SYSTEM REQUIREMENTS SPECIFICATION

for

FAULT TOLERANT SHIP-BOARD DATA LOGGING AND PROCESSING SYSTEM

Customer: Nils Haëntjens

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Team Aqua

FAULT TOLERANT SHIP-BOARD DATA LOGGING AND PROCESSING SYSTEM

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1. Introduction

1.1 Purpose of This Document

The Software Requirements Specification document is an agreement between the client and contractor. It defines the system (hardware, software), its goals and requirements in order to define the most appropriate design, deliverables, and set a timeline.

1.2 References

“The University of Maine In-Situ Sound & Color Lab.” *The University of Maine In-Situ Sound & Color Lab*, 18 Mar. 2014, misclab.umeoce.maine.edu/.

The official website for the MISC Lab located at the University of Maine.

Sommerville, Ian. *Software Engineering*. Pearson Education South Asia Pte Ltd, 2016.

Many aspect of this document are taken from this document. This is document also talk about general software engineering processes.

Fowler, Martin, and Kendall Scott. *UML Distilled: a Brief Guide to the Standard Object Modeling Language*. Addison-Wesley, 1999.

This document refers to the ideas being the Unified Modeling Language(UML) along with its purpose.

1.3 Purpose of the Product

The MISC Lab, part of the School of Marine Science of the University of Maine participates in month-long expeditions to better understand the plankton ecosystem. Throughout the expeditions the team collects data from an array of sensors onboard. When the vessel is on an expedition it has very limited access to internet meaning all of the data being collected by the sensor array must be stored onboard until the ship docks.

The purpose of this product is to build a software solution that records and process data coming off the sensor array. The system will be dynamic, allowing the swapping of sensors in the array for different expedition types. The system will be robust and stable due to the lack of technical support while on the missions. In addition to the system being operated in a remote environment where there are a lot of environmental concerns (e.g. water splash, high moisture level).

