

Requirements Specification Document

Group 7, Aperture Software Solutions
Multi-Point GPS Visualization System
(QuantumGPS/Aperture Software Solutions)

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1 Document History

Version	Date Published	Document Title	Changes
1.0	Feb 5, 2019	Requirements Document	Initial document
1.1	Feb 6, 2019	Requirements Document	Revisions based on client feedback
0.9	Mar 12, 2019	Requirements Specification Document	Added client specifications, including use cases, sequence diagrams, and user interface mock ups
1.0	Mar 19, 2019	Requirements Specification Document	Added experiments entities to specifications, Expanded user interface mock ups to include scenarios.
2.0	Mar 27, 2019	Requirements Specification Document	Removed experiment use cases, reworked user classes, added traceability.

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2 Introduction

2.1 Purpose

QuantumGPS conducts ocean based experiments using up to 16 sonobuoys, each equipped with a GPS transmitter. Over the course of an experiment, sonobuoys emit their GPS position approximately once every five seconds. The GPS positions are collected and stored within a text file in GPRMC format by a GPS receiver. One text file is created per experiment, and all the text files are saved to a datastore. The existing sonobuoy visualization system uses the the GPS datastore to show the movement of the sonobuoys over the course of an experiment. This existing solution is inadequate, difficult to use, and currently requires an expert to operate. As a result, QuantumGPS has requested a new visualization system, henceforth known as the "Aperture's Sonobuoy Visualization Solution" (ASVS).

2.2 Project Scope

ASVS aims to improve the visualization of multiple sonobuoys of both past and live experiments. ASVS provides a means to visualize and manipulate live and completed experiments as well as mark information for an experiment using annotations.

2.3 Glossary of Terms

- ASVS: New sonobuoy visualization system specified by Aperture Solutions.
- Experiment: A collection of sonobuoy GPS data within the bounds of a specified time and location
- GPRMC: Minimal formal format for GPS information as defined by the National Marine Electronics Association.
- GPS: Global Positioning System.
- GPS Position: Position information sent from a sonobuoy's GPS transmitter
- Invalid GPS Position: Position information sent from a sonobuoy's GPS transmitter which are either outside of the experiment boundary or not in GPRMC format
- Object: A sonobuoy or annotation
- Sonobuoy: An ocean based sound monitoring system equipped with a GPS transmitter.
- User: An individual who uses ASVS to visualize sonobuoy GPS data within the bounds of an experiment

2.4 References

RFP prepared by QuantumGPS:

Kwan, A.; Ahmed, A.; Smith, A.; Sampare, D.; Mansour, H.; St Martin, J.; Todorova, J.; and Liard, S. (2019). Multi-Point GPS Visualization System Request for Proposal. 1st ed. [ebook] Victoria. Available at: <https://justdare.github.io/seng321/documents/RFP.pdf> [Accessed 1 Feb. 2019]

2.5 Overview

This document contains ten main sections, an appendix, and a document history table. Section one contains the document history table, which details all revisions made to the document. Section two describes the purpose and scope of the project. Section three encompasses the existing visualization system and its issues, the primary features and user-classes of ASVS, as well as any assumptions, operating environment, or design constraints pertinent to ASVS. Section four discusses specific features of ASVS which are prioritized and broken down into requirements. Section five describes the external interface requirements including software and communications interfaces. Section six describes the non-functional requirements, introducing performance requirements, and software quality attributes. Section seven contains the level one and two data flow diagrams and the context diagram. Section eight contains the entity relationship diagram and the accompanying data dictionary. Section nine contains the use case model, use cases, sequence diagrams for the use cases, and UI scenarios for each use case. At the end of the document is an appendix that has a list of issues. Section ten contains the traceability matrix and test case table.

3 Overall Description

3.1 Product Perspective

The existing visualization software developed and deployed by QuantumGPS collects GPS information from each sonobuoy, formats the information into GPRMC format, and stores it in a text file. The created text file is stored on a database and is also streamed in real-time to the existing system. The current system has an application for viewing the location of the sonobuoys based on aforementioned text file.

3.2 Product Features

The features described in this document involve the processing, visualization, and interaction with the visualization of sonobuoy GPS positions. The sonobuoy information processing feature will analyze sonobuoy GPS data and ignore any erroneous entries. The visualization feature will provide users with an interface capable of displaying real time and previously collected sonobuoy GPS data.

Finally, the visualization interaction function will allow users to manipulate the way sonobuoy GPS data is displayed.

3.3 User Classes and Characteristics

3.3.1 Onshore User

An Onshore User refers to a user who has access to QuantumGPS's data-store of GPS text files. These users likely use ASVS in a QuantumGPS company office. Onshore users have access to all system features.

3.4 Operating Environment

ASVS must have access to either a live sonobuoy GPS stream or the QuantumGPS sonobuoy GPS data-store.

3.5 Design and Implementation Constraints

3.5.1 Data format

Information entering ASVS will strictly be GPRMC formatted text-files.

3.5.2 Time and Cost

Development must complete within three months and within a \$30,000 budget.

3.5.3 Maintenance and Modification

ASVS must be designed such that changes and updates to the source code can be made by QuantumGPS.

3.5.4 Security and Access

ASVS must be auditable by QuantumGPS. Additionally, it must be possible to link proprietary software from outside sources. GPS information must be classified and not exposed externally, thus the product must communicate only to known systems within a closed network.

3.6 Assumptions and Dependencies

3.6.1 Operating system

ASVS must be fully functional on Windows 7, 8, and 10.

3.6.2 Hardware environment

N/A

3.6.3 Assumptions

- Experiments are predefined by QuantumGPS containing all sonobuoy GPS data, experiment constraints, and location.

4 System Features

4.1 Visualize Live and Stored Experiments

Description and Priority

High Priority

It is difficult to perceive distance and motion of the sonobuoys on the water. As such, observing an ongoing experiment is challenging. By visualizing the location of the sonobuoys, conducting experiments will be easier.

Functional Requirements

4.1.1 FR1.1: View Previously Collected Sonobuoy Information

- **Derived Technical Requirement:**
Users must be able to view previously collected sonobuoy information.
- **Rationale:**
Users will need to access previously collected sonobuoy information in order to complete their data analysis.
- **Test Cases:**
TC#001, TC#002, TC#010, TC#017, TC#019, TC#021, TC#022

4.1.2 FR1.2: View Live Sonobuoy Information

- **Derived Technical Requirement:**
Users must be able to view live sonobuoy information.
- **Rationale:**
The majority of the analysis done by users will be on live experiments. To complete their data analysis, users must have access to live sonobuoy information
- **Test Cases:**
TC#001, TC#003, TC#0017, TC#019, TC#021, TC#022

4.1.3 FR1.3: View only valid GPS positions

- **Derived Technical Requirement:**
Invalid sonobuoy GPS positions are filtered such that it is not displayed in the visualization.

- **Rationale:**

It is important that the visualization is easy to understand and that users are not misled. As a result, Invalid sonobuoy GPS positions must be removed from the visualization.

- **Test Case:**

TC001, TC#002, TC#003, TC#010, TC#017, TC#019, TC#021, TC#022

4.2 Manipulate Visualizations

Description and Priority

Low Priority

In order for ASVS to be useful, the user must be able to manipulate and reorient the visualization.

Functional Requirements

4.2.1 FR2.1: Pan, Zoom, and Reorient

- **Derived Technical Requirement:**

Users must be able to pan, zoom, and reorient the ASVS visualization.

- **Rationale:**

As annotations, labels, and vectors are added to the ASVS visualization, the screen may become crowded with information. To better view specific sonobuoys or annotations on a crowded visualization, users must be able to zoom, pan, and reorient the visualization at their leisure.

- **Test Case:** TC#001, TC#002, TC#003, TC#004, TC#010, TC#017, TC#019, TC#021, TC#022

4.2.2 FR2.2: Toggle UI Elements and Sonobuoys

- **Derived Technical Requirement:**

Users must be able to optimize the visualization by toggling on and off user interface elements and sonobuoys.

- **Rationale:**

During data analysis, users may need view only sonobuoys or only user interface elements in order to complete the analysis efficiently.

- **Test Case:**

TC#001, TC#002, TC#003, TC#005, TC#006, TC#010, TC#017, TC#019, TC#021, TC#022

4.2.3 R2.3: Label Sonobuoys

- **Derived Technical Requirement:**

Users must be able rename sonobuoys to more memorable titles.

- **Rationale:**
Difficulty to distinguish between sonobuoys which can be mitigated by giving sonobuoys unique identifiers.
- **Test Cases:**
TC#001, TC#002, TC#003, TC#005, TC#007, TC#010, TC#011, TC#017, TC#019, TC#021, TC#022

4.3 Interpret Sonobuoy GPS Data from Visualizations

Description and Priority

Medium Priority

Functional Requirements

4.3.1 FR3.1: View GPS Coordinates, Cardinal Directions, and Metric Speed of Sonobuoys

- **Derived Technical Requirement:**
Users must be able to view GPS coordinates, cardinal directions, and speed in metric units sent directly from sonobuoys.
- **Rationale:**
GPS coordinates, cardinal directions, and metric speed of sonobuoys are critical to the data analysis done by users.
- **Test Cases:**
TC#001, TC#002, TC#003, TC#005, TC#006, TC#010, TC#017, TC#019, TC#020, TC#021, TC#022

4.3.2 FR3.2: View Relative Distances

- **Derived Technical Requirement:**
Users must be able to view relative distances between sonobuoys and fixed points.
- **Rationale:**
Relative distances between of sonobuoys and fixed points are critical to the data analysis done by users.
- **Test Cases:**
TC#001, TC#002, TC#003, TC#005, TC#008, TC#009, TC#010, TC#017, TC#019, TC#021, TC#022

4.4 Traverse Visualization of Experiment

Description and Priority

High Priority

Functional Requirements

4.4.1 FR4.1: Real Time Playback

- **Derived Technical Requirement:**
Users must be able to playback the visualization as though viewing it in real time.
- **Rationale:**
To be able to efficiently parse through sonobuoy information, users must be able to view previously collected sonobuoy information in a playback format.
- **Test Case:**
TC#001, TC#002, TC#010, TC#019, TC#021, TC#022

4.4.2 FR4.2: Pause and Resume Playback

- **Derived Technical Requirement:**
Users must be able to pause and resume the visualization playback.
- **Rationale:**
During data analysis, users may want to view sonobuoy information from a specific time. To do this, the user must be able to pause the playback of previously collected sonobuoy information.
- **Test Cases:**
TC#001, TC#002, TC#010, TC#011, TC#012, TC#019, TC#021, TC#022

4.4.3 FR4.3: Change Playback Speed

- **Derived Technical Requirement:**
Users must be able to change the speed at which they view the visualization playback.
- **Rationale:**
In order to analyze data over a longer period of time, users need to view sonobuoy information playback at a speed much faster than the default playback speed.
- **Test Case:**
TC#001, TC#002, TC#010, TC#013, TC#019, TC#021, TC#022

4.5 Annotate within Visualizations

Description and Priority

Low Priority

Documenting locations and events is important to QuantumGPS's experiments, therefore users must be able to make annotations on experiment visualizations.

Functional Requirements

4.5.1 FR5.1: Annotations

- **Derived Technical Requirement:**
Users must be able to create, edit, and delete annotations.
- **Rationale:**
While conducting data analysis, a user may need to label a specific point on the ASVS visualization.
- **Test Cases:**
TC#001, TC#002, TC#003, TC#005, TC#010, TC#014, TC#015, TC#016, TC#017, TC#019, TC#021, TC#022

5 External Interface Requirements

5.1 EIR1.1: Software Interfaces

- **Derived Technical Requirement:**
ASVS must operate on the Windows 7, 8, and 10 operating systems.
- **Rationale:**
The existing computers owned by Quantum GPS run on Windows 7 and 8, and 10.
- **Test Cases:**
TC#021

5.2 EIR1.2: Communications Interfaces

- **Derived Technical Requirement:**
ASVS must be able to track sonobuoys by pulling GPRMC text files from QuantumGPS's datastore.
- **Rationale:**
Sonobuoy information is sent from buoys and then put in QuantumGPS's datastore. As a result, the information must be accessed through the datastore.
- **Test Cases:**
TC#022

6 Non-Functional Requirements

6.1 Performance Requirements

6.1.1 NFR1.1: Visualization Speed

- **Derived Technical Requirement:**
Visualization must occur in less than 5 seconds.

- **Rationale:**
New sonobuoy positions are made available once every 5 seconds, meaning that visualization must occur within 5 seconds in order to avoid falling behind.
- **Test Case:**
TC#017

6.2 Software Quality Attributes

6.2.1 NFR2.1: The product must be maintainable.

- **Derived Technical Requirement:**
ASVS must score greater than 60 on the Maintainability Index.
- **Rationale:**
It is important that ASVS can be changed by QuantumGPS in the future as they develop. A high score on the maintainability index will ensure that that is the case.
- **Test Case:**
TC#018

6.2.2 NFR2.2: GPS Information must be easy to understand

- **Derived Technical Requirement:**
The users do not need prior knowledge of GPRMC to visualize sonobuoy information.
- **Rationale:**
GPRMC is a technical format and is not easily understandable by users.
- **Test Case:**
TC#023

