

Requirements Specification Document

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

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1 Introduction

1.1 Purpose

QuantumGPS conducts ocean-based experiments involving multiple sonobuoys. The sonobuoys are equipped with a Global Positioning System(GPS) and emit positional information once every 5 seconds. QuantumGPS collects all the sonobuoy GPS information and stores it in a text file in Global Positioning Recommended Minimum Version C(GPRMC) format. This same information is accessed later through QuantumGPS's databases. QuantumGPS's current system has proven to be difficult for onshore and offshore users to understand.

To alleviate this problem, QuantumGPS needs a new mapping system to display the collected sonobuoy information more effectively.

1.2 Project Scope

QuantumGPS's requested mapping system aims to better inform onshore and offshore users of the position and movement of sonobuoys during experiments. Additionally, QuantumGPS requests for the mapping system to connect to Automatic Identification System(AIS) to inform onshore and offshore users of commercial ships. Ultimately, the mapping system aims to provide Onshore and offshore users with a means to better understand their experiment.

1.3 Glossary of Terms

- AIS: An international service for monitoring boat traffic.
- AIS Object: The navigational course, absolute speed, and global position of a unique boat.
- Corrupted Data: Data which is not readable by the system such as an improperly formatted string.
- Current System: Solution currently used by QuantumGPS to manage experiment information.
- Database: One of QuantumGPS's stores of information used to access previously collected information. This also contains information that defines experiment parameters and time frames.
- Data-type: A specific type of information such as location, speed, etc.
- Display: The physical display that the user will be viewing the visualization on.
- Experiment: A set of gathered information with a defined beginning and end time.
- GPRMC: Minimal formal format for GPS information as defined by the National Marine Electronics Association.

- GPS: Global Positioning System.
- GUI: Graphical user interface.
- Impossible Data: Data which cannot fit within the parameters of a given experiment such as when a buoy moves outside of the experiment area.
- Live Playback: As "Playback", although this specifically refers to the playback of information as it is being received in real time. The speed of playback cannot be changed during live playback.
- Maintainability Index: A software metric which measures how maintainable code is.
- Multipoint: A computer network having more than two terminals connected by a single communications channel.
- NMEA: Data specification for communication between marine electronics, including sonars and GPS information.
- Offshore System: The system used by offshore users. The offshore system is only usable by Quantum GPS employees on a research boat. The offshore systems have access to sonobuoy GPS coordinates, but do not have access to Quantum GPS databases.
- Onshore System: The system to be used by onshore users. The onshore system is only accessible by Quantum GPS employees with internet access. The onshore system has access to both sonobuoy GPS coordinates and Quantum GPS databases.
- Playback: Information that is being updated as it would have in real time, or according to the playback speed setting for previously collected data. Similar to viewing a recording.
- Priority, High: A requirement that must be completed for all other requirement to function.
- Priority, Medium: A requirement that must be completed, but is not itself necessary for other requirements.
- Product: The software being developed by Aperture Software Solutions for QuantumGPS.
- Sonobuoy: A buoy equipped to detect underwater sounds and transmit them by radio.
- Sonobuoy Information: GPS data collected by a sonobuoy
- TBD: To be determined.
- TSRV: Torpedo Sound Range Vessel.

- User: A Quantum GPS employee who is accessing the onshore or offshore system.
- Visualization: The virtual representation of sonobuoy GPS coordinates and AIS data on a map interface.
- Whiskey Golf Area: This is the name given to a 500 sq. kilometers area in Canadian waters.
- ZULU Time: Greenwich Mean Time (Current time not taking daylight savings into account).

1.4 References

The 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]

Canadian Maritime Law:

Chircop, A. E., Moreira, W., Kindred, H. M., Gold, E. (2016). Canadian maritime law. Toronto, ON: Irwin Law.

1.5 Overview

This document contains six main sections and an appendix. Section one describes the purpose and scope of the project. Section two explains the current system and its associated problems, and expands on the primary features as well as their the user classes. Section two also introduces the operating environment, design constraints, and covers all assumptions and dependencies. Section three discusses specific features, which are prioritized and broken down into requirements. Section four describes the external interface requirements, including user, software, and communications interfaces. Section five describes the non-functional requirements, introducing performance requirements, safety requirements, and software quality attributes. Section six details all other requirements, including format specifications, language options, efficiency, legal documents, and proprietary rights. At the end of the document is an appendix that has a list of issues.

2 Overall Description

2.1 Product Perspective

The system, developed and deployed by QuantumGPS, collects GPS information from each sonobuoy, transmits it in GPRMC format, demodulates it, and stores said information in a text file. The created text files are then stored

on a database for future use or streamed in real-time to the current visualization system. The current system has a basic GUI application for viewing the location of the sonobuoys based on these text files.

2.2 Product Features

The features described in this document involve the processing, visualization, and interaction with the visualization of sonobuoy and GPS data. The sonobuoy information processing feature will analyze sonobuoy data and identify and ignore any erroneous data. The visualization feature will provide the user with an interface that displays real time and previously collected sonobuoy information along with data from AIS. Finally, the visualization interaction function will allow onshore and offshore users to manipulate the way sonobuoy information and AIS data is displayed.

2.3 User Classes and Characteristics

2.3.1 Offshore User

”Offshore User” refers to anyone who uses the system without access to a database. This is most common when the system is used on the water, or ”Offshore”. Offshore Data users do not have access to any previously collected data, and as a result can only view live information.

2.3.2 Onshore User

Onshore users have access to a database. This is likely only possible if they are in a QuantumGPS company office. Onshore users have access to all system features, including what offshore users have access to.

2.4 Operating Environment

Sonobuoy GPS information will stream in real-time from one internal server to the Onshore or Offshore User’s machine. Thus user must be able to connect to this server.

2.5 Design and Implementation Constraints

2.5.1 Data format

NMEA strings will be received from a GPS receiver in real-time over SSH. Any valid NMEA string must be visualized in GPRMC format.

2.5.2 Time and Cost

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

2.5.3 Maintenance and Modification

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

2.5.4 Security and Access

The system 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.

2.6 Assumptions and Dependencies

2.6.1 Operating system

The current system can only operate on Windows 7 and Windows 8. While it was not explicitly stated, the product should be able to work on Windows 10.

2.6.2 Hardware environment

The sonobuoys will remain in the ocean while information is being transmitted. AIS information and annotations will be accessed from Daintree's onshore databases.

3 System Features

3.1 Process Sonobuoy Information

3.1.1 Description and Priority

High Priority

Not all information received from the sonobuoys is clean or error free. In order to provide onshore and offshore users with an understandable visualization of the sonobuoy information, corrupted or invalid information must be ignored.

3.1.2 Functional Requirements

- R3.1.1: Corrupted data must be identified and filtered so that it is not displayed
- R3.1.2: Impossible or corrupted data must be identified so that the user can be alerted
- R3.1.3: Sonobuoy information that has been filtered of corrupt or invalid information must be stored so that it can be used to create visualizations for the onshore and offshore users.

3.2 Visualize Sonobuoy Information

3.2.1 Description and Priority

High Priority

It is difficult to perceive distance and motion of the sonobuoys on the water. As such setting up or observing an ongoing experiment is challenging. By visualizing the location of the sonobuoys, onshore and offshore will have an easier time conducting experiments.

3.2.2 Functional Requirements

- R3.2.1: Onshore users must be able to view both real time and previously collected sonobuoy information. Offshore users must be able to view real time sonobuoy information
- R3.2.2: Onshore and offshore users must be able to view sonobuoy information on a visual interface, which is large enough to display the entire experiment area
- R3.2.3: The visual interface must update every 5 seconds to display the most recent set of sonobuoy information available when the user is viewing in real time
- R3.2.4: Onshore and offshore users must be able to view GPS coordinates, cardinal directions, and speed in metric units sent directly from sonobuoys
- R3.2.5: Onshore and offshore users must be able to view information from AIS as GPS coordinates, cardinal directions, or speed in metric units
- R3.2.6: Onshore and offshore users must be able to view relative distance between sonobuoys, AIS objects, and fixed points.

3.3 Visualization Interactions

3.3.1 Description and Priority

Medium Priority

Providing a visualization onshore and offshore users can't interact with isn't sufficient. It is important that onshore and offshore user are able to manipulate the visualization in order to access specific data.

3.3.2 Functional Requirements

- R3.3.1: Onshore and offshore user must be able classify AIS objects and sonobuoys as being part of one or multiple groups. Groups can contain both AIS objects and sonobuoys.
- R3.3.2: Onshore and offshore user must be able to pan, zoom, and rotate the display.

