FAMU-FSU College of Engineering

Senior Design Team 103
Biosense Webster Catheter

Sarah Churchwell & Diana Shaughnessy

Team Introductions

Vivian Bernard
Biomedical Engineer

Sarah Churchwell
Mechanical Design Engineer

Lauren Kazzab
Biomedical Engineer

Katelyn Kennedy
Biomedical Engineer

Zach Leachman
Biomedical Engineer

Samuel McMillan
Electrical Engineer

Diana Shaughnessy
Mechanical Design Engineer

Hunter Walsh
Electrical Engineer

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Sponsors and Advisors

<u>Development Mentor</u>
Charles Lindholm
Director of R&D

<u>Engineering Mentor</u>
Audrey Claire Goo
R&D Engineer II

<u>Academic Advisor</u>
Stephen Arce, Ph.D.
BME Professor

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Stakeholders

<u>Engineering Mentor</u>
Shayne McConomy, Ph.D.
ME Senior Design Coordinator

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Johnson & Johnson
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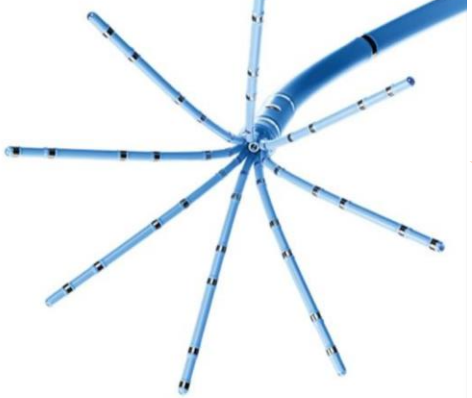
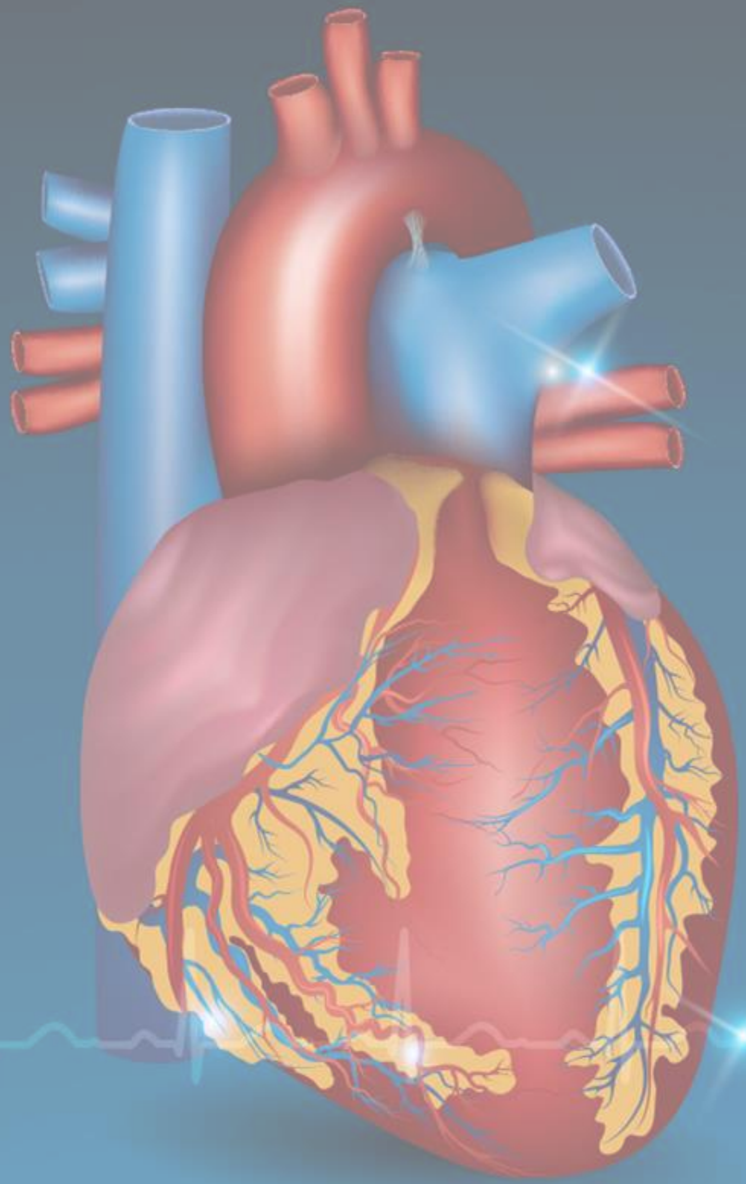


Objective

- The objective of this project is to build a measurement device that measures manual inputs and evaluates those against a 1:1 promise.

Proximal ⟷ **Distal**

Background



Cardiac catheterization is one of the most common medical procedures to treat heart conditions.

Biosense Webster altered one of the early-stage production materials within the catheter build.

This alteration has ultimately affected end-stage performance and resulted in <u>unpredictability</u>.

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Key Goals

Design a testing arena that will be broken down and stored away.

Read the signals of angular deflection with a +/- 0.5° of freedom.

Develop an **image processing algorithm.**

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Assumptions

Demographic that will benefit from the success of the project will be those with heart issues.

Product can be replicable.

Measuring Device will only be designed to be applied to the Biosense Webster Catheters.

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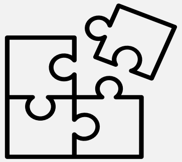
Sarah Churchwell

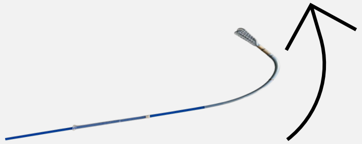
Customer Needs

Compatibility



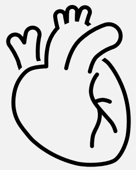
A more concise and efficient way to measure across different Biosense Webster catheters.

1:1 Rotational Promise



Ensure that rotation at proximal end matches output at distal end.

Simulated Environment of Veins



Allows for more real-life augmented prototyping and testing.