7 Data Flow and Context Diagrams

7.1 Context Diagram

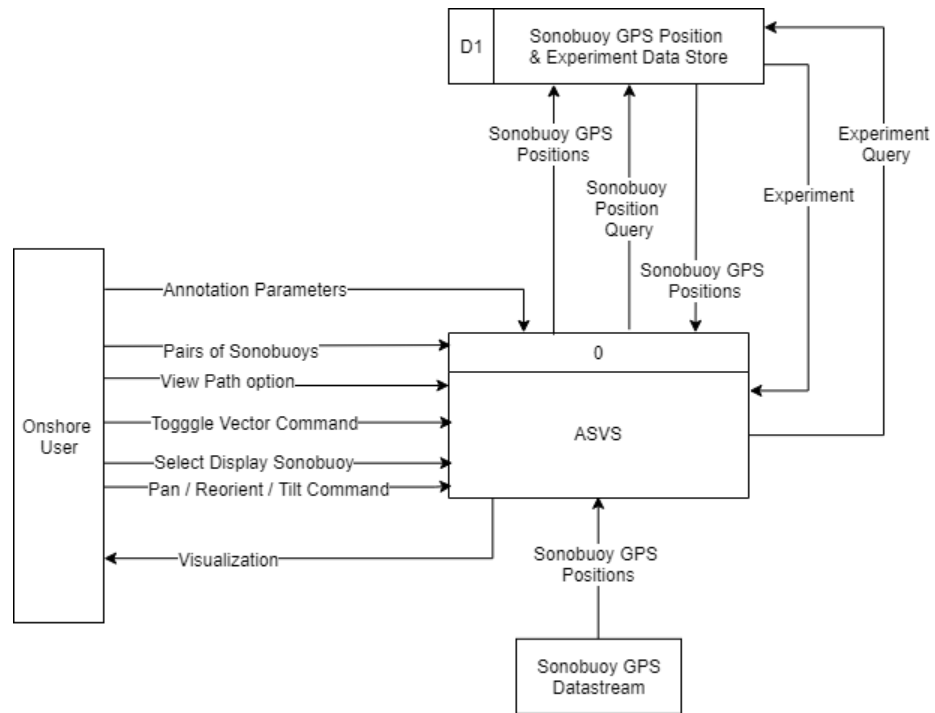


Figure 1: Data Flow Diagram 0

7.2 DFD 1

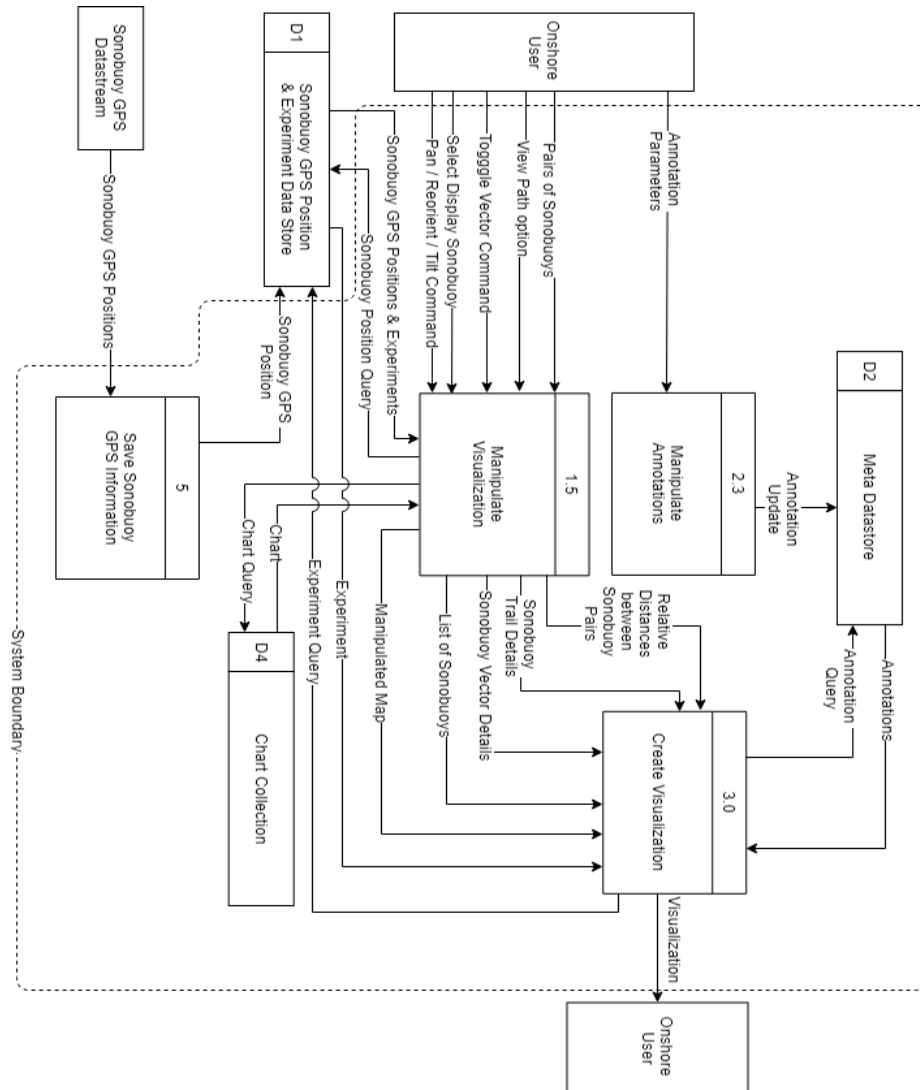


Figure 2: Data Flow Diagram 1

7.3 DFD 2

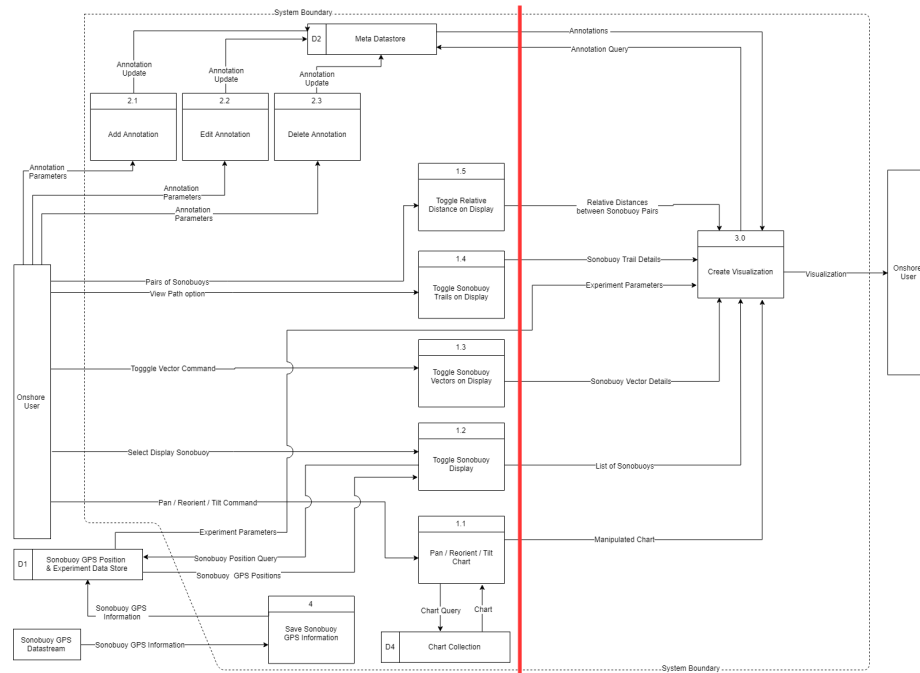


Figure 3: Data Flow Diagram 2 - Overview

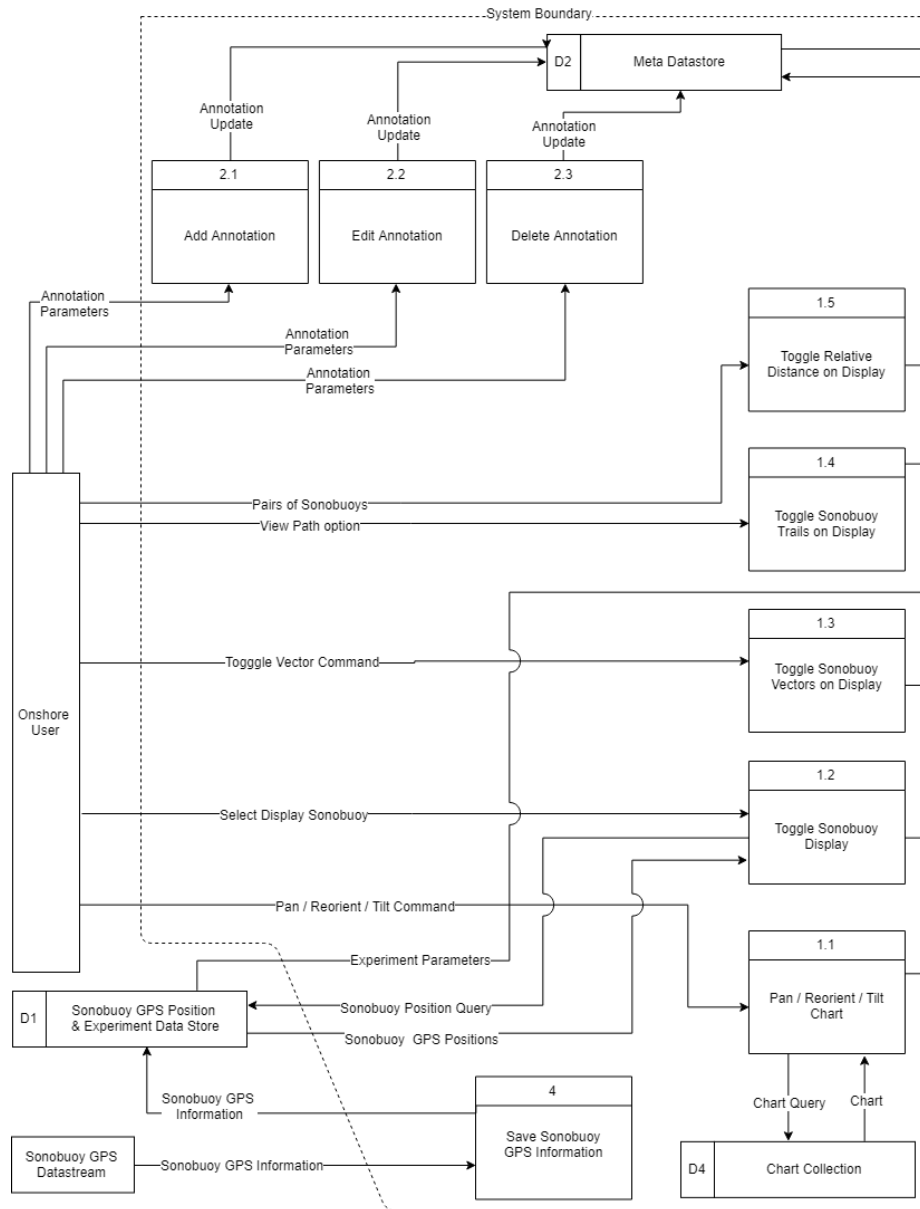


Figure 4: Data Flow Diagram 2 - Left

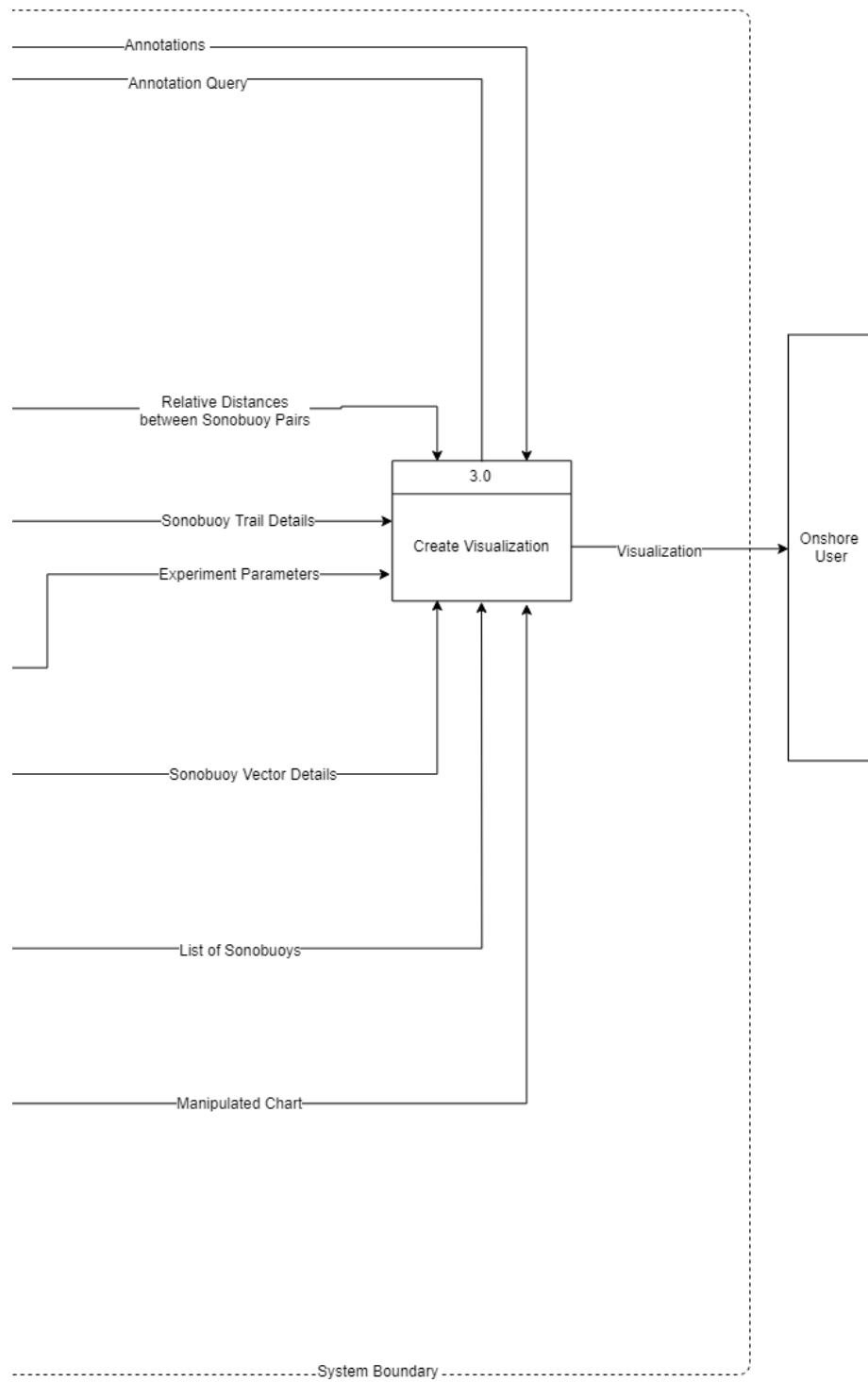


Figure 5: Data Flow Diagram 2 - Right

8 Entity Relationships and Data Dictionary

Our system is built upon 3 entities: Sonobuoys, Experiments, and Annotations. Sonobuoys are described by a set of GPS Coordinates, a speed, and a heading. Experiments are defined outside of our system, but they consist of a Date, Time, a list of Sonobuoys involved, and a list of Annotations. Annotations are made on a GPS Coordinate and have a description (eg. rock here).

Up to 16 Sonobuoys can be in use at any one given time, thus a maximum of 16 Sonobuoys can be involved in any given experiment, additionally experiments must involve at least one Sonobuoy. Sonobuoys have GPS Coordinates, as well as have information as to their speed and heading. Annotations are made on GPS Coordinates and have a description describing an event or observation.

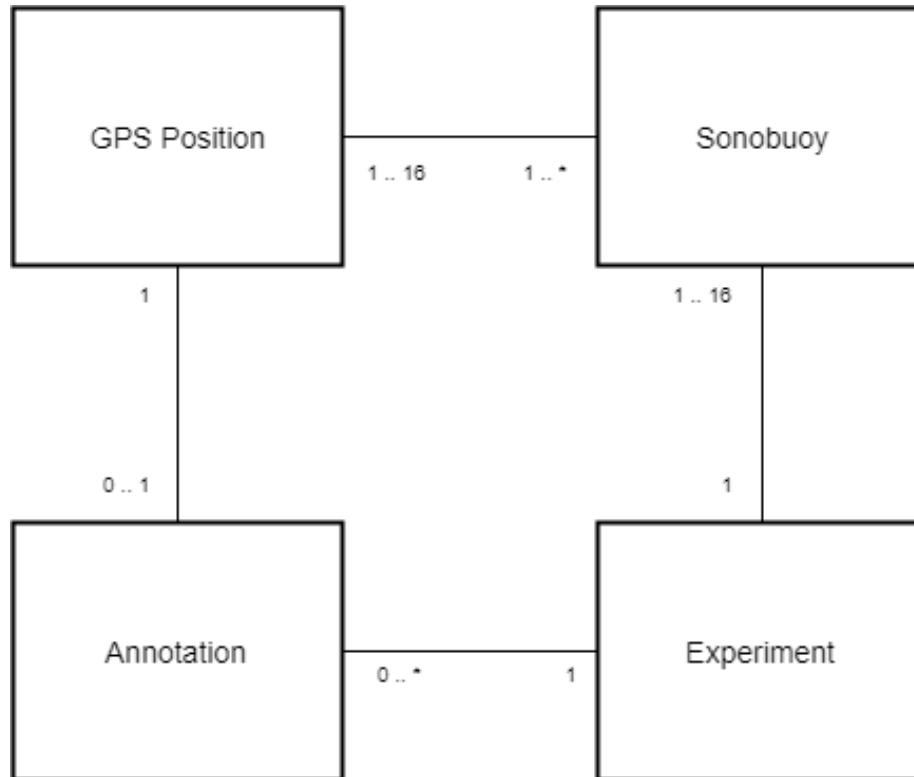


Figure 6: Entity Relationship Diagram

Datatype	Description	Primary Key
Sonobuoy	Sonobuoy ID, GPS Coordinates, Speed, Heading	Sonobuoy ID
Annotation	Annotation ID, GPS Coordinates, Description	Annotation ID
Experiment	Date, Time, List of Sonobuoys, List of Annotations	Date, Time, List of Sonobuoys
GPS Coordinates	Latitude, Longitude	Latitude, Longitude

