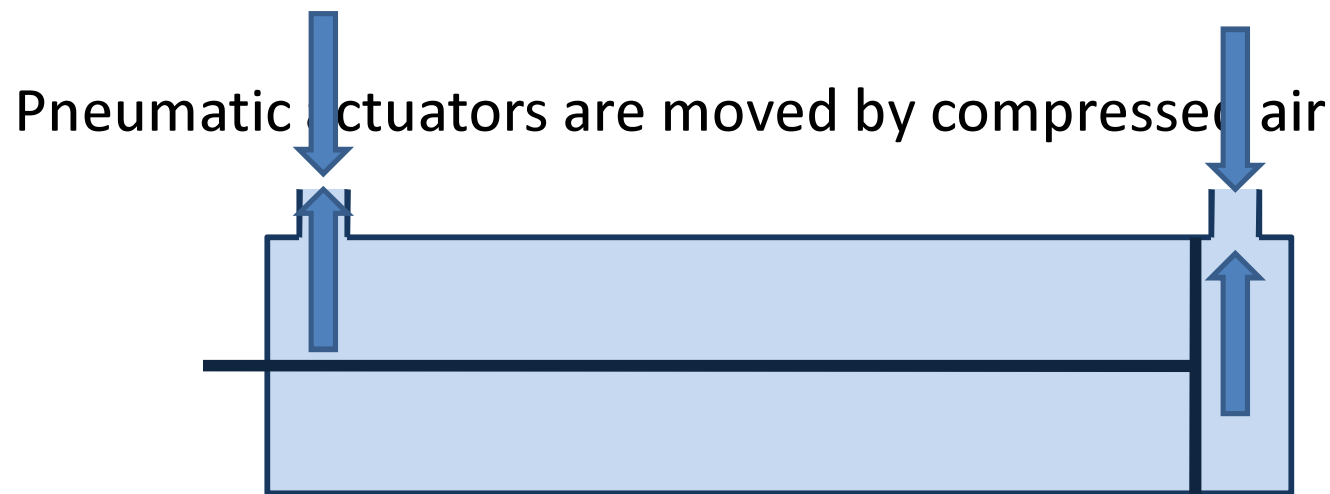


## *Option 1: Piezoelectric Circuit System*

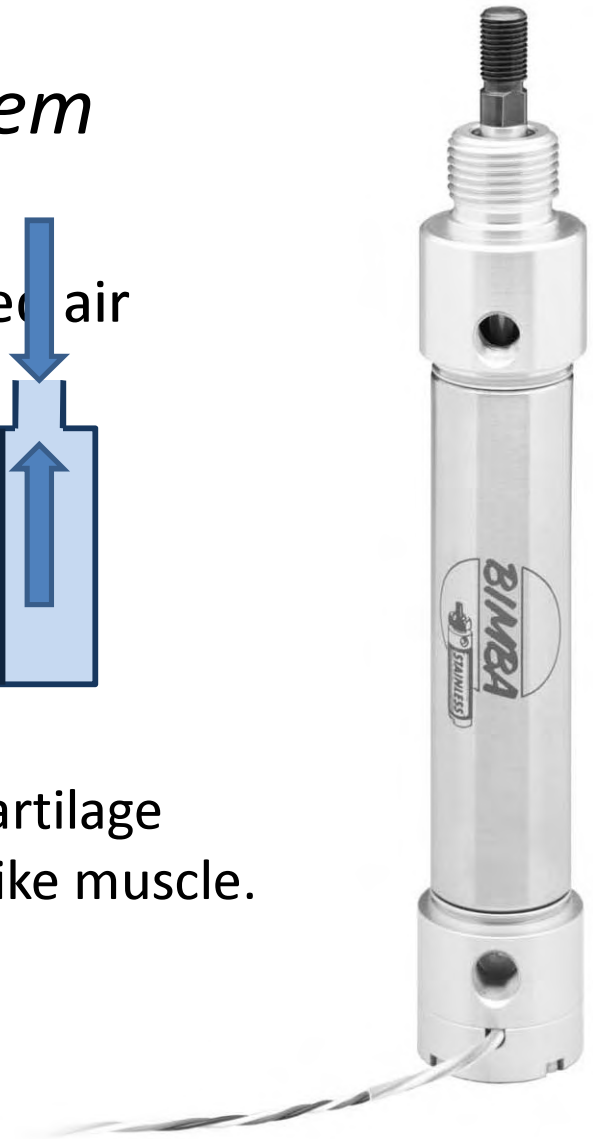
- Electric currents make piezoelectric materials change volume
  - Current on: muscles contract
  - Current off: muscles return to original shape
- The muscles would be stretched to their original positions by an elastic material