- R3.3.3: Onshore users must be able to display previously collected sonobuoy information. When observing previously collected sonobuoy information, the user must be able to use the following functions:
 - R3.3.3.1: Onshore users must be able to select what previously collected sonobuoy information to view.
 - R3.3.3.2: Onshore users must be able to playback previously collected sonobuoy information as though it were real time.
 - R3.3.3.3: Onshore users must be able to pause and resume the playback.
 - R3.3.3.4: Onshore users must be able to increase or decrease the speed of the playback.
 - R3.3.3.5: Onshore users must have the ability to add textual labels or annotations for sonobuoys or AIS objects.

4 External Interface Requirements

4.1 User Interfaces

Onshore users must be able to see, filter, and label both real-time and previously gathered GPS information. Live GPS information; with regards to location, direction, and speed; must be updated in no later than five second intervals. Sonobuoy, GPS, and AIS information visualized must be viewed in ZULU time.

4.2 Software Interfaces

The visual interface must operate on Windows 7, 8, or 10. GPS information will be received as plain text in GPRMC format.

4.3 Communications Interfaces

Tracking objects such as sonobuoys and large ships will be done using GPS information streamed directly to the product.

5 Non-Functional Requirements

5.1 Performance Requirements

- R5.1.1: Visualization must occur in less than 5 seconds.
- R5.1.2: The system must be able to receive sonobuoy GPS coordinates and AIS data from two experiments simultaneously.

5.2 Safety Requirements

- R5.2.1: Onshore and offshore users must be able to define a physical range in which they can see charted hazards and ship routes.
- R5.2.2: A warning must be given to the user if a buoy drifts within 10 meters of the edge of the defined area described in R5.2.1.
- R5.2.3: Offshore users with GPS/AIS devices must be visible in relation to obstacles and ships.

5.3 Software Quality Attributes

- R5.3.1: The product must score greater than 60 on the Maintainability Index.
- R5.3.2: Onshore and offshore users do not need prior knowledge of GPRMC or AIS specifications to visualize sonobuoy information.

6 Other Requirements

- R6.1: The display must support both English and French languages.
- R6.2: Displayed sonobuoy and GPS information is accurate and must be in accordance to Canadian and International maritime law [1].