Table 1: Data Dictionary

9 Use Cases

9.1 Use Case Model

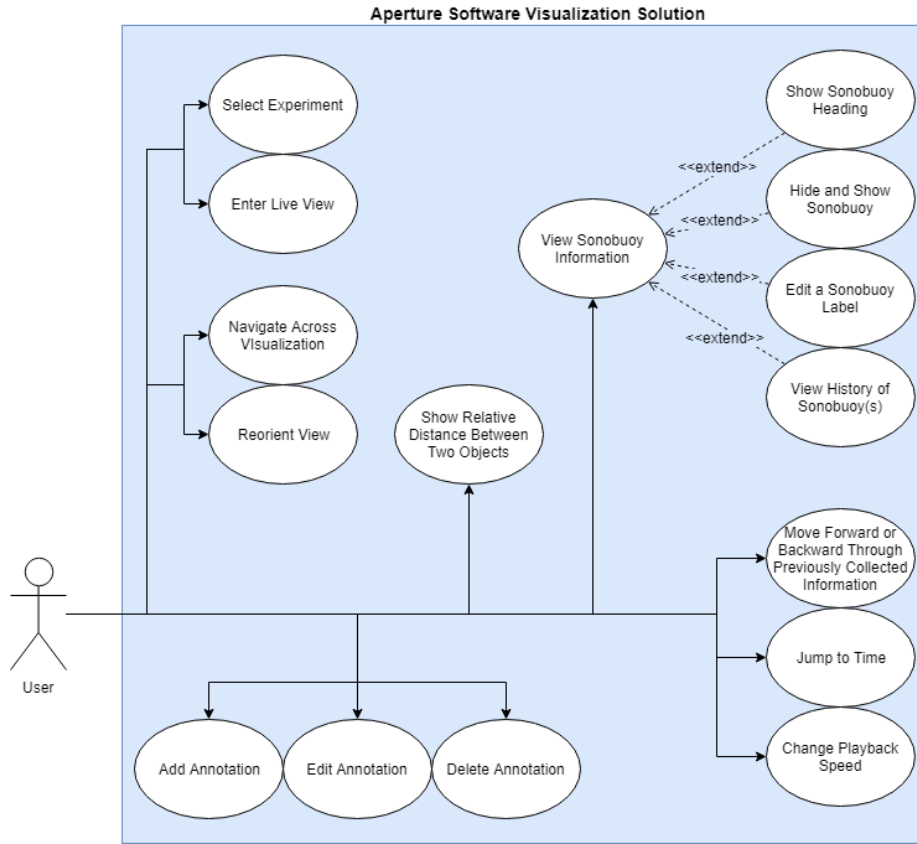


Figure 7: Use Case Model

9.2 Select Experiment

Actors	User
Preconditions	<ul style="list-style-type: none"> The user is on the home page
Steps	<ol style="list-style-type: none"> The user selects the experiment they wish to view The user is shown the map view of the experiment
Success Conditions	<ul style="list-style-type: none"> The selected experiment is visible in map view mode
Alternate Paths	<ol style="list-style-type: none"> a) The user enters a name to narrow down the list of experiments b) The display updates to show only relevant experiments

Table 2: Select Experiment Use Case Table

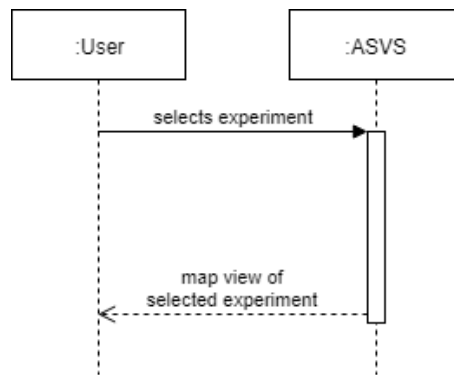
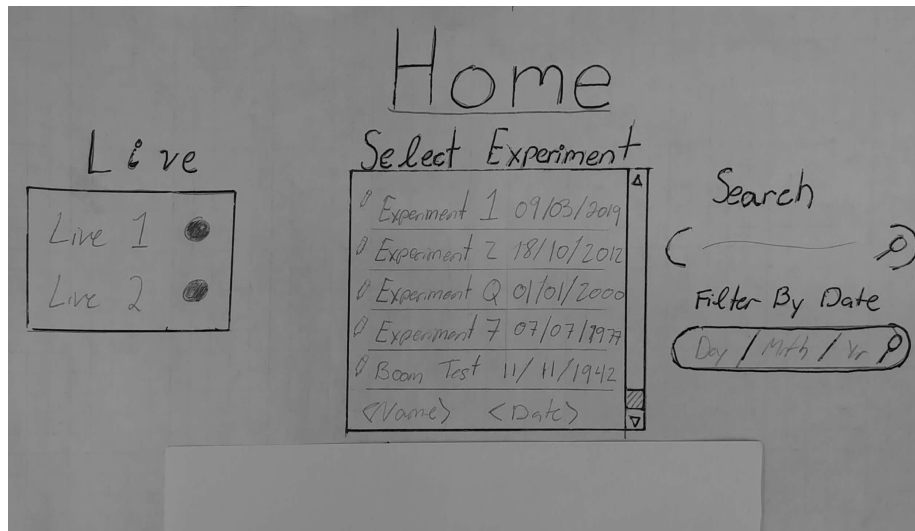


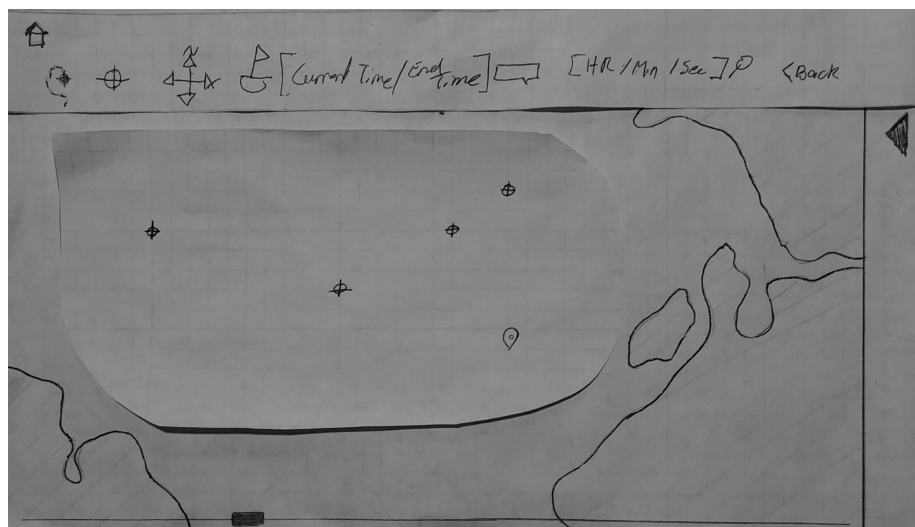
Figure 8: Select Experiment Sequence Diagram

9.2.1 View experiment 3

The user is viewing the home page and selects Experiment 3



The user is brought into view mode with Experiment 3 showing on the screen.



9.3 Enter Live View

Actors	User
Preconditions	<ul style="list-style-type: none"> • There is an experiment currently being performed • The user is viewing an experiment viewing previously collected data for a currently running experiment
Steps	<ol style="list-style-type: none"> 1. The user selects the live button 2. The display updates to show live data
Success Conditions	<ul style="list-style-type: none"> • The display is updated to be in real time viewing mode
Alternate Paths	N/A

Table 3: Transition from historical view to live view Use Case Table

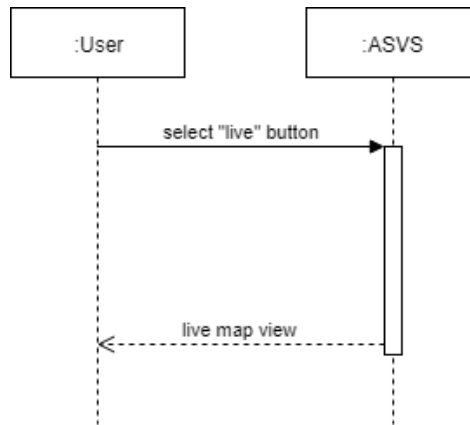
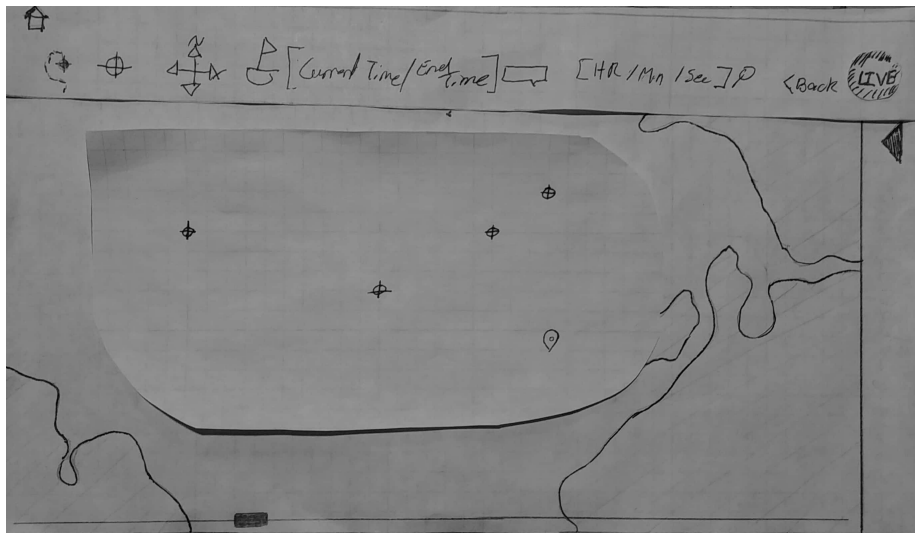


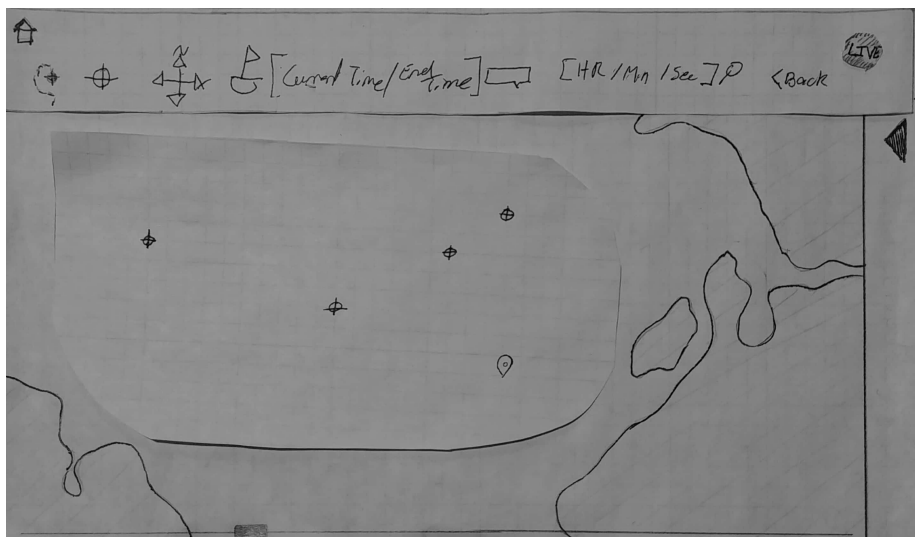
Figure 9: Transition from historical view to live view Sequence Diagram

9.3.1 Move from historical to live view

User clicks the the greyed out live button



Visualization begins showing live updates of sonobuoy positions



9.4 Navigate Across Visualization

Actors	User
Preconditions	<ul style="list-style-type: none"> The user is viewing an experiment
Steps	<ol style="list-style-type: none"> The user selects the "zoom in" option The display is updated with a zoomed-in visualization The user selects the "zoom out" option The display is updated with a zoomed-out visualization The user selects the "pan" option The display is updated with a panned visualization
Success Conditions	<ul style="list-style-type: none"> The display and map successfully pans and zooms in response to the user's input
Alternate Paths	<ol style="list-style-type: none"> 2. b) The display does not zoom in further as it has reached its limit. 4. b) The display does not zoom out further as it has reached its limit. 6. a) The visualization does not move because it has reached its boundary

Table 4: Pan and Zoom Use Case Table

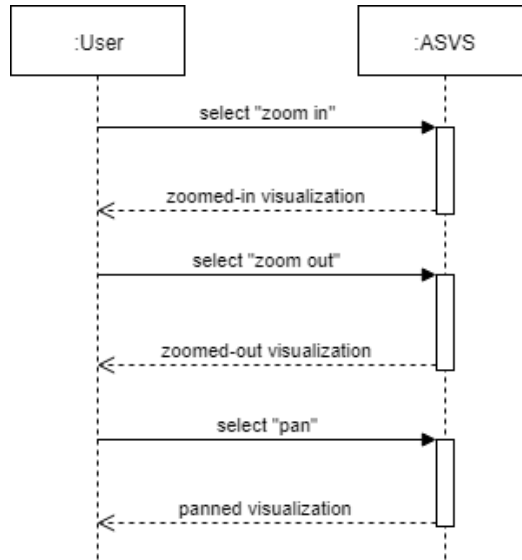
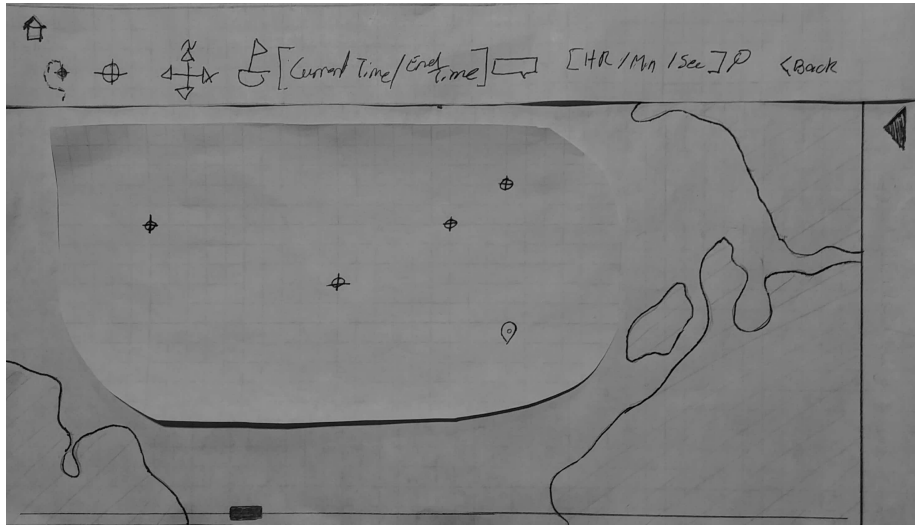
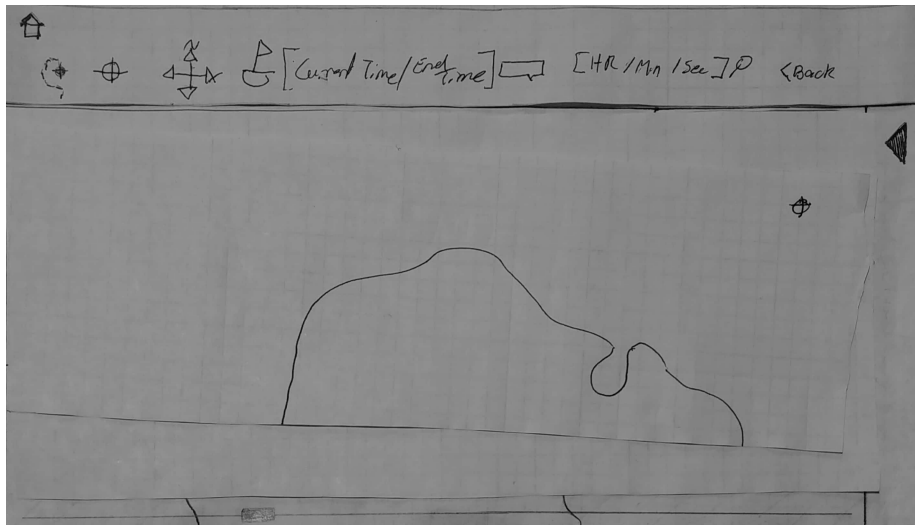


