

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
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SYSTEM REQUIREMENTS SPECIFICATION
CSE 4316: SENIOR DESIGN I
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THE BREWS
BLUETOOTH HYDROMETER

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1 PRODUCT CONCEPT

This section describes the purpose, use and intended user audience for the Bluetooth hydrometer. The Bluetooth hydrometer is a system that allows remote monitoring of temperature and specific gravity of beer during the fermentation process. Home brewers, the intended audience, will be able to check both temperature and specific gravity(SG) at any point during the brewing process by using their smart phones running an app or a web server on a Raspberry Pi.

1.1 PURPOSE AND USE

The Bluetooth hydrometer is a device that can be sanitized and placed into a fermentation vessel. This would allow a home brewer to take the specific gravity and temperature of their brew without having to open their fermenter to take a sample which could potentially expose their beer to contamination. The device would send the temperature and SG data to the brewer's phone running an app or a web server. By using this data the home brewer would then be able to monitor the fermentation process enabling them to know when they should change the temperature of their brew.

1.2 INTENDED AUDIENCE

Home brewers who love to ferment and create their own variety of beers at home are the intended audience of the Bluetooth hydrometer. Experienced home brewers trying to increase the yield of their beers by removing the need of taking samples of their beer during the fermentation process, would buy this product if it were to be made available publicly or commercially. The product is designed for home brewers but can be bought by anyone wishing to try and become a home brewer. As of now the Bluetooth hydrometer is intended for general use and is not a specific component of a more complex system.

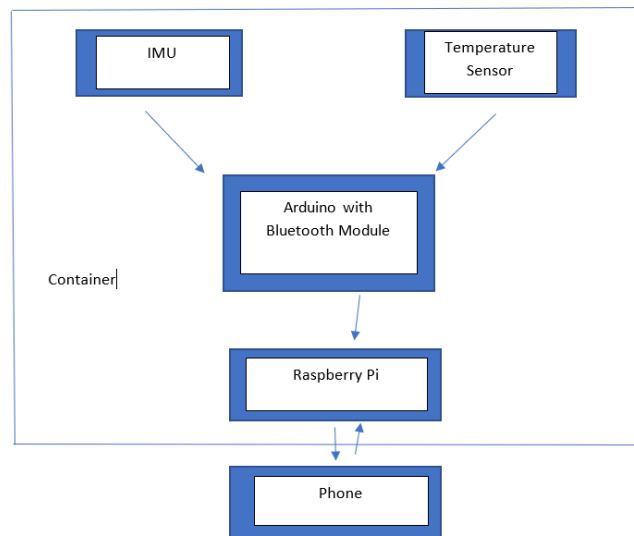


Figure 1: Bluetooth hydrometer conceptual drawing

2 PRODUCT DESCRIPTION

This section provides the reader with an overview of our Bluetooth Hydrometer. Key functionalities of the hardware include measuring the specific gravity of the brew, measuring temperature, and transmitting this data via Bluetooth to a Raspberry Pi. The Raspberry Pi will store the data for the user to access via a web app. The user will be able to monitor the tilt of the hydrometer and the temperature of the brew in any location through this web app, as long as they are connected to WiFi.

2.1 FEATURES & FUNCTIONS

The hydrometer measures the specific gravity, temperature, and transmits this data to a Raspberry Pi. As of right now, the hydrometer cannot receive commands, only send data to the Raspberry Pi. The specific gravity will be captured using an IMU. The temperature will be measured in an independent sensor. The data will be sent via a separate Bluetooth module. All of these components communicate with an Arduino microprocessor.

2.2 EXTERNAL INPUTS & OUTPUTS

External Inputs & Outputs	Description	Use
Specific gravity	output flow	calculate tilt
Temperature of brew	output flow	monitor temperature
Bluetooth signal	output flow	transmit data
Server	output flow	update user's app
Web app	input flow	request data from server

Table 2: Critical External Data Flows

2.3 PRODUCT INTERFACES

The user will only need to interact with the hydrometer and the web app. They will need to place and remove the hydrometer from the brew. They will not need to interact with any of the internal components unless that are replacing the battery. The administrator/ maintainer will be able to interact with the hydrometers internal components as well as update server and web app functionality.

