Surgical Neck Traction Device

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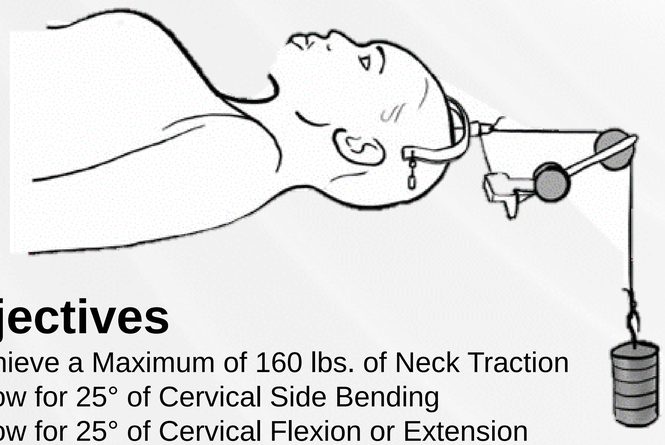
Introduction

Current neck traction devices rely on hanging weights from a patient's head over the edge of a surgery table. This requires a long and difficult setup with very imprecise forces being applied to the patient's neck. This is potentially dangerous, slow, and prone to accidents. Our team aims to create a robotic device with an intuitive user interface that will allow for quicker setup, a more compact footprint, and safer operation for the surgeon to use in the operating room.

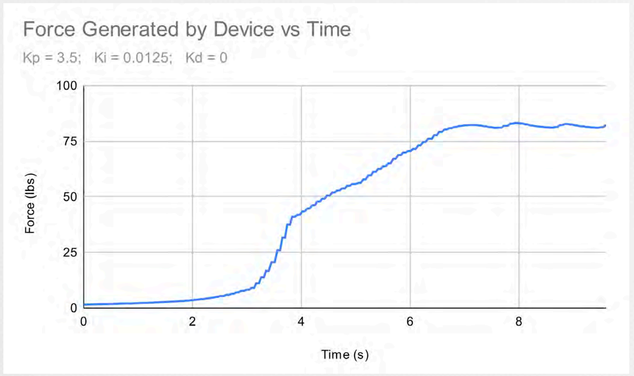


Objectives

- Achieve a Maximum of 160 lbs. of Neck Traction
- Allow for 25° of Cervical Side Bending
- Allow for 25° of Cervical Flexion or Extension
- Storage for Real Time Data Collection
- Increase Efficiency and Safety of Surgery
- Facilitate Quick Setup and Take Down
- Provide Simple and Intuitive Control User Interface
- Total Weight < 25 lbs. for Easy Transportation

PI Control

A PI control method is used to control the actuators from the screen. With Kp value of 3.5 and Ki value of 0.0125, the steady-state error is 0.11% from the desired force.



Design

User Control Interface

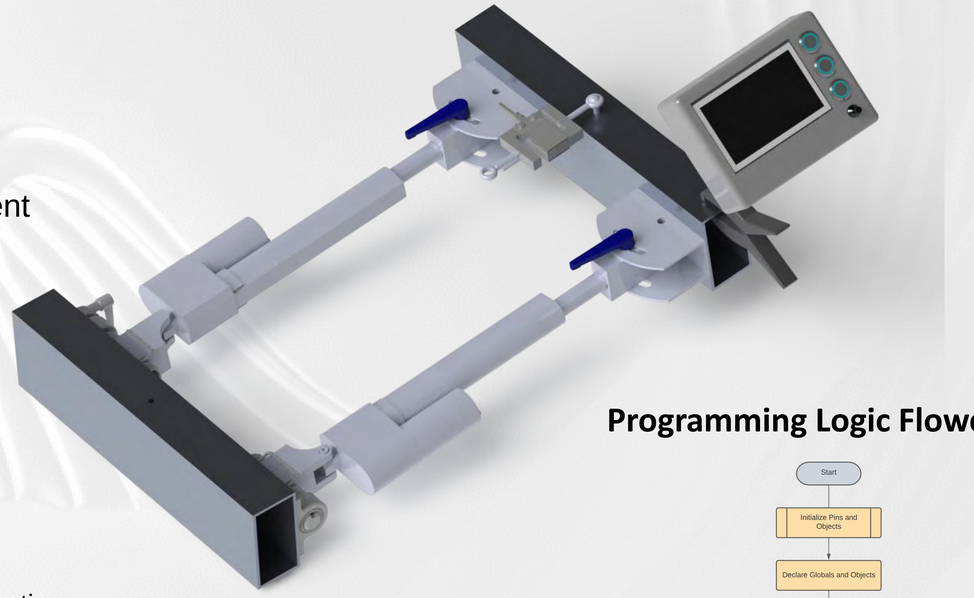
- 5" TFT LCD display
- Pushbuttons for menu navigation
- Rotary Encoder Dial for force adjustment

