FAMU-FSU College of Engineering

Senior Design Team 103
Biosense Webster Catheter

Diana Shaughnessy & Hunter Walsh

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

Development Mentor
Charles Lindholm
Director of R&D

Engineering Mentor
Amar Patel
R&D Engineer II

Academic Advisor
Stephen Arce, Ph.D.
BME Professor

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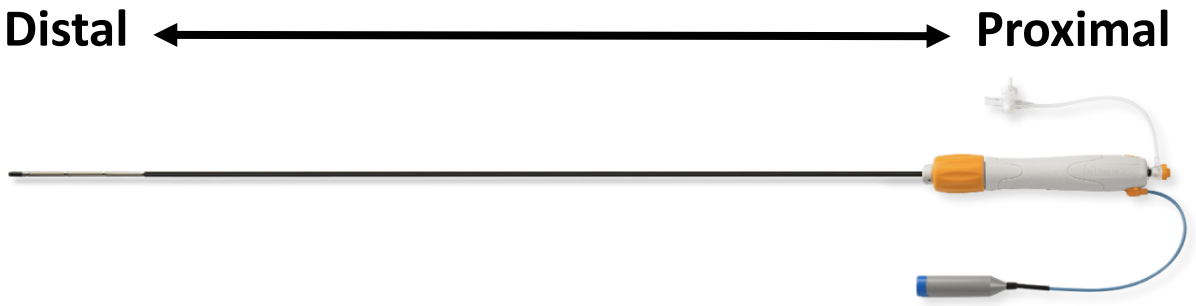
Objective

Build a measurement device that measures manual inputs and evaluates those inputs against a 1:1 promise.



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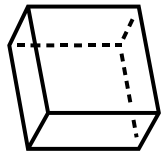
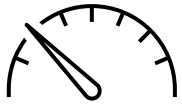
Key Goals



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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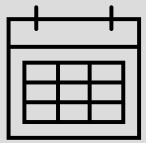
Primary & Secondary Markets

Primary			Secondary
Cardiac Surgeons	**Cardiology Researchers**	**Cardiology Centers**	**Biotech Resell Companies**

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

Stakeholders

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ME Senior Design Coordinator

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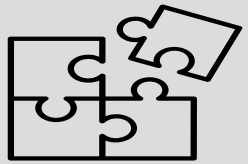
Customer Needs

Compatibility

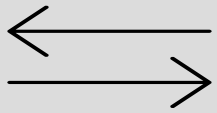


Compatibility allows for a more concise and efficient way to measure across catheters

1:1 Rotational Promise

Ensure that rotation at proximal end matches output at distal end

Measures Translation



Translation is just as crucial to the measurements as rotation

Simulated Environment of Veins

Allows for more real-life augmented prototyping and testing

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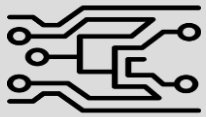
Hunter Walsh

Customer Needs

Non-invasive Electronics

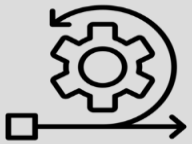


Electronics will not interfere with the user's ability to use the catheter

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

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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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Targets ⟶ Critical Targets

Detects Translation	Detects Rotation	Detects Deflection	Data Manipulation	Veinal Replication
Sterilization	Data Acquisition	Sensor Adjustability	Reproducibility	Stabilization
	Non-invasive Electronics	Maintain Functionality	Sensor Durability	

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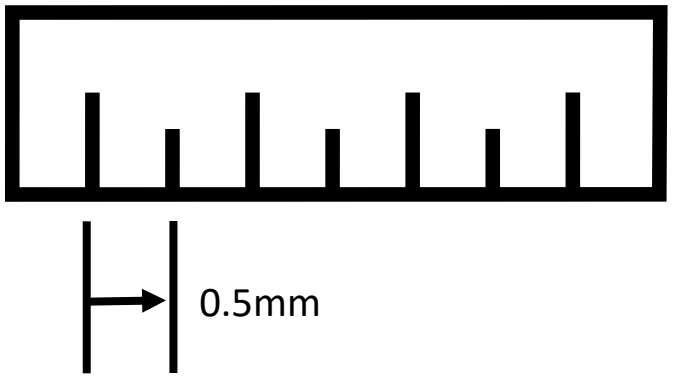
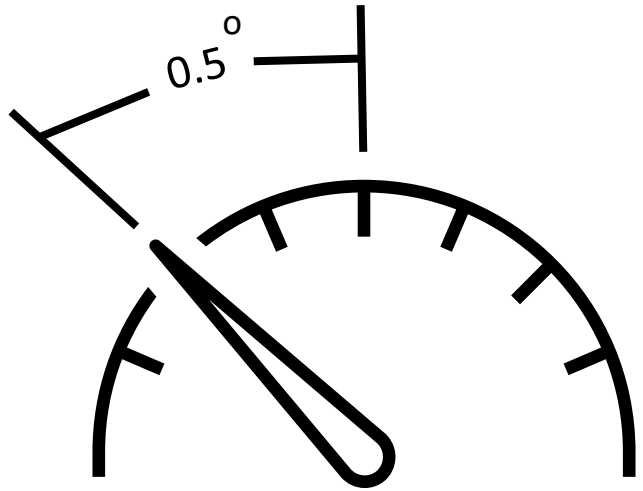
Targets