7 Data Flow and Context Diagrams

7.1 DFD 0

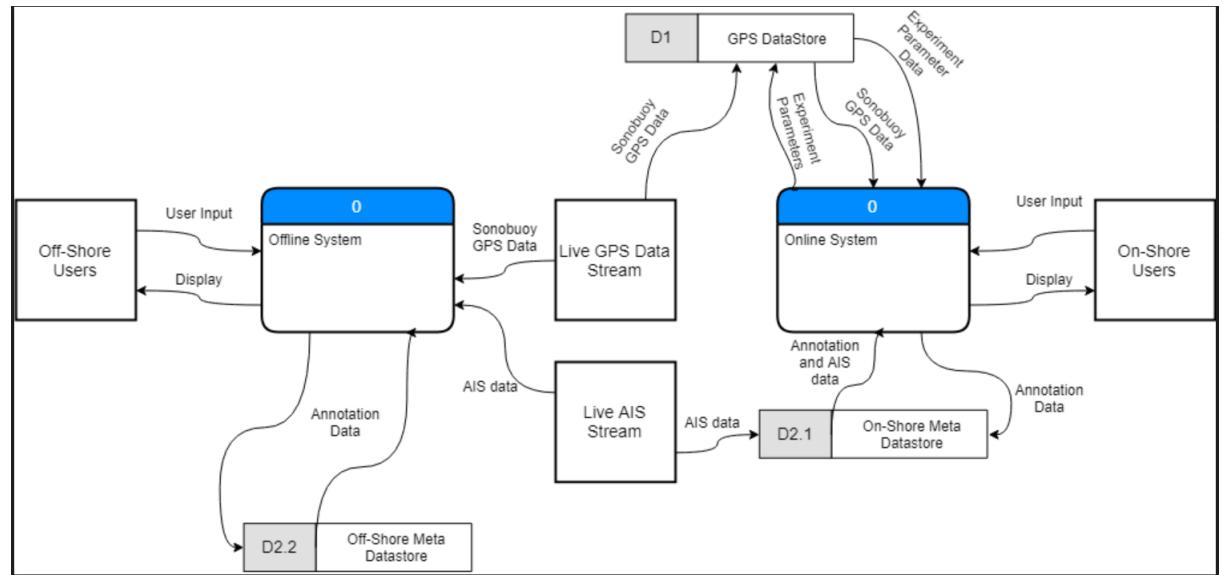


Figure 1: Data Flow Diagram 0

7.2 DFD 1

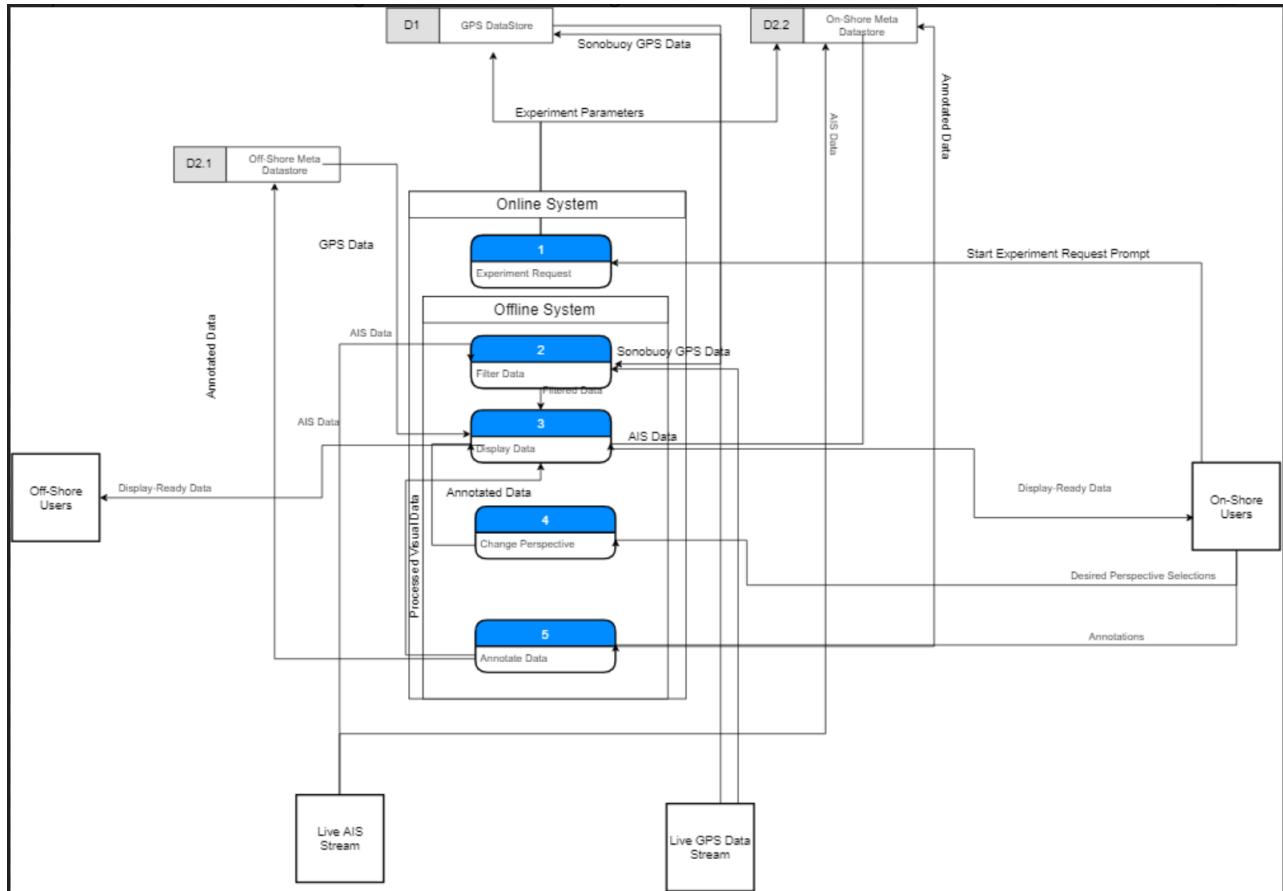


Figure 2: Data Flow Diagram 1

7.3 DFD 2

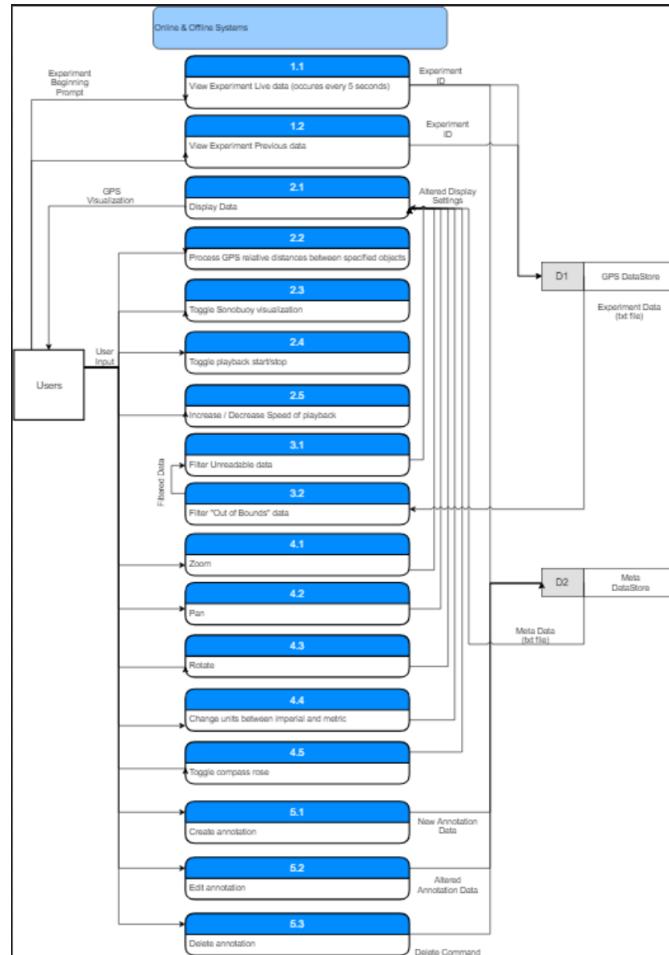


Figure 3: Data Flow Diagram 2

8 Entity Relationships and Data Dictionary

Our system is built upon 4 entities: Sonobuoys, Experiments, Annotations, and AIS Entities. 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. Both Sonobuoys and AIS Entities 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.

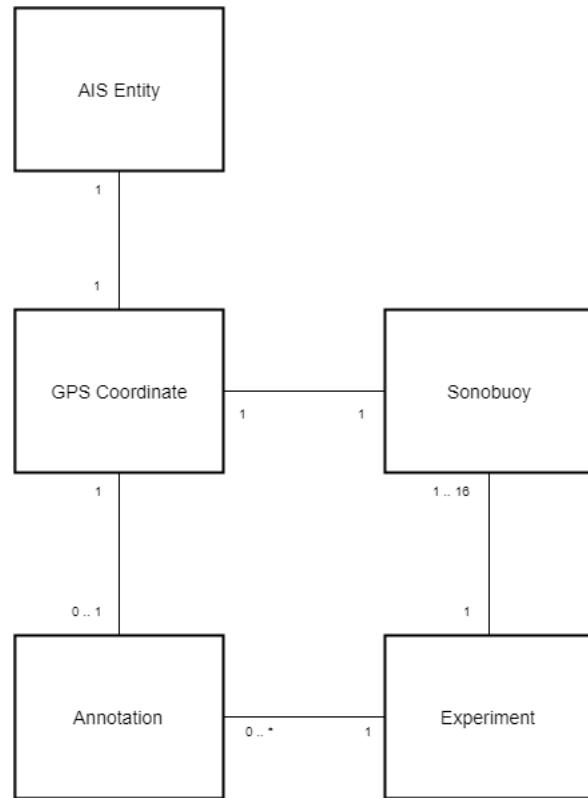


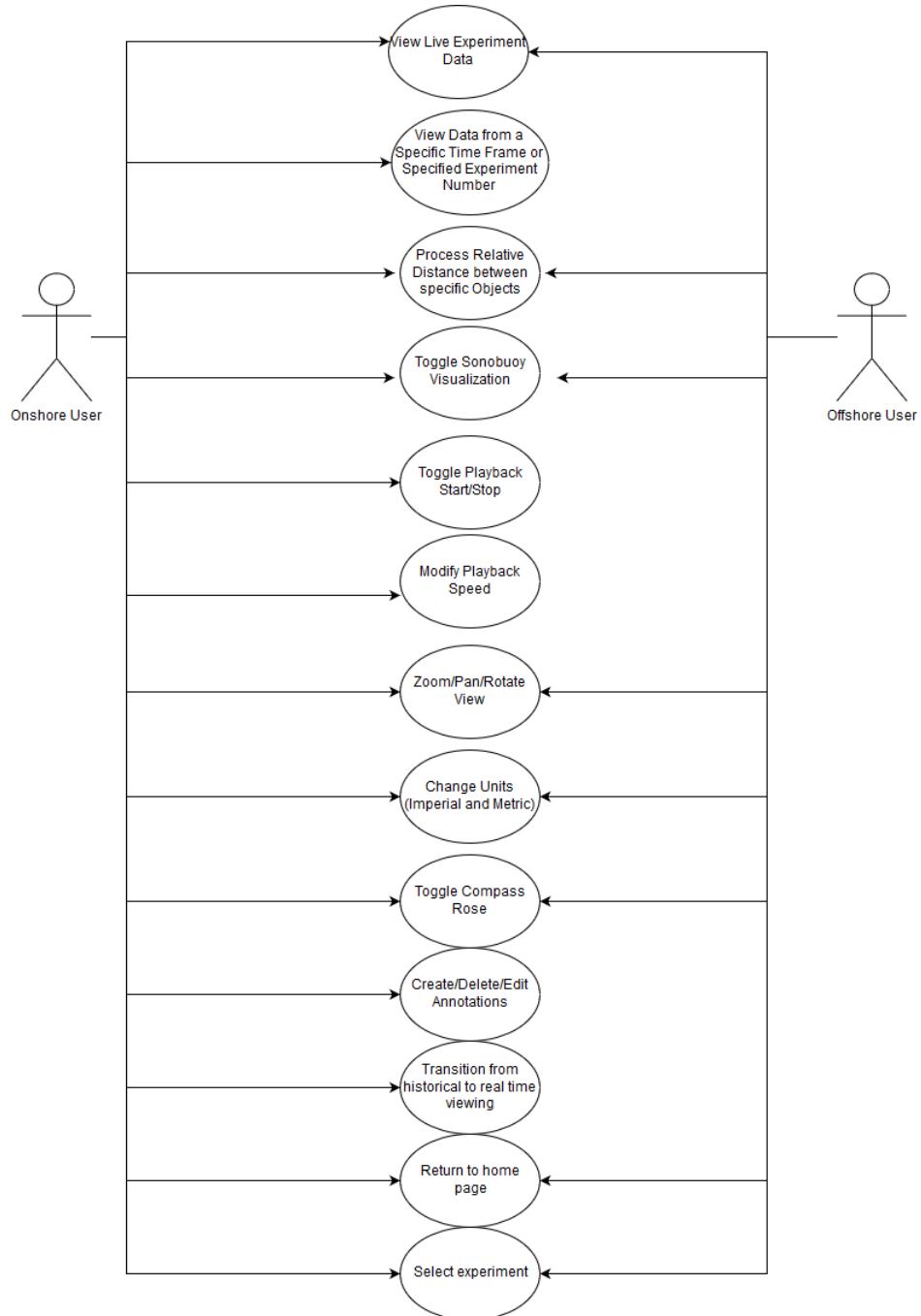
Figure 4: Entity Relationship Diagram

Datatype	Description
Sonobuoy	GPS Coordinates, Speed, Heading
AIS Entity	GPS Coordinates, Speed, Heading
Annotation	GPS Coordinates, Description
Experiment	Date, Time, List of Sonobuoys, List of Annotations
GPS Coordinates	Latitude, Longitude

Table 1: Data Dictionary

9 Use Cases

9.1 Use Case Model



9.2 Enter Real Time Viewing

1. Enter Real Time Viewing

Actors	User (Onshore or Offshore)
Preconditions	<ul style="list-style-type: none"> • There is an experiment in progress • The user is on the home page
Steps	<ol style="list-style-type: none"> 1. The user selects the real-time viewing option 2. A live feed of GPS coordinates that are displayed on a map.
Success Conditions	<ul style="list-style-type: none"> • Display real-time AIS data or sonobuoy GPS coordinates
Alternate Paths	N/A