Structure

- Hinged joints for multi-axis articulation
- Full metal construction

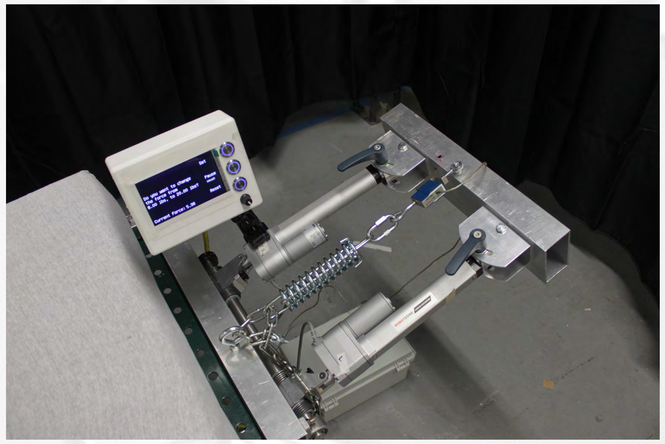
Force Application

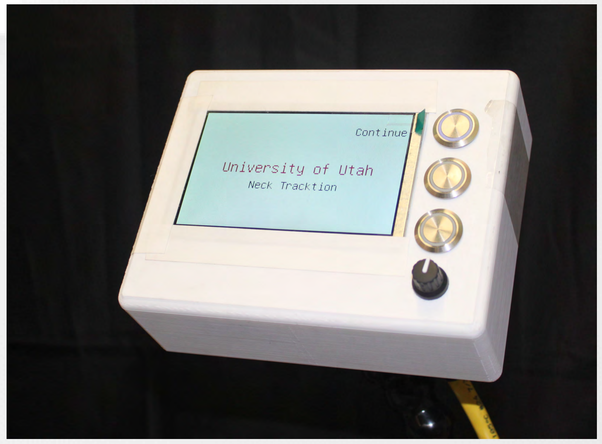
- Parallel linear actuators
- S-Beam Load cell
- PI Controller



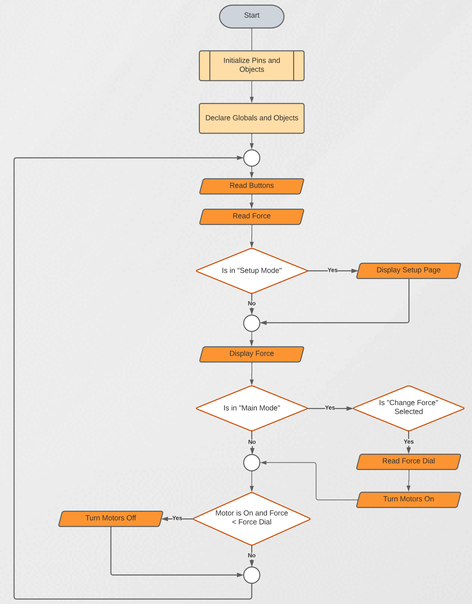
Testing

The functionality of the device was verified by load testing with a spring which simulates a human neck.





Programming Logic Flowchart



Results

Metric	Target	Achieved
Maximum Force Maximum force device can exert	150 lbs	200 lbs
Force Accurracy Precision of force robot can opperate under	1 lbs	1 lbs
Set Up Time Time to set up device for surgery	< 5 minutes	5 minutes
Cervical Flextion Maximum angle of flextion that robot can opperate at	25º	12º
Cervical Side Bending Maximum angle of flextion that robot can opperate at	25º	12º
Device Weight Weight of entire surgical device	< 25 lbs	20 lbs

Conclusion

The device enhances the safety and precision of neck traction by providing new, robotically assisted capabilities. The device can be used by surgeons to perform surgery with increased angles up to 12 degrees and finer control of the applied force compared to current methods.

Acknowledgements

Dr. Brandon Sherrod
Dr. Marcus Mazur
Daniel Waldram
Trever Schwehr

AO SPINE