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BACKGROUND

THE SPECULUM

- Medical device that allows healthcare providers to see inside the vaginal canal
- Enables the detection of cervical cancer, HPV, endometriosis, etc.

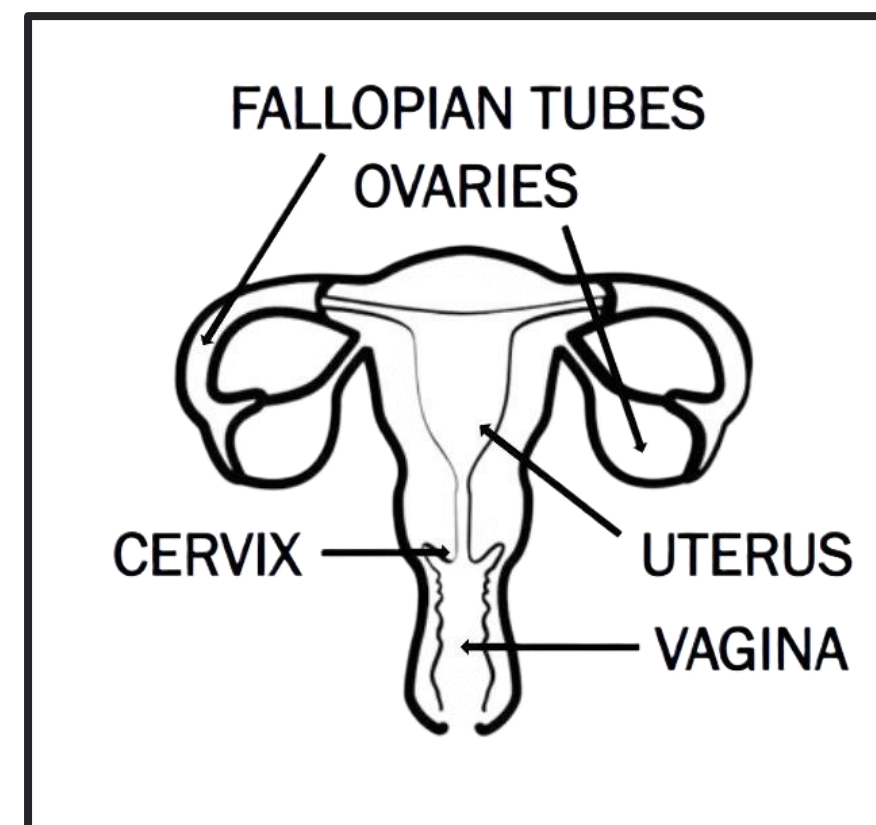


Figure 1: Labeled diagram of the vagina

VALUE PROPOSITION

- Cervical exams are essential for women's health but often cause discomfort and anxiety
- The standard single-use speculum contributes to this with its noisy operation and jarring movements
- The goal of our project is to design a new opening mechanism, to provide a quieter and smoother experience for both patients and healthcare providers*

KEY REQUIREMENTS

STANDARD SINGLE-USE SPECULUM	UPDATED SPRING-PIN DESIGN SPECULUM
Noisy Operation	Silent Operation
Rigid Opening	Smooth Opening
Easy-use For Healthcare Providers	Maintain Functionality
Force And Opening Capabilities Optimized	Maintain Necessary Medical Specifications

CONCEPT DEVELOPMENT



Figure 2: Hook Design



Figure 3: Spring-Pin Design

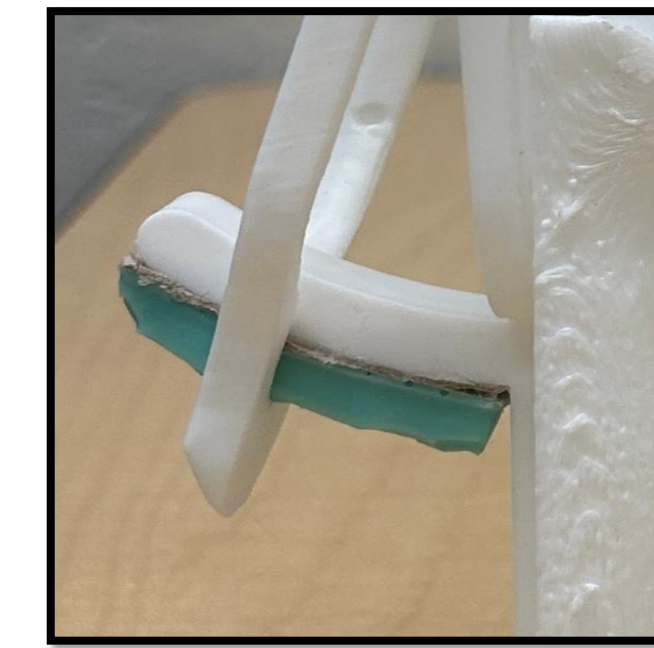


Figure 4: Silicone Design

- Our team followed a cycle of testing, CAD work, and 3D-Printed prototypes to refine our design
- Continuous client approval at each milestone