Figure 6: Use Case Table 1

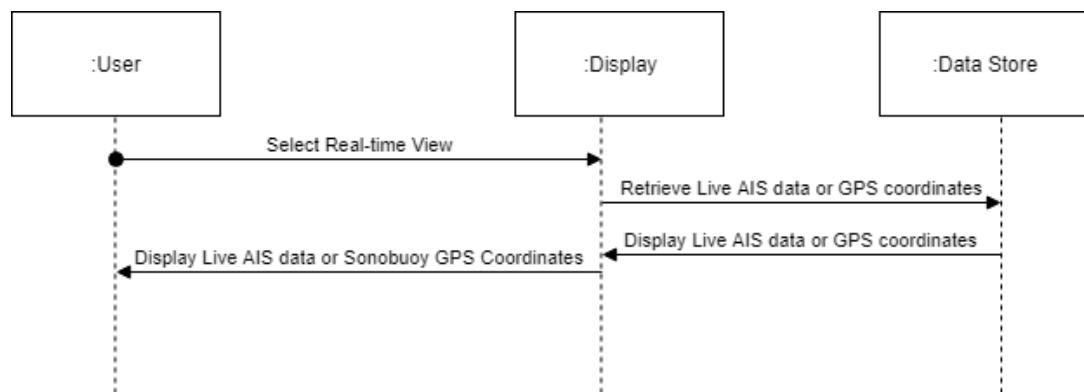


Figure 7: Use Case 1 Sequence Diagram

9.3 Focus on a Single Sonobuoy

2. Focus on a single buoy

Actors	User (Onshore or Offshore)
Preconditions	<ul style="list-style-type: none"> • There is an experiment in progress • The user is in map view mode • Sonobuoy list is visible
Steps	<ol style="list-style-type: none"> 1. The user selects buoy they wish to view on the map 2. Sonobuoy GPS information specific to the selected buoy is displayed
Success Conditions	<ul style="list-style-type: none"> • The information of a single buoy is shown on the display
Alternate Paths	<ol style="list-style-type: none"> a) The user selects a buoy they wish to view from the list of sonobuoys. a) A message is shown indicating that sonobuoy GPS coordinates are unavailable for the selected buoy.

Figure 8: Use Case Table 2

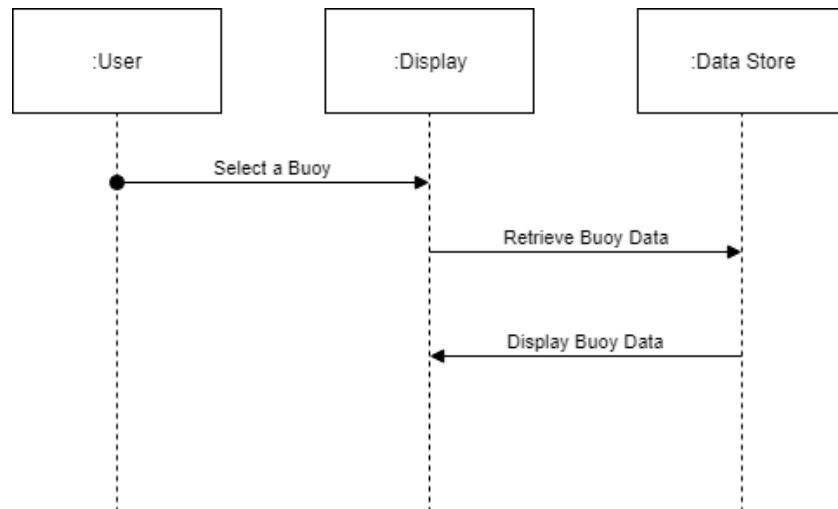


Figure 9: Use Case 2 Sequence Diagram

9.4 Label a Data Point

3. Label a data point

Actors	User (Onshore or Offshore)
Preconditions	<ul style="list-style-type: none"> • There is an experiment in progress • The user is in map view mode • The user has selected a sonobuoy
Steps	<ol style="list-style-type: none"> 1. The user selects the name options 2. The user enters a name 3. The display is updated with the new label and the label is saved to the database.
Success Conditions	<ul style="list-style-type: none"> • A label shows up beside the sonobuoy on the display
Alternate Paths	3. a) The sonobuoy information does not match the sonobuoy user wants

Figure 10: Use Case Table 3

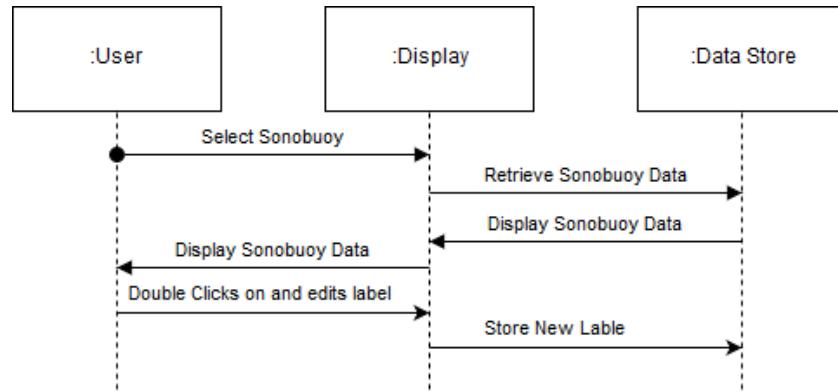


Figure 11: Use Case 3 Sequence Diagram

9.5 Show AIS Data

4. Show AIS data

Actors	User (Onshore)
Preconditions	<ul style="list-style-type: none"> • There is an experiment in progress • The user is in map view mode
Steps	<ol style="list-style-type: none"> 1. The user selects "show AIS" from the display 2. AIS data from nearby ships are overlaid on the map
Success Conditions	<ul style="list-style-type: none"> • AIS data from all nearby ships are displayed on the display.
Alternate Paths	2. a) A message is shown indicating no available AIS data

Figure 12: Use Case Table 4

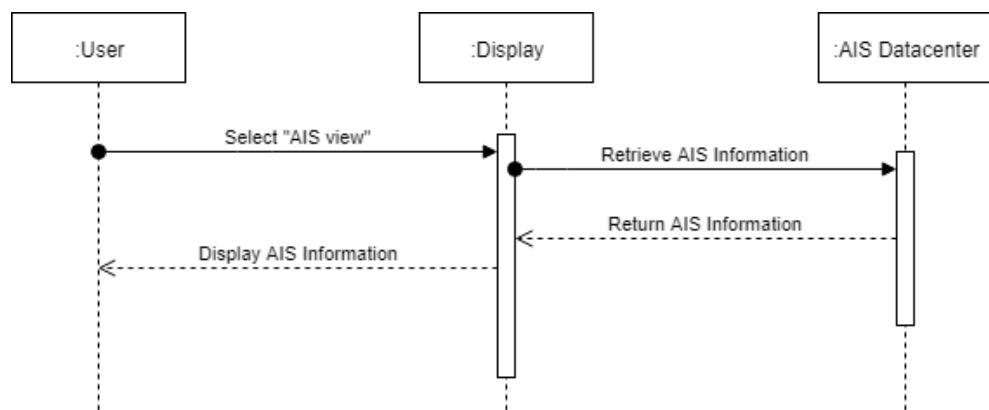


Figure 13: Use Case 4 Sequence Diagram

9.6 Filter Historical Data by Time Frame

5. Filter historical data by time frame

Actors	User (Onshore), database
Preconditions	<ul style="list-style-type: none">• There is an experiment in progress• The user is in map view mode observing previously collected AIS data or sonobuoy GPS coordinates.• The user is in search mode
Steps	<ol style="list-style-type: none">1. The user selects the "filter" option2. Filter options are displayed3. The user enters the time frame they wish to view4. Sonobuoy GPS coordinates and AIS data that matches the time frame is displayed from the database5. The sonobuoy GPS coordinates and AIS data are filtered to show only the selected time frame
Success Conditions	<ul style="list-style-type: none">• The time frame of sonobuoy GPS coordinates is displayed on the display
Alternate Paths	4. a) A message is shown indicating no sonobuoy GPS coordinates or AIS data is available for the selected time frame