3 CUSTOMER REQUIREMENTS

This section outlines customer requirements for the Bluetooth hydrometer. Customer requirements are the required features and functions specified for and by our sponsor Dr. Conly. These requirements are directly observable features and functions that will be encountered by the user/consumer.

3.1 MEASURING THE TEMPERATURE OF THE BREW

3.1.1 DESCRIPTION

The Bluetooth hydrometer will measure the temperature of the brew throughout the entire brewing process. This ensures that the brew stays at the correct temperature during the fermentation phase.

3.1.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.1.3 CONSTRAINTS

The main constraint is whether or not we will have a brew available for measurements in the summer. Another constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing.

3.1.4 STANDARDS

N/A

3.1.5 PRIORITY

The priority of this requirement is moderate.

3.2 MEASURING THE SPECIFIC GRAVITY OF THE BREW

3.2.1 DESCRIPTION

The Bluetooth hydrometer will measure the specific gravity of the brew throughout the entire brewing process. Since the sugar is consumed by the yeast to produce alcohol and CO₂, knowing the specific gravity allows us to both estimate the alcohol by volume (ABV) of the beer and know when fermentation is finished.

3.2.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.2.3 CONSTRAINTS

The main constraint is whether or not we will have a brew available for measurements in the summer. Another constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing.

3.2.4 STANDARDS

N/A

3.2.5 PRIORITY

The priority of this requirement is critical.

3.3 INERTIAL MEASUREMENT UNIT(IMU) FOR TILT

3.3.1 DESCRIPTION

The Bluetooth hydrometer will measure the specific gravity of the brew using an IMU to measure tilt of the device.

3.3.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.3.3 CONSTRAINTS

The main constraint is whether or not we will have a brew available for testing in the summer. Another constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing of the IMU.

3.3.4 STANDARDS

N/A

3.3.5 PRIORITY

The priority of this requirement is moderate.

3.4 USE OF BLUETOOTH TECHNOLOGY

3.4.1 DESCRIPTION

The Bluetooth hydrometer will use a Bluetooth module and Bluetooth Low Energy(BLE) to receive data.

3.4.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.4.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing. Our Bluetooth module has to be small enough to fit in our containment unit.

3.4.4 STANDARDS

N/A

3.4.5 PRIORITY

The priority of this requirement is moderate.

3.5 PHONE APP OR WEB INTERFACE

3.5.1 DESCRIPTION

The Bluetooth hydrometer will need either a phone application or a website on a Raspberry PI to connect to our specific hydrometer.

3.5.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.5.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing. Our group only has moderate knowledge in website development so we will have to learn as we work on it.

3.5.4 STANDARDS

N/A

3.5.5 PRIORITY

The priority of this requirement is moderate.

3.6 PLOTS OF SPECIFIC GRAVITY AND TEMPERATURE

3.6.1 DESCRIPTION

The Bluetooth hydrometer will need to be able to plot specific gravity and temperature measurements via a bar chart or a line graph.

3.6.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.6.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing.

3.6.4 STANDARDS

N/A

3.6.5 PRIORITY

The priority of this requirement is moderate.

3.7 USE OF MICROCONTROLLER

3.7.1 DESCRIPTION

The Bluetooth hydrometer will need a microcontroller such as an Arduino or Teensy in order to receive data from the IMU and temperature sensor.

3.7.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.7.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing. We are limited to using a microcontroller that is small enough to fit within our containment unit.

3.7.4 STANDARDS

N/A

3.7.5 PRIORITY

The priority of this requirement is moderate.

3.8 USE OF TEMPERATURE SENSOR

3.8.1 DESCRIPTION

The Bluetooth hydrometer will need a temperature sensor such as the LM35 in order to measure the current temperature of the brew.

3.8.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.8.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing. We also may not have a brew available in the summer for testing.

3.8.4 STANDARDS

N/A

3.8.5 PRIORITY

The priority of this requirement is moderate.

3.9 USE OF RASPBERRY PI

3.9.1 DESCRIPTION

The Bluetooth hydrometer will need a Raspberry PI to receive both the temperature and specific gravity data.

3.9.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.9.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing.

3.9.4 STANDARDS

N/A

3.9.5 PRIORITY

The priority of this requirement is high.