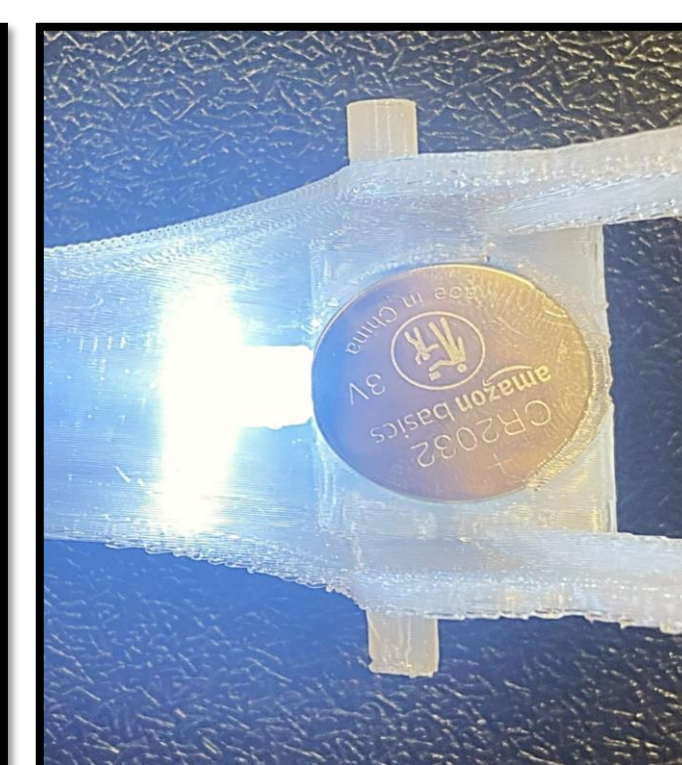


Figure 5: Light Fixture Design with and without LED and battery

LIGHT FEATURE

- Battery cavity with LED attachment is included
- Minimal material and cost impact
- Single-use and easy on

FINAL DESIGN

SPRING-PIN DESIGN

- SLA/Resin print
- Spring locking mechanism
- 100 degree angled, finger-gripped base
- Light feature included

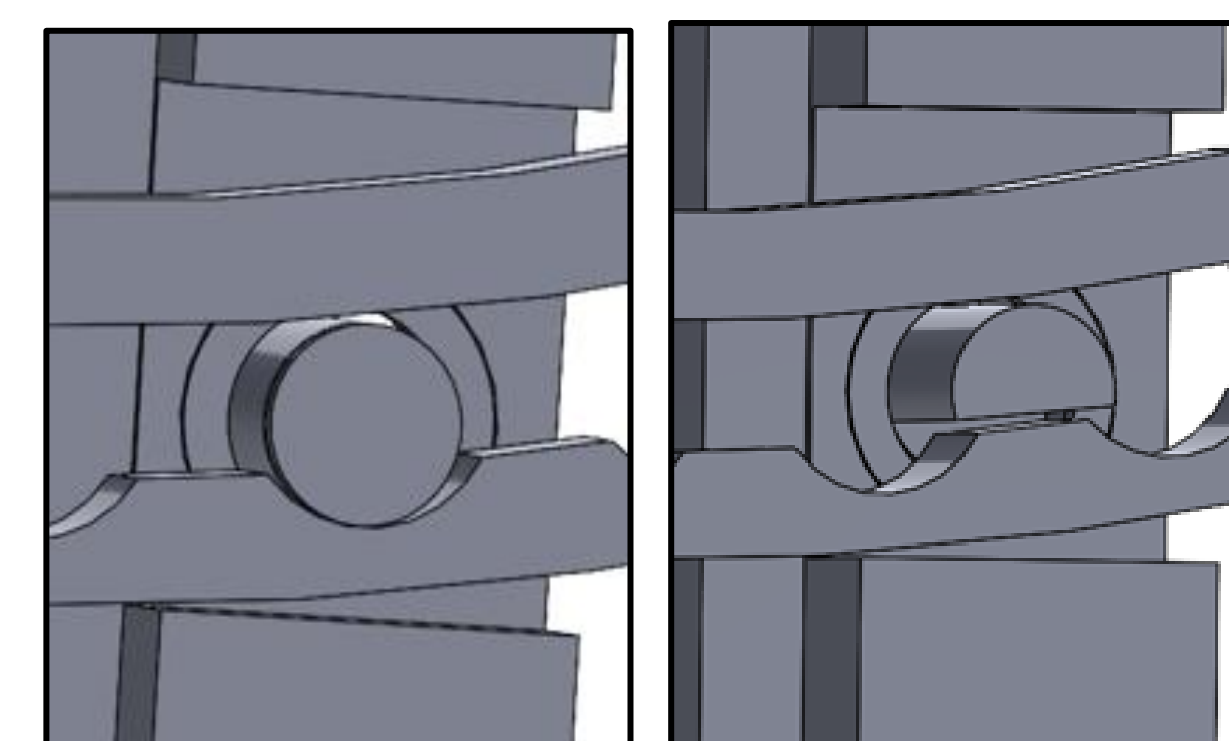


Figure 6: Section view of spring locking mechanism: locked (left) and unlocked (right)



Figure 7: Spring-Pin Speculum

VALIDATION

FORCE TESTING

- Used Arduino software and constructed test fixture to obtain force data
- 3-5N force needed

Table 1 : Average force production

	Standard	Spring-Pin
Opening Distance	49 mm	55 mm
Force	3.7 N	4 N

Table 2 : Average dB reading from sound testing

Standard	Spring-Pin
64.9 dB	42.7 dB

SOUND TESTING

- Used sound meter to compare average sound levels

Table 3: Average survey ratings for key requirements

	Standard	Spring-Pin
Easy Use	2.8	8.3
Noise	3	9
Overall	4	7.9

SURVEY ANALYSIS

- Medical students provided feedback of the design criteria for each model on a 1-10 scale

CONCLUSIONS

- The Spring-Pin Speculum is 65% quieter, 196% easier to use, and overall preferred by 79% of survey respondents over the standard speculum, while maintaining the necessary force and functionality.



2025 Capstone Project