- Detect Translation
  - Test various lengths of product and product within various common environments.
    - Product can detect translation of the distal end inside the testing arena within **0.5 mm**.



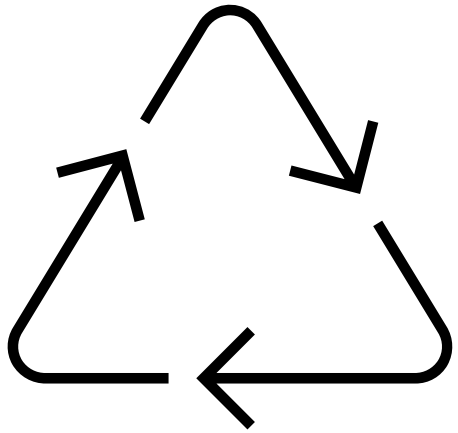
Targets

- Detect rotation
  - The amount at which the product will be able to turn.
    - Product will detect the distal end output rotation and puller wire orientation with an accuracy of **0.5 degrees**.



Targets

- Reproducibility
  - Research which material will be able to be used more than once or singularly.
    - Product will be able to be used **more than once**.



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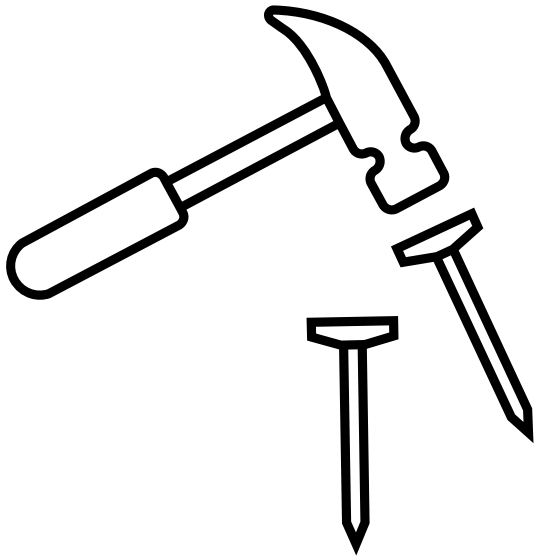
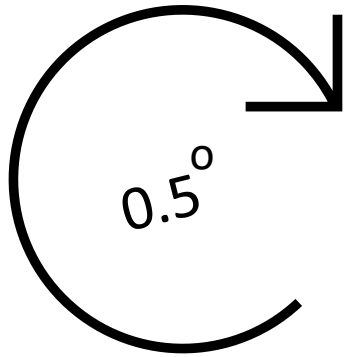
Targets

- Stabilization
  - Develop various options for the testing area to be made from.
    - Product will be made of either **metal or wood** to ensure a firm foundation to test within.



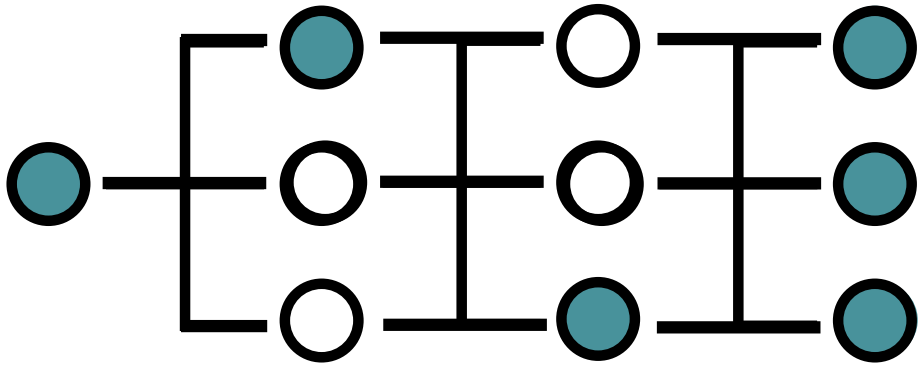
Targets

- Detect Deflection
  - Amount at which the product will be able to deflect.
    - Product will detect the distal end output translation and puller wire orientation with an accuracy of **0.5 degrees**.