3.10 RASPBERRY PI CONNECTIVITY

3.10.1 DESCRIPTION

The Raspberry Pi will need to be able to connect to up to four Bluetooth hydrometers.

3.10.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.10.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing.

3.10.4 STANDARDS

N/A

3.10.5 PRIORITY

The priority of this requirement is low.

3.11 RECEIVING CURRENT TEMPERATURE

3.11.1 DESCRIPTION

The Bluetooth hydrometer will need a website on a Raspberry PI or a phone app to poll the hydrometer to receive the current brew temperature.

3.11.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.11.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing. Our group only has moderate knowledge in website development so we will have to learn as we work on it.

3.11.4 STANDARDS

N/A

3.11.5 PRIORITY

The priority of this requirement is moderate.

3.12 CURRENT TEMPERATURE DISPLAY

3.12.1 DESCRIPTION

The Bluetooth hydrometer will need a website on a Raspberry PI or a phone app to display the current temperature.

3.12.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.12.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing. Our group only has moderate knowledge in website development so we will have to learn as we work on it. Also temperature access must be working.

3.12.4 STANDARDS

N/A

3.12.5 PRIORITY

The priority of this requirement is moderate.

3.13 RECEIVING HISTORICAL TEMPERATURE

3.13.1 DESCRIPTION

The Bluetooth hydrometer will need a website on a Raspberry PI or a phone app to log historical temperature data.

3.13.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.13.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing. Our group only has moderate knowledge in website development so we will have to learn as we work on it.

3.13.4 STANDARDS

N/A

3.13.5 PRIORITY

The priority of this requirement is high

3.14 HISTORICAL TEMPERATURE DISPLAY

3.14.1 DESCRIPTION

The Bluetooth hydrometer will need a website on a Raspberry PI or a phone app to display the historical temperature data.

3.14.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.14.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing. Our group only has moderate knowledge in website development so we will have to learn as we work on it. Also temperature access must be working.

3.14.4 STANDARDS

N/A

3.14.5 PRIORITY

The priority of this requirement is high.

3.15 RECEIVING CURRENT SPECIFIC GRAVITY

3.15.1 DESCRIPTION

The Bluetooth hydrometer will need a website on a Raspberry PI or a phone app to poll the hydrometer to receive the current specific gravity of the brew.

3.15.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.15.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing. Our group only has moderate knowledge in website development so we will have to learn as we work on it.

3.15.4 STANDARDS

N/A

3.15.5 PRIORITY

The priority of this requirement is critical.

3.16 CURRENT SPECIFIC GRAVITY DISPLAY

3.16.1 DESCRIPTION

The Bluetooth hydrometer will need a website on a Raspberry PI or a phone app to display the current specific gravity data.

3.16.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.16.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing. Our group only has moderate knowledge in website development so we will have to learn as we work on it. Also specific gravity access must be working.

3.16.4 STANDARDS

N/A

3.16.5 PRIORITY

The priority of this requirement is critical.

3.17 RECEIVING HISTORICAL SPECIFIC GRAVITY

3.17.1 DESCRIPTION

The Bluetooth hydrometer will need a website on a Raspberry PI or a phone app to log historical specific gravity data.

3.17.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.17.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing. Our group only has moderate knowledge in website development so we will have to learn as we work on it.

3.17.4 STANDARDS

N/A

3.17.5 PRIORITY

The priority of this requirement is high.

3.18 HISTORICAL SPECIFIC GRAVITY DISPLAY

3.18.1 DESCRIPTION

The Bluetooth hydrometer will need a website on a Raspberry PI or a phone app to display the historical specific gravity data.

3.18.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.18.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing. Our group only has moderate knowledge in website development so we will have to learn as we work on it. Also specific gravity access must be working.

3.18.4 STANDARDS

N/A

3.18.5 PRIORITY

The priority of this requirement is high.

3.19 SPECIFIC GRAVITY ALARM

3.19.1 DESCRIPTION

The Bluetooth hydrometer will need an alarm to notify the user when the specific gravity has reached a certain point in the brew process.

3.19.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.19.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing.

3.19.4 STANDARDS

N/A

3.19.5 PRIORITY

The priority of this requirement is low.

3.20 TEMPERATURE ALARM

3.20.1 DESCRIPTION

The Bluetooth hydrometer will need an alarm to notify the user when the temperature has reached a certain low or high point in the brew process.

