Intub-Aid

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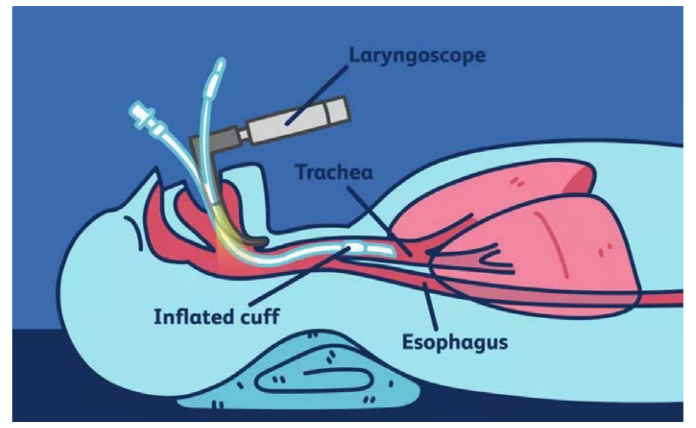
Introduction

Medical Background



- Endotracheal intubation establishes an airway for patients who cannot breathe.
- 13-20 million intubations performed every year in US. [4]

Problem

Intubation success rates **drop significantly** in out of hospital settings, leading to potential **airway trauma and inconsistent care.**

Needs Statement

We aim to develop a device that allows EMS to reliably and safely intubate patients suffering from respiratory complications outside of a hospital setting.

Current Challenges

Current Intubation Solutions

- Laryngoscope used first to align airway and position tongue
- Bag-valve-mask for manual ventilation
- ET tube for intubation
- ET tube stabilizer to hold tube position
- Optical stylet or videolaryngoscope to visualize trachea and ET tube placement
- X-ray or capnograph to confirm placement [1]

Intubation Challenges

- Patient's **head placement and size**
- Current equipment for intubation is often not **cohesive** (all in one) [2]