Figure 14: Use Case Table 5

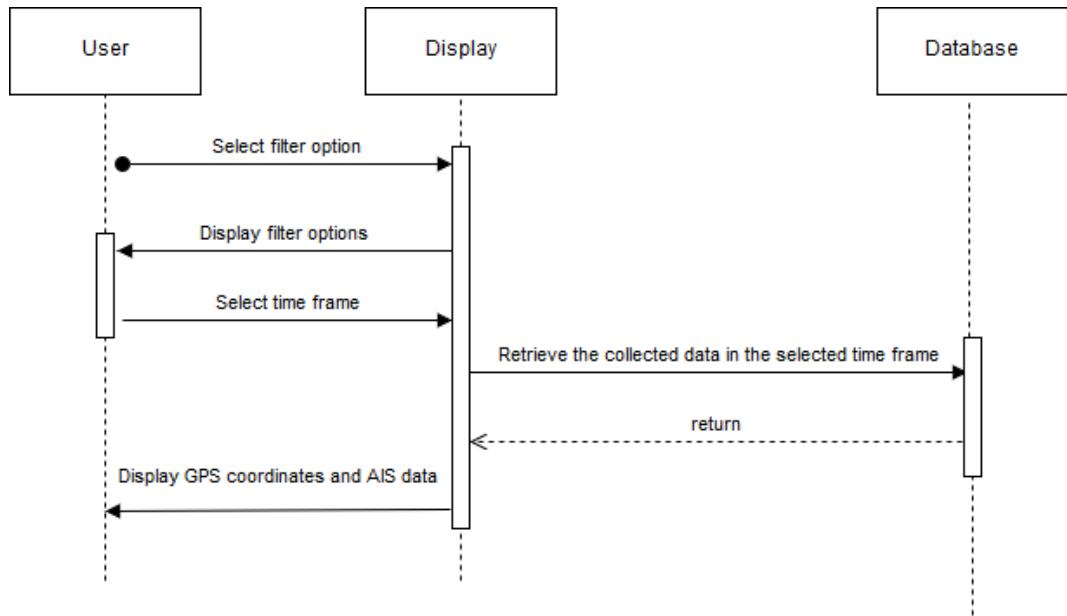


Figure 15: Use Case 5 Sequence Diagram

9.7 Playback Previously Collected Data by Sonobuoy

6. Filter previously collected data by sonobuoy

Actors	User (Onshore)
Preconditions	<ul style="list-style-type: none"> • There is an experiment in progress • The user is viewing previously collected data • The user has selected a sonobuoy
Steps	<ol style="list-style-type: none"> 1. The user selects the search option 2. Filter options are displayed 3. A given set of filter parameters are selected 4. The display switches to map view mode and only shows sonobuoys and annotations that match the selected filter options
Success Conditions	<ul style="list-style-type: none"> • Only the sonobuoy GPS coordinates that have not been filtered out are displayed
Alternate Paths	4. a) No filtered sonobuoy GPS coordinate displayed 3. a) No parameters are selected and every sonobuoy and annotation is displayed in map view mode.

Figure 16: Use Case Table 6

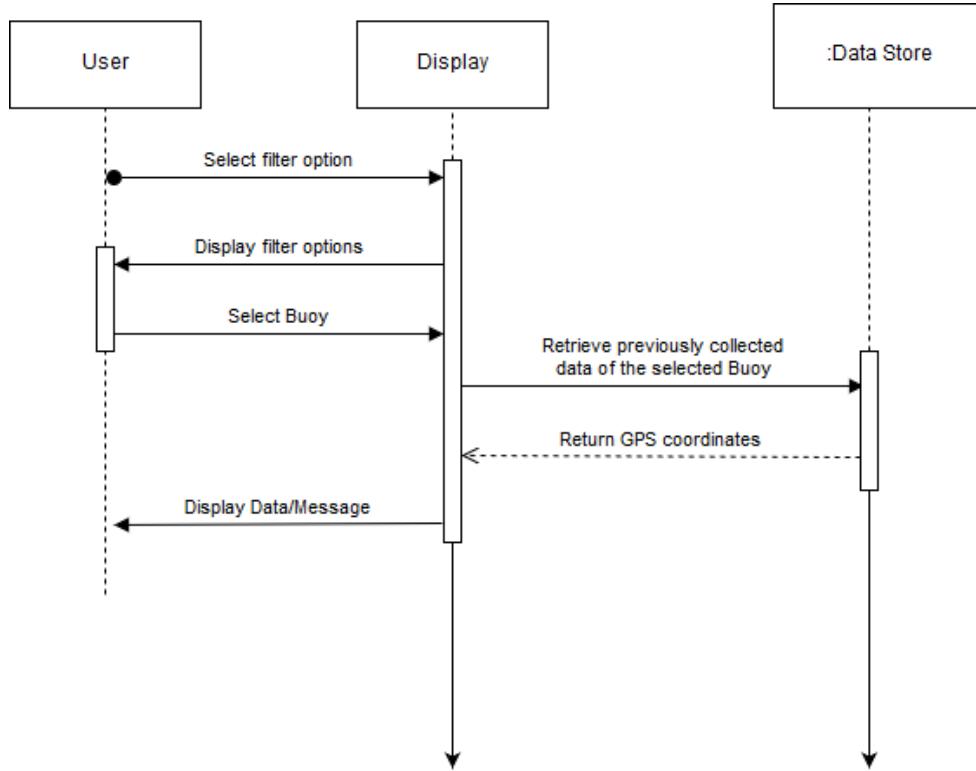


Figure 17: Use Case 6 Sequence Diagram

9.8 Playback Previously Collected Data

7. Playback previously collected data.

Actors	User (Onshore)
Preconditions	<ul style="list-style-type: none"> The user is not viewing live playback The user is viewing a frame of previously collected data that is not the last one in the experiment
Steps	<ol style="list-style-type: none"> The user selects the "play" button. Displayed information begins to play as it would in real time or at a different rate if the playback speed is different.
Success Conditions	<ul style="list-style-type: none"> Playback begins.
Alternate Paths	2. a) The most recent information is already being displayed, so playback doesn't begin.

Figure 18: Use Case Table 7

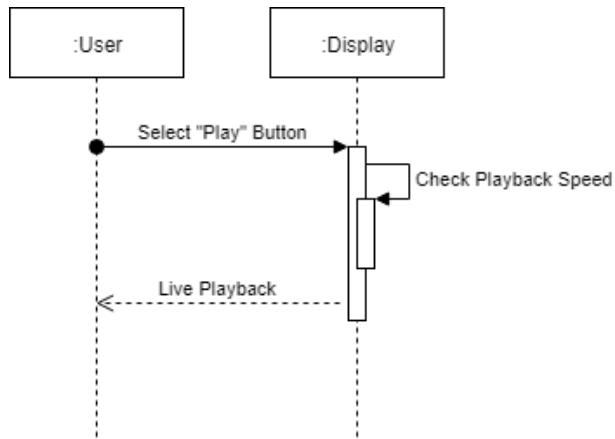


Figure 19: Use Case 7 Sequence Diagram

9.9 Change Playback Speed

8. Change playback speed

Actors	User (Onshore)
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 "0.5x" and "2.0x" The user selects one of these options "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

Figure 20: Use Case Table 8

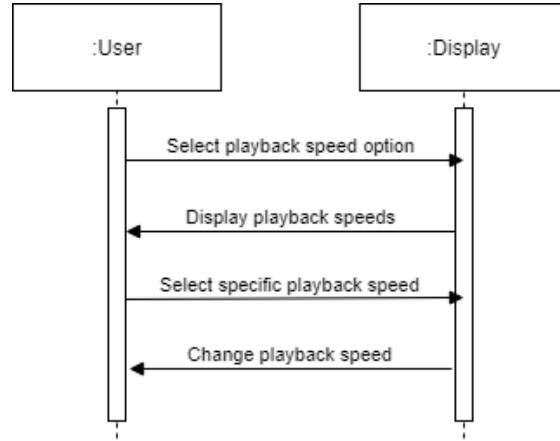


Figure 21: Use Case 8 Sequence Diagram

9.10 Show Relative Distance Between Two Objects

9. Show Relative distance between two objects

Actors	User (Onshore or Offshore)
Preconditions	<ul style="list-style-type: none"> • There is an experiment in progress • The user is in map view mode • The user has selected a sonobuoy or annotation
Steps	<ol style="list-style-type: none"> 1. The user selects the compare button 2. The user selects a second sonobuoy or annotation 3. Lines appear 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

Figure 22: Use Case Table 9

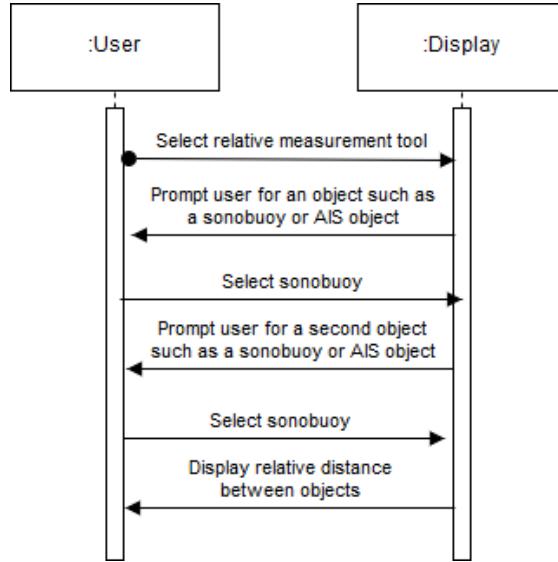


Figure 23: Use Case 9 Sequence Diagram

9.11 Pause Playback

10. Pause playback

Actors	User (Onshore)
Preconditions	<ul style="list-style-type: none"> The user is viewing previously collected data
Steps	<ol style="list-style-type: none"> User selects pause Display stops updating A play button is displayed
Success Conditions	<ul style="list-style-type: none"> The playback is paused The play button is visible
Alternate Paths	N/A

