The Knotorious Five

October 17th - October 23rd

Client: Dr. Margene Anderson, Dr. Sara Colopy. Dr. Paul Merkatoris
Advisor: Professor Wally Block

Team Members:
Madison Michels (mmichels2@wisc.edu), Leader
Lucy Hockerman (lhockerman@wisc.edu), Communicator
Presley Hansen (pmhansen3@wisc.edu), BWIG
Sadie Rowe (skrowe2@wisc.edu), BPAG
Kate Hiller (khiller@wisc.edu), BSAC

Problem Statement:

In veterinary training, mastering the skill of applying appropriate suture tension is essential for successful wound closure and patient recovery, However, novice practitioners often struggle to judge the correct amount of force needed, leading to either insufficient tension or excessive tension, which can cause plastic deformation of the suture material or tissue damage. Currently, the evaluation of suture technique relies heavily upon subjective instructor feedback, lacking objective, real-time metrics to guide learners. This gap hinders consistent skill development and increases the risk of procedural errors. There is a critical need for a real-time suture tension measurement and feedback system to help students learn to apply optimal tension, prevent material or tissue compromise, and improve surgical outcomes through data-driven training.

Brief Status Update:

This week, the team continued to work on our individual prototypes. Presley and Kate calibrated the force resistor circuit using a scale and known weights applied. Sadie, Lucy, and Maddie met with the clients about knot classifications and validation of suture images.

Team Goals:

- In the upcoming week, the team plans to continue to develop our solutions and explore potential models and digitalization of the FSR circuit.

Individual Accomplishments:

- Lucy: This week I met with the clients to gather more suture materials and further discussed tight vs loose knot characteristics. Additionally, I tied 100 knots (50 loose and 50 tight) to photograph and classify for our data set.

- Presley: This week I worked with Kate to calibrate the FSR circuit. We used a scale to measure the force we placed on the force resistor while also collecting ADC and resistor values. We made a graph that compared force and voltage outputs and used an exponential equation that will be integrated into Arduino code to output force when a user applies force on the FSR.
- Maddie: This week I met with the clients to determine the qualities of a tight vs. loose knot. The client clarified that a tight knot is classified when the top of the knot is flush with the bottom of the knot. I also tied about 100 knots (50 loose and 50 tight) to start creating the image dataset we plan to train our model on.
- Sadie: This week, I met with the clients to further understand what visual qualities differentiate a tight knot from a loose one. From this meeting, we collected additional suturing practice materials. I tied 100 knots (50 loose and 50 tight) to photograph and be used in the image dataset for training purposes
- Kate: This week, I worked with Presley to further develop the force sensor resistor circuit. We figured out how to calibrate the FSR using a balance and collected data to create a calibration curve. We decided to use Force vs. Voltage and created an exponential equation that was integrated into Arduino code to output force when a user applies force on the FSR.

Individual Struggles:

- Lucy: No struggles this week.
- Presley: I struggled to calibrate force values above 600g which is where the scale maxes out. We wanted values up to 2000 g because that is the maximum that the FSR can read.
- Maddie: I had no struggles this week.
- Sadie: No struggles this week.
- Kate: I am struggling with calibrating the FSR as it is very difficult to place a centralized weight on the FSR that it will read and be heavy enough. I am struggling with seeing how this circuit is going to be an accurate measurement as a final prototype.

Individual Goals:

- Lucy: My goal for next week is to work with Sadie and Maddie to photograph the 300 knots we collectively tied and confirm their classification with the clients. Also, prepare for show and tell with the team by discussing aspects of our ideas/prototypes we want advice on.
- Presley: My goal for next week is to work with Kate to add a visual cue to the circuit (a green LED that will light up when enough force is applied) and ensure that the code is functioning properly. I would also like to determine which force value to use that will cause the LED light to turn on.
- Maddie: My goal for next week is to take images of the knots I have tied and run them in the model I created last week.

- Sadie: Next week, I plan to photograph the 300 knots Lucy, Maddie, and I tied and confirmed their classification (tight vs. loose) with the client prior to training on the ML model.
- Kate: Next, I would like to continue working on digitizing the circuit to provide real-time feedback and figure out how to further calibrate it to be more accurate with heavier weights. I would like to complete the circuit for show and tell next week.

Project Timeline:

Week	Description	Status
9/5 - 9/11 Week 1	Initial research	Complete
	Client Meeting 1	Complete
	Team Meeting 1	Complete 9/12
	Advisor Meeting 1	Advisor did not attend
9/12 - 9/18 Week 2	Product Design Specifications	Due 9/16
	Team Meeting 2	Complete 9/18
9/19 - 9/25 Week 3	Design Matrix	Due 9/25
	Team Meeting 3	Complete 9/22 Complete 9/24
	Advisor Meeting 2	Complete 9/19
	Meeting with Dr. Numinkar	Complete 9/24
9/26 - 10/2 Week 4	Client Meeting 3	Complete 9/26
	Team Meeting 4	Complete 9/29 and 10/1
	Preliminary Presentation Review	Complete 10/1
10/3 - 10/9 Week 5	Preliminary Presentation	Complete 10/3 at 12:35 PM
	Preliminary Report	**Due 10/8**
10/10 - 10/16 Week 6	Advisor Meeting 3	Scheduled for 10/10
	Team Meeting 5	Scheduled for 10/10
~~10/17 - 10/23~~	Advisor Meeting 3	Scheduled for 10/17

Week 7	Team Meeting 5	Scheduled for 10/17
	Force Sensor Resistor Value Testing and Research	Goal by 10/17
	Calibrate Sensor	Goal by 10/17
	Determine Output Force Equation	Goal by 10/17
	MTS Testing	Goal by 10/17
10/24 - 10/30 Week 8	Advisor Meeting 4	Scheduled for 10/24
	Team Meeting 6	Scheduled for 10/24
	Digitalize Circuit	Goal by 10/24
	RoboFlow Model	Goal by 10/24
	MTS Data Analysis	Goal by 10/24
	Python Model	Goal by 10/24
10/31 - 11/7 Week 9	**Show and Tell**	**Due 10/31**
	Team Meeting 7	Scheduled for 10/29
11/8 - 11/14 Week 10	Advisor Meeting 5	Scheduled for 11/08
	Team Meeting 8	Scheduled for 11/08
11/15 - 11/21 Week 11	Advisor Meeting 6	Scheduled for 11/15
	Team Meeting 9	Scheduled for 11/15
Thanksgiving Break 11/22 - 11/28		
11/29 - 12/5 Week 13	**Final Presentation**	**Due 12/05**
12/6 - 12/12 Week 14	**Final Report**	**Due 12/10**
	Advisor Meeting 7	Scheduled for 12/6
	Team Meeting 10	Scheduled for 12/6
12/13 - 12/18 Week 15	Advisor Meeting 8	Scheduled for 12/13

	Team Meeting 11	Scheduled for 12/13
Winter Break		

Expenses

Item	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	QTY	Cost Each	Total	Link
Force Sensor Resistor	Force sensor that outputs resistance in a voltage divider circuit (2 in pack)	Haosie?	N/A	Amazon Prime	N/A	10/1	1	$7.59	$7.59	Link