The Knotorious Five

November 14th - November 20th

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
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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 evaluated multiple different knot identification models, including Roboflow, ResNet, and VGG. We created new knot images for testing purposes and recorded confidence and accuracy scores for each model.

Team Goals:

- In the upcoming week, the team plans to decide on the best knot identification model, complete necessary testing, and begin final deliverables.

Individual Accomplishments:

- Lucy: This week, I met with the team to set-up and run python code to evaluate VGG/Resnet models. Additionally, I took photos for a new image testing set, recorded confidence and accuracy scores for the roboflow classification model, and began creating templates for final deliverable data visuals.

- Presley: This week, I met with the team to set-up and run python code to evaluate VGG/Resnet models. I was able to successfully run Pytorch on my computer, and I analyzed a testing dataset of 40 loose and 40 tight knots on my side view only model. The data outputted tight or loose knot predictions along with confidence levels, which was saved in the lab notebook. I also discussed final poster presentation plans with the team.
- Maddie: This week, I met with the team to help everyone run through the Python code that trains our ResNet and VGG models. I also ran my own models with side and top knot images and selected the best one for further testing. Using new testing images, I ran through the model and created a csv with the images, their predictions, and their confidences.
- Sadie: This week, I met with the team to run our Python code for training the ResNet and VGG models on the full image set, and I recorded the resulting accuracy metrics. I also returned to Roboflow and used our suture knot dataset to train a new classification model on the 304 tight and loose images, which expanded to 730 images after augmentation and reached an accuracy of 93.3%. In addition, I annotated each image to create a second model designed to locate the bulk of a knot in each image and crop to that region. I then built a Roboflow workflow that combines both models to identify, crop, and classify the knots, and I used the new testing images to generate a CSV containing each image along with its predicted label and confidence score.
- Kate: This week, I met with the team to run through the Python code with the VGG and ResNet models. I ended up not being able to successfully run Pytorch on my computer, so I was unable to run the models. I also created a test dataset for testing by taking 80 pictures total of sutures, tight and loose, and edited them to be ready for use. I brainstormed with the team on how we are going to talk about our project for the poster presentation and testing for our project.

Individual Struggles:

- Lucy: As a macbook user, I struggled with my kernel not running the VGG and ResNet models. For large datasets, I am unable to consistently run the model on my current macOS system.
- Presley: The model I was running is pretty effective for tight knots, however, it struggles more with the loose knots. I am unsure of how to make this model more accurate.
- Maddie: I am struggling to find ways that optimize our Python models. They seem to be performing mediocre, but I am unsure of the tools and hyper parameters to fine tune them.
- Sadie: I am struggling to implement the Roboflow model in Python to obtain more detailed performance metrics. I am also having a difficult time achieving the desired model accuracy with limited coding knowledge.

- Kate: I struggled with getting PyTorch to work on my computer when running the Python models. My computer was having trouble with paths. I tried uninstalling softwares and writing additional code to fix it, but I was unsuccessful.

Individual Goals:

- Lucy: My goal next week is to begin final deliverables and assist in any additional testing that is necessary.
- Presley: My goal next week is to analyze testing results and work on my portion of the final deliverables.
- Maddie: My goal next week is to synthesize outcome testing results and finish the final presentation slides.
- Sadie: My goal next week is to determine which model to move forward with based on testing results and complete final deliverables.
- Kate: My goal for next week is to work on the poster presentation and decide which model we will move forward with.

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	Complete 10/1

	Review	
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 Week 7	Advisor Meeting 3	Scheduled for 10/17
	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
	Add Visual Queue to 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 - 11/6 Week 9	**Show and Tell**	**Due 10/31**
	Team Meeting 7	Scheduled for 10/31
11/7 - 11/14 Week 10	Advisor Meeting 5	Scheduled for 11/07
	Team Meeting 8	Scheduled for 11/07
	Team Meeting 9	Scheduled for 11/12
11/14 - 11/20 Week 11	Advisor Meeting 6	Scheduled for 11/14
	Team Meeting 10	Scheduled for 11/14

	Team Meeting 11	Scheduled for 11/19
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 12	Scheduled for 12/6
12/13 - 12/18 Week 15	Advisor Meeting 8	Scheduled for 12/13
	Team Meeting 13	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