1.4 Product Scope

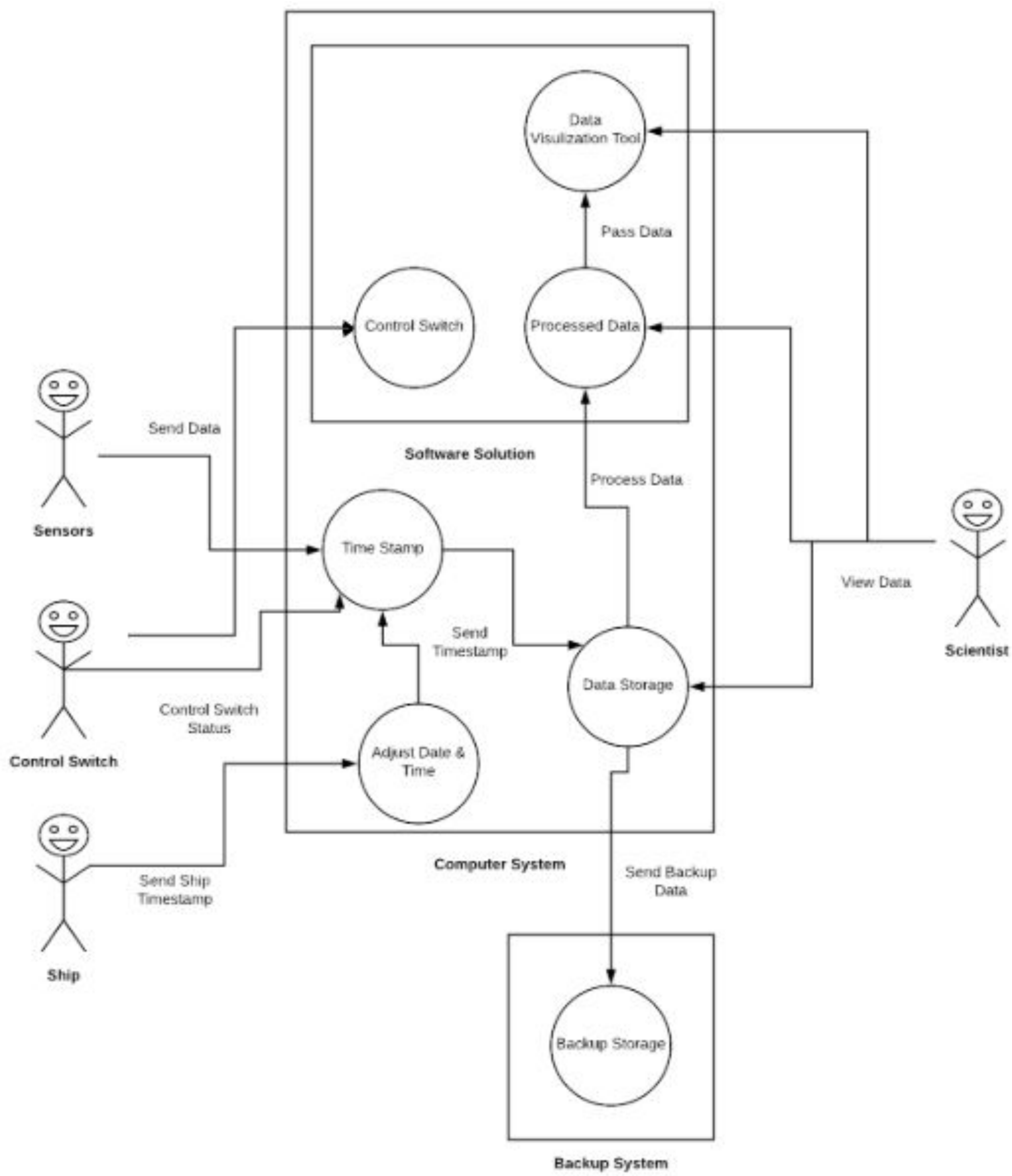

Figure 1.

The scope of the system resides within this diagram (Figure 1.). There are four actors within the system: the ship's computer system, the switching mechanism, sensors, and scientist. The switching system brings either total sea water (for measurements) or filtered sea water (for reference), used for calibration, to the instruments. The scientist can interact with the system by viewing the raw data or processed data through figures, can turn on or off the visualization of data for each instrument, and can turn on and off the logging of data for each instrument independently. The computer system stores the data which is then backed up to the external backup system. When the data is being collected by the computer system, the timestamp is added to the data and adjusted to the ships internal clock.

2. Functional Requirements

Functional requirements are aspect of system that are required for the project to be successful. Each of the requirements are numbered in order or importance with a brief explanation of the requirement. The priority level is a number assigned to each of the requirements from the range of one to five where one is a low priority and five is the highest priority. If actions are required before or after the requirement is met it will be listed under the preconditions or postconditions section of the requirement.

Number	1	
Name	Record Raw Data	
Summary	Incoming data needs to be stored	
Priority	5	
Preconditions	Data coming in from the sensors will be gathered	
Postconditions	After data is collected it will be stored and viewable	
Primary Actor	The Computer System	
Secondary Actors	The Sensors	
Trigger	when the computer system receives input from the sensors	
Main Scenario	**Step**	
Receive data	1	Data is received from the sensors
Add timestamp	2	The time stamp is added to the system
Store data	3	The data is stored to the data system

Extensions	**Step**	Data stays accessible to the visualization interface
none		none
Open Issues	none	

Table 1.

Test(s) for requirement 1:

1. Data will be tested by creating a simulation environment in the lab to determine if the data being collected is accurate.
2. The data being collected in the new system will be compared to the existing system to make sure the data is similar across the system.
3. The comparisons of the data size, format, and content will be used to make sure the data is being collected and stored correctly without any differences.

Number	2	
Name	Data Visualization	
Summary	The data coming in from the sensors are graphed in real time	
Priority	5	
Preconditions	Data being received by the computer	
Postconditions	Interactive output figures	
Primary Actor	Scientist	
Secondary Actors	None	
Trigger	Data coming into the system	
Main Scenario	**Step**	**Action**
Data is read	1	Data is received by computer
Data is processed	2	Data is converted from binary file to a human readable format
Data is plotted	3	The data is read by graphing software and plotted
Extensions	**Step**	**Branching Action**
None		None
Open Issues	None	

Table 2.

Test(s) for requirement 2:

1. The processed data being stored in a file will be compared to the data being plotted to confirm its graphing accurate data.