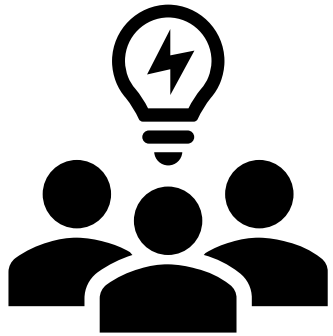


Concept Generation

Generation Methods



Morphological Chart



Brainstorming

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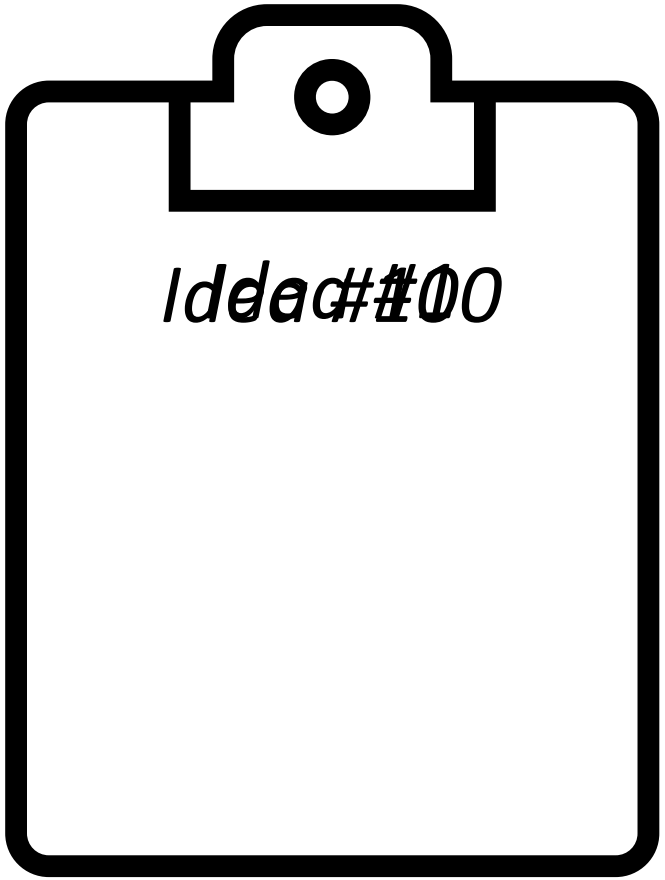
Concept Generation

Our team was able to generate over a 100 concepts using the forementioned generation methods and tools.

Some were great!

Some not so much…



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Morphological Chart

Morphological chart was proved to be the most useful tool in terms of generating concepts.

Data Collection	Box Material	Sensor Type	Receiving Data	Fluid mixture
Excel	Wooden	Paint	Bluetooth	Water
Hand/ Visual Observation/ Protractor	Glass	Electromagnetic Sensor	Wire USB	Corn Syrup
Matlab, C++, Python	Plastic Polymer	GPS Module		Saline
	Metal	RFID Tags		Water and Corn Syrup
		Ultrasound Sensor		All 3
		Pressure Sensors		

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5 Medium Fidelity Concepts

Idea #7

Idea #12

Idea #65

Idea #74

Idea #78

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Medium Fidelity - #1

#1	#74	#12	#78	#65
Wooden	Wooden	Metal	Metal	Metal
GPS sensors	Ultrasound Processing	RFID Processing	Ultrasound Processing	Pressure Sensor Processing
Bluetooth	USB	Bluetooth	Bluetooth	Bluetooth
Mix of 3	Corn Syrup	Corn Syrup	Corn Syrup	Corn Syrup
MATLAB	Excel	Excel	MATLAB	MATLAB

