Improving the Ergonomics of the Colonoscope

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I. Abstract

Colonoscopy is an important tool in the detection and prevention of colorectal cancer [1]. Colonoscopes are used for a wide variety of diagnostic and therapeutic purposes. They are primarily used for the detection precancerous polyps, colorectal cancer and other colonic pathologies.

In the largest survey-based study for endoscopic related injuries (ERI) in gastroenterologists, 71% of respondents reported an ERI. More than half of the respondents (63.3%) reported pain in thumb followed by hands/fingers (59%) [2].

The endoscopist uses the left thumb to turn angular dials to steer the endoscope's tip during the procedure. This thumb provides all the mechanical force to turn the colonoscopes tip and repeatedly exerts this force to negotiate colonic turns. The current design has not been altered significantly since its development [3].

The primary objective of this research is to make a more ergonomic design for the interaction interface of the colonoscope. This study will change the current interaction interface from dials to a directional pad. Feedback will then be obtained from endoscopists on the new design interface and its comfort and ergonomic performance.

The first phase of this study was the development of a directional pad (D-pad) to replace the angular wheels of the colonoscope. The D-pad will translate the up-down, left-right wheel functions directly into its counterpart buttons.

The colonoscope has bowden cables running along the shaft from the angular wheels to the tip of the scope. The rotational movement of the wheels translates to a linear motion of the cables which results in the tip deflection in one of four degrees of freedom.

The bowden cables were attached to a servo motor with a roational force of 21.5 kgf.cm. The motor weighs 60 g and achieves a maximum tip deflection of 70 degrees in 2.5 seconds, in one degree of freedom.

One motor controls the motion of the tip in one entire plane of motion and is responsible for tip deflection in either up/down or left/right movement. The new design uses two motors to replace the entire mechanical wheel system.

The motors are being controlled by an arduino uno microcontroller and a system of four push buttons which act as a D-pad. Fig. 1 shows the current interface and tip deflection.

In the second phase of the study the new design will be evaluated by endoscopists. Feedback on the new interface will be obtained and ergonomic stress measured with validated scales.

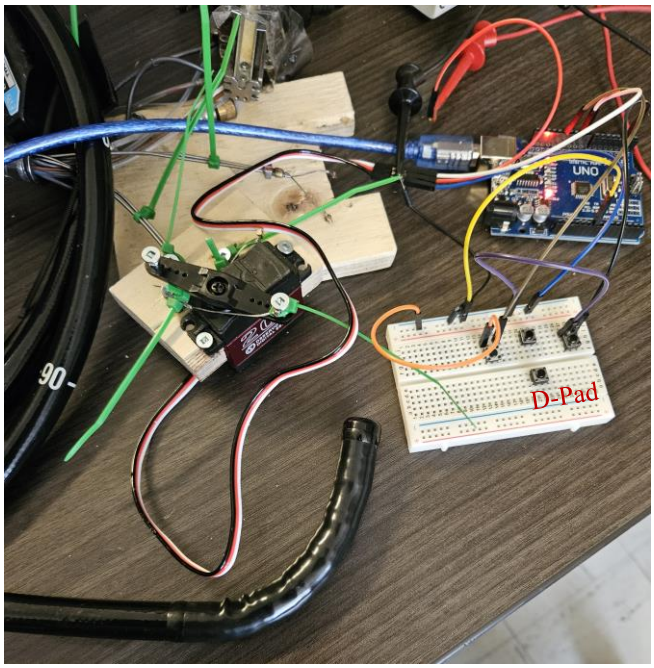

Fig. 1: Current design interface and tip deflection of scope

References

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