# Three Design Options

## *Option 2: Pneumatic Actuator System*



The actuators could be attached between the cartilage pieces, and then coated to make them look like muscle.





# Three Design Options

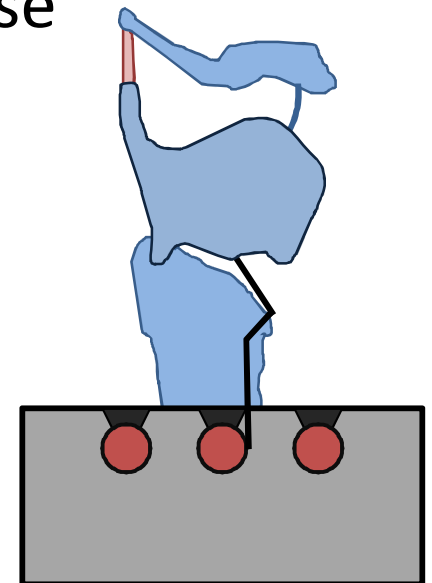


## *Option 3: Precision Motor System*

- Reversible motors have variable speed and direction
  - Allows precise, coordinated speed and movement
- 3 battery powered, reversible motors would be located at the base of the model in a box
- The muscles would be controlled by flexible wires connected to the motors.
  - Motor forward: muscle contracts
  - Motor reverse: elastic material pulls muscle to original position

# Model Construction

- The bone and cartilage will be made from plastic (polycarbonate)
  - The hyoid bone and trachea will be used as an attachment base
- An elastic material (natural rubber) will pull muscles back to their original positions when the motors are reversed
- The model will be mounted on a plastic box which holds the 3 motors and provides a stable base
- Wires run up through the trachea and into their respective muscles, hidden within the model cartilage
- The motor pulls the hinged thyroid forward, simulating the crycothyroid muscle



