Holonomic Videobronchoscope

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Many non-expert practitioners are called upon to place a breathing tube into the airway (endo-tracheal intubation). The skills needed to place an ETT require years of training with continued education and hours of continued practice annually \{Hawkins, 1995\}, the later of which is not easily attained. A study shows success rates of placing ETT is decreasing, especially in children, in the pre-hospital setting. Airway skills are not improving despite additional education and the initiation of extensive training programs. \{Diggs, 2014; Gausche, 2000\}. 
Project Overview

To build a self-driving, holonomic videobronchoscope that can place a breathing tube into a child, moving the tip of the bronchoscope automatically based on image recognition of airway anatomy that drives the bronchoscope into the airway. After the bronchoscope is in the airway, the breathing tube will advance ontop of the bronchoscope, intubating the patient. 2 innovative components:

1. Mechanical Engineering: To build a holonomic tip for the videobronchoscope.
2. Computer Program: To write a program where the computer recognizes airway anatomy and advances the bronchoscope to/around structures, stopping after getting to the carina in the lungs.
Standard Breathing Tube Placement
Intubation
Current Technology

Camera on the end of a laryngoscope (left) or on a flexible bronchoscope (below)
Current Flexible Bronchoscope

The flexible bronchoscope only flexes up and down (no side to side movement)
Holonomic Videobronchoscope

Computer to recognize image/drive bronchoscope

Motor

Holonomic tip bronchoscope

Disposable Component
Holonomic Videobronchoscope

- Mechanical Engineering
  - Develop a Holonomic Tip
    - Tip of the Videobronchoscope moves in every direction
Multi-Flex Videobronchoscope

- **Computer Programming**
- **Structure from motion**
  - Using fiberoptic imaging from patients all ages, we will “teach” the computer to advance/move around/to airway structures to perform endotracheal intubation.
- **Visual surveying, matching, and movement**
Advance midline
Anterior flex over uvula
Advance under Epiglottis
Advance between VC
Stop 2 cm above carina
Deliverables

- **Mechanical Engineer**
  - Draft of holonomic tip design
  - Prototype of holonomic videobronchoscope

- **Image recognition and movement computer program**
  - To write program where the computer recognizes the anatomic image and navigates to/around specific airway structures to complete intubation
Group Size

2 – 3 students for Mechanical and Computer components

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