End Effector Development for Endoscopic Laser-Assisted Polyp Removal

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Introduction

- Colorectal cancer is the second leading cause of cancer-related mortality in Canada [1].
- Early detection & excision of polyps is essential for reducing disease progression.

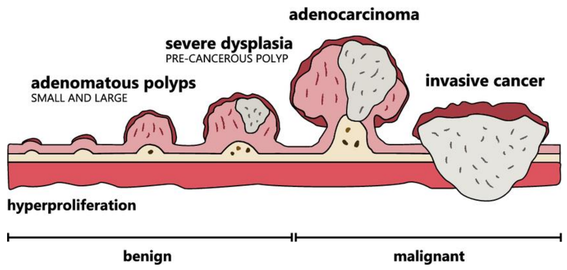


Figure 1. Benign to malignant progression of colorectal polyps [2].

- Conventional endoscopic polypectomy techniques are constrained by limited scanning speeds, which prolong procedural duration, and by cauterization methods that lead to colon tissue damage [3].
- Picosecond Infrared Laser (PIRL) incorporates ultrafast laser pulses to selectively disrupt tissue at the molecular level without inducing thermal or acoustic damage [4].

Objectives

Develop a **PIRL-integrated endoscopic device** that enhances the rate of colon polyp removal by incorporating a **high-speed scanning mechanism** for rapid polyp excision to improve **cutting precision** and **minimizing tissue damage**.

Methods & Materials

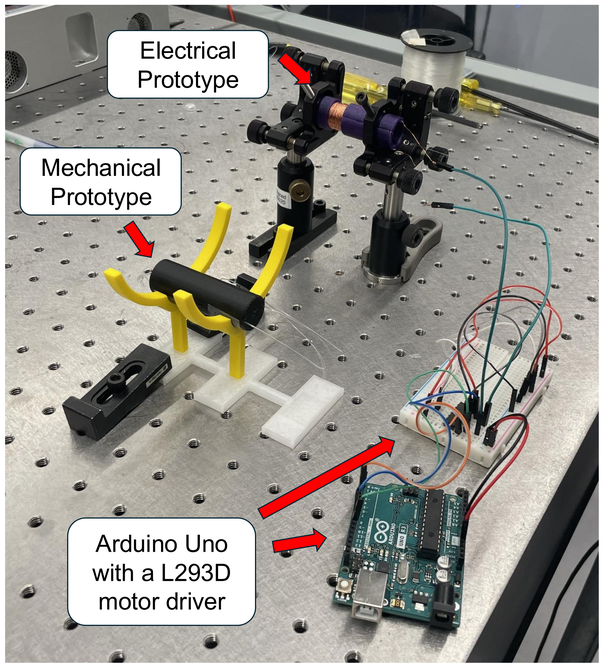
- Computer-aided design (CAD) used to develop endoscopic mechanism.
- 3D printing at a 10x scale of two distinct actuation mechanisms: a mechanical scanning approach and an Arduino controlled electronic system.

Results

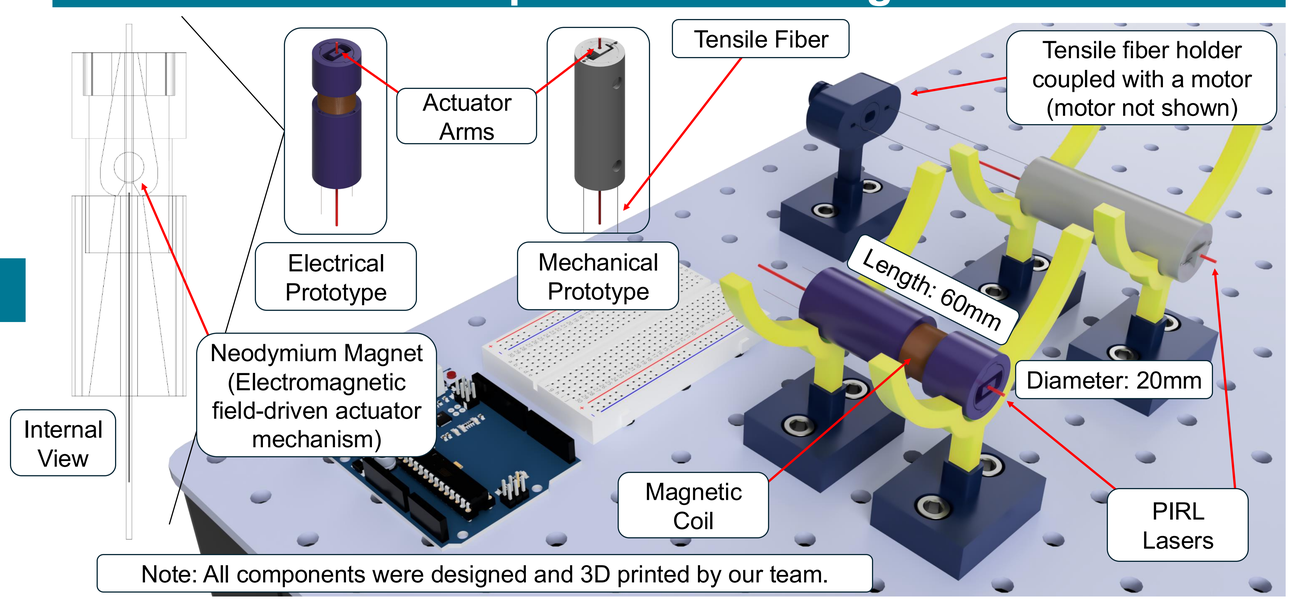
- Macroscale prototypes scan more rapidly yet exhibit smaller diameters, with potential for PIRL integration.

Design	Scanning Speed	Scanning Diameter
Current Clinical Standards	~1 Hz	~5 cm
Electrical Prototype	>15 Hz	1.5 cm
Mechanical Prototype	>15 Hz	1.5 cm

Laser Set Up



Computer-Aided Designs



Note: All components were designed and 3D printed by our team.

Conclusions

- Ongoing efforts focus on optimizing the apparatus using surrogate tissue testing and incorporating a tension-control mechanism to improve cutting rates.
- This research represents an early step towards a method of polyp removal that has the potential to reduce treatment times and improve patient outcomes.

References

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