Figure 10: Pan and Zoom Sequence Diagram

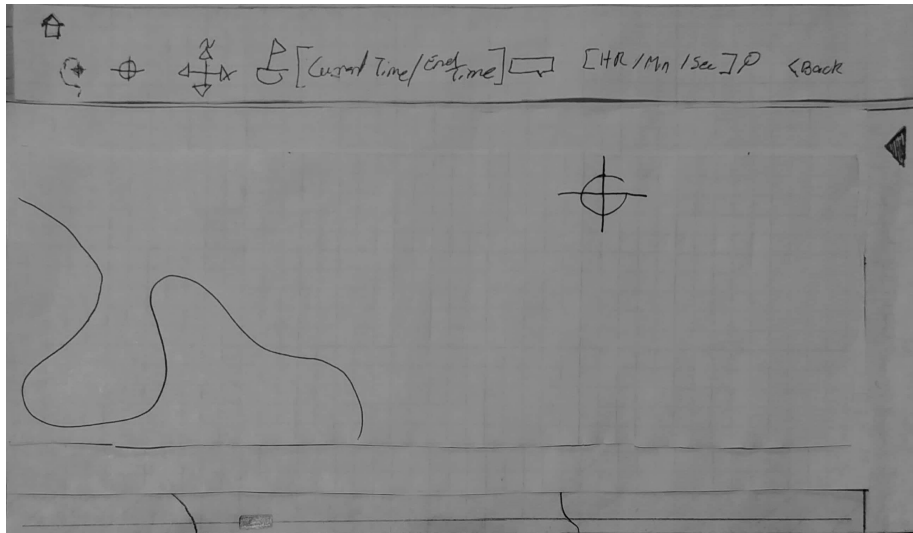
9.4.1 Move right and zoom



User drags left



User scrolls upwards



9.5 Reorient Visualization

Actors	User
Preconditions	<ul style="list-style-type: none"> • The compass rose is toggled ON • The user is viewing an experiment
Steps	<ol style="list-style-type: none"> 1. The user selects the reorient option. 2. The display updates to show a reoriented view of the map
Success Conditions	<ul style="list-style-type: none"> • The map successfully reorients and returns to the default orientation
Alternate Paths	N/A

Table 5: Reorient Use Case Table

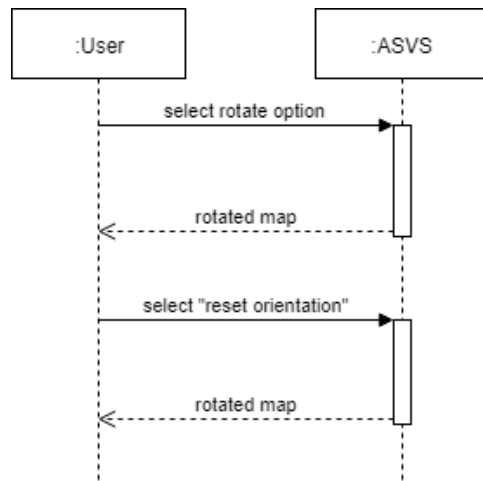
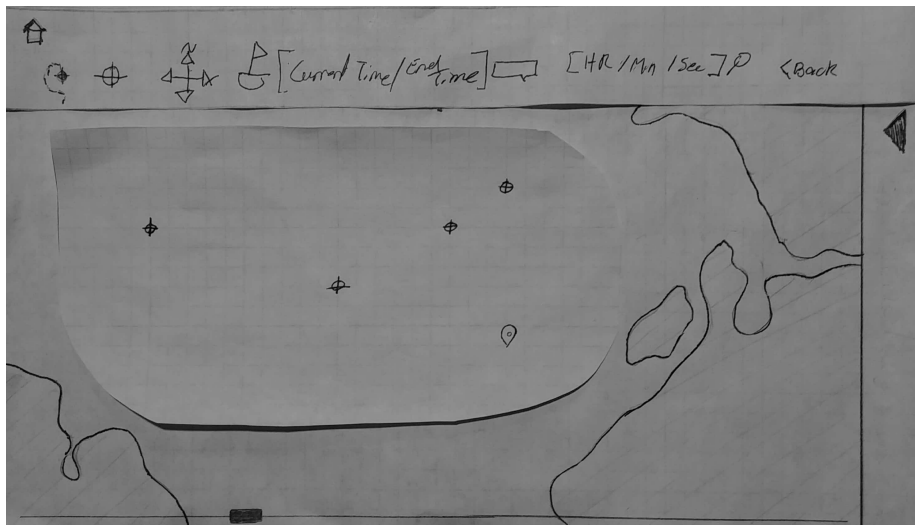


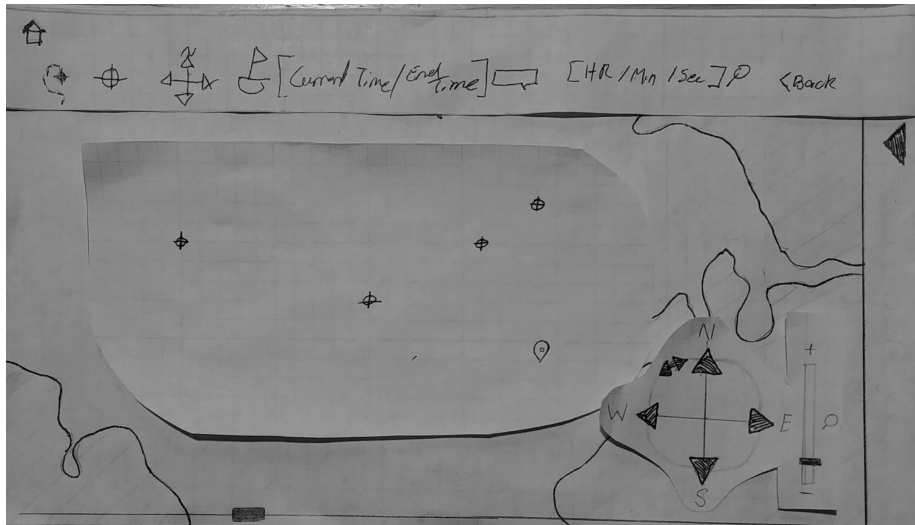
Figure 11: Reorient Sequence Diagram

9.5.1 Reorient

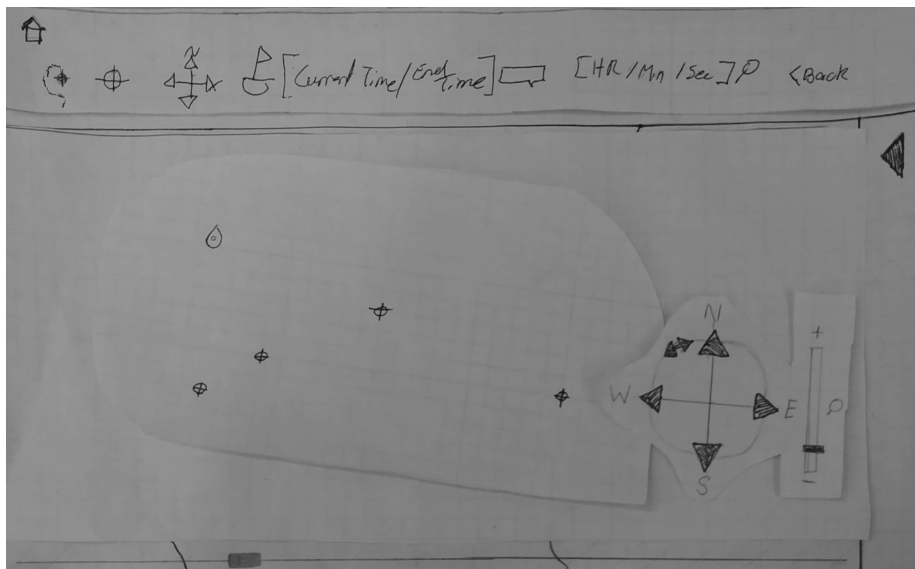
User toggles the compass rose



User drags the rerorient arrow



Map reorients



9.6 View Sonobuoy Information

Actors	User
Preconditions	<ul style="list-style-type: none"> The user is viewing an experiment
Steps	<ol style="list-style-type: none"> The user selects a sonobuoy The display updates to show information for the selected sonobuoy
Success Conditions	<ul style="list-style-type: none"> The sonobuoy GPS position and the speed of the sonobuoy are displayed under the sonobuoy name.
Alternate Paths	This is an extension point for several other use cases

Table 6: View a Sonobuoy Position and Speed Use Case Table

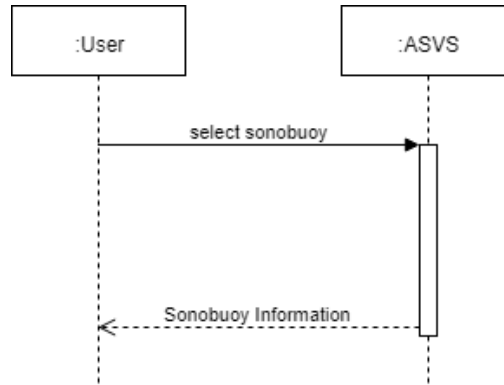
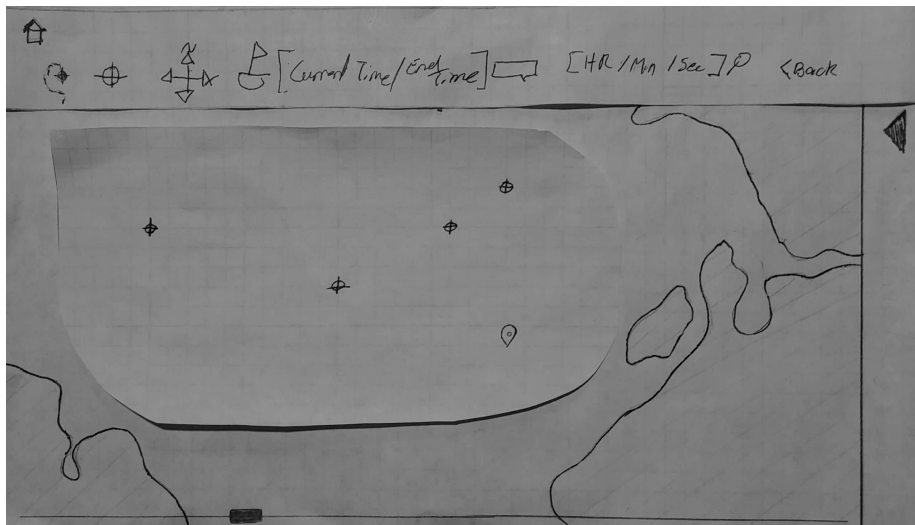


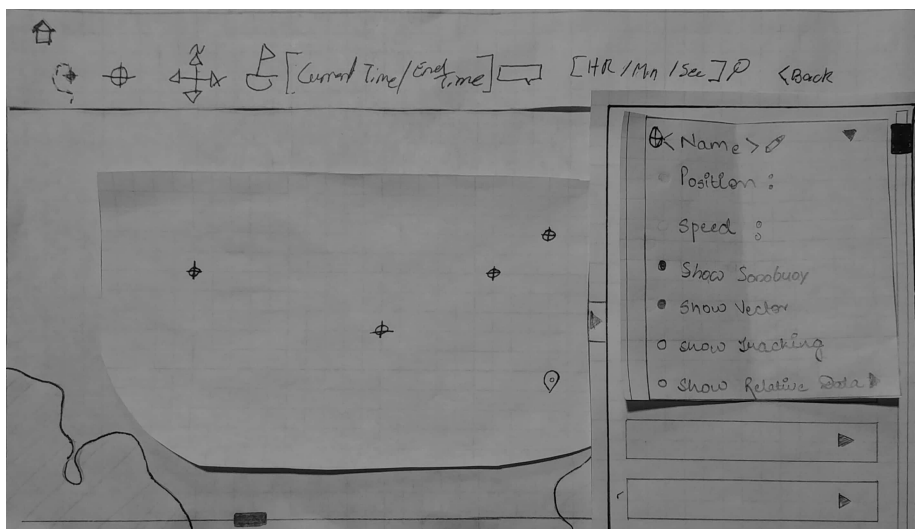
Figure 12: View a Sonobuoy Position and Speed Sequence Diagram

9.6.1 Label Sonobuoy

The user is in the map view



The user clicks on a sonobuoy and the sidebar is opened with the sonobuoy opened.



9.7 Edit a Sonobuoy Label

Actors	User
Preconditions	<ul style="list-style-type: none"> The user is viewing an experiment
Steps	<ol style="list-style-type: none"> <i>Extends Use Case 9.6</i> The user selects the sonobuoy's "name" The user enters a new name The display is updated to show an updated sonobuoy label
Success Conditions	<ul style="list-style-type: none"> The name of the sonobuoy is updated
Alternate Paths	N/A

Table 7: Label a Sonobuoy Use Case Table

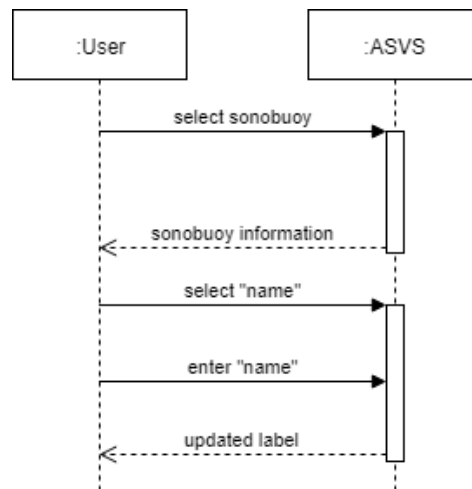
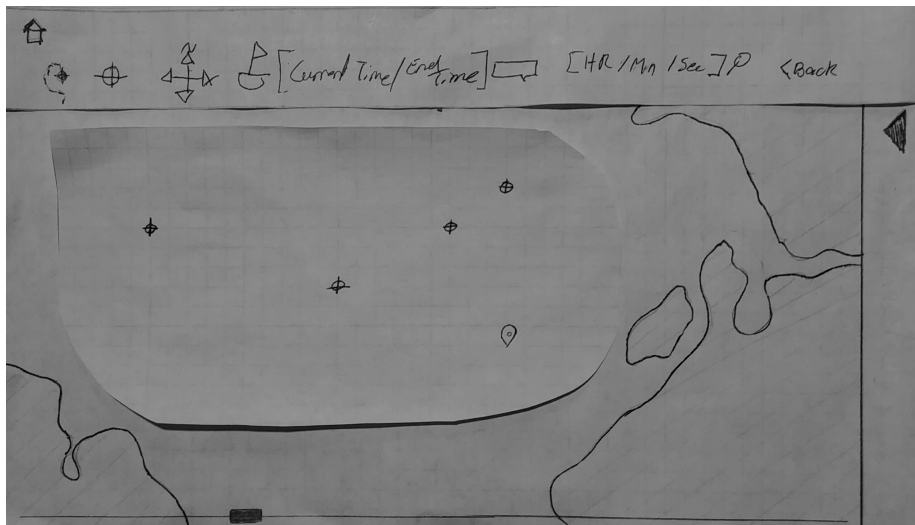