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High Fidelity - #1

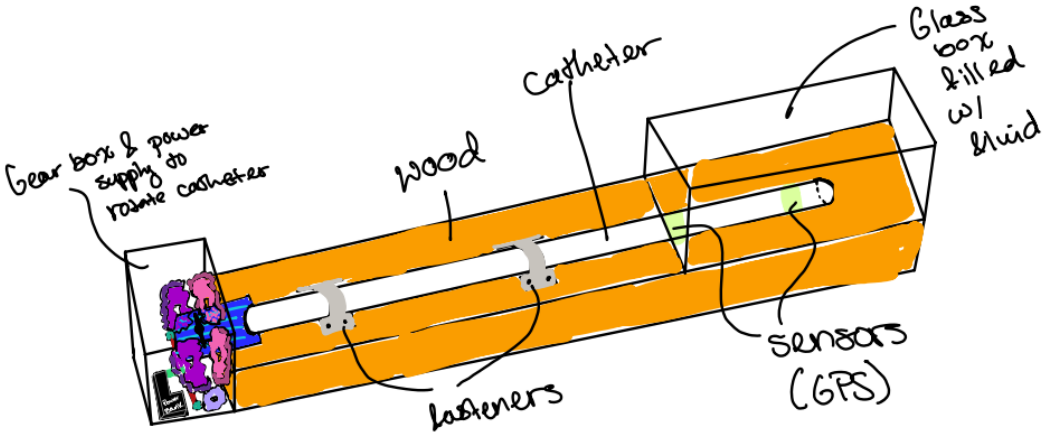
Wooden Box

Image Processing

Bluetooth Connection

Corn Syrup + Water

MATLAB



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High Fidelity - #2

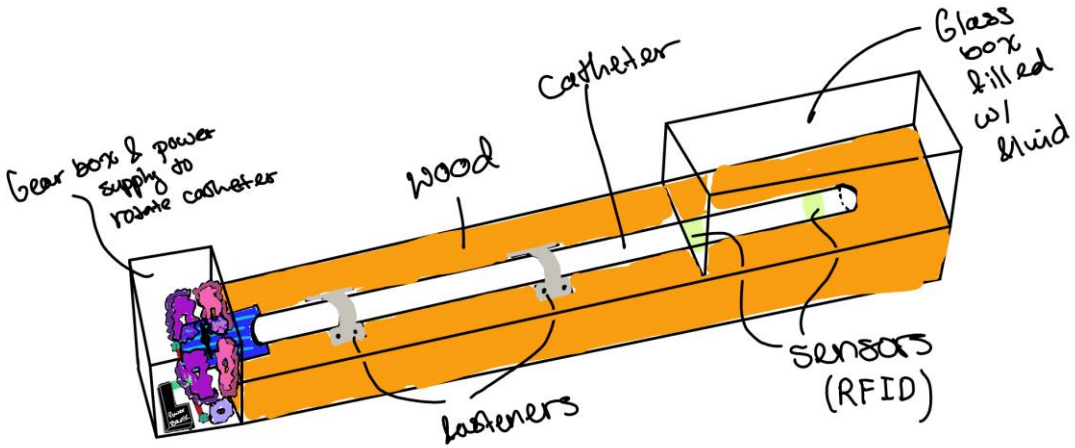
Wooden Box

RFID Sensors

USD Connection

Corn Syrup + Water

MATLAB



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High Fidelity - #3

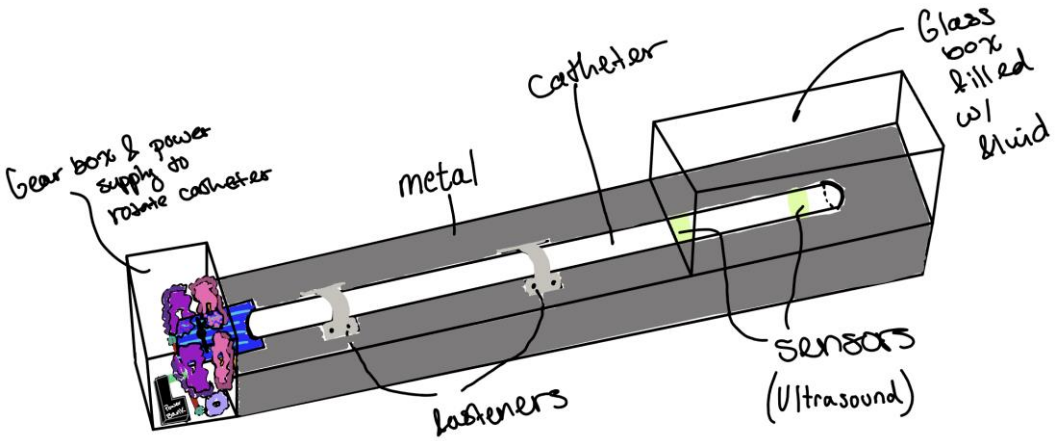
Metal Box

Ultrasound Sensor

Bluetooth Connection

Corn Syrup + Water

MATLAB



Binary Pairwise

Data Collection | 1 | Veinal Replication

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House of Quality

Detects Translation	Detects Rotation	Detects Deflection	Data Manipulation	Veinal Replication
Sterilization	Data Acquisition	Sensor Adjustability	Reproducibility	Stabilization

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Pugh Chart

Idea #78