Figure 24: Use Case Table 10

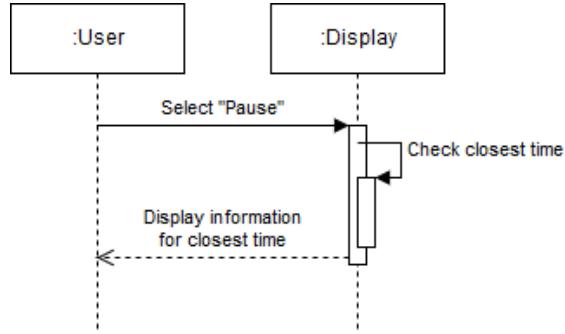


Figure 25: Use Case 10 Sequence Diagram

9.12 Show Movement Lines

11. View "Movement Lines"

Actors	User (Onshore or Offshore)
Preconditions	<ul style="list-style-type: none"> The user is viewing either real-time or historical information The user is in map view mode
Steps	<ol style="list-style-type: none"> The user selects the toggle movement lines tool A line appears behind each sonobuoy showing the path which it has followed during the experiment The user selects a buoy Only the movement line for the single boy is displayed
Success Conditions	<ul style="list-style-type: none"> AIS data are already collected
Alternate Paths	N/A

Figure 26: Use Case Table 11

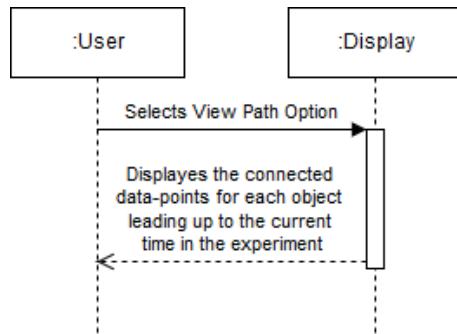


Figure 27: Use Case 11 Sequence Diagram

9.13 Pan and Zoom

12. Pan and zoom

Actors	User (Onshore or Offshore)
Preconditions	<ul style="list-style-type: none"> • There is an experiment in progress • The user is in map view mode
Steps	<ol style="list-style-type: none"> 1. The user rolls the scroll wheel upward 2. The display zooms in towards their cursor 3. The user rolls the scroll wheel downward 4. The display zooms out away from their cursor 5. User right clicks and drags in a direction on the map 6. The map pans in that direction
Success Conditions	<ul style="list-style-type: none"> • The display and map successfully respond to the user's input
Alternate Paths	<ol style="list-style-type: none"> a) The user uses the zoom in button to zoom into the center of the map a) The display does not zoom in further as it has reached its limit. a) The user uses the zoom out button to zoom out from the center of the map a) The display does not zoom out further as it has reached its limit. a) User right clicks and drags, but the map does not move because the map is at the edge of the specified boundary

Figure 28: Use Case Table 12

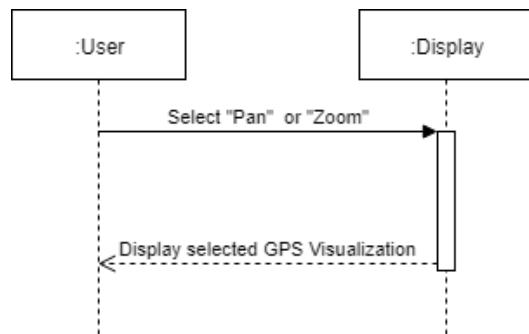


Figure 29: Use Case 12 Sequence Diagram

9.14 Rotate

13. Rotate	
Actors	User (Onshore or Offshore)
Preconditions	<ul style="list-style-type: none">• There is an experiment in progress• The user is in map view mode
Steps	<ol style="list-style-type: none">1. The user clicks and holds on the compass and drags it in a circular direction.2. The map rotates to match the rotation of the compass.3. The user clicks on the center of the compass4. The map returns to its original north upward orientation
Success Conditions	<ul style="list-style-type: none">• The map successfully rotates and returns to the default orientation
Alternate Paths	3. a) User selects the reset orientation button, but the display does not change because the map is already at default orientation

Figure 30: Use Case Table 13

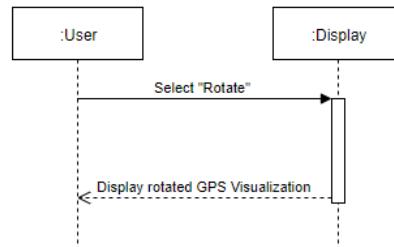


Figure 31: Use Case 13 Sequence Diagram

9.15 Select Experiment

14. Transition from a historical view to real-time

Actors	User (Onshore)
Preconditions	<ul style="list-style-type: none">• There is an experiment in progress• The user is in map view mode viewing historical data for a currently running experiment
Steps	<ol style="list-style-type: none">1. The user selects the live button2. 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

Figure 32: Use Case Table 14

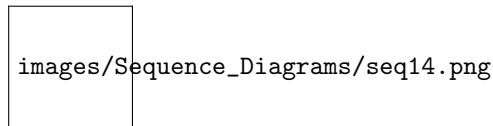


Figure 33: Use Case 14 Sequence Diagram

9.16 Return to Home Page

15. Return to home page

Actors	User (Onshore and offshore)
Preconditions	<ul style="list-style-type: none">• The user is in map view
Steps	<ol style="list-style-type: none">1. The user selects the home button2. The display updates to show the home page
Success Conditions	<ul style="list-style-type: none">• The homepage is visible to the user
Alternate Paths	N/A

Figure 34: Use Case Table 15

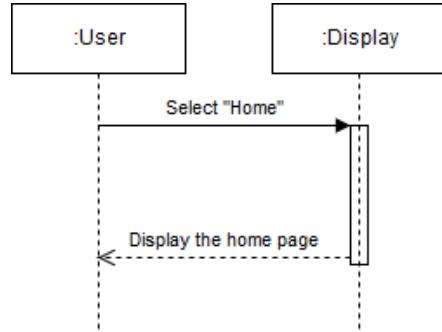


Figure 35: Use Case 15 Sequence Diagram

9.17 Select Experiment

16. Select experiment

Actors	User (Onshore and Offshore)
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 "select experiment button" The user selects the experiment they wish to view Display updates to show the selected experiment in map view
Success Conditions	<ul style="list-style-type: none"> The user selected experiment is visible in map view mode
Alternate Paths	N/A

Figure 36: Use Case Table 16

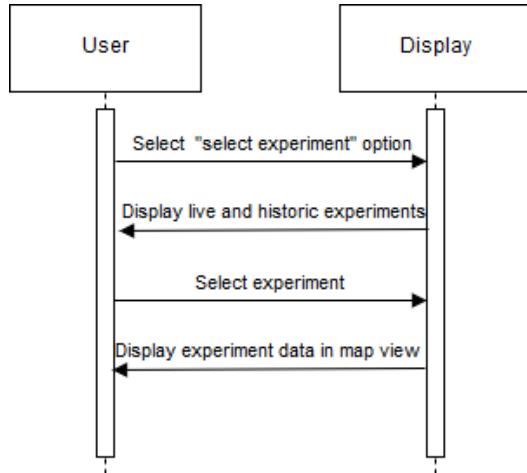


Figure 37: Use Case 16 Sequence Diagram

9.18 Add Annotation

17. Add annotation

Actors	User (Onshore)
Preconditions	<ul style="list-style-type: none"> The user is in map view mode
Steps	<ol style="list-style-type: none"> The user selects the "add annotation" option The user selects a point on the map An empty text box appears over the selected coordinate The user enters the annotation name and description The annotation is stored in the database
Success Conditions	<ul style="list-style-type: none"> Annotation object is created in the database and is visible on the map
Alternate Paths	4. a) User submits the empty text box and returns to map view mode