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Customer Needs

Non-invasive Electronics

Electronics will not interfere with the user's ability to use the catheter.

Collect & Analyze Data

Procedure will be developed to allow for consistent, reliable, and valid results.

Maintain Functionality

Measuring device does not interfere with the catheter's current functions/abilities.

Sensor Durability

Sensors can withstand movement through the vein and in the heart without getting deteriorated.

Targets

Detect rotation

Product will detect the distal end output rotation and puller wire orientation with an accuracy of **0.5 degrees**.

Replicability

Simple design for Biosense Webster Team to **reproduce the final product**.

Repetitive

Product and materials will be used **more than once**.

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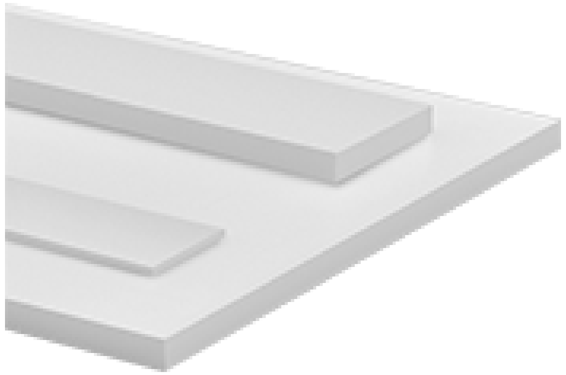
Targets

<u>Stabilization</u>

- Product will be made of **plastic** to ensure a firm foundation.
- 3D printed fasteners secure catheter and sheath in place on platform.



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Final Design Selection

Plastic Platform

Image Processing

USB Connection

Water

MATLAB

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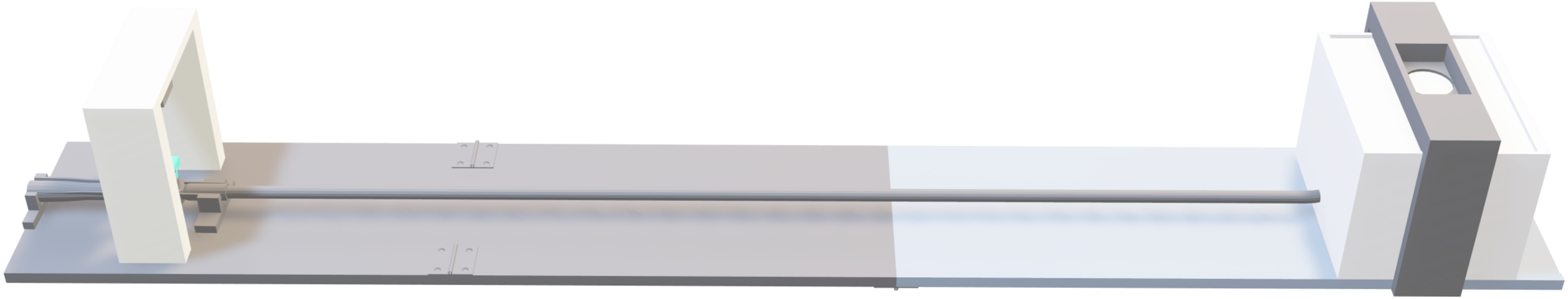
Prototype in Production



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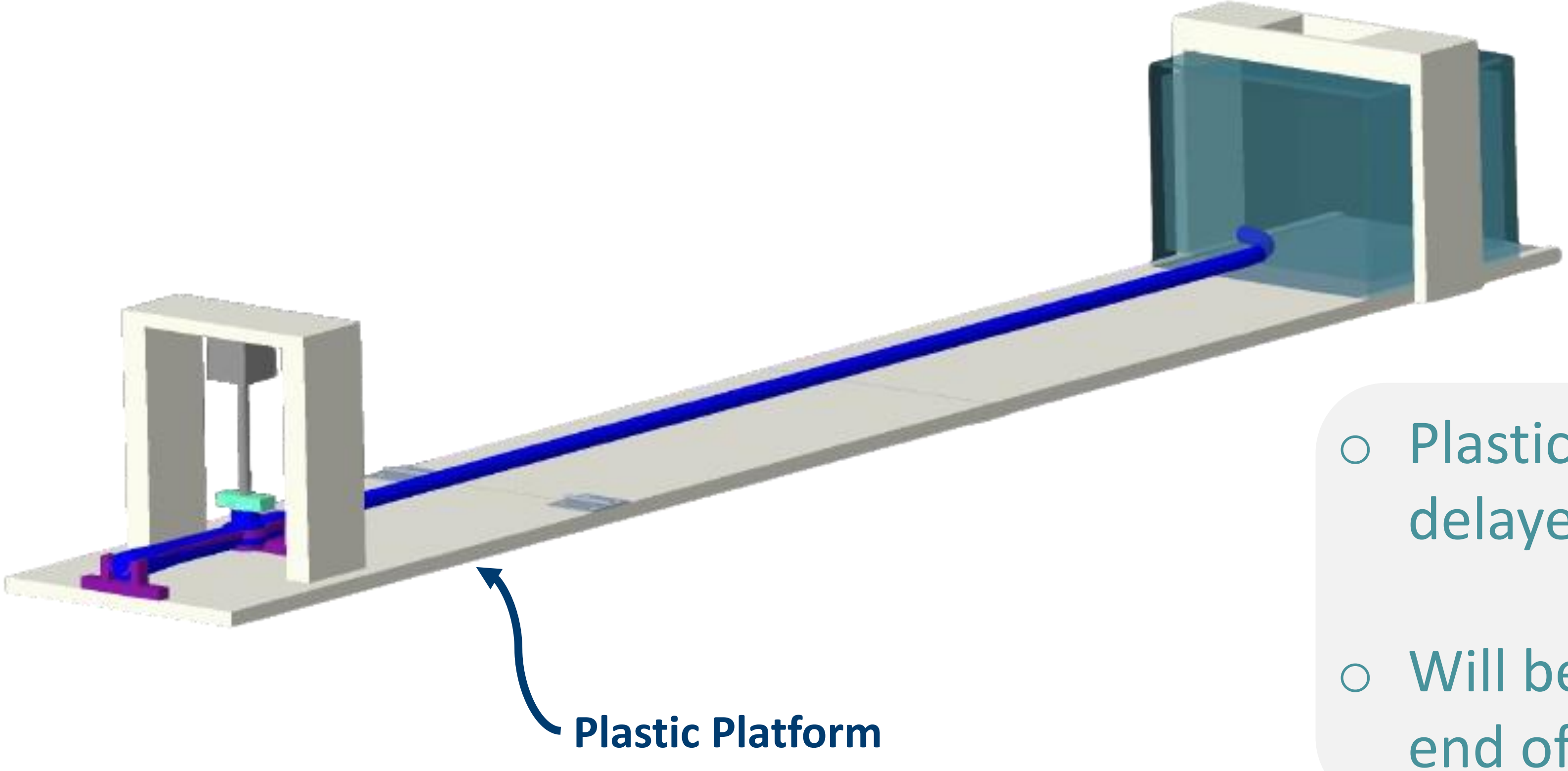
Prototype 3: Plastic Platform