Idea #1

Idea #7

Idea #12

Idea #23

Idea #65

Idea #78

1 2 3

Idea #75

Idea #78

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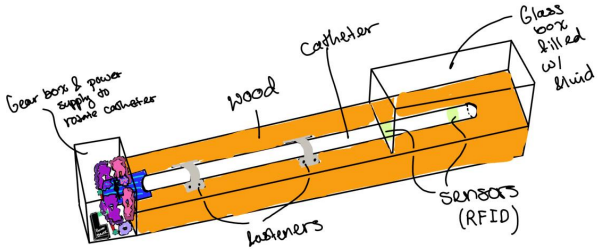
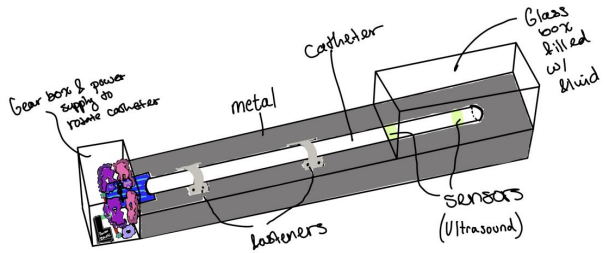
Diana Shaughnessy

Analytical Hierarchy Process



1



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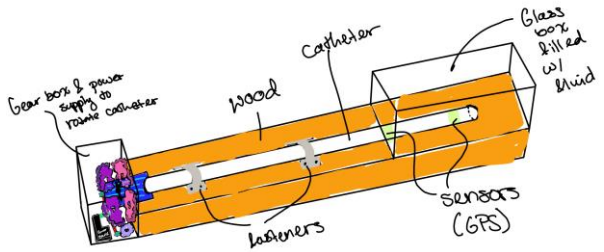

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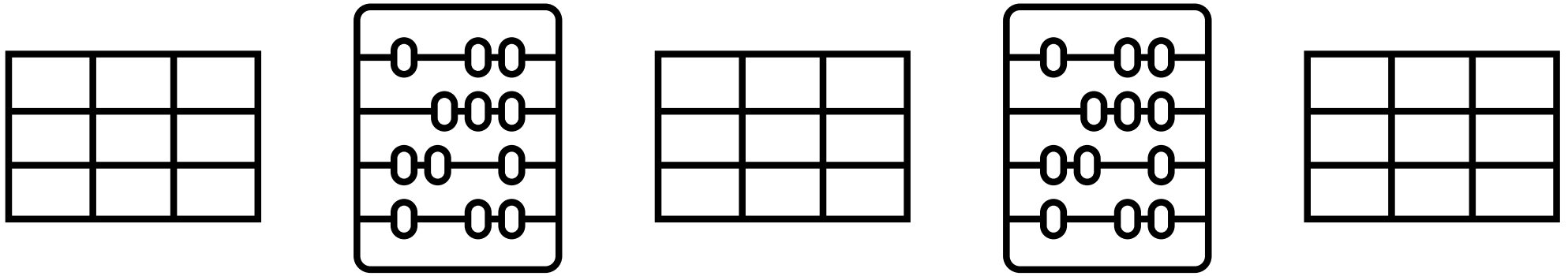

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Final Selection

Our team's final selection

Material: Wooden Box

Sensor: Image Processing

Data Collection: Bluetooth Connection

Fluid: Corn Syrup + Water

Data Analysis: MATLAB

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Future Work

- CAD model for design (11/13)
- Finalize Prototype Material (11/16)
- Order Parts for Prototype
- Assemble Prototype in B327
- Trip to Gainsville for Wet Lab
- Spring Project Plan (12/8)

