Magnetic PillCam

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Project Background

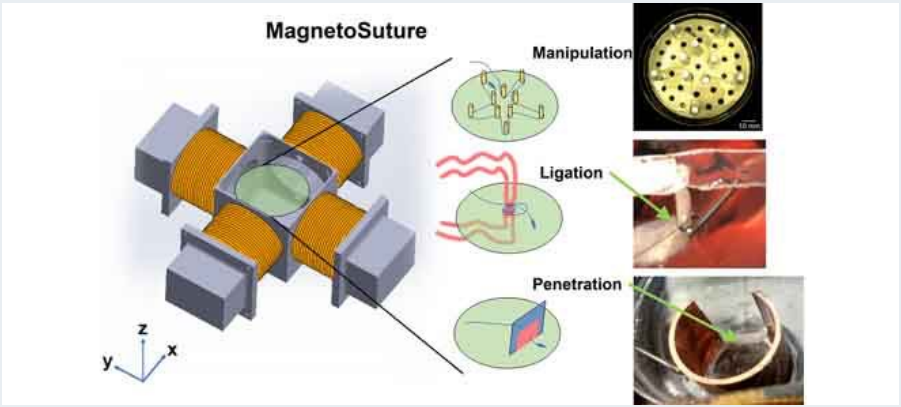
PillCam

- A minimally invasive device developed as an alternative to endoscopic devices.
- No active robotic control on PillCam
  - Movement of a PillCam in GI-tract relies on passive body movements
- PillCam comes in a model with a camera on both ends and a model with a camera only on one end

Project Background

MagnetoSuture

- Technology that uses electromagnetic fields to control a magnet's motion
- Consists of four electromagnet coils (EMs) arrayed in a plane separated by 90 degrees
- EMs are controlled by wireless remote controller and individual coil current ranges from −20 A to 20 A
- Using this wireless remote controller, a needle or magnet can be moved in any direction in the space between the coils



https://www.researchgate.net/publication/340723819_MagnetoSuture_Tetherless_Manipulation_of_Suture_Needle

Project Goal

- Create an actively controlled PillCam using magnets on the device and electromagnets to steer the PillCam
- Integrate the camera from the PillCam to control the movement of PillCam without external camera
- Automate the movement of PillCam using its camera

Technical Approach

- Mechanical
  - Analyze PillCam to identify most optimal placement of magnets
  - 3D print structure to add onto PillCam to hold magnets in a specific area
- Programming
  - Write code to calibrate the magnetic PillCam in the MagnetoSuture
  - Be able to control the movement of PillCam using only a controller changing the field strength from the coils
  - Integrate the camera from the PillCam to the code and control the PillCam while only using the PillCam camera
  - Automate PillCam movements using it's camera to map out a space around it

Phases

Phase 1: Mechanical Approach (3/14)

Phase 2: Closed Loop Control (4/11)

Phase 3: Manuscript Work (5/2)

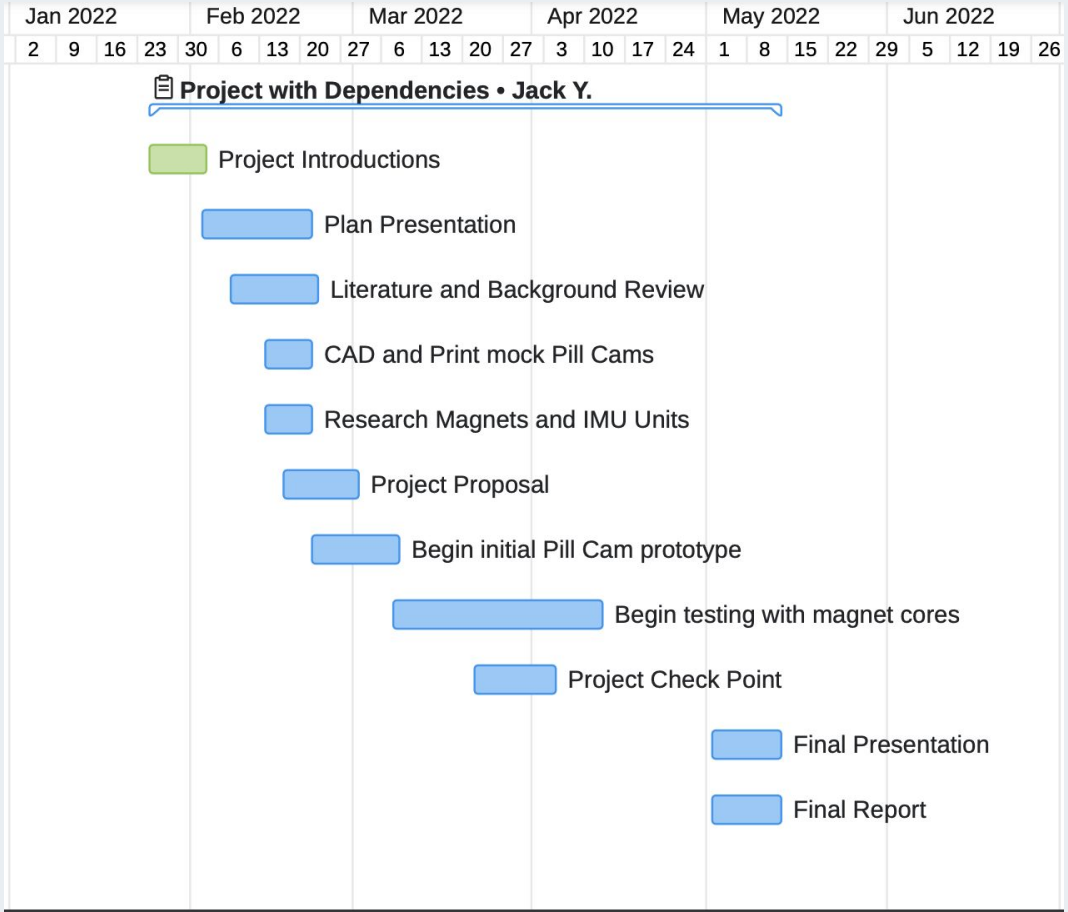
Project Deliverables

Minimum: Develop the pill cam that can be controlled and have an IMU

Expected: Min+ Closed loop control of system

Maximum Expected + Publication

Gantt Chart


Jan 2022
Feb 2022
Mar 2022
Apr 2022
May 2022
Jun 2022
2 9 16 23 30 6 13 20 27 6 13 20 27 3 10 17 24 1 8 15 22 29 5 12 19 26
Project with Dependencies • Jack Y.
Project Introductions
Plan Presentation
Literature and Background Review
CAD and Print mock Pill Cams
Research Magnets and IMU Units
Project Proposal
Begin initial Pill Cam prototype
Begin testing with magnet cores
Project Check Point
Final Presentation
Final Report

Dependencies

Dependency	Solution	Contact	Expected Date	Status	Effect
Pillcam Procurement	Utilize other models currently in the lab	Onder Erin	3/5/2021	Ongoing	Delay in integration with magnets
Magnet Procurement	Order from another company instead	Bharath Hegadahalli	3/5/2021	Ongoing	Delay in integration with Pillcam
Functional Magnet Testing System	Test with individual magnets instead	Onder Erin	3/25/2021	Not Started yet	Alternative testing method of prototypes

Project Management

- All CAD and other design and code will be shared via a google drive folder
- Weekly team meetings with Mentors every Monday at 5pm
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Reading List

https://www.nature.com/articles/s41598-021-90523-w

https://invensense.tdk.com/products/motion-tracking/9-axis/mpu-9250/