- Plastic is currently delayed in shipping.
- Will be delivered by end of week.

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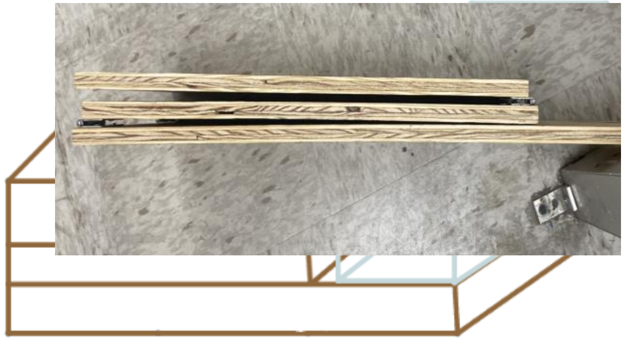
Collapsing Platform

- Inversed hinges allow for the platform to fold onto itself.
- Implementing buckles for camera and motor mounts.



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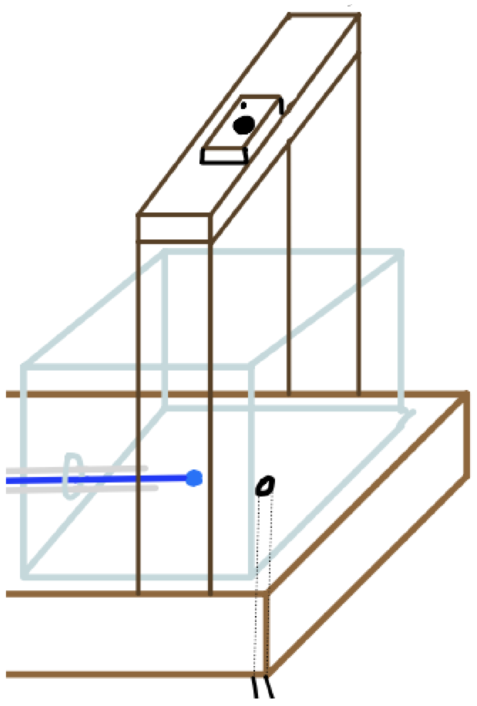
Acrylic "Heart" Box

- 1/2" thick acrylic.
- Sealed with aquarium grade silicon sealant.
- **9.5" width** for full range of motion from camera.
- Indented box shape on plastic platform to slide in acrylic box.



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Liquid

- Saline solution flows inside catheter.
  - Prevents coagulation.
- Bucket or sink to drain fluids from acrylic box.
- Laminar flow allows for no ripples.
  - Allows camera to easily identify points on catheter tip without distortion.
- Laminar flow achieved by setting pump flow rate = fluid draining out.
  - Constant volume in box.

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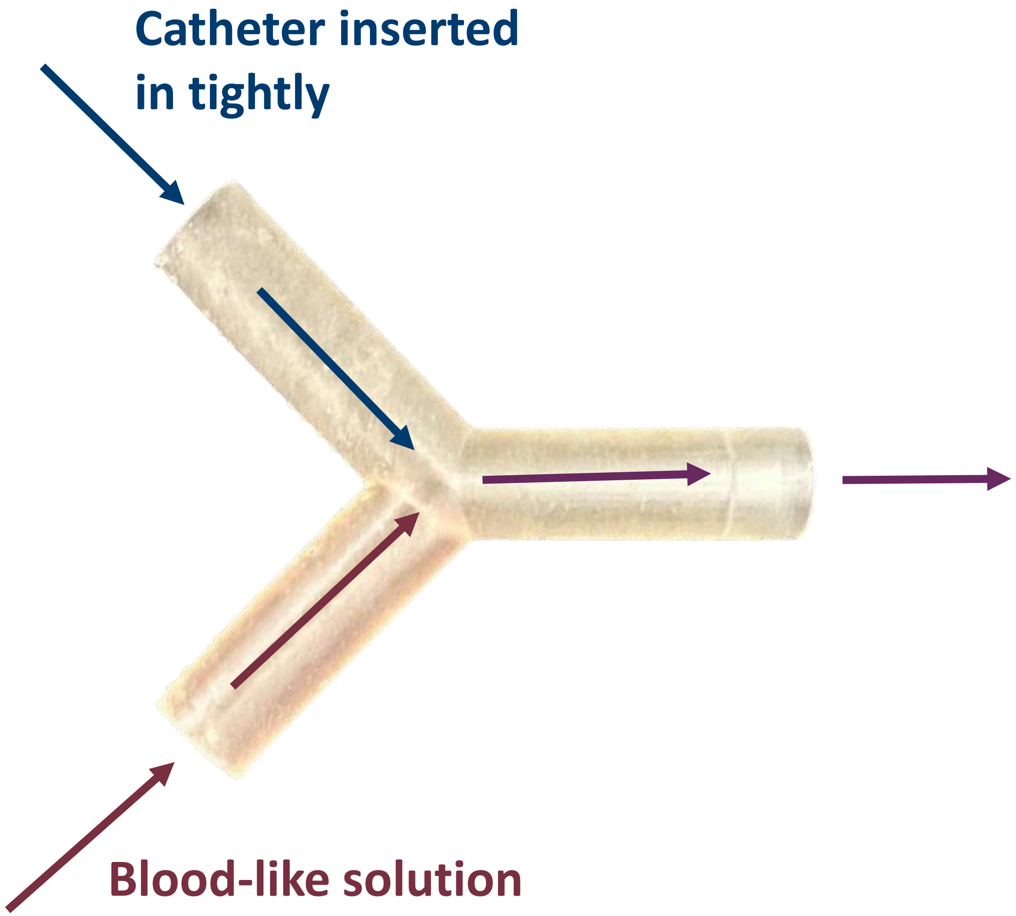
Liquid

