Requirements Document

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

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February 6, 2019
Version 1.0

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1 Introduction

1.1 Purpose

QuantumGPS conducts ocean-based experiments involving multiple sonobuoys. The sonobuoys are equipped with a GPS and emit positional information once every 5 seconds. QuantumGPS collects all the sonobuoy GPS information and stores it in a text file in GPRMC format. QuantumGPS's current system has proven to be difficult for users to understand; users have frequently required assistance to interpret the text file.

To alleviate this problem, QuantumGPS needs a mapping system to display the collected sonobuoy information. This is version 1.0 of a document detailing the requirements of the mapping system requested by QuantumGPS.

1.2 Project Scope

QuantumGPS's requested mapping system aims to better inform users of the position and movement of sonobuoys during experiments. Additionally, QuantumGPS requests for the mapping system to connect to AIS to inform users of large ships. This may interfere with the audio data collected during their experiments. Ultimately, the mapping system aims to provide users with a means to better understand their experiment.

1.3 Glossary of Terms

- AIS: An international service for monitoring boat traffic.
- Current System: Solution currently used by QuantumGPS to mange experiment information.
- Data-type: A specific type of information such as location, speed, etc.
- 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.
- 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.

- Priority, High: A requirement that must be completed for any 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.
- TBD: To be determined.
- TSRV: Transport Systems Research Vehicle.
- User: The operator of the product.
- Whiskey Golf Area: 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]

1.5 Overview

This document contains six main sections and an appendix. Section one describes the users and user expectations. 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 current system, developed and deployed by QuantumGPS, collects GPS information from each sonobuoy, formats this information into GPRMC format, and stores said information in a text file. The created text files are then stored on a server for future use. 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 data 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. Finally, the visualization interaction function will allow users to manipulate the way sonobuoy and GPS information is displayed.

2.3 User Classes and Characteristics

2.3.1 Operators

Operators are familiar with the current system, and will be the product's most frequent user. Operators will manage sonobuoy information displayed to fit the analyst's needs.

2.3.2 Data Analysts

Data analysts will use the product to conduct their research and understand the movement of the sonobuoys. As researchers, they have little to no experience with similar systems and thus will need special attention so that they do not necessarily need the assistance of an operator.

2.4 Operating Environment

GPS information will stream in real-time from an internal server to the user's machine. Users must be able to use Windows 7, 8, or 10. Users must also be able to conect to the server that GPS information is being streamed to.

2.5 Design and Implementation Constraints

2.5.1 Data format

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

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. As such, QuantumGPS will be able to issue maintenance internally or to independent contractors.

2.5.4 Security and access

The system must be auditable by QuantumGPS, meaning no proprietary intellectual property can be used in the development of the product. GPS information must be classified and not exposed externally, thus the product must only communicate 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 is not explicitly stated, the product should be able to work on Windows 10.

2.6.2 Hardware environment

The sonobuoys will remain over the ocean while information is being transmitted. There are multiple servers that information from text files can be accessed from.

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 users with an understandable visualization of the sonobuoy information, the dirty information must be ignored. After dirty information has been removed, the remaining clean sonobuoy information must be stored and used to update the visualizations discussed.

3.1.2 Functional Requirements

- R3.1.1: Sonobuoy information must be received every five seconds

- R3.1.2: Corrupted data must be identified and filtered so that it is not displayed
- R3.1.3: Impossible data must be identified so that the user can be alerted
- R3.1.4: Sonobuoy information that has been filtered must be stored so that it can be used to create visualizations for the 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, users will have an easier time conducting experiments.

3.2.2 Functional Requirements

- R3.2.1: Users must be able to view both real time and previously collected sonobuoy information
- R3.2.2: 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: Users must be able to view information sent directly from sonobuoys including:
  - R3.2.4.1: Display GPS coordinates
  - R3.2.4.2: Display cardinal direction
  - R3.2.4.3: Display speed in metric units
- R3.2.5: Users must be able to view information from AIS to what ever degree is available including:
  - R3.2.5.1: Display GPS coordinates
  - R3.2.5.2: Display cardinal direction
  - R3.2.5.3: Display speed in metric units
- R3.2.6: Users must be able to view information derived from GPS information including:
  - R3.2.6.1: Relative distance between sonobuoys and AIS objects
  - R3.2.6.2: Relative distance between fixed points
  - R3.2.6.3: Relative distance between sonobuoys and AIS objects and fixed points

3.3 Visualization Interactions

3.3.1 Description and Priority

Medium Priority
Providing a static visualization isn't sufficient. It is important that users are able to manipulate the visualization to fit their needs.

3.3.2 Functional Requirements

- R3.3.1: Users must be able to select and deselect which sonobuoys and AIS objects are displayed either individually or in groups which are still TBD.
- R3.3.2: Users must be able to pan, zoom, and rotate the virtual display.
- R3.3.3: 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: Users must be able to select what to view previously collected sonobuoy information based on time.
  - R3.3.3.2: Users must be able to playback previously collected sonobuoy information as though it were real time.
  - R3.3.3.3: Users must be able to pause and resume the playback.
  - R3.3.3.4: Users must be able to increase and decrease the speed of the playback.
  - R3.3.3.5: Users must have the ability to create labels or annotations for visualized elements.

4 External Interface Requirements

4.1 User Interfaces

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

Users must be able to use 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, boats, etc will be done using GPS streamed directly to the product. Users must not require an internet connection.

5 Non-Functional Requirements

5.1 Performance Requirements

- R5.1.1: Visualization must occur in less than 5 seconds.
- R5.1.2: It must be possible to run multiple experiments simultaneously. Multiple concurrent experiments must not impact performance in any noticeable way.
- R5.1.3: It must be possible for users to use Windows 7, 8, or 10.

5.2 Safety Requirements

- R5.2.1: Users must be able to define a range in which they can see charted hazards and ship routes.
- R5.2.2: A warning must be given to the  if a buoy drifts within 10 meters of the edge of the aforementioned defined area.
-  .3: Sonobuoy information must conform to AIS regulations.
- R5.2.4: Users with personal 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 to be maintainable.
- R5.3.2: GPRMC information obtained through sonobuoys are graphically interpreted to aid the user in visualization.
- R5.3.3: Users must not need prior knowledge of GPRMC or AIS specifications to visualize sonobuoy information.

6 Other Requirements

- R6.1: Information gathered by the sonobuoys must be available in AIS and NMEA formats for users
- R6.2: Those capable of reading in either English and French must be able to visualize sonobuoy information.
- R6.3: Displayed sonobuoy and GPS information is accurate and must be in accordance to Canadian and International maritime law.
- R6.4: Quantum GPS must have access to all code on project completion.
- R6.5: Quantum GPS must be able to audit source code.

- R6.6: Quantum GPS must be able to hire contractors for software maintenance.

7 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.