3.20.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.20.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing.

3.20.4 STANDARDS

N/A

3.20.5 PRIORITY

The priority of this requirement is low.

3.21 DEVELOPER DATA ACCESS

3.21.1 DESCRIPTION

The Bluetooth hydrometer will need to allow for API access to developers so that they can pull data to integrate into future designs and systems.

3.21.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.21.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing.

3.21.4 STANDARDS

N/A

3.21.5 PRIORITY

The priority of this requirement is high.

3.22 REMOTE CONTROL OF TEMPERATURE

3.22.1 DESCRIPTION

Our device should allow the user to change the temperature of the brew by having remote control of the fermentation system.

3.22.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.22.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing. Our group will more than likely not have enough time to get to this requirement according to our sponsor Dr. Conly.

3.22.4 STANDARDS

N/A

3.22.5 PRIORITY

The priority of this requirement is future.

3.23 DATA TIME INTERVAL

3.23.1 DESCRIPTION

The Bluetooth hydrometer will need to allow the user to set time intervals for reading the temperature and specific gravity data. It would not be ideal to take measurements of the data every second. The user should be able to set the time interval to anywhere from a few minutes to a few hours as needed.

3.23.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

3.23.3 CONSTRAINTS

Main constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing.

3.23.4 STANDARDS

N/A

3.23.5 PRIORITY

The priority of this requirement is moderate.

4 PACKAGING REQUIREMENTS

The packaging will include the Bluetooth hydrometer with all of the components assembled except for the battery which will need to be connected to turn on the device. The user will not need to interact with the components inside of the device once turned on unless the battery needs to be changed. The Raspberry Pi will be provided and instructions for the user to download the app and software will also be included in the packaging. The Raspberry Pi will need to be set up and packaging will not include batteries. The hydrometer will have a clear plastic encapsulation. The packaging will have the product name on it as well as our logo.

4.1 BLUETOOTH HYDROMETER

4.1.1 DESCRIPTION

This requirement is the hardware piece, the Bluetooth Hydrometer. The Hydrometer will come fully assembled in the box and will not require any hardware set up other than connecting the battery. The end-user will not need to interact with the inside components unless they are changing the battery or reinstalling the Arduino script. The batteries are not included.

4.1.2 SOURCE

All of our information comes from what we come up with as a team and our sponsor Professor Conly.

4.1.3 CONSTRAINTS

The plastic encapsulation needs to be clear and waterproof.

4.1.4 STANDARDS

N/A

4.1.5 PRIORITY

This requirement is considered moderate.

4.2 RASPBERRY PI

4.2.1 DESCRIPTION

The Raspberry Pi comes with the package and will come with a black plastic encapsulation with the Raspberry Pi logo on it. The user will need to put the Raspberry Pi into a separate plastic encapsulation.

4.2.2 SOURCE

All of our information comes from what we come up with as a team and our sponsor Professor Conly.

4.2.3 CONSTRAINTS

The encapsulation needs to be snug around the Raspberry Pi to prevent possible hardware damage.

4.2.4 STANDARDS

N/A

4.2.5 PRIORITY

This requirement is considered moderate.

4.3 APP DOWNLOAD INSTRUCTIONS

4.3.1 DESCRIPTION

The packaging will include instructions explaining how to download the app and software needed to interact with the Raspberry Pi. This app is also needed for the user to access data being output from the Bluetooth hydrometer.

4.3.2 SOURCE

All of our information comes from what we come up with as a team and our sponsor Professor Conly.

4.3.3 CONSTRAINTS

The instructions need to be legible to an English speaker.

4.3.4 STANDARDS

N/A

4.3.5 PRIORITY

This requirement is considered moderate.

5 PERFORMANCE REQUIREMENTS

This section outlines the performance related requirements of the Bluetooth Hydrometer. The Device relies heavily on both battery power as well as the accuracy of the specific gravity and temperature measurements.

5.1 BATTERY LIFE

5.1.1 DESCRIPTION

The Bluetooth hydrometer has to function for the entirety of the brew process which can be anywhere from several days to a few months.

5.1.2 SOURCE

This requirement was determined by our team as a necessity since we will have to be able to check the specific gravity and temperature data at various periods during the brew process.