- Water "Blood" flows between a polyurethane rubber sheath and the catheter.
- Water from pump feeds into combiner tube with use of a pump.
  - Pump replicates blood movement that occurs through veins.



Diana Shaughnessy

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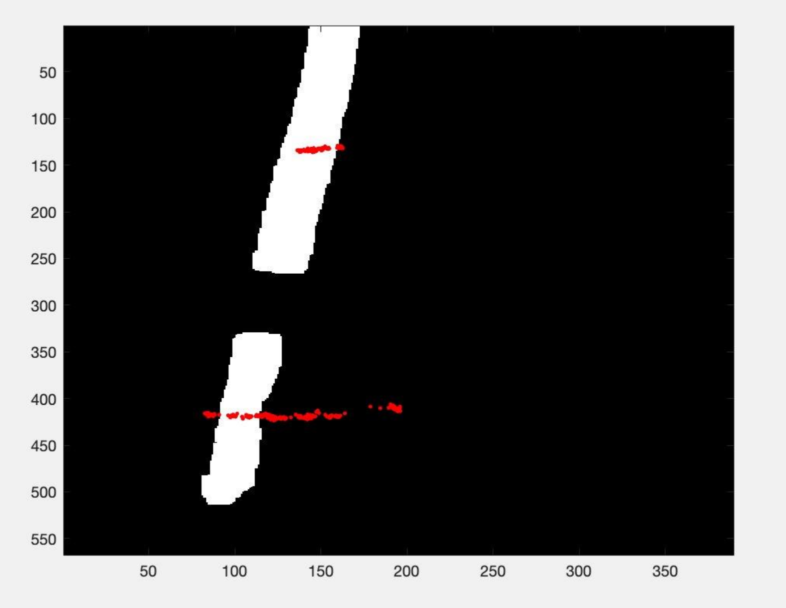
Update on Image Processing

- 4 dimensions to code.
  - X, Y, time, RGB. (color pixels on tip marked by paint)
- Stepper motor will determine the angle which the knob should output.
  - Algorithm will detect the angle of the distal end through the videos captured.
  - Comparison between input vs output.



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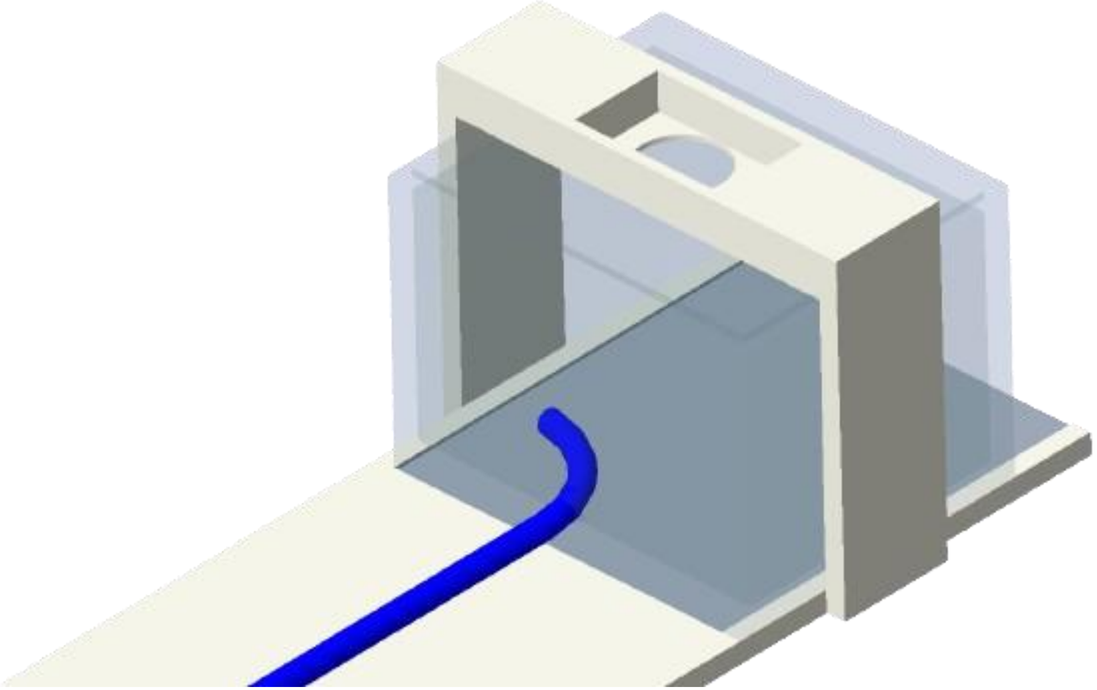
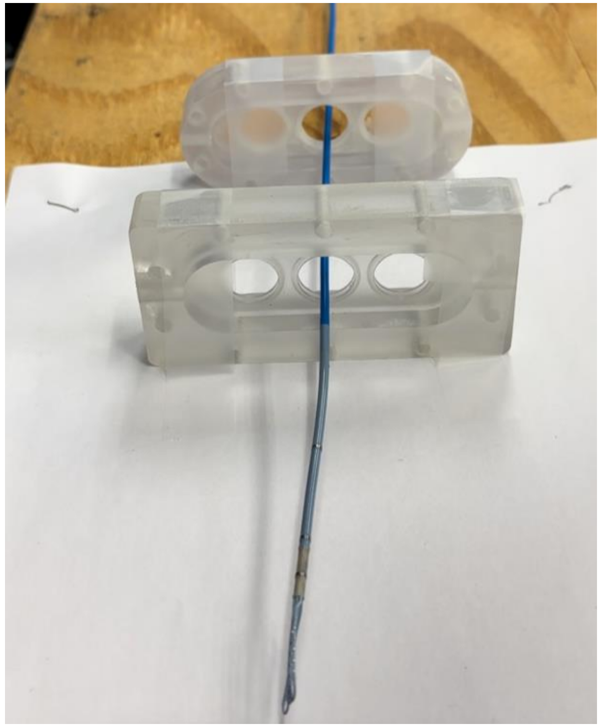
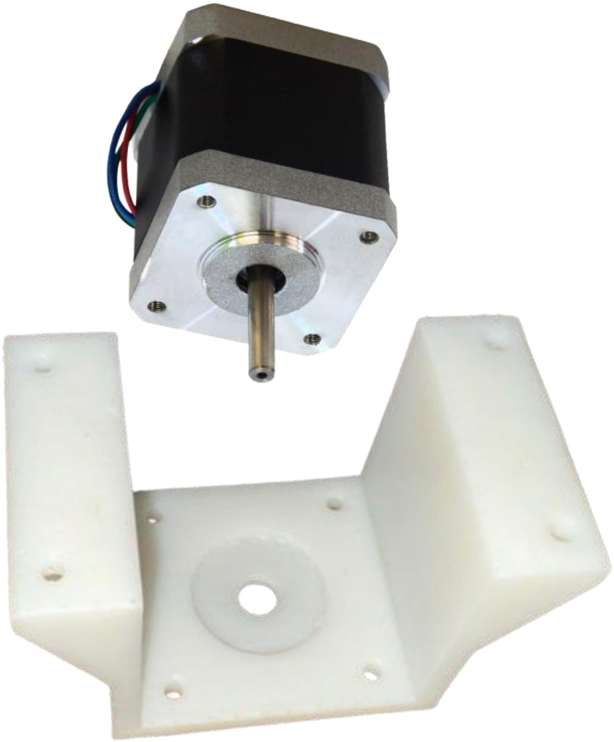
Camera Mount