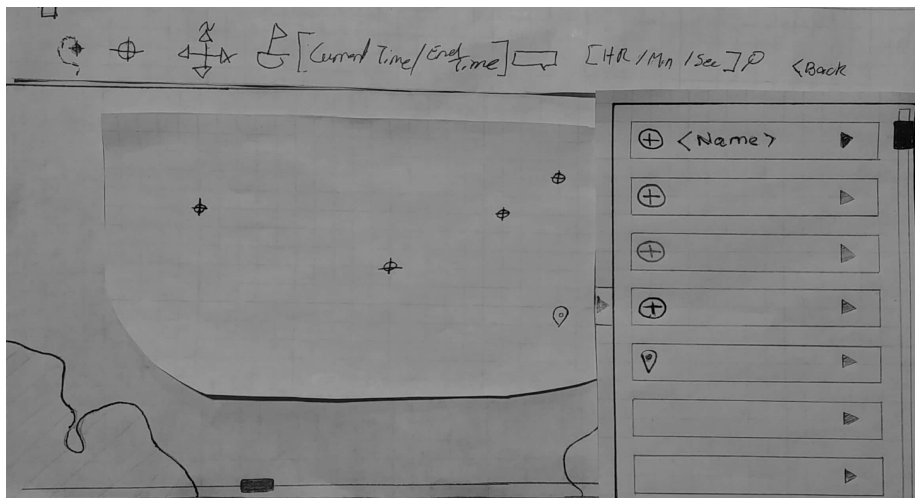
Figure 13: Label a sonobuoy Sequence Diagram

9.7.1 Edit a Sonobuoy Label

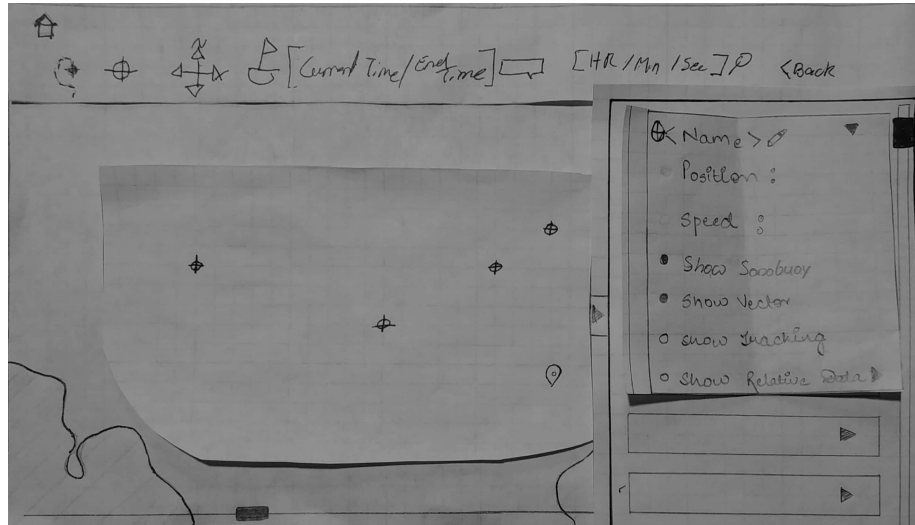
Open the sidebar



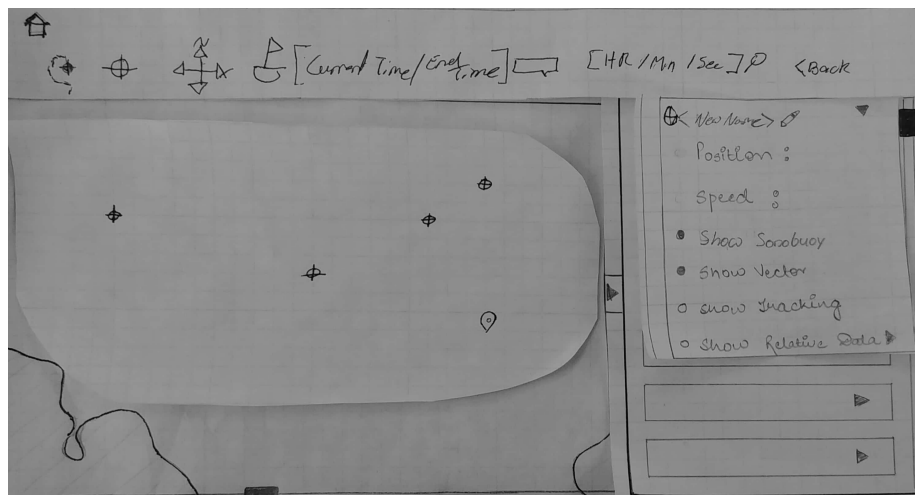
Select a sonobuoy



Click the current name and enter new a label



New name is saved and displayed



9.8 Hide and Show Sonobuoy

Actors	User
Preconditions	<ul style="list-style-type: none"> The user is viewing an experiment
Steps	<ol style="list-style-type: none"> <i>Extends Use Case 9.6</i> The user selects “Hide sonobuoy” option Display is updated to hide the selected sonobuoy
Success Conditions	<ul style="list-style-type: none"> Selected sonobuoy is hidden
Alternate Paths	<ol style="list-style-type: none"> a) Sonobuoy is already hidden, and display updates to reveal the sonobuoy

Table 8: Toggle Sonobuoy Display Use Case Table

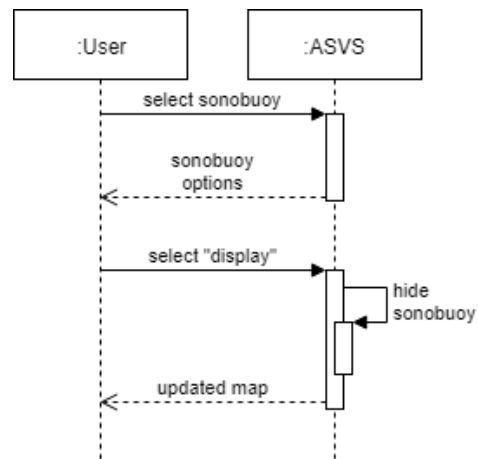
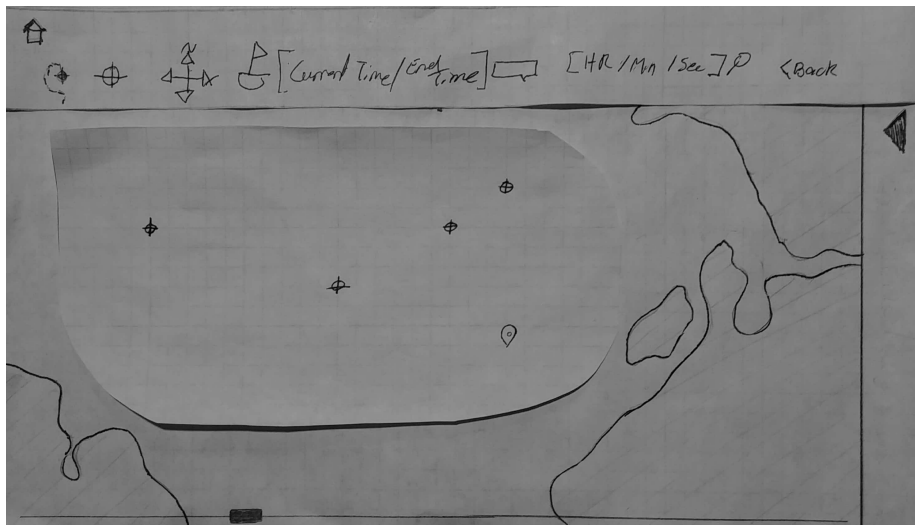
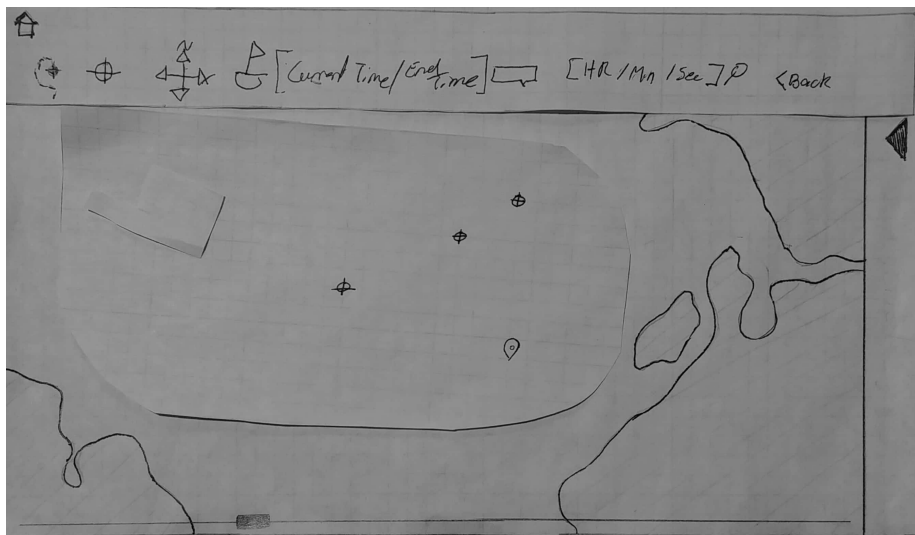


Figure 14: Toggle Sonobuoy Display Sequence Diagram

Select the right three sonobuoys



Select hide option, the left sonobuoy is hidden



9.9 View History of Sonobuoy(s)

Actors	User
Preconditions	<ul style="list-style-type: none"> The user is viewing an experiment
Steps	<ol style="list-style-type: none"> <i>Extends Use Case 9.6</i> The user toggles “Show Tracking” on or off The display is updated to show movement line(s)
Success Conditions	<ul style="list-style-type: none"> Movement line(s) are displayed
Alternate Paths	N/A

Table 9: Show Movement Lines Use Case Table

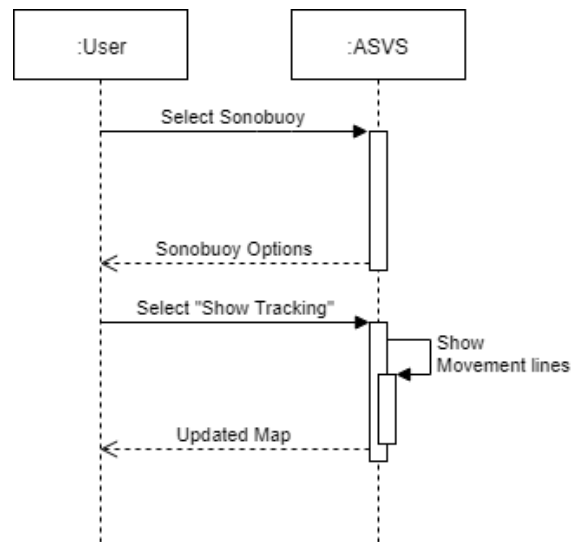
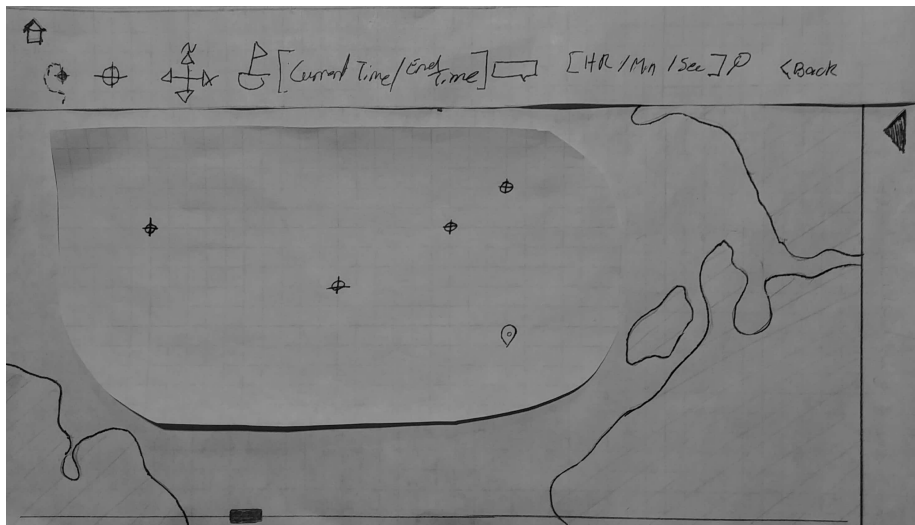


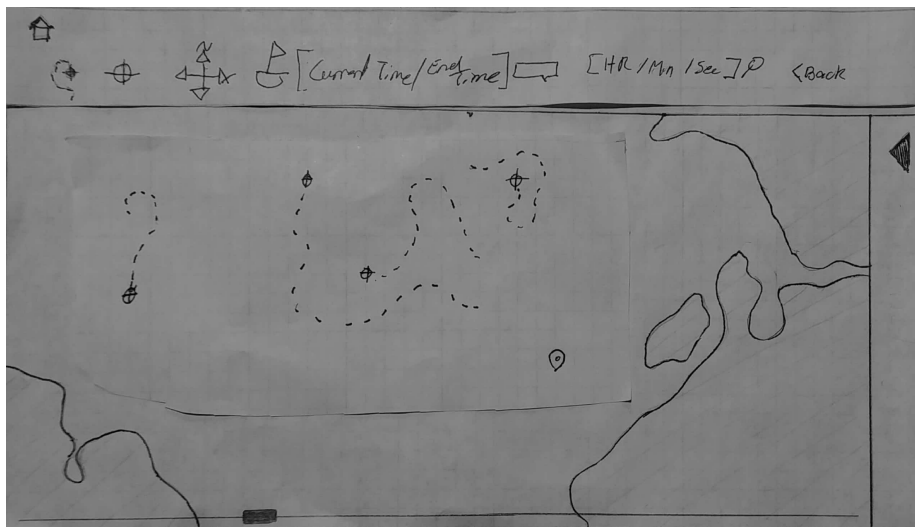
Figure 15: Show Movement Lines Sequence Diagram

9.9.1 Use map toolbar to toggle tracking line

User clicks the toggle tracking button in the menu toolbar



Tracking is displayed



9.10 Show Sonobuoy Heading

Actors	User
Preconditions	<ul style="list-style-type: none"> • The user is in map view • The user has the sidebar open
Steps	<ol style="list-style-type: none"> 1. <i>Extends Use Case 9.6</i> 2. The user selects the toggle vector option 3. The display is updated to show sonobuoy heading
Success Conditions	• Arrows appear beside Sonobuoys showing direction
Alternate Paths	N/A