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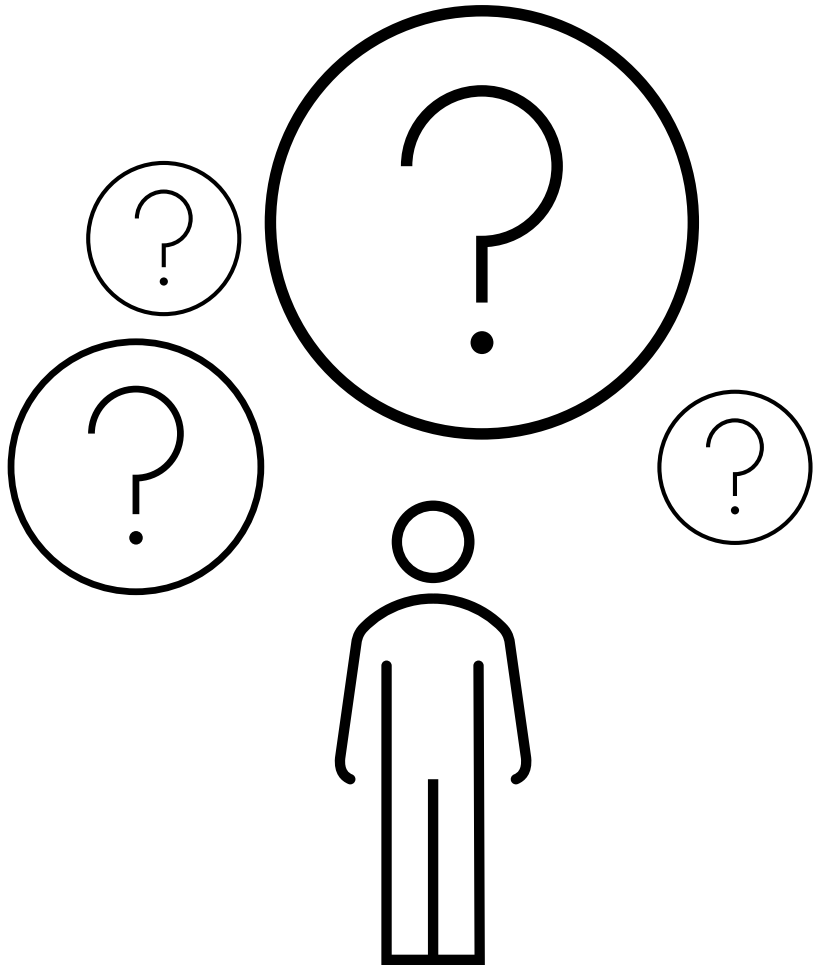
Questions?

Thank you for listening!



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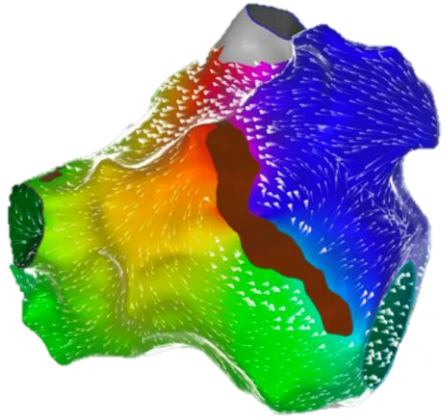


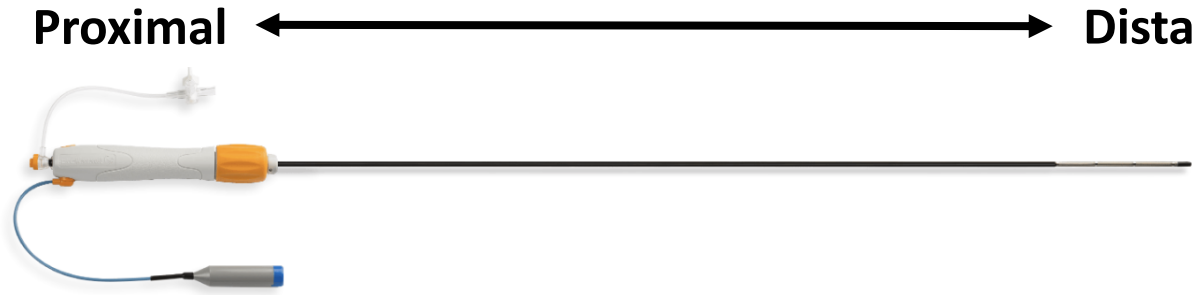
Biosense Webster®
PART OF THE Johnson & Johnson FAMILY OF COMPANIES