# The Matrix

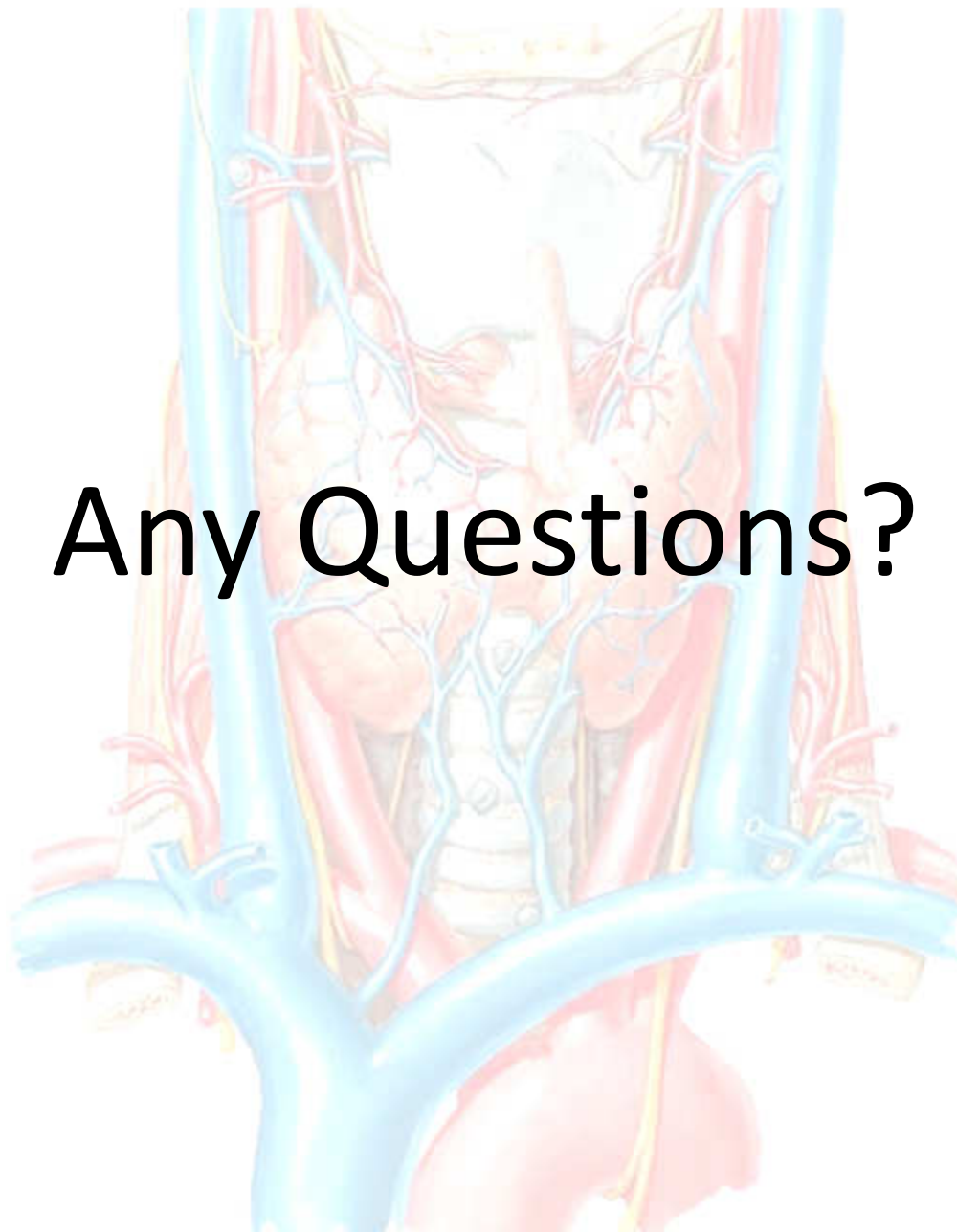
	<b>Realism</b> 0.3	<b>Feasibility</b> 0.3	<b>User Friendliness</b> 0.15	<b>Cost</b> 0.1	<b>Durability</b> 0.1	<b>Future Expandability</b> 0.1	<b>Total</b>
<b>Precision Motor</b>	4 1.2	5 1.5	4 0.6	5 0.5	4 0.4	5 0.5	4.45
<b>Pneumatic Actuator</b>	3 0.9	3 0.9	2 0.3	3 0.3	4 0.4	2 0.2	2.9
<b>Piezoelectric</b>	5 1.5	1 0.3	4 0.6	1 0.1	5 0.5	4 0.4	3.2

# Future Work

An anatomical illustration of the human torso, showing the skeletal structure, muscles, and a network of blue and red vessels or nerves. The illustration is semi-transparent, allowing the text to be overlaid on it.

- Construction
- Motor selection and programming
- Testing and implementation

**Any Questions?**



# References

- Pictures:

- [http://www.bimba.com/pdf/catalogs/FL\\_PCS.pdf](http://www.bimba.com/pdf/catalogs/FL_PCS.pdf)
- <http://facstaff.bloomu.edu/jhranitz/Courses/APHNT/Laboratory%20Pictures.htm>
- [http://64.14.24.41/product.asp\\_Q\\_pn\\_E\\_IG0013782\\_A\\_SOMSO%AE%3B+Comprehensive+Functional+Larynx+Model](http://64.14.24.41/product.asp_Q_pn_E_IG0013782_A_SOMSO%AE%3B+Comprehensive+Functional+Larynx+Model)
- <http://spiff.rit.edu/classes/phys301/lectures/age/age.html>
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- <http://www.pitt.edu/~anat/Head/Larynx/Larynx.htm>
- <http://apps.uwhealth.org/locations/detail.jsp?locationId=1>
- [http://www.modelflight.com.au/electric\\_motors\\_mega\\_brushless.htm](http://www.modelflight.com.au/electric_motors_mega_brushless.htm)
- <http://cst-www.nrl.navy.mil/lattice/struk/NiTi2.html>