Number	3	
Name	System clock synchronization	
Summary	The date and time of the computer (used for timestamping the data) is synchronized with the ship's time server.	
Priority	5	
Preconditions	Timestamp calculated by the computer	
Postconditions	Adjusted time stamp is saved	
Primary Actor	None	
Secondary Actors	None	
Trigger	Data coming into the system	
Main Scenario	**Step**	**Action**
Start of data collection	1	The system beings collecting data from the sensors
Timestamp is produced	2	The time stamp is produced based off the internal clock
Time comparison	3	The time is taken from the ships clock and compared to the computer's clock
Timestamp adjustment	4	The time is adjusted from the comparison
Notify	5	If the computer clock was significantly adjusted notify the user the clock was adjusted.
Extensions	**Step**	**Branching Action**
None		None

Open Issues	None

Table 3.

Test(s) for requirement 3:

1. This requirement will be tested by gathering data and adding a timestamp. An additional computer will be used to simulate the ships clock. Both timestamps will be recorded and the adjusted timestamp will be validated by confirming the new timestamp was successfully calculated and saved.

Number	4	
Name	Control the switching system	
Summary	Every hour, the sensors need to have filtered seawater run through them for 10 minutes (though this can be adjusted).	
Priority	4	
Preconditions	An hour has passed	
Postconditions	The sensors have had filtered seawater pass through them for 10 minutes	
Primary Actor	The Switch System	
Secondary Actors	None	
Trigger	Every hour on a given minute	
Main Scenario	**Step**	
start	1	The computer system detects is time to trigger
run	2	The pumps start running freshwater through themselves
stop	3	The pumps stop pumping freshwater after 10 minutes
Extensions	**Step**	
none		none
Open Issues	None	

Table 4.

Test(s) for requirement 4:

1. The system will be tested when water is running through the pumps after every 1-hour interval.
2. The control switch will be monitored, and the system will be tested if it triggers for the correct duration.

Number	5	
Name	Automatic Data Backup	
Summary	The data must backed up to the backup system on a consistent basis	
Priority	4	
Preconditions	After a given time of data collection the backup system will run	
Postconditions	Data collected since the previous backup will be stored on the backup system	
Primary Actor	Scientist	
Secondary Actors	None	
Trigger	After a given amount of time since the previous backup the backup system will run	
Main Scenario	**Step**	**Action**
Start backup	1	Time timer triggers to start the backup system
Size Calculation	2	Calculates how much data is collected
Transferring Data	3	Transfer the data to the backup system
Extensions	**Step**	**Branching Action**
None		None
Open Issues	We have to decide on how often the data is backed up and how the system will handle the backup	

Table 5.

Test(s) for requirement 5:

1. Sample data will be used to represent past data. After a certain amount of time, we can compare the data backed up into the external backup system and the original system.

2. If this test is successful, we will test the amount of data backed up each time. After each backup period, the amount of data backed up will be recorded and the numbers will be used for comparison.

3. Non-Functional Requirements

Non-Functional requirements are qualifications that can be used to elaborate the performance characteristics of the system . The priority level is a number assigned to each of the requirements from the range of one to five where one is a low priority and five is the highest priority.

Case #	Cases and Tests Description	Priority Level
1	No data loss after unexpected failures such as power failures	**5**
	Test: Power outages will be simulated by disconnecting the power from the devices at random intervals making sure the system has a successful backup.	
2	The ability to work with more than 300GB of data.	**4**
	Test: Testing will take place by collecting mass amount of test data in the lab, additionally data from past expeditions will be used to further ensure the system can handle mass amount of data.	
3	Backup process' stability unaffected by the amount of data.	**3**
	Test: Different data sets will be used to test for performance.	
4	The ability to monitor from different devices	**3**
	Test: At least 4-5 different laptops will be available to monitor at the same time. As another test, one computer will start monitoring after the other computers have started, to test for interruption.	
5	Need to be able to easily change inputs and algorithm options.	**2**

	Test: The user/tester will attempt to change inputs and select algorithms	
6	Will take less than 10 minutes to start up	**2**
	Test: When the system starts, a timer will also be activated.. The time for the system to start will be recorded, and this test will be done 5-8 times.	

4. User Interface

User Interface Design Document for Fault Tolerant Ship-board Data Logging and Processing System will be provided at a later date(see deliverable section). The system will have a graphical user interface which allows the scientist to configure the system and view a graphical representation of the data being collected. The design of the system will be finalized in the User Interface Design Document.

