The Knotorious Five

February 20 - February 26

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 ordered and received our Raspberry Pi materials. We assembled the Pi board and case. Our original dataset was increased, augmented, and K-fold cross validation was performed using the augmented images. We met with Dr. Adamczyk to discuss our use of Raspberry Pi and our plan to implement it into the project's final user interface design. Lastly, the second model was trained on the augmented images.

Team Goals:

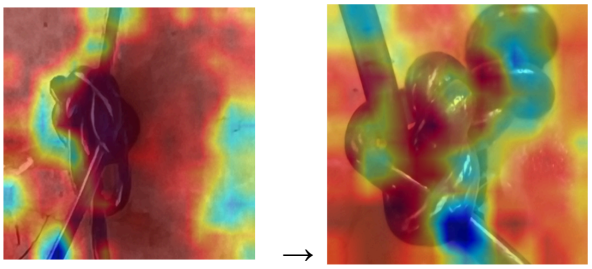
Next week, the team hopes to upload the new model onto the Pi board and create a circuit that integrates the LEDs, button, and camera. We also plan to complete our preliminary report and ensure the camera is capturing the correct field of view for this application.

Individual Accomplishments:

- Lucy: This week, I met with the team to discuss and complete our method outline for our future research project paper. I also researched differences between TensorFlow and TensorLite because I found a pre-trained temporary model online to use in piloting raspberry pi implementation. I am currently trying to get the model to run successfully on my device before the team works on implementing it into our RaspberryPi.
- Presley: This week I met with the team to get the Raspberry Pi set up. I worked on the code for downloading necessary packages and setting up a virtual environment.
- Maddie: This week I figured out how to remove the background from the suture images. The mask seems to struggle with the clear sutures because they blend in too much with the background. I also wrote part of the methods outlined to turn in. I trained a model on the new images without augmentation, which achieved the following performance metrics:

	precision	recall	f1-score	support
0	0.83	0.86	0.84	22
1	0.85	0.81	0.83	21
accuracy			0.84	43
macro avg	0.84	0.84	0.84	43
weighted avg	0.84	0.84	0.84	43

  Lastly, I was able to create a heatmap during model training to show what portions of the images the model is looking at. It appears the new model is looking more so at the suture pad in the background rather than the suture itself. Examples are shown below: (red symbolizes what the model is looking at, and blue shows where the model is not looking)



- Sadie: This week, I downloaded the Raspberry Pi OS and installed it onto the Raspberry Pi board. I also worked with Kate and Presley to begin setting up a virtual environment on the Raspberry Pi to simulate a standard development environment. This will allow us to experiment with loading a model onto the board without installing applications globally. As we worked through the setup process, I documented our procedure for future reference.
- Kate: This week, I built the circuit based on the circuit schematic I made last week. I met with the team to start getting the Raspberry Pi working. We got it hooked up to the peripherals, but we are having trouble downloading a later version of Python so we are able to use Tensorlite for our Machine Learning Model.

Individual Struggles:

- Lucy: I am struggling with my personal mac system to run the temporary model because my kernel in jupyter notebook is frequently dying while attempting to run the model.
- Presley: I was running into some issues with getting pyenv installed on the raspberry pi so that we can get an earlier version of python (3.11) that is necessary to install tensorflowlite.
- Maddie: I am struggling to identify the best training set for our data without overloading our computers. The background images will create issues with the clear sutures, decreasing the size of our already small dataset.
- Sadie: I am struggling to figure out how to install a model on the board and the best method to downgrade Python on the board without causing OS issues. Hoping our meeting with the Makerspace staff will help clear things up.
- Kate: I am struggling with getting Python 3.11 on the Raspberry Pi as we are not able to uninstall Python 3.13, as the software is integrated into the Pi and would cause internal error. We are planning on meeting with staff from the MakerSpace on Friday to help us with the Pi set up.

Individual Goals:

- Lucy: My goal next week is to successfully run the temporary model on my device and meet with Markerspace faculty for assistance in setting up the raspberry pi.
- Presley: My goal next week is to get tensorflowlite successfully installed and get the temporary model on it as well.
- Maddie: My goal next week is to create a ML model with only black and white, background removed images. I also want to find a way to pass an image through our old model and have it output a heatmap to show where that model is looking specifically.
- Sadie: My goal next week is to successfully get a model running on the board and get the circuit working in conjunction with the Pi board.
- Kate: I would like to figure out how to get the ML model onto the Pi and for it to run.

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
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	