Table 10: Toggle Sonobuoy Vector Use Case Table

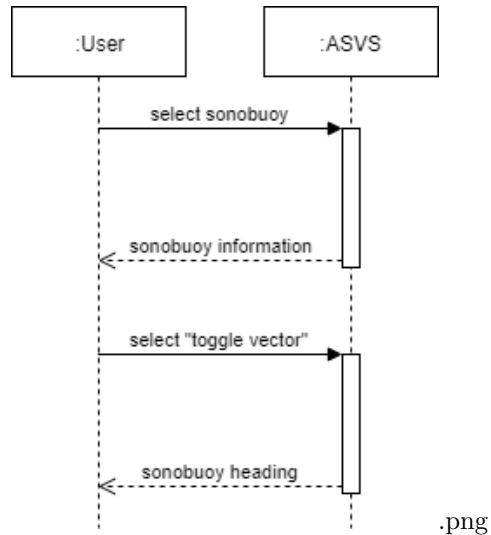
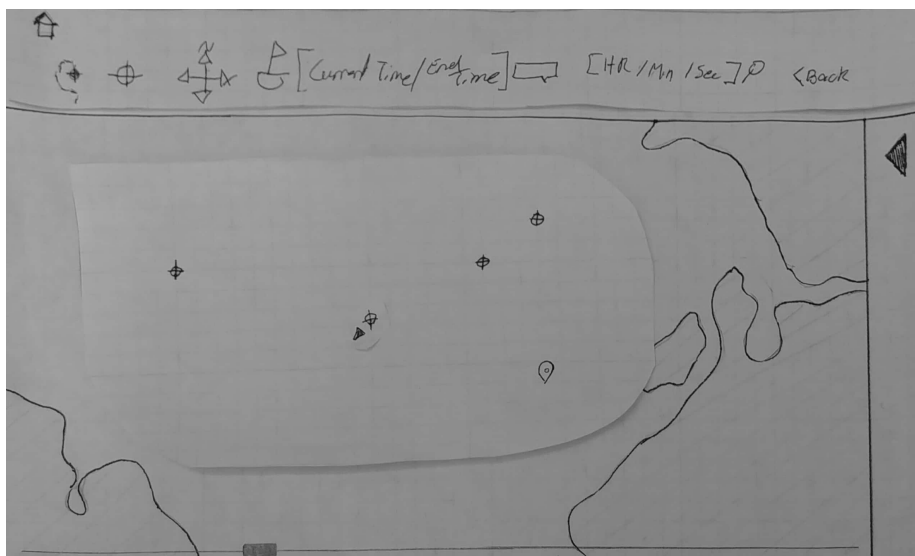
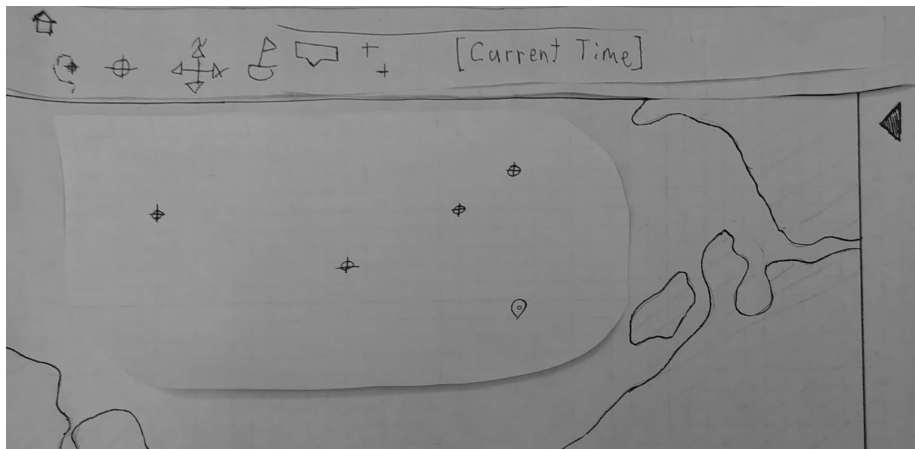


Figure 16: Toggle Sonobuoy Vector Sequence Diagram

9.10.1 Toggle Vector On

User selects the toggle vector option Vectors of sonobuoys are now visible



9.11 Show Relative Distance Between Two Objects

Actors	User
Preconditions	<ul style="list-style-type: none"> • There are at least two valid elements • The user is viewing an experiment • The user has selected a sonobuoy or annotation
Steps	<ol style="list-style-type: none"> 1. The user expands the “Relative Data” Tab 2. The user selects the compare button 3. The user selects a second sonobuoy or annotation 4. The display updates to show lines connecting the objects with each other
Success Conditions	<ul style="list-style-type: none"> • A line with a description of relative speed and position is displayed.
Alternate Paths	N/A

Table 11: Show Relative Distance Between Two Objects Use Case Table

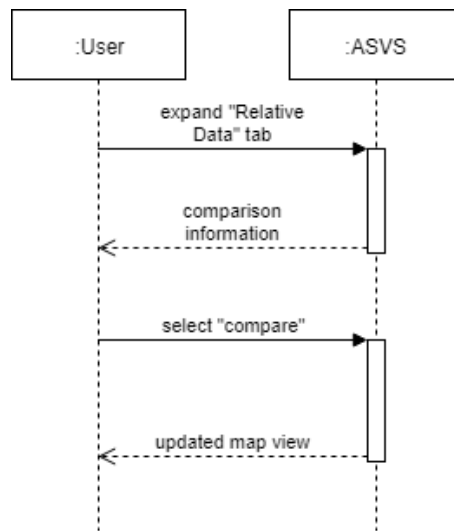
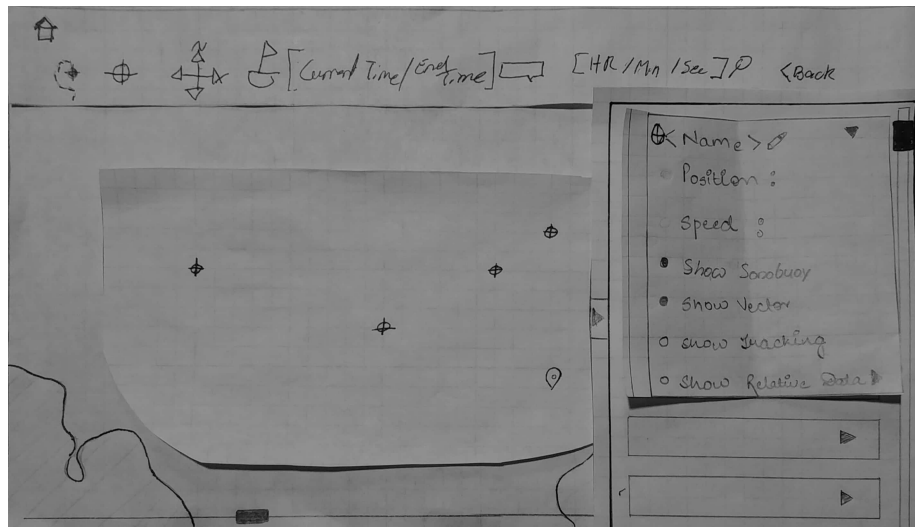


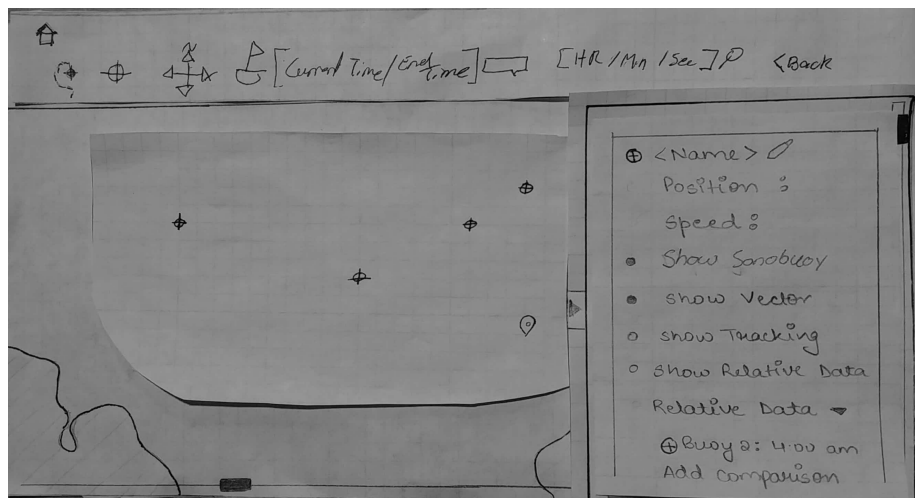
Figure 17: Show Relative Distance Between Two Object Sequence Diagram

9.11.1 Display distance between two sonobuoys

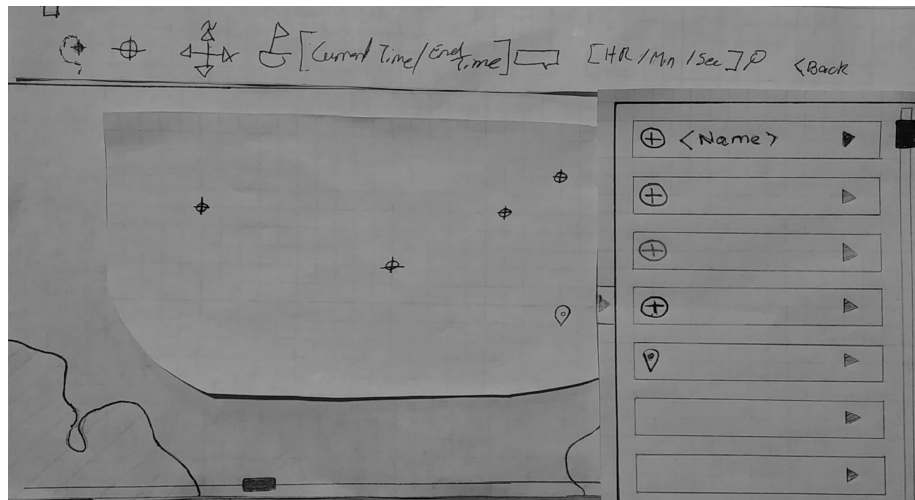
User expands the "Show Relative Data" tab



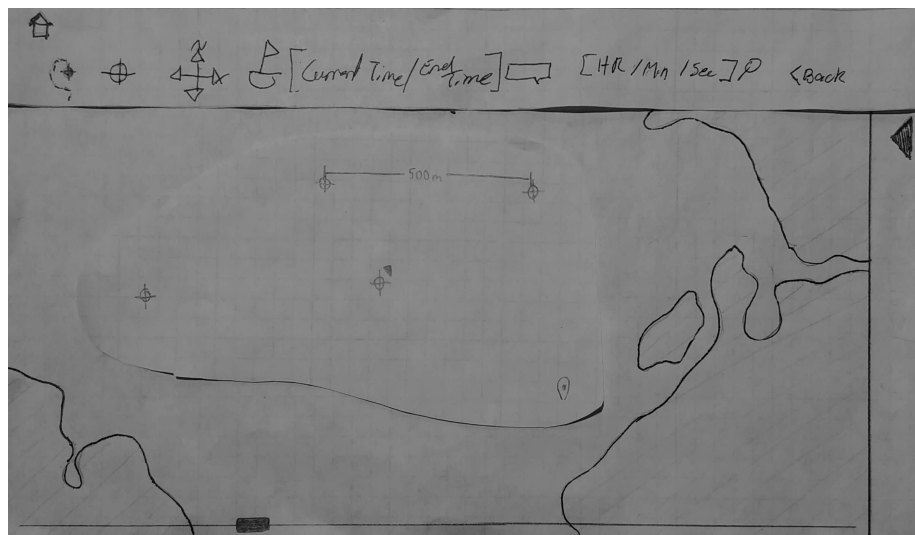
User Clicks the "Add Comparison" button



User selects a sonobuoy or annotation



Display Relative Data



9.12 Move Forward or Backward Through Previously Collected Information

Actors	User
Preconditions	<ul style="list-style-type: none"> • The user is viewing previously collected data • The user is viewing an experiment
Steps	<ol style="list-style-type: none"> 1. The user selects the “skip forward” option 2. The data displayed moves forward by 20 seconds 3. The user selects the “skip backwards” option 4. The data displayed moves backwards by 20 seconds
Success Conditions	<ul style="list-style-type: none"> • The display jumps forwards and backwards in time successfully
Alternate Paths	<ol style="list-style-type: none"> 2. a) The information displayed does not move forward by less than 20 seconds because they are less than 20 seconds behind live data 4. a) The information displayed moves backwards by less than 20 seconds because the user is less than 20 seconds from the beginning of the previously collected data.

Table 12: Move Forward or Backward through Previously Collected Data Use Case Table

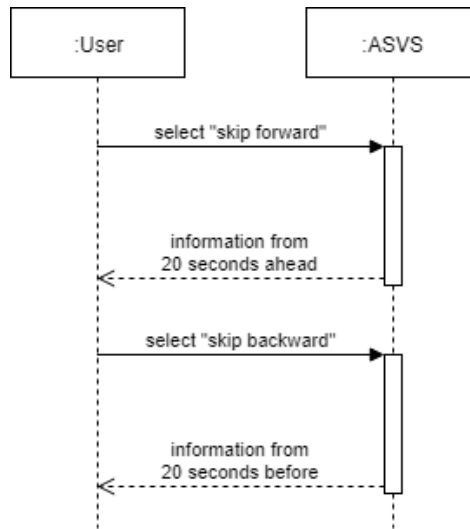
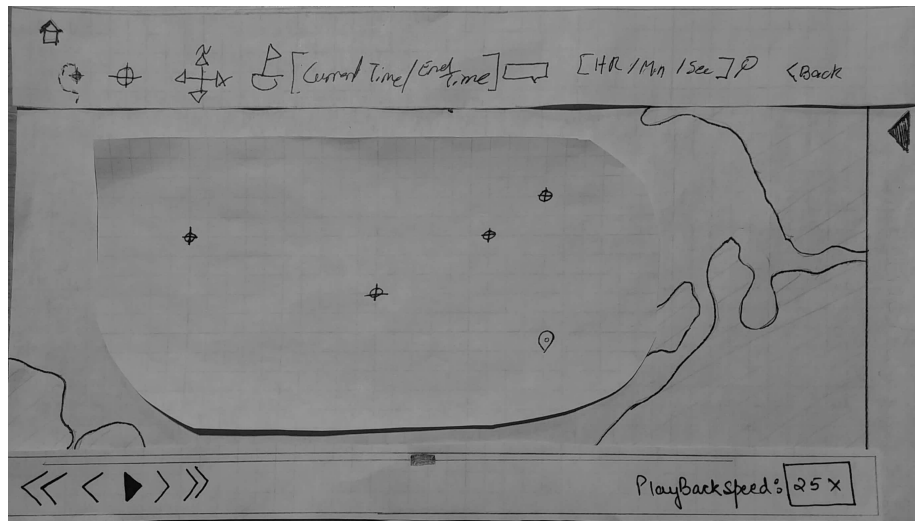


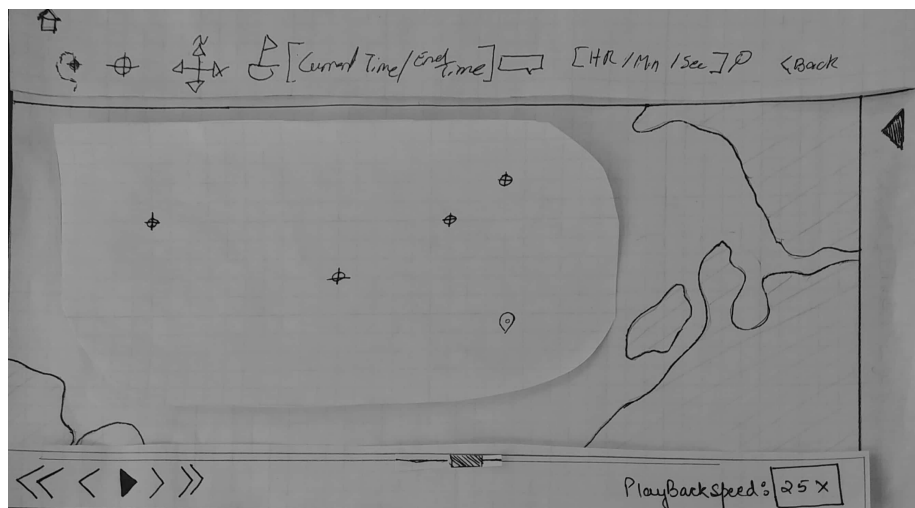
Figure 18: Move Forward or Backward through Previously Collected Data Sequence Diagram

9.12.1 Move forward through previously selected data

User selects the move forward arrow.