Figure 38: Use Case Table 17

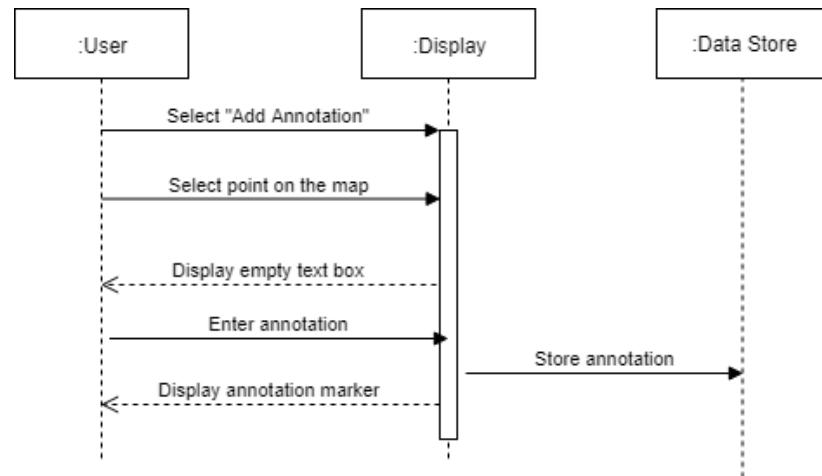


Figure 39: Use Case 17 Sequence Diagram

10 UI Model

10.1 Annotation

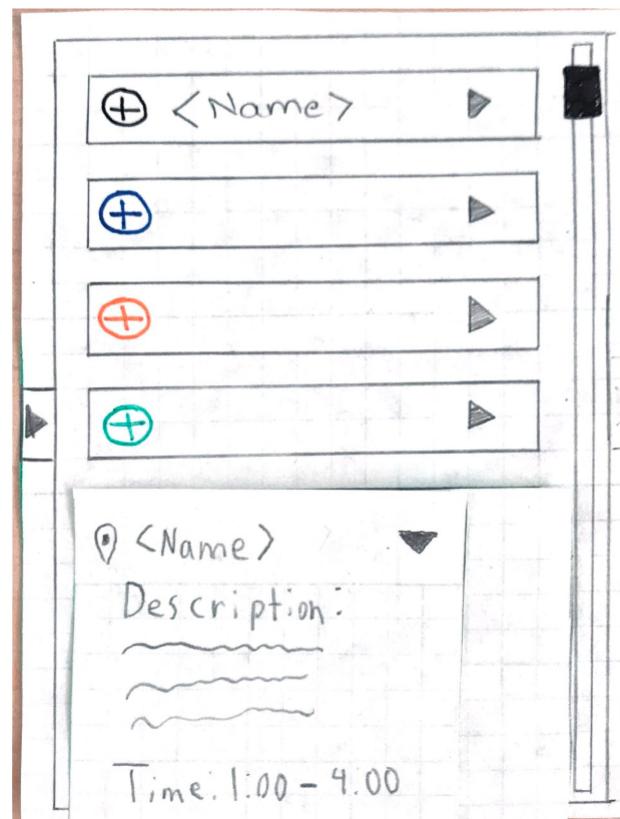


Figure 40: Annotation Page

10.2 Buoy Info Expanded

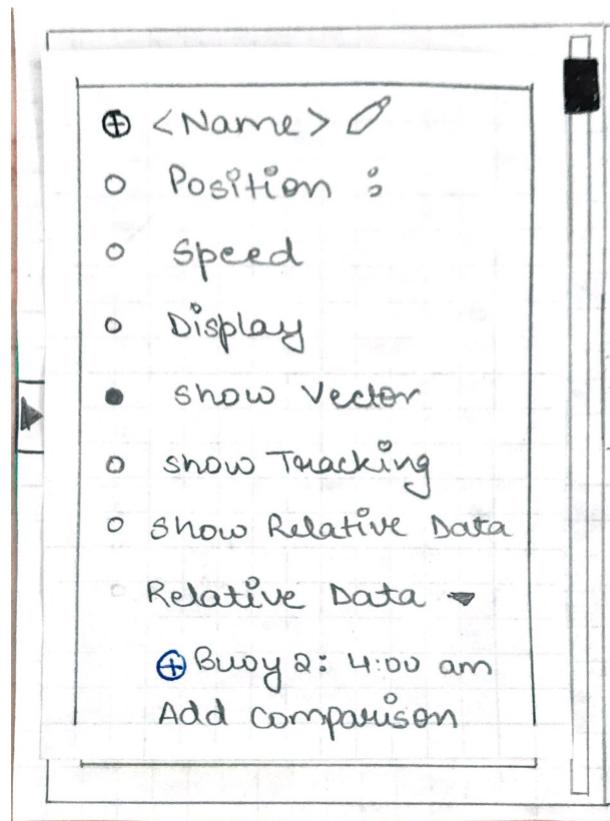


Figure 41: Buoy Info Expanded

10.3 Buoy Info Expanded with Relative Distance Info

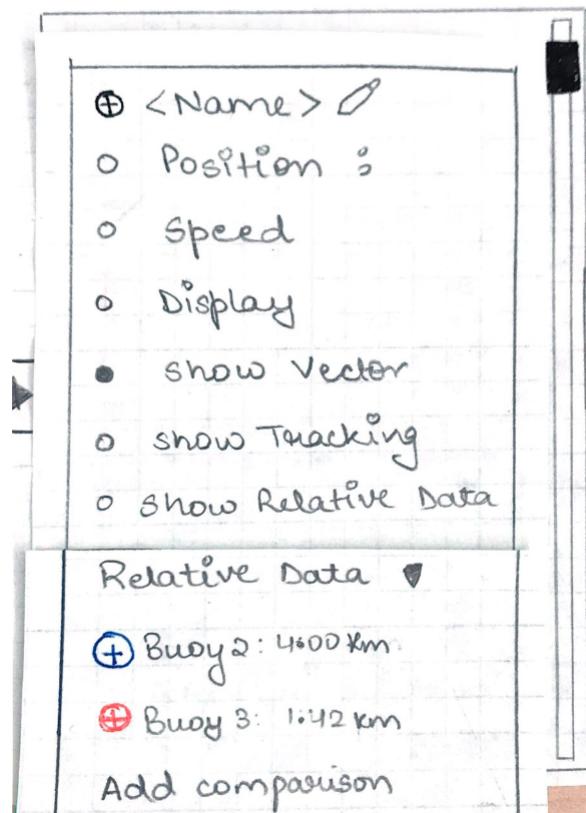


Figure 42: Buoy Info Expanded Page with Relative Distance Info

10.4 Default View

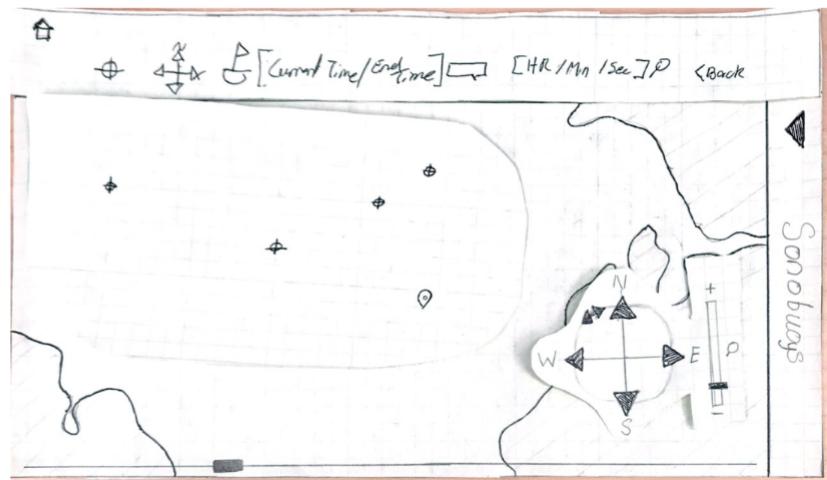


Figure 43: Default View

10.5 Home View

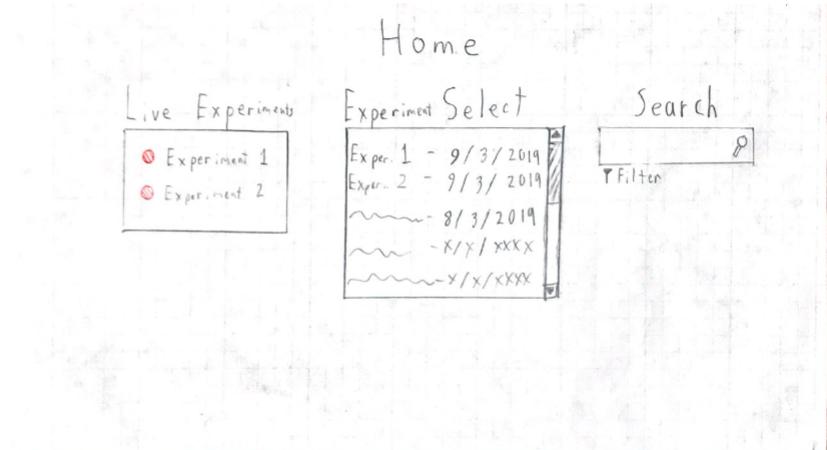


Figure 44: Home Page

10.6 Playback Speed

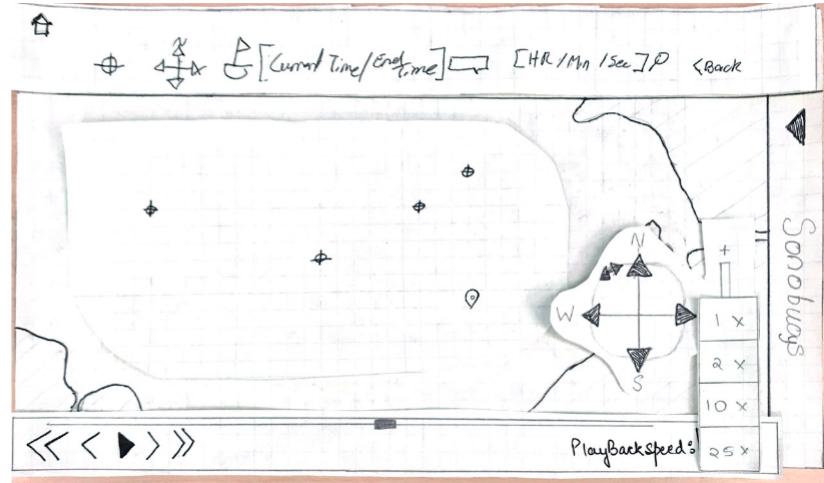