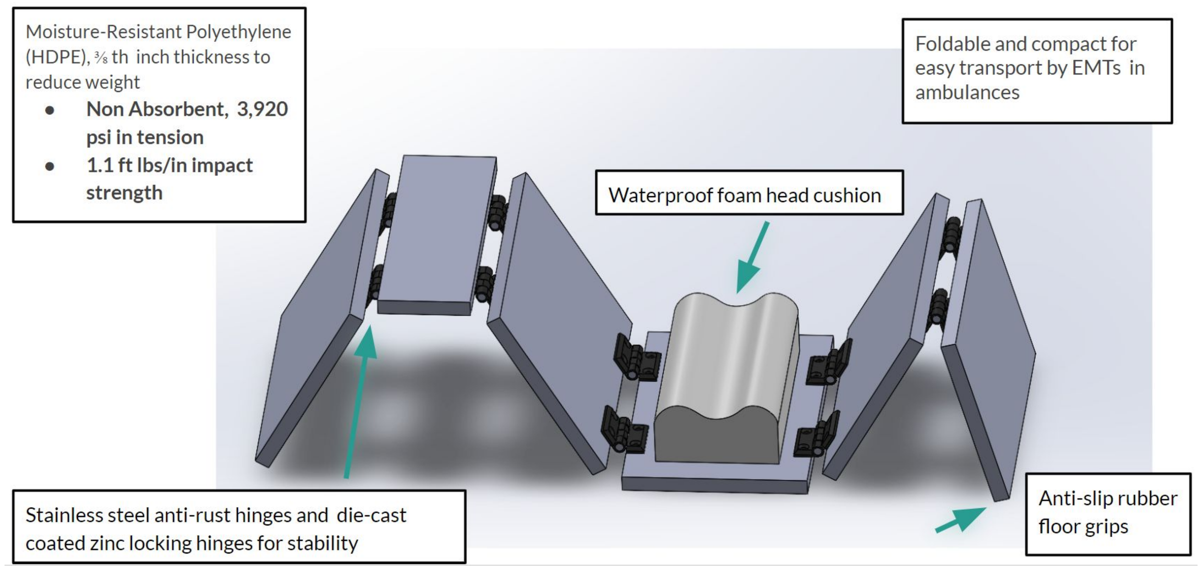
Proposed Solution

Head and Neck Positioning

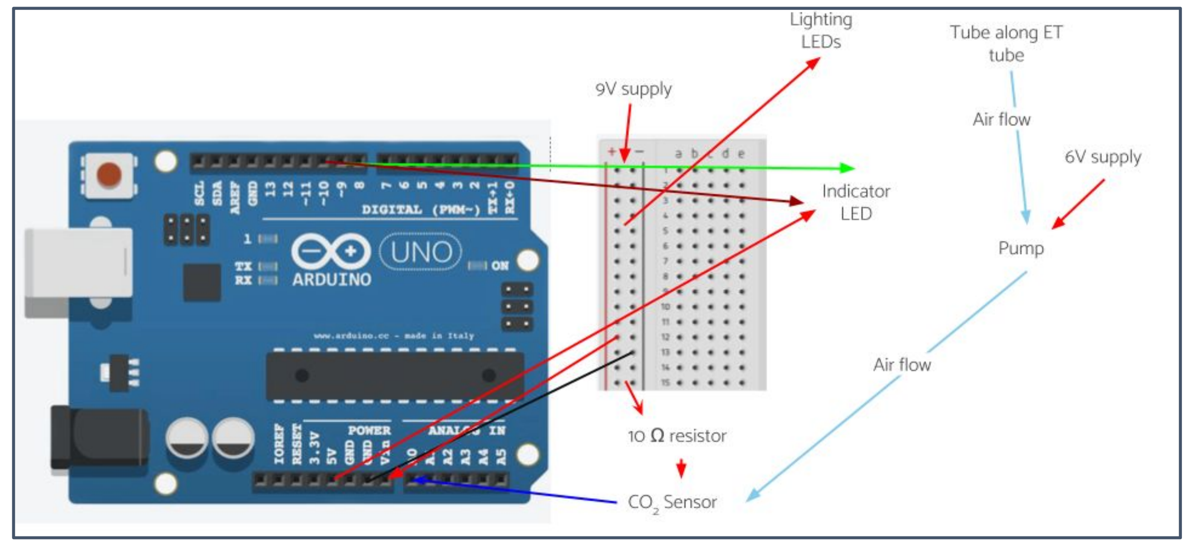
- Positions head and neck in the proper "sniffing" position for easy ET tube insertion
- Foldable body allows for easy transport by EMTs, compact storage in ambulances, and quick deployment

Carbon Dioxide Sensor for Placement Verification

- LED lights improve working visibility
- Use of CO_2 sensor allows user to differentiate between ET tube placement in the trachea and esophagus
- Arduino processes data collected by CO_2 sensor and turns on indicator light to alert user of ET tube placement
- Green signals proper placement in trachea, red signals improper placement in esophagus



Final headrest design includes a folding, compact body with a weight of 4.12 lbs. The unfolded design is 9 in by 19 in.

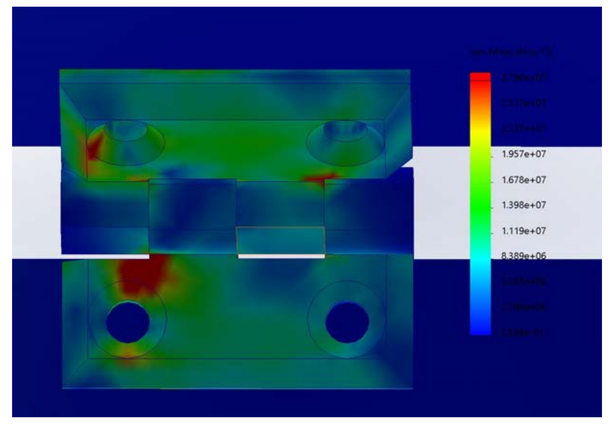


Electrical circuit design for CO2 sensor includes 9V supply voltage for in-line sensor and light. Separate 6V supply used for suction.