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

Sarah Churchwell

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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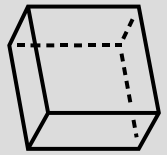

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Sarah Churchwell=

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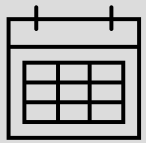

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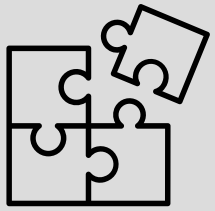
Compatibility

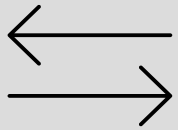


1:1 Rotational

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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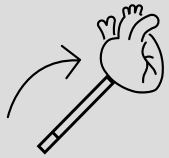
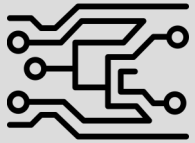
Customer Needs Cont.

Simulated Environment of Veins



Sensor Interchangeability

Non-invasive Electronics

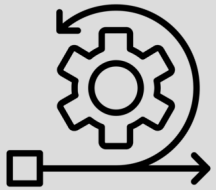


- Allows for more real-life augmented prototyping and testing
- Multiple tips of catheters that the sensors will need to be able to adapt with
- Electronics will not interfere with the user's ability to use the catheter

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

Functional Decomposition

Customer Needs

Main Functions/Systems

Main Functions/Systems

Functions/Subsystems

Environment Simulation

- Veinal Replication
- Sterilization
- Stabilization

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Detects Translation	x			
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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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Function Interrelations

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

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Veinal Replication			x	x
Sterilization				x
Sensor Adjustability			x	x
Reproducibility		x		x
Stabilization	x			x

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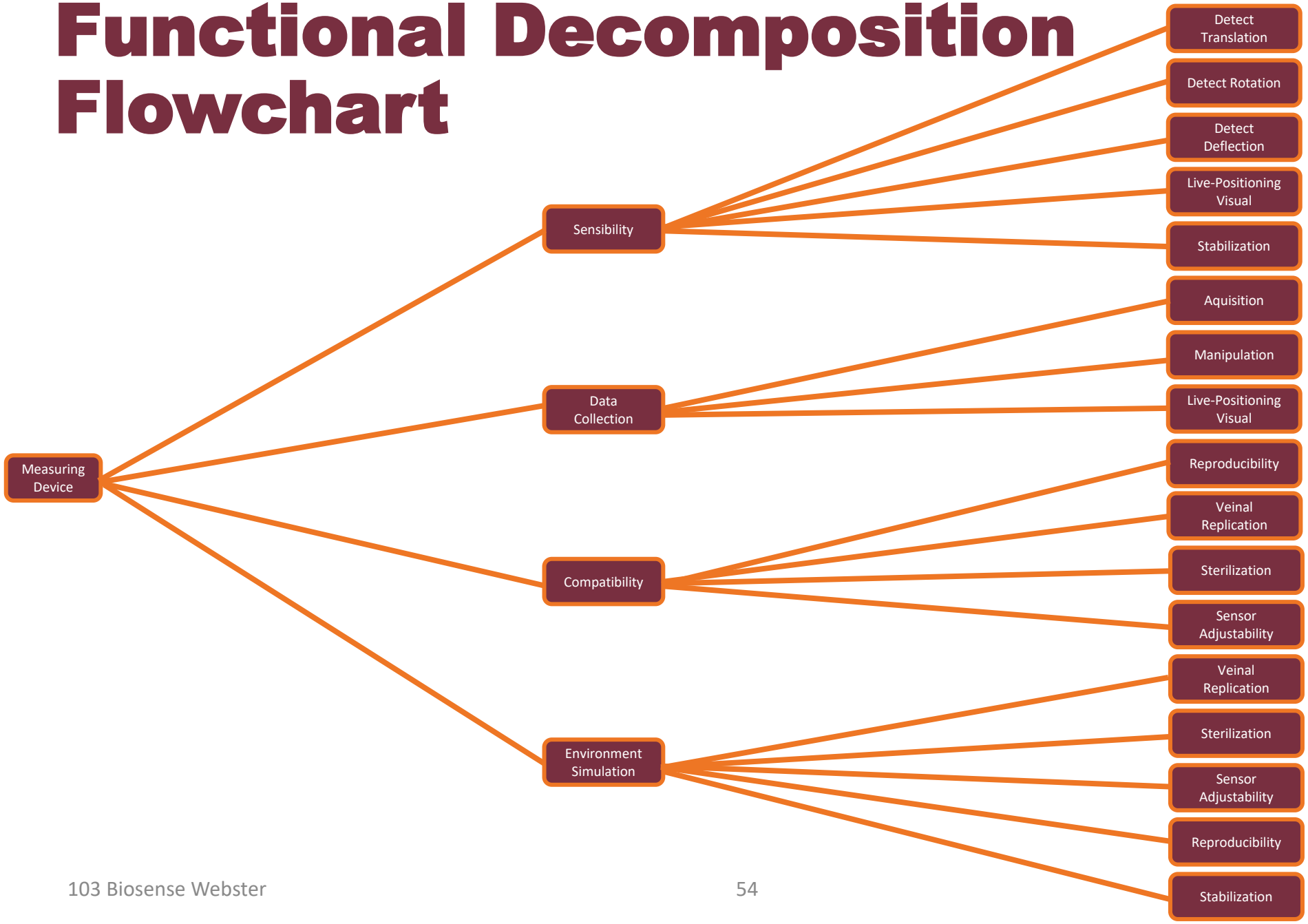
Functional Decomposition Flowchart