Figure 45: Home with Playback Speed

10.7 Play bar

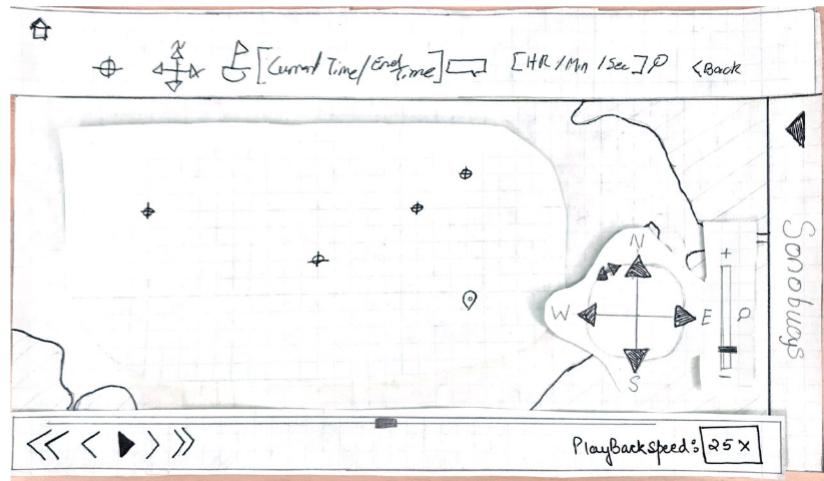


Figure 46: Home Page with Playback Bar

10.8 Relative Distances

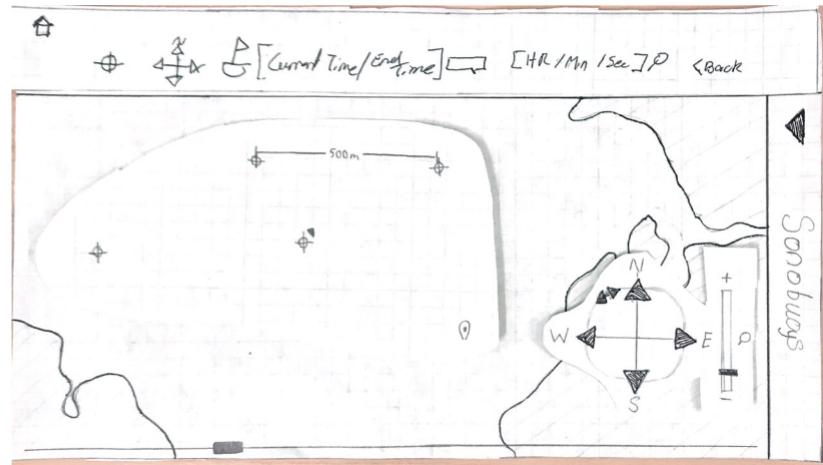


Figure 47: Home Page with Relative Distances

10.9 Display Results

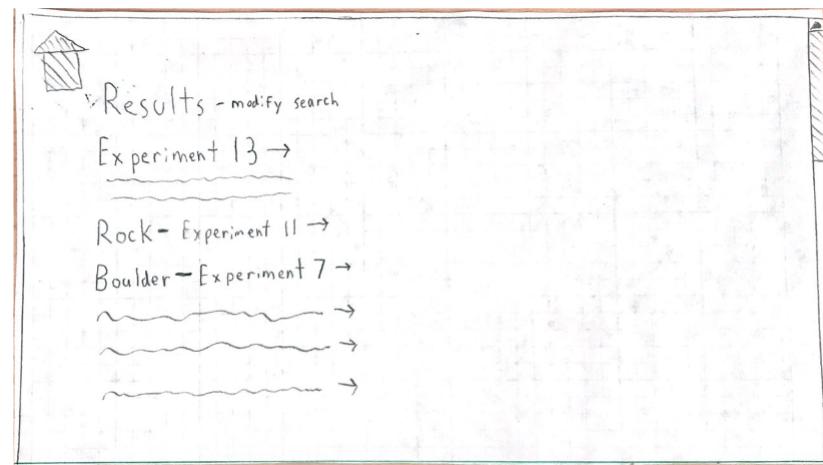


Figure 48: Shown Results

10.10 Searching

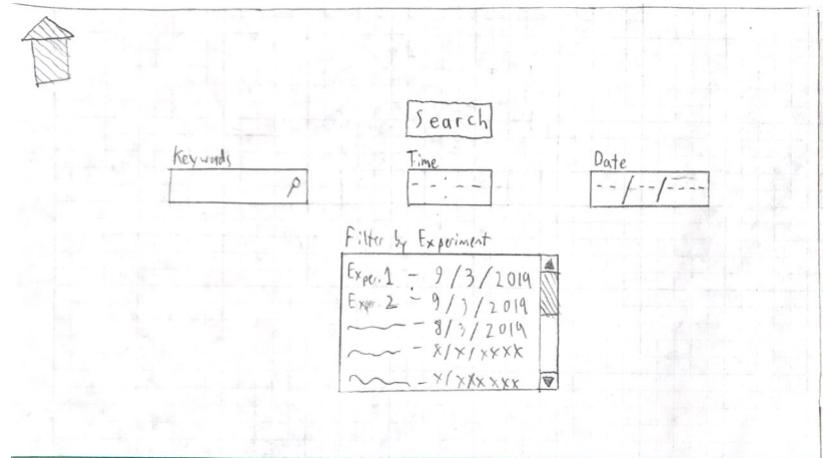


Figure 49: Searching

10.11 Sonobuoy Trails

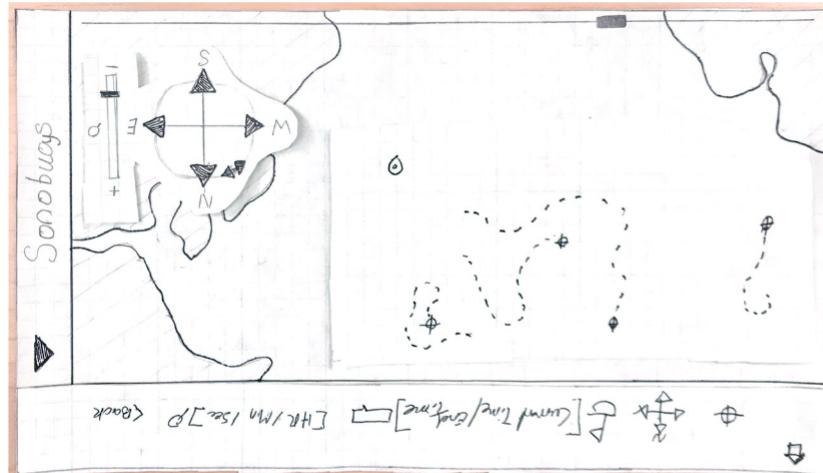


Figure 50: Home with Sonobuoy Trails

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.
- Information received from aid may not be complete or the same as information sent from the sonobuoys.