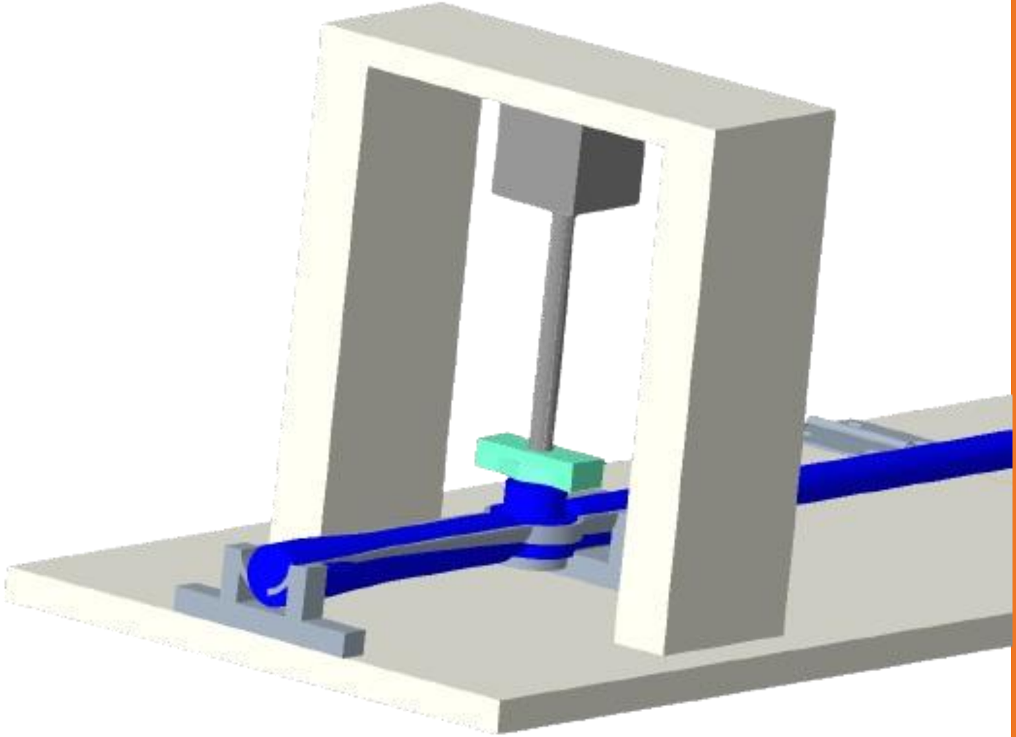




Motor Mount



Motor mount



Electronic Parts

- Stepper motor code will be executed in MATLAB.
  - Arduino conversion.
- Nema 17 Stepper Motor.
  - Equipped with a 100mm T8 lead screw.
- Mold uses a combination of screws and nuts to fasten.

Knob Mold

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Catheter Handle Mount

- Handle of catheter snuggly sits inside of 3D printed mount.
- Buckles will secure onto exterior tabs to aid in easy collapsing of the platform.