5.1.3 CONSTRAINTS

The battery has to be small enough to fit the container but also have a long battery life despite it's size.

5.1.4 STANDARDS

N/A

5.1.5 PRIORITY

This priority is critical.

5.2 TEMPERATURE ACCURACY

5.2.1 DESCRIPTION

The Bluetooth hydrometer has to output a fairly accurate temperature reading to within a 5 percent error.

5.2.2 SOURCE

This requirement was determined by our team and Dr. Conly.

5.2.3 CONSTRAINTS

The main constraints are whether or not we will have a brew available as well as time for measurements in the summer. Another constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing.

5.2.4 STANDARDS

N/A

5.2.5 PRIORITY

This priority is low.

5.3 SPECIFIC GRAVITY ACCURACY

5.3.1 DESCRIPTION

The Bluetooth hydrometer has to output a fairly accurate specific gravity reading to within a 5 percent error.

5.3.2 SOURCE

This requirement was determined by our team and Dr. Conly.

5.3.3 CONSTRAINTS

The main constraints are whether or not we will have a brew available as well as time for measurements in the summer. Another constraint is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing.

5.3.4 STANDARDS

N/A

5.3.5 PRIORITY

This priority is low.

6 SAFETY REQUIREMENTS

This section addresses the safety requirements specific to the use of the Bluetooth hydrometer. Since the Bluetooth hydrometer is an electrical device, care must be used to ensure a watertight seal on the hardware container to ensure the safety of the user and the hardware. Our team also needs to follow LOTO procedures, NEC wiring compliance, and RIA robotic manipulator safety standards.

6.1 LABORATORY EQUIPMENT LOCKOUT/TAGOUT (LOTO) PROCEDURES

6.1.1 DESCRIPTION

Any fabrication equipment provided used in the development of the project shall be used in accordance with OSHA standard LOTO procedures. Locks and tags are installed on all equipment items that present use hazards, and ONLY the course instructor or designated teaching assistants may remove a lock. All locks will be immediately replaced once the equipment is no longer in use.

6.1.2 SOURCE

CSE Senior Design laboratory policy

6.1.3 CONSTRAINTS

Equipment usage, due to lock removal policies, will be limited to availability of the course instructor and designed teaching assistants.

6.1.4 STANDARDS

Occupational Safety and Health Standards 1910.147 - The control of hazardous energy (lockout/tagout).

6.1.5 PRIORITY

Critical

6.2 NATIONAL ELECTRIC CODE (NEC) WIRING COMPLIANCE

6.2.1 DESCRIPTION

Any electrical wiring must be completed in compliance with all requirements specified in the National Electric Code. This includes wire runs, insulation, grounding, enclosures, over-current protection, and all other specifications.

6.2.2 SOURCE

CSE Senior Design laboratory policy

6.2.3 CONSTRAINTS

High voltage power sources, as defined in NFPA 70, will be avoided as much as possible in order to minimize potential hazards.

6.2.4 STANDARDS

NFPA 70

6.2.5 PRIORITY

Critical

6.3 RIA ROBOTIC MANIPULATOR SAFETY STANDARDS

6.3.1 DESCRIPTION

Robotic manipulators, if used, will either housed in a compliant lockout cell with all required safety interlocks, or certified as a "collaborative" unit from the manufacturer.

6.3.2 SOURCE

CSE Senior Design laboratory policy

6.3.3 CONSTRAINTS

Collaborative robotic manipulators will be preferred over non-collaborative units in order to minimize potential hazards. Sourcing and use of any required safety interlock mechanisms will be the responsibility of the engineering team.

6.3.4 STANDARDS

ANSI/RIA R15.06-2012 American National Standard for Industrial Robots and Robot Systems, RIA TR15.606-2016 Collaborative Robots

6.3.5 PRIORITY

Critical

6.4 WATERTIGHT SEAL

6.4.1 DESCRIPTION

The Bluetooth hydrometer is an electrical device that will be placed into a fermenter containing liquid. It is important that a watertight seal be kept on the hardware during all stages of the fermentation process to ensure the safety of both the user and the hardware.

6.4.2 SOURCE

Both Dr. Conly and Dr. Gieser have told us to ensure our hardware has a watertight seal.