5. Deliverable

Digital copies of relevant documents will be supplied during the development of the software and physical copies will be supplied upon request after the digital copy if finalized. The following is a list of what documents will delivered at specific times :

An electronic file containing the following:

Document	Estimated delivery date
A copy of the Systems Requirement Specification	October 26th, 2018
A copy of the System Design Document	November 16th, 2018
A copy of the User Interface Design Document	November 30th, 2018
A copy of the User Manual	TBA
A copy of the Administrator Manual	TBA
A copy of all source code	TBA
A copy of the The executable program	TBA

Any other software required for installation and execution of the delivered program	TBA

6. Open Issues

Issues that have been raised and do not yet have a conclusion. These issues will be addressed later in the development process.

Open issues are issues whose solution haven’t yet been determined. There are three primary open issues in our project: the programming language the software will be written in, the hardware on which the program will run, and the way data will be backed up. We do, however, have ideas of how to address these issues. The programming language will either be Python or Matlab; however, we are leaning towards Python since the team’s average amount of experience with Python is higher than with Matlab, and Matlab is more expensive. Furthermore, Python is the more ideal choice for its maintainability: the team of the customer are also moving towards Python, so our purpose and client’s team will synchronize well with each other .

We are considering using a network of either Raspberry Pis or Arduino Boards connected to a central laptop with ethernet cables to simulate the program, since Raspberry Pi and Arduino are excellent choices in simulating interactive applications However, this is also being considered carefully, since the tests may include a great amount of data, which might cause unexpected negative outcomes for the Raspberry Pis. Finally, we are considering using a separate laptop connected to the primary laptop through the network to use to backup the data. Thanks to the customer’s generosity, we will also able to utilize the equipment available in the laboratory.

Appendix A – Agreement Between Customer and Contractor

This document is an agreement between the Customer(Nils Haëntjens) and Contractor(Team Aqua) stating the requirements that will be included in the system. For the system to accepted all functional requirements must be completed and pass the test documented. By signing this both the Customer and Contractor agree on the work that must be completed and handed over to the Customer (Nils Haëntjens) before the deadline of December 19, 2019.

If changes of the system or requirements are requested from either the Customer or Contractor this document will be updated stating the changes requested and the reasoning behind the changes. For the requested changes to go into effect the document will need to be signed by the entirety of the team and the customer. From that point on the most recent System Requirements Specification will be the document referred to in future documentation.

Team Signatures:

Jacob Hall Jacob Hall Date: 11/2/18

Aaron Krevans ______________ Date: ________

Samuel Segee ______________ Date: 11/2/18

Chi Anh Nguyen ______________ Date: 11/2/18

Customer Signatures:

Nils Haëntjens ______________ Date: 11/03/18

Customer Comments:

Appendix B – Team Review Sign-off

By signing my name below, I certify that I have read, reviewed, and agreed to the information and requirements stated in this document.

Contractor Signatures:

Jacob Hall Jacob Hall Date: 11/2/18

Comments:

Aaron Krevans ______________________ Date: ____________

Comments:

Samuel Segee ______________________ Date: 11/2/18

Comments:

Chi Anh Nguyen ______________________ Date: 11/2/18

Comments:

Customer Signatures:

Nils Haëntjens ______________________ Date: 11/03/18

Customer Comments:

Appendix C – Document Contributions

Jacob Hall contributed to this document by writing the entirety of the Introduction which includes the Purpose of This Document, References, Purpose of the Product, and Project Scope. Jacob contributed by writing and formatting Appendix A and Appendix B. In addition to writing the sections mention above Jacob also did the graphics for both the logo and Unified Modeling Language(UML) diagram. Finally he contributed to the Functional and Non-Functional Requirements revising some of Requirements. Approx Percentage contributed 52%.

Aaron Krevans contributed nothing to this document. Approx Percentage contributed 0% to the final document.

Samuel Segee contributed to the document by writing entirely the Deliverable and Open Issues sections. He also provided use cases number 2 and 3 for the Functional Requirements. He also contributed half of the cases for the Non-Functional Requirements. Approximately, Sam contributed 13% to the final document.

Chi Anh Nguyen is responsible for the content and display of the cover page, Functional Requirements use case number 1 and tests for case 1 and 2, half of the Non-Functional Requirements and 5/10 of the Non-Functional Requirements' tests. Approximately, Chi contributed 35% to the final document.