The Knotorious Five

February 26 - March 5

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 started our pi up and began attempting to upload the model to it. We also went through refinement and investigational checks in our previous model performance. The team was able to connect our laptops to the pi, download Python 3.9.13, create a virtual environment, and create a website infrastructure for running our algorithm.

Team Goals:

Next week, the team hopes to complete the pi code necessary to capture an image of a suture and upload it onto the model website. We also hope to create an open source website for our model to run on.

Individual Accomplishments:

- Lucy: This week, I met with the meet twice in the makerspace to get assistance starting up the pi including downgrading the python version on our pi environment and transferring our model onto the system. I wrote notes and documented code the team can refer back to to replicate this process.
- Presley: This week I went with the team to the Makerspace two times to get some assistance with downloading an earlier version of python and working through some error messages when trying to upload the model to the raspberry pi. I also worked on getting the HQ camera attached to the board and getting it set up through code in the terminal. I set up a meeting with a comp sci student to hopefully discuss a new plan for our model implementation.
- Maddie: This week I filtered through our images without the clear sutures. While removing the background of our training dataset images, I noticed it struggled with the clear sutures. I created data for and trained a model to identify white vs. black pixels in the center of images to use as a preliminary model for our pi testing. I also set up a website interface to use with our model that allows us to run our model in a format that would better integrate with the pi module. This will ideally become open-source to allow for other users to utilize the model without the file on their computers. I was able to upload the correct Python and PyTorch modules onto the pi environment, but had troubles uploading the model onto the pi. Lastly, I created heat maps of last semester's model output images to identify where our model is looking in the pictures to make its prediction.
- Sadie: This week, I worked with the team and makerspace staff to get help setting up the Raspberry Pi. We were able to work through updating the Python version, but ran into significant issues when trying to upload the model. The team re-installed the OS and is working to connect the camera and ensure its functionality before moving forward. After discussions with Makerspace staff, we will need to find a workaround for model implementation – using a laptop as an intermediate step to run the model and the Raspberry Pi as computing power for the user interface (taking pictures and providing feedback).
- Kate: This week, I focused on trying to set up the Raspberry Pi and camera. We were able to load the OS and update Python to the correct version. However, we ran into issues with Torch and its weights. I am having trouble figuring out where the Pi is saving things and where it is pulling from. We met with maker space employees twice this week, and we have decided to pivot and just get the camera working with the Pi and LEDs. I documented our progress and coding in LabArchives for future reference.

Individual Struggles:

- Lucy: I, and the team, struggled with uploading the model on raspberry pi.
- Presley: I struggled to get the model uploaded to the raspberry pi and also getting the board to recognize the HQ camera.
- Maddie: I struggled to upload the model onto the pi due to infrastructure discrepancies and pi capabilities.
- Sadie: I am struggling to make progress with the Raspberry Pi given limited coding knowledge and am having difficulty finding resources for our specific need/application.
- Kate:I am struggling with getting the ML model onto the Pi. The makerspace staff told us they weren't sure it was possible, but online, it has worked for people. I am also having trouble getting the camera to connect to the Pi.

Individual Goals:

- Lucy: My goals next week are to meet with compsci students and additional experts on raspberry pi to resolve our errors. Also, begin the housing unit by developing a sketch with dimensions for a future CAD model.
- Presley: My goal next week is to get the Raspberry Pi to recognize the HQ camera and be able to take photos.
- Maddie: My goal next week is to finish making the website interface that will send data to the pi and to upload our module onto the pi with the camera integrated.
- Sadie: Next week, my main goal is to get the camera working on the Pi and ideally find a resource/person who can help us understand if it's possible to run the model locally on the Pi. If materials come in time, I will also tie additional knots (with dark suture material) to rebuild the dataset after deleting clear knot images.
- Kate: I would like to get the camera and circuit system working with the Pi. Also, I want to tie more knots to beef up our dataset.

Project Timeline:

Week	Description	Date	Status
1/22 - 1/29 Week 1	Team Meeting 1	1/26	Completed
	Advisor Meeting 1	1/23	Canceled
1/30 - 2/5 Week 1	Team Meeting 2	2/4	Completed
	Advisor Meeting 2	1/30	Completed
2/6 - 2/12 Week 3	Preliminary Presentations	2/6	Completed

	Team Meeting 3	2/9	Completed
	Advisor Meeting 3	2/13	Completed
	Order Raspberry Pi Camera and Board	2/13	Completed
2/13 - 2/19 Week 4	Images Augmented	2/16	Completed
	K-Fold Cross Validation	2/18	Completed
	Receive Materials	2/18	Completed
	Model Trained	2/20	Failed
	Team Meeting 4	2/18	Completed
	Advisor Meeting 4	2/20	Completed
2/20 - 2/26 Week 5	Preliminary Deliverables	2/25	Completed
	Upload Model onto Pi	2/20	In progress
	Team Meeting 5	2/23	Completed
	Advisor Meeting 5	2/27	Scheduled
2/27 - 3/6 Week 6	Submit Patent to WARF or IDR	3/6	Undecided
	Team Meeting 6	3/4	Complete
	Advisor Meeting 6	3/6	Scheduled
3/7 - 3/13 Week 7			
3/13 - 3/19			

Week 8			
3/20 - 3/26 Week 9	**Show and Tell**	**3/20**	Not Started
3/27 - 4/2 Week 10	Select Design Award	4/1	Not Started
	Executive Summary (Draft)	4/1	Not Started
4/2 - 4/8 Week 11			
4/9 - 4/15 Week 13			
4/16 - 4/22 Week 14	**Executive Summary**	4/17	Not Started
4/23 - 4/29 Week 15	Final Pressentations	4/24	Not Started
4/30 - 5/5 Week 16			
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
Raspberry Pi Kit	Contains: Raspberry Pi 5 8GB, 27W power supply, active cooler, 64 GB SD card, card reader, 4K Mico HD out cables, and case	Vemico	B0D2WYFS23			2/8/2026	1	$173.99	$173.99	Link
Arducam IMX477 Pi HQ Camera	HQ Camera + CS 6mm lens	Arducam	B024002			2/8/2026	1	$67.99	$67.99	Link
									TOTAL: $249.57	