The playback moves forward by 20 seconds



9.13 Jump to Time

Actors	User
Preconditions	<ul style="list-style-type: none">• The user is viewing an experiment• The user is viewing previously collected data
Steps	<ol style="list-style-type: none">1. The user selects the “jump to timestamp” field2. The user enters time they want to select
Success Conditions	<ul style="list-style-type: none">• Display updates to show a map view for the entered time
Alternate Paths	N/A

Table 13: Jump to Time Sequence Diagram Use Case Table

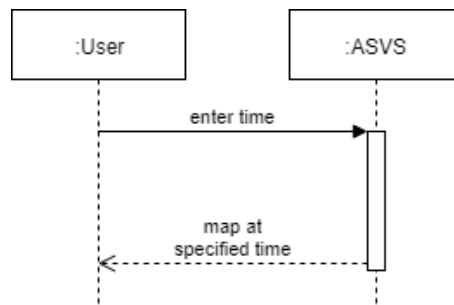
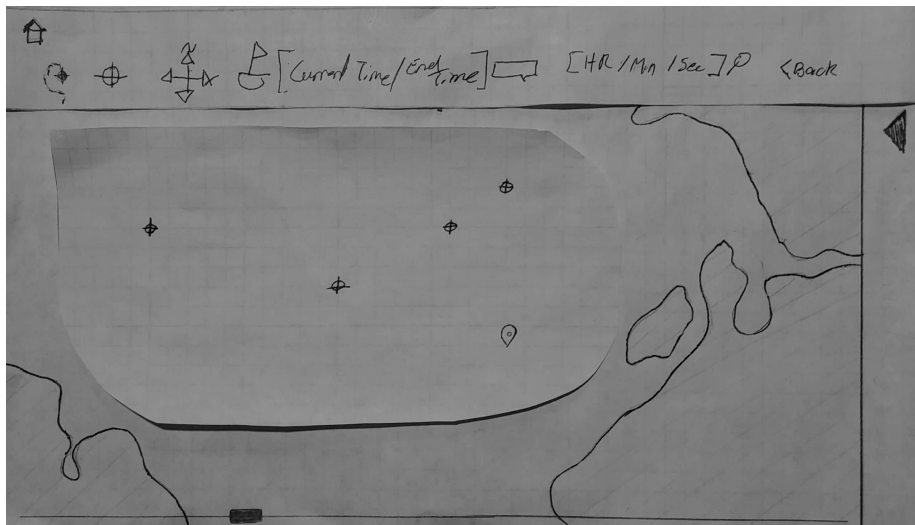


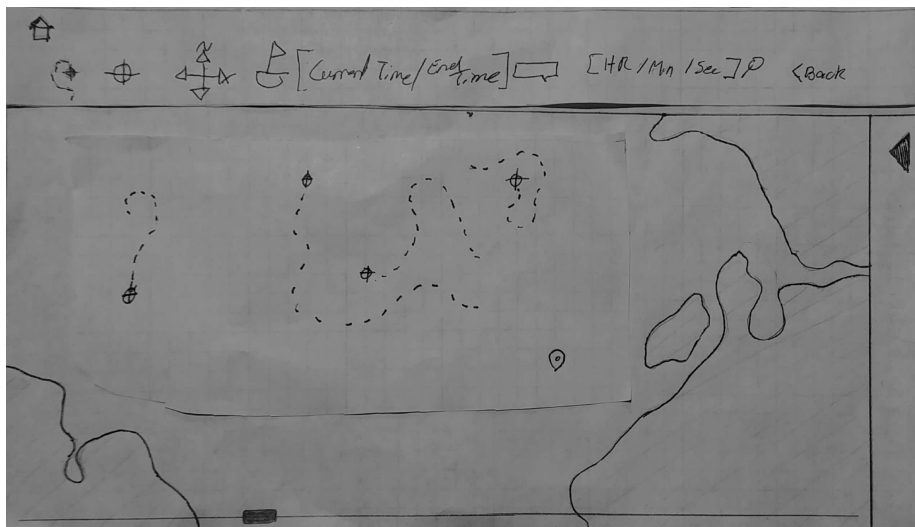
Figure 19: Jump to Time Sequence Diagram

9.13.1 Jump to time

The user is viewing historical data.



The user enters a time and jumps the later time.



9.14 Change Playback Speed

Actors	User
Preconditions	<ul style="list-style-type: none"> The user is viewing previously collected data
Steps	<ol style="list-style-type: none"> The user selects “playback speed” The user is shown multiple options for playback speed, such as 1x, 2x, 10x, and 25x The user selects a playback speed “Playback speed” field changes to reflect the user’s selected option
Success Conditions	<ul style="list-style-type: none"> When information is played back, it will be at the selected speed until changed
Alternate Paths	N/A

Table 14: Change Playback Speed Use Case Table

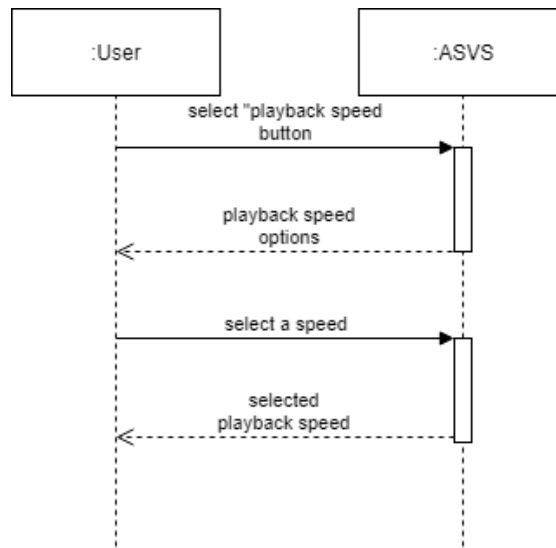
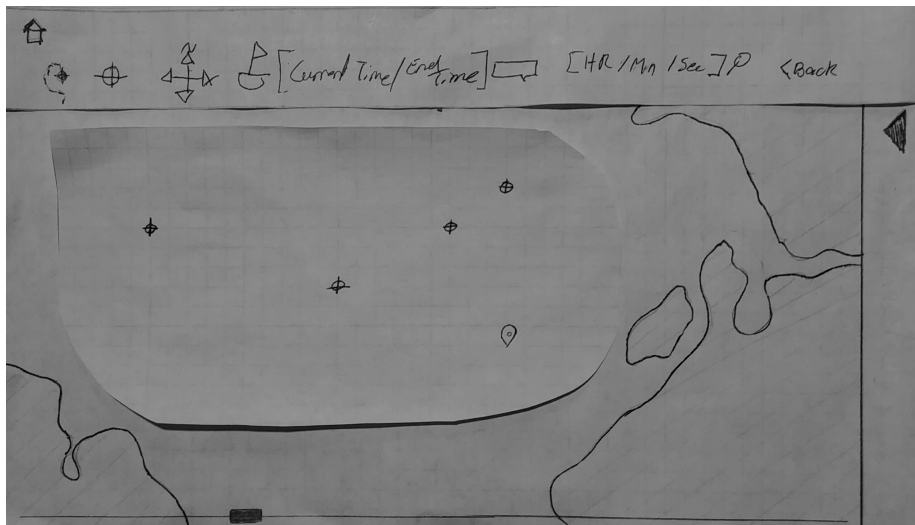


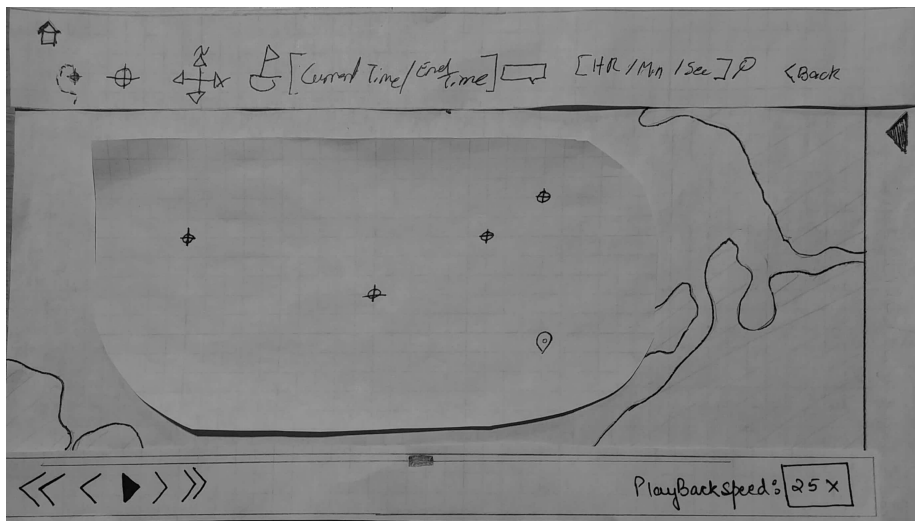
Figure 20: Change Playback Speed Sequence Diagram

9.14.1 Change speed to x10

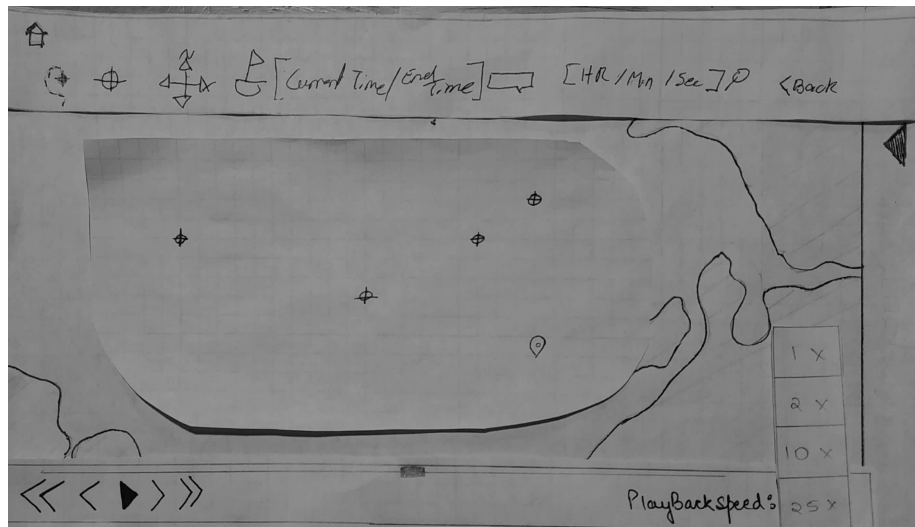
User hovers cursor over scrub-bar



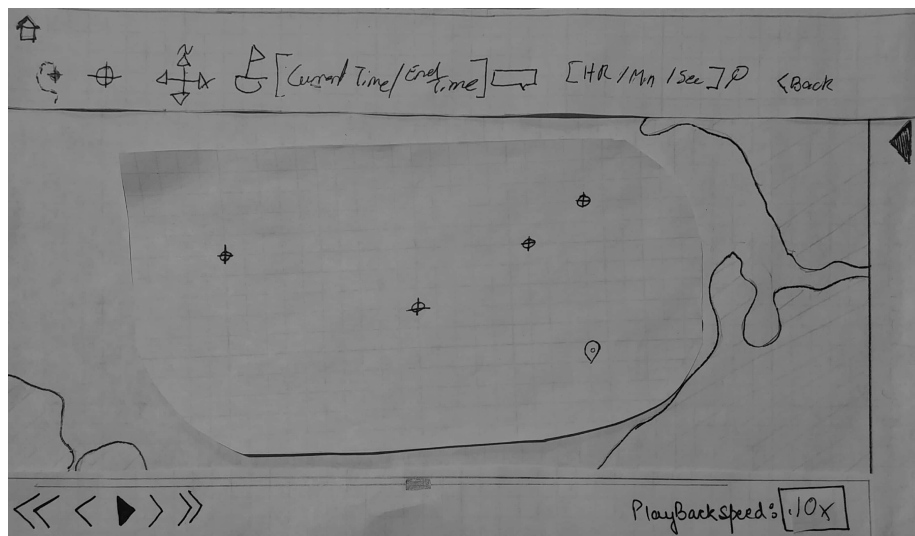
User selects playback speed button



User selects a new playback speed



Playback speed is changed



9.15 Add Annotation

Actors	User
Preconditions	<ul style="list-style-type: none"> The user is viewing an experiment
Steps	<ol style="list-style-type: none"> The user selects a point on the map The display updates to show fields for annotation creation The user enters content into annotatio. The display updates to show the annotation on the map
Success Conditions	<ul style="list-style-type: none"> The annotation is added.
Alternate Paths	N/A

Table 15: Add Annotation Use Case Table

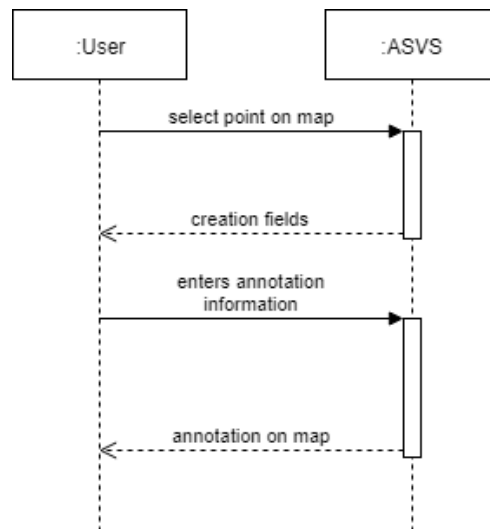
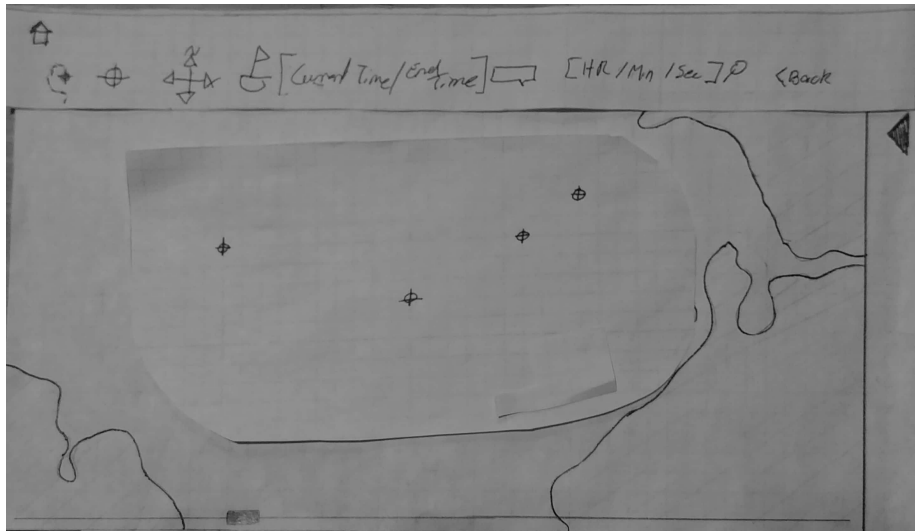


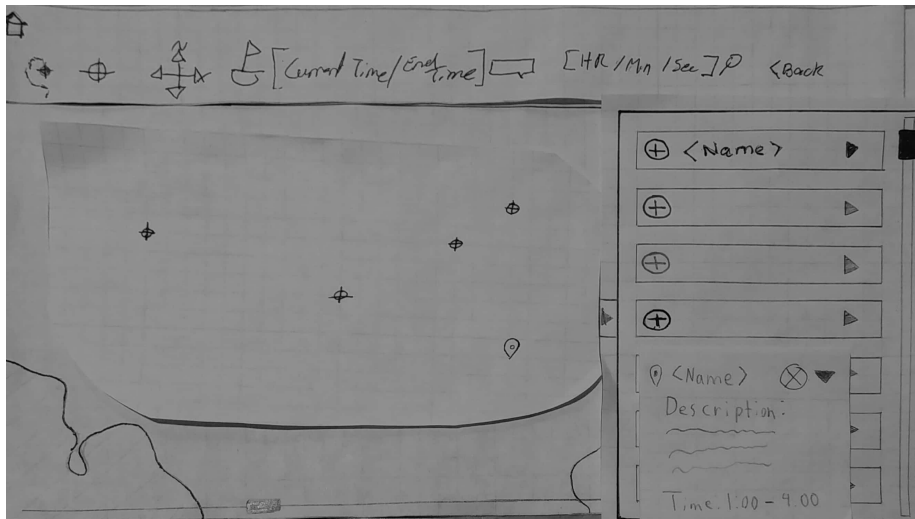
Figure 21: Add Annotation Sequence Diagram

9.15.1 Label wreckage

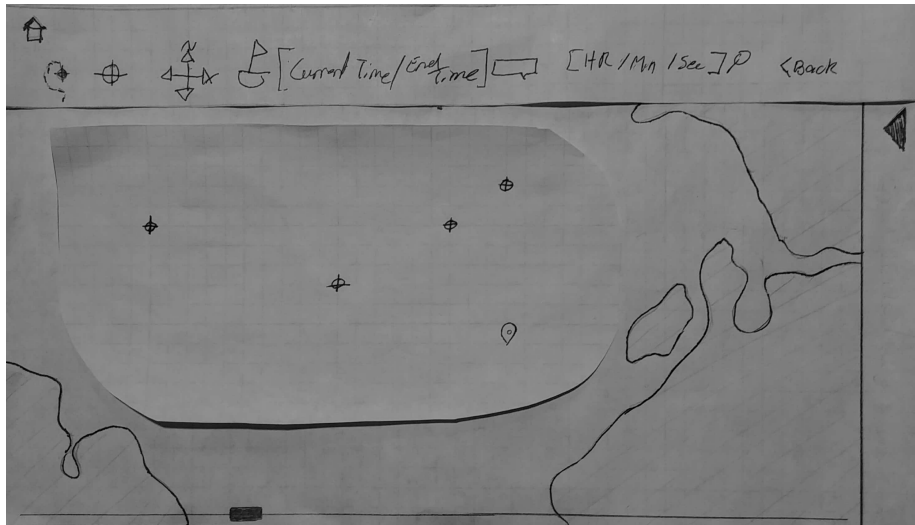
User clicks the annotation tool followed by the location on the map



User enters content into annotation



New annotation displayed on map.