Testing and Verification

Headrest Design Integrity

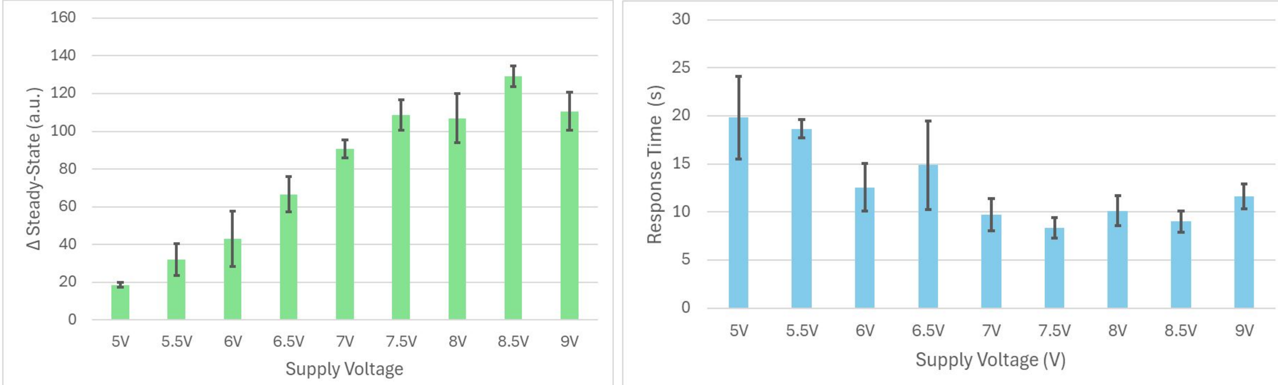
- Stress was concentrated in the hinges, with the highest value of 27.8 MPa between the hole and the outer seam of the hinge.
- Maximum stress is less than the ASME yield strength of die-cast zinc by a satisfactory FOS of 7.9



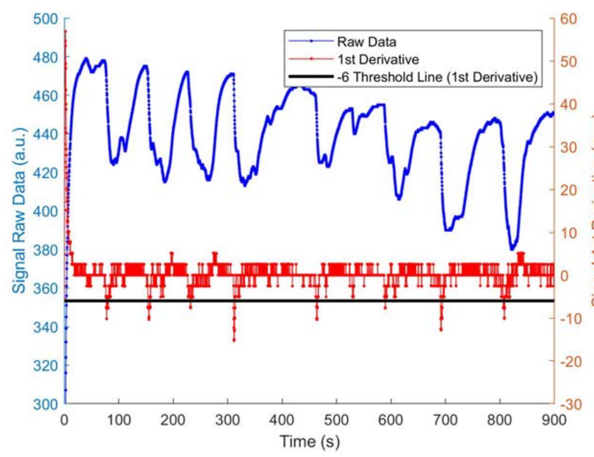
Prototype #3 FEA Analysis with Von Mises Stress (N/m^2) under loading conditions of average male body weight [3]

CO_2 sensor

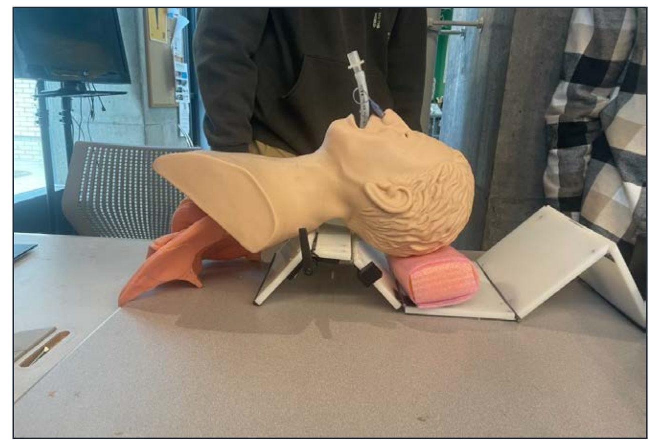
- Calibration - performed **voltage sweep** to determine **optimum operating voltage**
- Concluded a **9V voltage source** in parallel would correspond to best performance.
- Lead time reduction via first derivative algorithm.



Voltage sweep experiments for CO_2 sensor, includes optimization of a 9V battery power supply for binary CO_2 sensing.



Application of a 1st derivative algorithm on a breath experiment. Demonstrates a reduction in time to CO_2 threshold at 6 a.u.



Device puts intubation testing dummy in the proper "sniffing" position to consistently and successfully insert ET tube

Manufacturing Cost, Market Analysis, Patent, Reimbursement

Manufacturing Cost

The cost to produce 1 unit of this device is **$294.32**

Retail Information

Retail Price: **$500** → Gross profit of **$205.68** per unit

Patentability

Patentable claims include: Foldable design, electronics-embedded ET tube

Reimbursement

Our device will not be reimbursed by Medicare or Medicaid because the device is not to be purchased by patients.

Instead, hospitals and EMS stations will purchase this device separately as medical providers

Conclusions

This device provides a robust, compact, portable solution to assist emergency medical technicians and democratize care during out-of-hospital intubation procedures. This solution provides proper head, neck, and jaw positioning in addition to carbon dioxide detection for placement verification.

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References

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[3]https://docs.google.com/document/d/1lUxOWkNYIu0szqo_umFU6DCAMj-ETu1s6YVVKzFdXOs/edit

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