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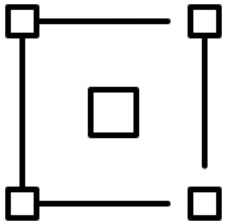
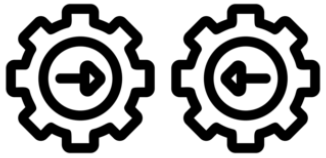
Prioritization

Sensibility

Environment Simulation 

Data Collection

Compatibility 

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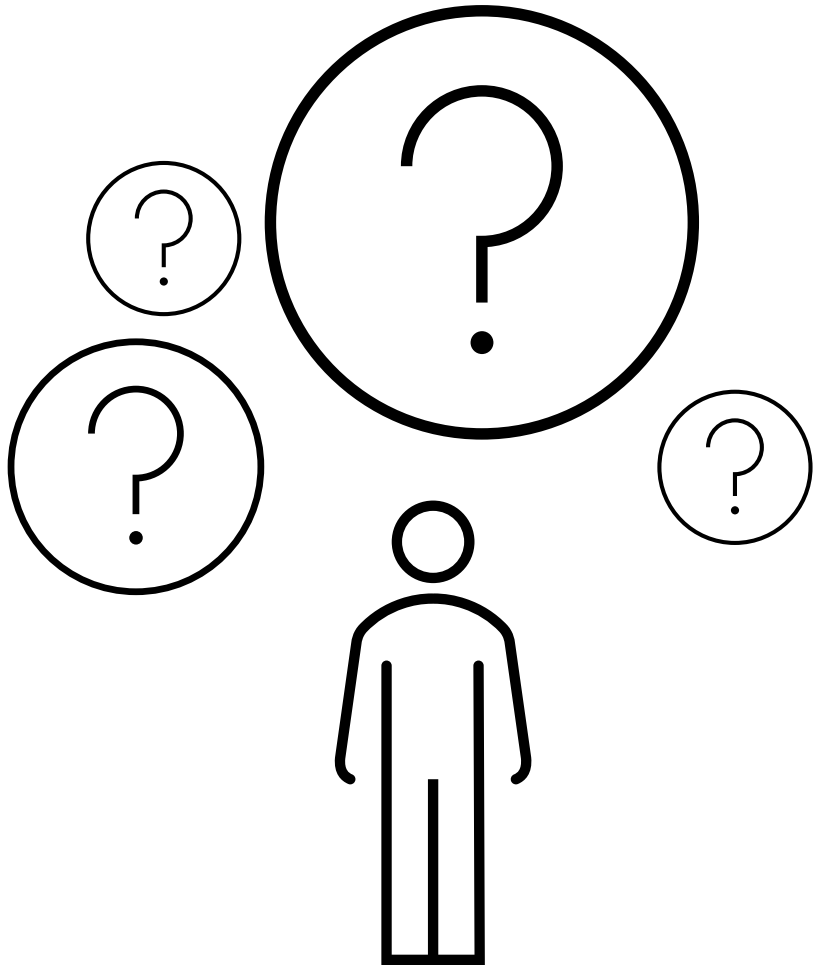
Questions?

Thank you for listening!



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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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