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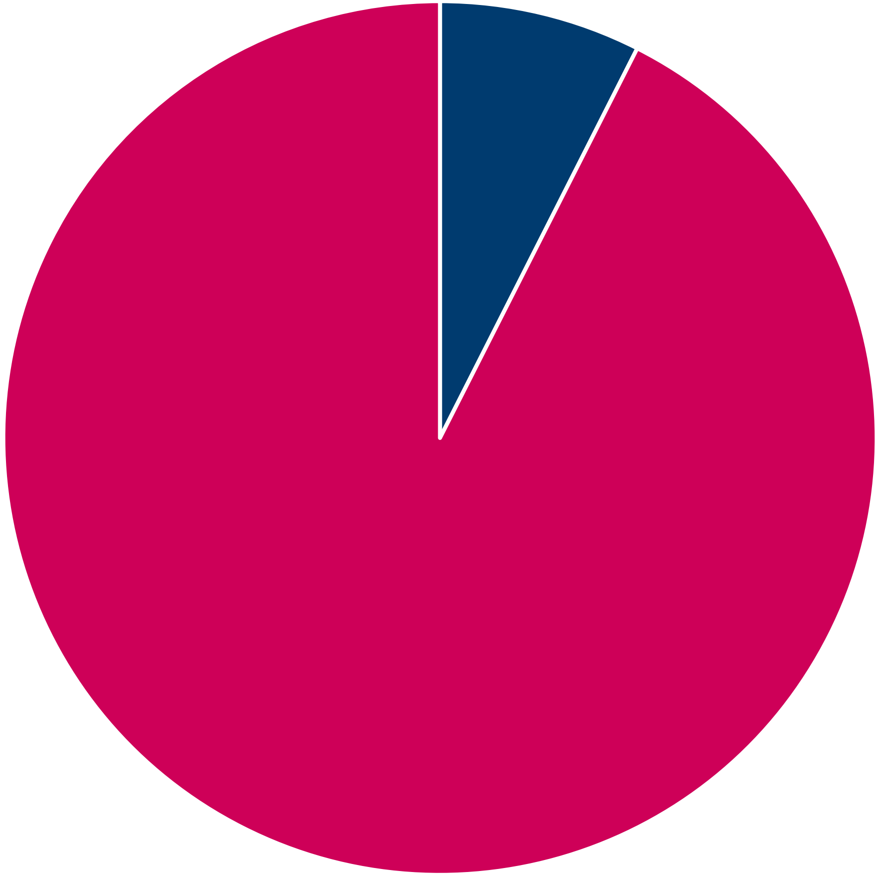
Funding



- Biomedical Engineers have access to an order sheet.
- $31.88 for electronic items.
- $395.22 for mechanical items.

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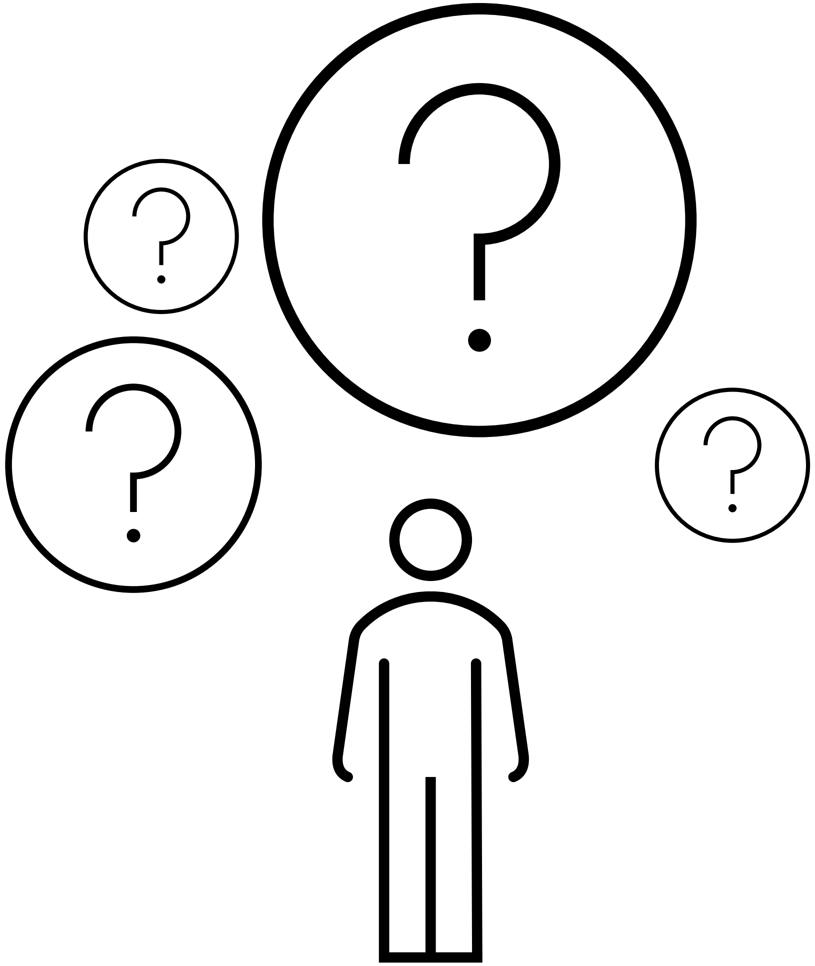
Action Items

- New testing with a new prototype.
- Determine a correlation between stepper motor and image processing.
  - An equation that allows us to accurately find the relationship.
- Improve MATLAB to display the angle of the distal end.
  - Compare this to the stepper motor.
  - More trial runs for image processing.
- Assemble prototype version 3.
- Discuss which mold for the knob is best.
- Update website.

Questions?

Thank you for listening!



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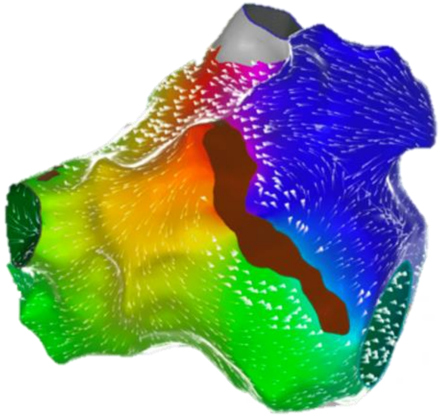
Biosense Webster



Biosense Webster
PART OF THE Johnson & Johnson FAMILY OF COMPANIES

"At Biosense Webster, Inc. we have one goal –
To help those with cardiac arrhythmias live the lives they want."

