

Thesis Portfolio

Improving the Ergonomics of the Modern GI Endoscope
(Technical Report)

Infrastructures and Public Trust of Chinese Telemedicine
(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science
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Bachelor of Science, School of Engineering

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Thesis Prospectus

Sociotechnical Synthesis

Technical Thesis:

In the US, a minimum of 19 million colonoscopies are conducted annually as the primary diagnostic tool to identify otherwise undetectable gastrointestinal pathologies. However, with a high case load of up to 22 procedures per week, 89% of practicing gastroenterologists report related musculoskeletal overuse injuries, with 28% of the physician population citing left thumb pain as a result of their work. Therefore, advancements to the ergonomics of the modern colonoscope are required to ameliorate the risk of developing musculoskeletal overuse injuries, such as De Quervain's Tenosynovitis. Therefore, the aim of this study is to develop a mechanical solution that mitigates the three primary risk factors associated with daily endoscope usage: exertion magnitude, frequency, and duration. After performing a Pugh Analysis, we chose and pursued a medical device solution that centered around a dial-locking mechanism. Our design incorporates an overarching handle-based housing that interfaces a pair of dial masks with a bidirectional ratcheting mechanism. Static stress analysis identified failure points within the interface of the ratchet with the dial masks at the pawls of the ratchet and at the interface between the mask and the dials. Ultimately, electromyography and tactile force tests measured a $79.5\% \pm 1.5\%$ ($p = 0.002$) decrease in muscle activation and a $50.4\% \pm 9.2\%$ ($p = 0.005$) decrease in forces imparted on the left thumb during 90° of dial rotation. Our results validate the efficacy of our device and motivate further pursuit in improving ergonomics in endoscopy.

STS Thesis:

Under the Healthy China 2030 initiative, the development of Chinese telemedicine has been pushed to the forefront of development. Within a span of few years, the field of telemedicine has transformed itself into a major industry ready to bloom. To gain a deeper understanding of the status quo of the infrastructures and social forces in play in Chinese telemedicine, I conducted a thorough socio-technical analysis using the Social Construction of Technology (SCOT) STS framework. Additionally, a survey was conducted with Zhejiang University students to gauge the public perception and trust of Chinese telemedicine. Combining the perspectives gained from the infrastructure and public trust analyses, I conducted a case study on the social factors that helped Ping An Good Doctor, China's largest telemedicine platform, achieve its success. Results show that the development of Chinese telemedicine has been a coordinated effort with many relevant stakeholders and led by the Chinese government. The Chinese students who responded to the survey exhibit a general optimism and trusting sentiments to the future development of the technology. Ultimately, Ping An Good Doctor was able to capitalize on the social conditions and create a favorable ecosystem, consisting of major stakeholders and technology development, to achieve its success today. The findings from this analysis will serve to deepen the current understanding of the social construction of telemedicine in China, which can provide valuable lessons for other countries to learn.

The technical and STS theses are not related.