9.16 Edit Annotation

Actors	User
Preconditions	<ul style="list-style-type: none"> • The user is viewing an experiment • The user is viewing the sidebar
Steps	<ol style="list-style-type: none"> 1. The user opens a specific annotation 2. The display shows the selected annotation 3. The user alters the annotation 4. Display updates to reflect changes the user made
Success Conditions	<ul style="list-style-type: none"> • The annotation displays with the changes visible on the map
Alternate Paths	<ol style="list-style-type: none"> 2. a) The user closes the annotation without changing it, resulting in no saved changes

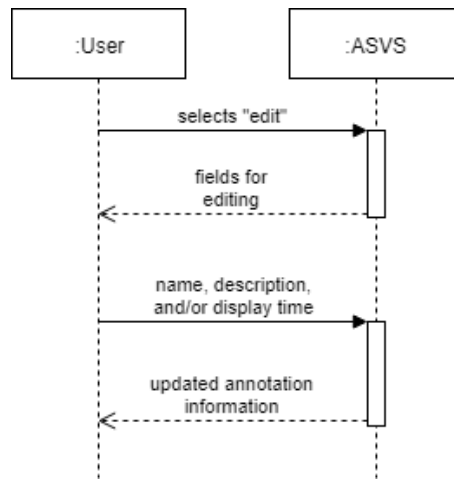
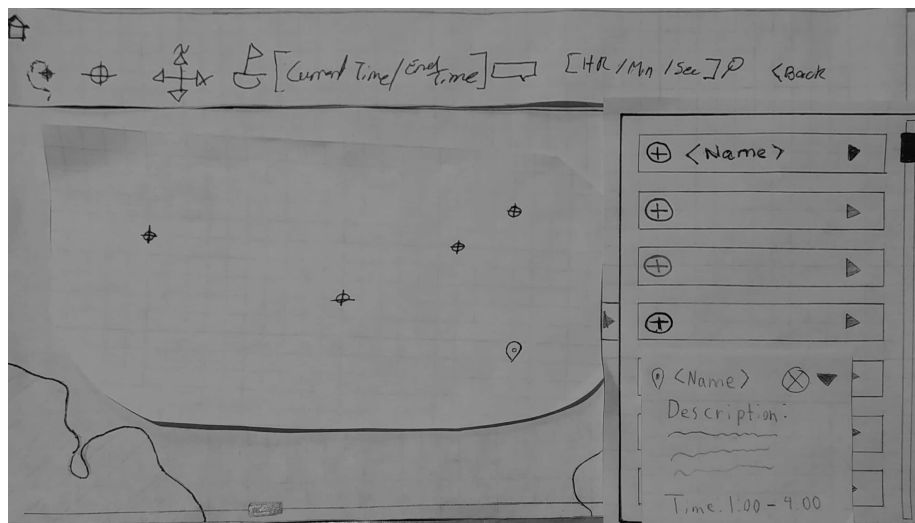


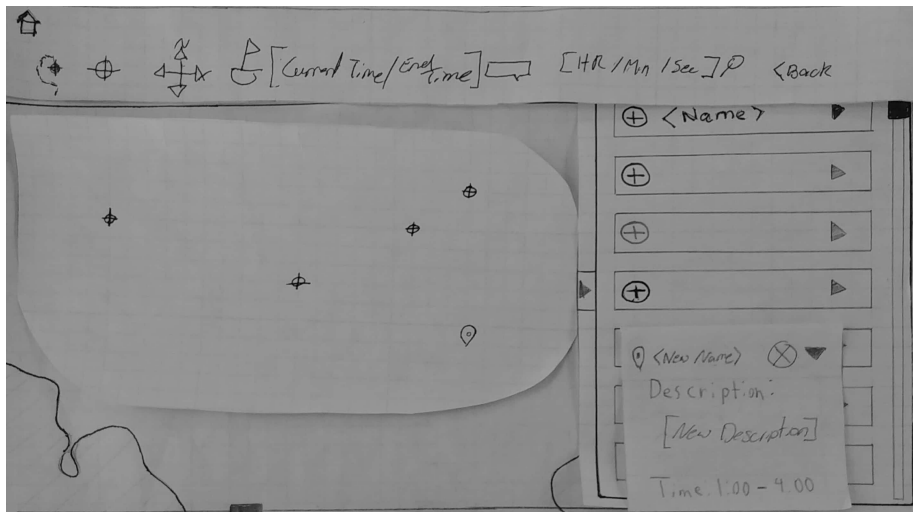
Figure 22: Edit Annotation Sequence Diagram

9.16.1 Edit an existing annotation

User selects an annotation and changes the description



Edited annotation is displayed.



9.17 Delete Annotation

Actors	User
Preconditions	<ul style="list-style-type: none"> The user is viewing an experiment The user is viewing the annotation list
Steps	<ol style="list-style-type: none"> The user opens an annotation from the list The display shows the selected annotation The user selects the delete option A confirmation option is displayed The user confirms
Success Conditions	<ul style="list-style-type: none"> The annotation is no longer available
Alternate Paths	<ol style="list-style-type: none"> a) The user closes the annotation without changing it a) The user cancels the deletion

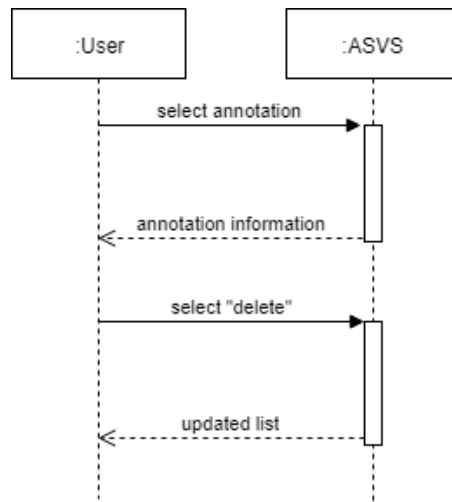
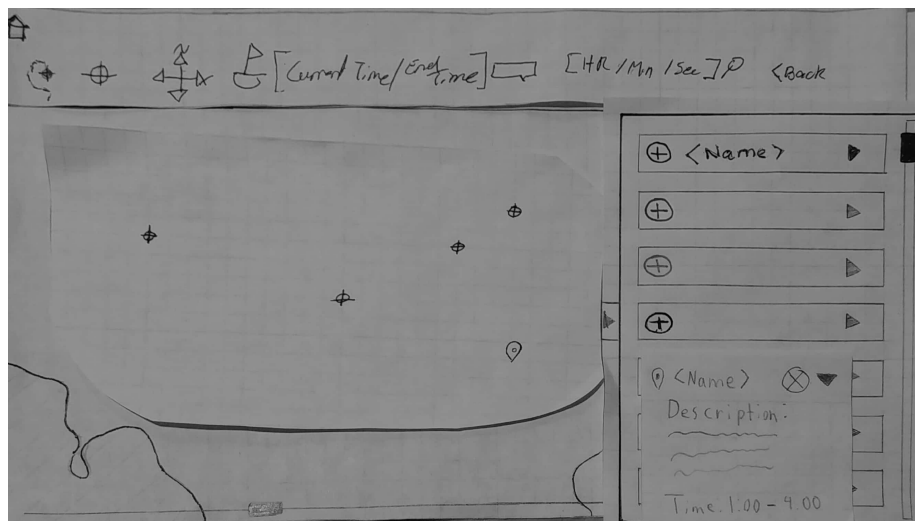


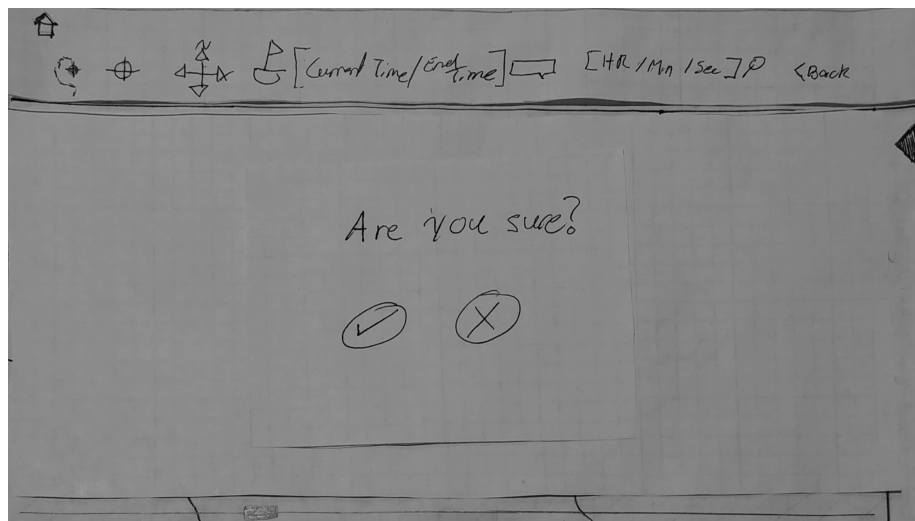
Figure 23: Delete Annotation Sequence Diagram

9.17.1 Delete an annotation

User selects an annotation and deletes it



User selects confirm on the “Are you sure” screen and annotation is deleted



10 Traceability

Test Case ID#	Test Case Description
TC#001	Verify if user is able to select an experiment
TC#002	Verify if user is able to view previous experiment information
TC#003	Verify if user is able to view live experiment information
TC#004	Verify if user is able to pan, zoom, and reorient visualization
TC#005	Verify if user is able to toggle sonobuoys on and off
TC#006	Verify if user is able to toggle UI elements on and off
TC#007	Verify if user is able to change the label of a sonobuoy
TC#008	Verify if user is able to view the relative distance between a sonobuoy and a fixed point
TC#009	Verify if user is able to view the relative distance between two sonobuoys
TC#010	Verify if user is able to view previously collected sonobuoy information in playback format
TC#011	Verify if user is able to pause playback of previously collected sonobuoy information
TC#012	Verify if user is able to resume playback of previously collected sonobuoy information
TC#013	Verify if user is able to change the playback speed of previously collected sonobuoy information
TC#014	Verify if user is able to add an annotation to a GPS coordinate
TC#015	Verify if user is able to edit an existing annotation
TC#016	Verify if user is able to delete an existing annotation
TC#017	Verify that ASVS's display updates once every 5 seconds with the most recent information
TC#018	Verify that ASVS scores greater than 60 on the Maintainability Index.
TC#019	Verify that when ASVS receives invalid sonobuoy information, that information is ignored
TC#020	Verify if users are able to view GPS coordinates, cardinal direction, and metric speed of sonobuoys
TC#021	Verify that ASVS is able to run on Windows 7, 8, and 10
TC#022	Verify that ASVS is able to access sonobuoy information from QuantumGPS's datastore

Table 16: Test Case Table

Feature Number	Feature Name	Priority	Requirement Number	Requirement Name	Test Case #
4.1	Visualize Live and Stored Experiments	High	4.1.1	View Previously Collected Sonobuoy Information	TC#001, TC#002 TC#010, TC#017 TC#019, TC#021 TC#022
			4.1.2	View Live Sonobuoy Information	TC#001, TC#003 TC#017, TC#019 TC#021, TC#022
			4.1.3	Filter Invalid GPS Positions in Visualization	TC#001, TC#002 TC#003, TC#010 TC#017, TC#019 TC#021, TC#022
4.2	Manipulate Visualizations	Low	4.2.1	Pan, Zoom, Reorient	TC#001, TC#002 TC#003, TC#004 TC#010, TC#017 TC#019, TC#021 TC#022
			4.2.2	Toggle Sonobuoys and User Interface Elements	TC#001, TC#002 TC#003, TC#005 TC#006, TC#010 TC#017, TC#019 TC#021, TC#022
			4.2.3	Edit Sonobuoy Label	TC#001, TC#002 TC#003, TC#005 TC#007, TC#010 TC#011, TC#017 TC#019, TC#021 TC#022
4.3	Interpret Sonobuoy GPS Data from Visualizations	Medium	4.3.1	View GPS Coordinates, Cardinal Directions, and Convert Speed Units	TC#001, TC#002 TC#003, TC#005 TC#006, TC#010 TC#017, TC#019 TC#020, TC#021 TC#022
			4.3.2	View Relative Distance between Two Objects	TC#001, TC#002 TC#003, TC#005 TC#008, TC#009 TC#010, TC#017 TC#019, TC#021 TC#022
4.4	Traverse Visualization of Experiment	High	4.4.1	Playback Visualization	TC#001, TC#002 TC#010, TC#019 TC#021, TC#022
			4.4.2	Pause and Resume Visualizations	TC#001, TC#002 TC#010, TC#011 TC#012, TC#019 TC#021, TC#022
			4.4.3	Change Visualization Speed	TC#001, TC#002 TC#010, TC#013 TC#019, TC#021 TC#022
4.5	Annotate within Visualizations	Low	4.5.1	Create, Edit, and Delete Annotations	TC#001, TC#002 TC#003, TC#005 TC#010, TC#014 TC#015, TC#016 TC#017, TC#019 TC#021, TC#022
5.1	Software Interfaces	N/A	5.1.1	Operate on Windows 7, 8, and 10 OS	TC#021
5.2	Communications Interfaces	N/A	5.2.1	Access Sonobuoy Information from QuantumGPS's Datastore	TC#022
6.1	Performance Requirements	N/A	6.1.1	Visualization must occur in less than 5 seconds	TC#017
6.2	Software Quality Attributes	N/A	6.2.1	Score greater than 60 on the Maintainability Index	TC#018
			6.2.2	No prior knowledge of GPRMC required	TC#023

Table 17: Traceability Matrix

11 Appendix: Issues List

- Some additional data-types and derived data that may need to be displayed have yet to be determined.
- The categories by which certain visual elements are grouped have yet to be determined.