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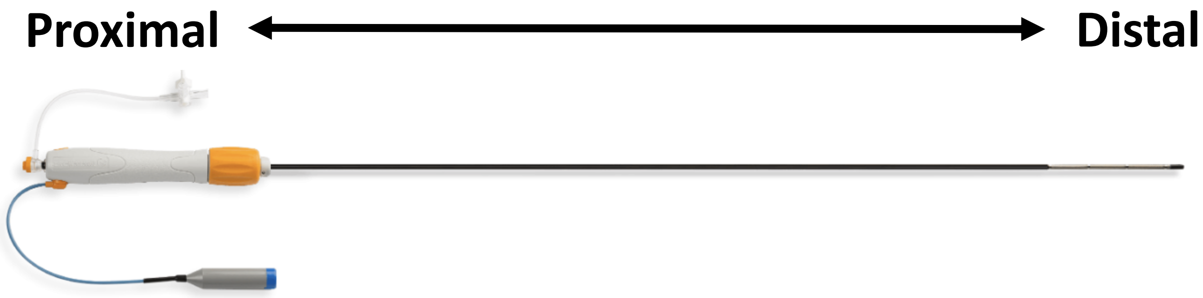
Objective

Design, build, and test a measurement device that measures manual inputs at the proximal end of a catheter and evaluates those inputs against a promise of a 1:1 translation of those inputs at the distal end.



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Key Goals

Develop the testing arena that will be utilized for all proceeding manners

Determine the torsional deflection using the developed measuring system

Read the signals of angular deflection with a +/- 0.5° of freedom

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Sarah Churchwell=

Primary & Secondary Markets

Primary			Secondary
Cardiac Surgeons	Cardiology Researchers	Cardiology Centers	Biotech Resell Companies
			

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Assumptions

Demographic that will benefit from the success of the project will be those with heart issues (ex. Atrial Fibrillation)

Prototype will be design and in-production by the end of Fall 2023

Measuring Device will only be designed to be applied to the Biosense Webster Catheters

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Stakeholders

<u>Engineering Mentor</u>
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ME Senior Design Coordinator

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Samuel McMillan

Customer Needs

Compatibility

1:1 Rotational Promise

Measures Translation

- Compatibility allows for a more concise and efficient way to measure across catheters

- Ensure that rotation at proximal end matches output at distal end

- Translation is just as crucial to the measurements as rotation

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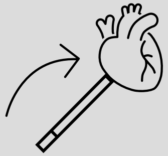
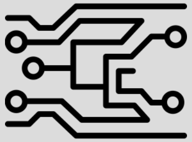
Customer Needs Cont.

Simulated Environment of Veins



Sensor Interchangeability

Non-invasive Electronics



- Allows for more real-life augmented prototyping and testing
- Multiple tips of catheters that the sensors will need to be able to adapt with
- Electronics will not interfere with the user's ability to use the catheter

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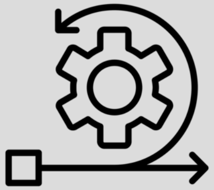
Customer Needs Cont.

Collect and Analyze Data

Maintains Functionality



Sensor Durability

- Procedure will be developed to allow for consistent, reliable, and valid results
- Measuring device does not interfere with the catheter's current functions/abilities
- Sensors can withstand movement through the vein and in the heart without getting deteriorated

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Functional Decomposition

Customer Needs

↓

Main Functions/Systems

Main Functions/Systems

↓

Functions/Subsystems

Environment Simulation

- Veinal Replication
- Sterilization
- Stabilization

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Functional Decomposition Table

Functional Cross Reference Table				
	Sensibility	Data Collection	Compatibility	Environment Simulation
Detects Translation	x			
Detects Rotation	x			
Detects Deflection	x			
Data Aquisition		x		
Data Manipulation		x		
Live-Positioning Visual	x	x		
Veinal Replication			x	x
Sterilization				x
Sensor Adjustability			x	x
Reproducibility		x		x
Stabilization	x			x

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Samuel McMillan

Function Interrelations

- Live-Positioning Visual
- Sensor Adjustability
- Veinal Replication
- Stabilization

Functional Cross Reference Table				
	Sensibility	Data Collection	Compatibility	Environment Simulation
Detects Translation	x			
Detects Rotation	x			
Detects Deflection	x			
Data Aquisition		x		
Data Manipulation		x		
Live-Positioning Visual	x	x		
Veinal Replication			x	x
Sterilization				x
Sensor Adjustability			x	x
Reproducibility		x		x
Stabilization	x			x