6.4.3 CONSTRAINTS

User may not be aware of damage to watertight seal if damage occurs during shipping process.

6.4.4 STANDARDS

NFPA 70

6.4.5 PRIORITY

Critical for functioning product.

7 MAINTENANCE & SUPPORT REQUIREMENTS

The maintenance and support requirements that will exist for this product will consist of a number of things which include: system updates, hardware troubleshooting, hardware failures. Each of these requirements will have its own way of needing to be tended to after product launch. They are as follows:

7.1 SYSTEM UPDATES

7.1.1 DESCRIPTION

System updates will be used to provide any new information that will be used for the hydrometer, along with the usage of the web application/ mobile application that will be integrated as the user keeps track of their products. These system updates will allow for feedback from user experience in order to make the most proficient and user friendly device available.

7.1.2 SOURCE

We developed this requirement as a team.

7.1.3 CONSTRAINTS

Constraints for the system updates include bugs that arise from these given updates. As with all updates, one aspect may be improved while another aspect is diminished in the process. Another constraint would be from the user feedback itself. The feedback, although useful, will be difficult to sift through to determine the "best outcome" for the application.

7.1.4 STANDARDS

Standards for the system updates are that the old software continue to be used until the updated software has been tested. The tested software must have standards of not having any apparent bugs before deployment so that the users continue to get the best quality user experience.

7.1.5 PRIORITY

This requirement is considered low.

7.2 HARDWARE TROUBLESHOOTING

7.2.1 DESCRIPTION

When a user has a problem with the hydrometer, there will be a manual/online manual to aid the consumer. Included in the manual will be instructions for re-downloading software. It will also include solutions to other common malfunctions.

7.2.2 SOURCE

We developed this requirement as a team.

7.2.3 CONSTRAINTS

Constraints will be that there could be possible malfunctions that were overlooked in the creation of the Bluetooth hydrometer.

7.2.4 STANDARDS

Standards within the troubleshooting criteria would be having test cases performed that show the possibilities of certain malfunctions happening that can be fixed by the user. These tested malfunctions can then be added to the manual/ online manual.

7.2.5 PRIORITY

This requirement is considered low.

7.3 HARDWARE FAILURES

7.3.1 DESCRIPTION

Hardware failures would entail that the device is no longer usable. The failures would call for a replacement of the product or a refund of the product depending on the amount of time that the product has been used.

7.3.2 SOURCE

We developed this requirement as a team.

7.3.3 CONSTRAINTS

Constraints on these failures would be the amount of time that the product has been used, the condition that the product is in at the time of the failure, and the amount of time that has passed to entail that the product is still under warranty.

7.3.4 STANDARDS

Standards of failures are as listed with the constraints. The amount of time the product has been used, condition of product, and warranty.

7.3.5 PRIORITY

This requirement is considered low.

8 OTHER REQUIREMENTS

8.1 OPERATING SYSTEMS

8.1.1 DESCRIPTION

This Senior Design project ideally should be compatible with all operating systems, such as: MacOS, Windows, Android and IOS. When using our software, your device should be updated to the latest version. Any problems be sure to email **jorge.avila@mavs.uta.edu**

8.1.2 SOURCE

Requirement determined as a team with experience through testing on different operating systems

8.1.3 CONSTRAINTS

Constraints should apply on Ubuntu's Operating System. This OS will cause unexpected behavior and should not be used when using the tilt hydrometer as the bluetooth module tends to fail with Ubuntu.

8.1.4 STANDARDS

N/A

8.1.5 PRIORITY

This is labeled as a low priority

9 FUTURE ITEMS

This section addresses the future requirements that were listed as priority 5. These requirements will only be addressed in the prototype Bluetooth hydrometer if time and budget permits.

9.1 REMOTE CONTROL OF TEMPERATURE

9.1.1 DESCRIPTION

Our device should allow the user to change the temperature of the brew by having remote control of the fermentation system.

9.1.2 SOURCE

The source of this requirement is our sponsor Dr. Conly.

9.1.3 CONSTRAINTS

Main constraint is having the time needed to work on this requirement. Another is the restrictions currently in place for social distancing which may hinder our group being able to work together for testing.

9.1.4 STANDARDS

N/A

9.1.5 PRIORITY

The priority of this requirement is future.

REFERENCES