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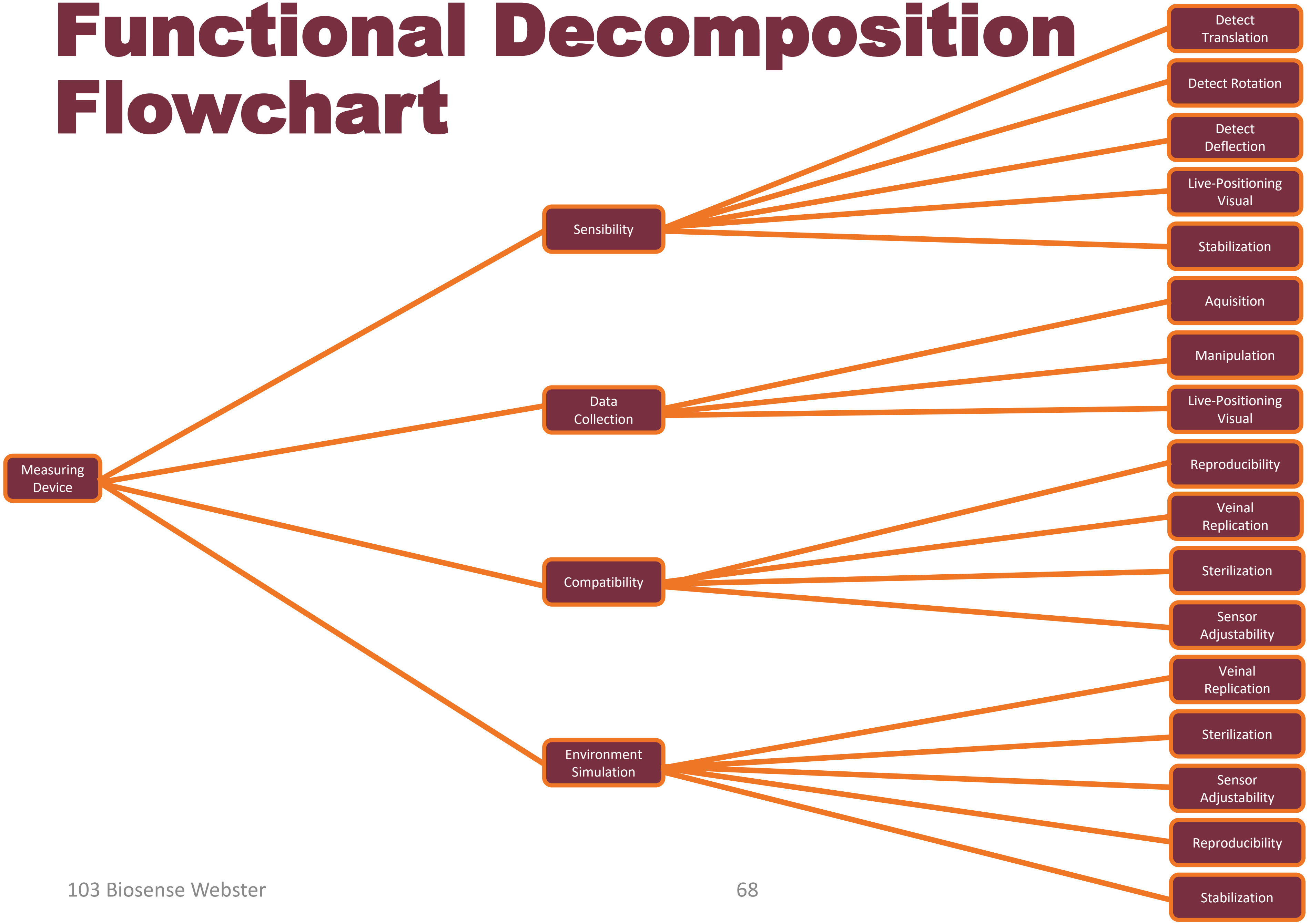
Functional Decomposition Flowchart



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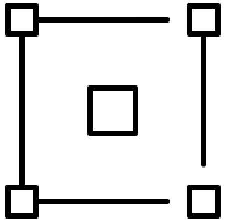
Prioritization

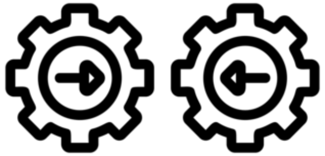
Sensibility

Environment Simulation



Data Collection

Compatibility



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Questions?

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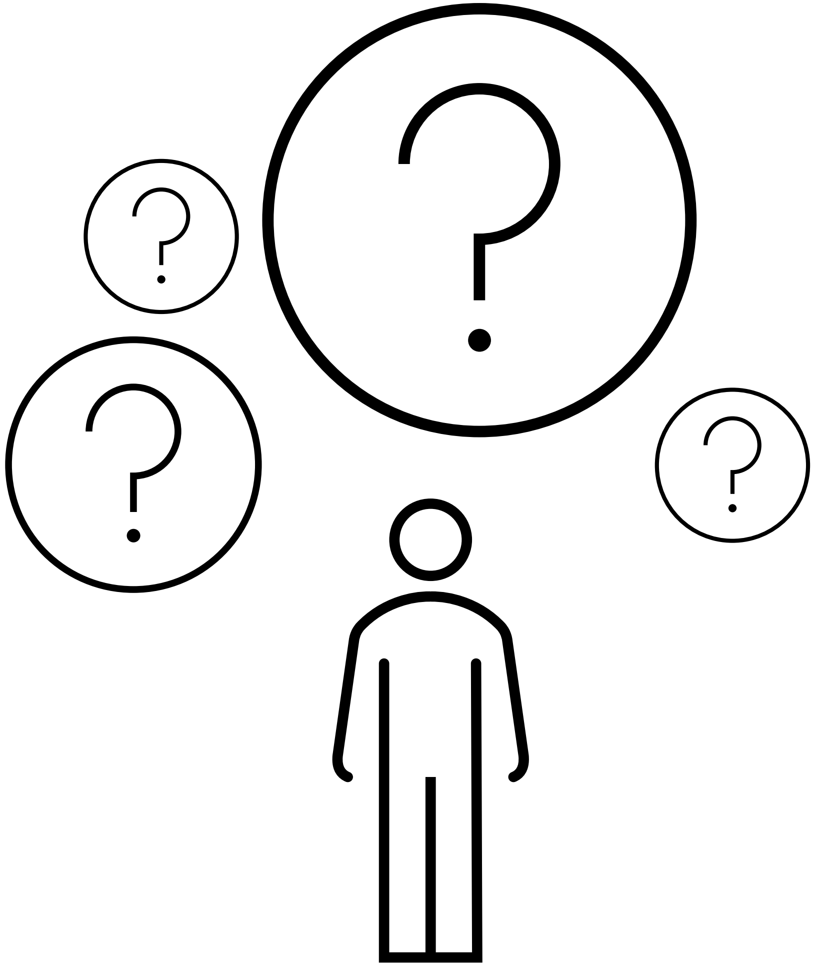

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Future Work

- Targets (11/3)
- Concept Generation (11/10)
- Concept Selection (11/10)
- Risk Assessment (11/24)
- Bill of Materials (12/4)
- Spring Project Plan (12/8)

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