DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
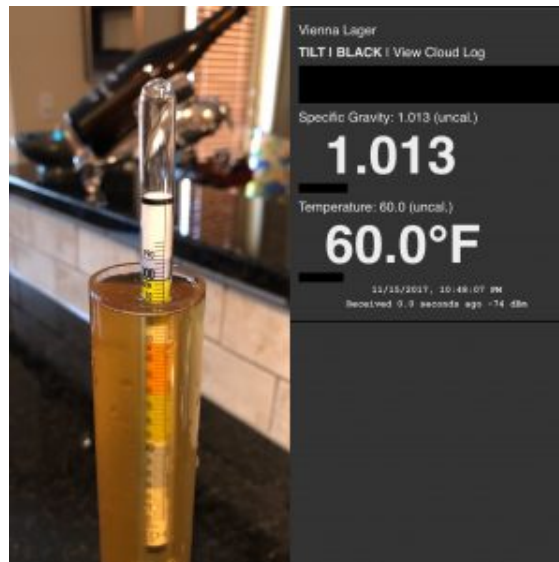# THE UNIVERSITY OF TEXAS AT ARLINGTON

SYSTEM REQUIREMENTS SPECIFICATION
CSE 4316: SENIOR DESIGN I
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TEAM HYDRO
BLUETOOTH HYDROMETER

ANDREW DUONG
REBECCA BYUN
GAM B. GARBUJA
RYAN TYLER

REVISION HISTORY

Revision	Date	Author(s)	Description
0.1	08.01.2020	AD	document creation
0.2	08.12.2020	GB	complete product concept
0.3	08.12.2020	GB	complete product description
0.4	08.12.2020	RB	complete performance requirements
0.5	08.12.2020	RB	complete safety requirements
0.6	08.13.2020	RT	complete customer requirements
0.7	08.13.2020	RT	complete packaging requirements
0.8	08.13.2020	AD	complete maintenance requirements
0.9	08.13.2020	AD	convert srs from google docs to tex
1.0	10.20.2015	AD, GB, RB, RT	official release

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1 PRODUCT CONCEPT

The purpose of "Bluetooth Hydrometer" is to help users to digitally keep track of useful data such as temperature and specific gravity (SG) of beer during the fermentation process. Intended audiences, mostly home brewers, would be able to check temperature and SG constantly with the help of smartphone or computer..

1.1 PURPOSE AND USE

Arduino nano 33 BLE is a Bluetooth enabled device that can receive analog and digital data from external sensors, temperature sensors in our case. Built in Gyroscope sensor would be able to help in determining SG of denser liquids such as beers which is ideal for Bluetooth Hydrometer. Sending temperature and SG data to smartphones or a website is another huge part of this project which involves building an app for smartphones and creating websites.

1.2 INTENDED AUDIENCE

Intended audiences are mostly brewers who love to ferment and create a variety of beers at home. Home brewers would be able to leave the device floating inside the fermentation vessel during the period of fermentation. Bluetooth Hydrometer is a standalone product which is not designed to be a part of a bigger system as of now.
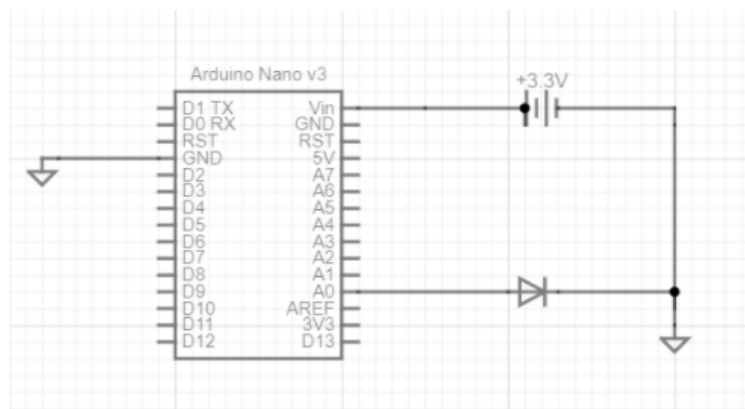

Figure 1: Bluetooth Hydrometer

Conceptual Drawing

2 PRODUCT DESCRIPTION

The overview of Bluetooth Hydrometer is provided in this section. Arduino Nano 33 BLE is a microcontroller used for Bluetooth Hydrometer. Nano 33 is a small and low powered Bluetooth enabled device with a built in 9-axis gyroscope. Nano operates at 3.3 V, it has 14 digital inputs, 8 analog inputs and 6 power modulations (PWM) and a clock speed of 64 MHz. Temperature sensor used operates at 3.3V with temperature range of -40 to $125°$C having an accuracy of $\pm1.5°$C.

Figure 2: Arduino Nano 33

Figure 3: Temperature Sensor

2.1 FEATURES & FUNCTIONS

What the product does and does not do. Specify in words what it looks like, referring to a conceptual diagram/graphic (Figure X). Define the principle parts/components of the product. Specify the elements in the diagram/graphic that are part(s) of this product as well as any associated external elements (e.g., the Internet, an external web server, a GPS satellite, etc.)

2.2   EXTERNAL INPUTS & OUTPUTS

External input is temperature and specific gravity data from temperature sensor and built in gyroscope sensor respectively. Arduino nano outputs those data to smartphones via Bluetooth and a website.

2.3   PRODUCT INTERFACES

Bluetooth module plays an important role to interface nano. Datas are constantly uploaded via Bluetooth to a smartphone or a website. Nano can be interfaced to send data only after a certain time interval, since temperature and SG don't change every second or minute. Software can handle and analyze those datas within an app or a website to provide visual interface to users.

3   CUSTOMER REQUIREMENTS

This section outlines customer requirements. The requirements listed here are the functionalities of the hydrometer given by the user. These requirements are directly observable by the user.

3.1   MEASURING SPECIFIC GRAVITY OF THE BREW

3.1.1   DESCRIPTION

Hydrometer will measure the specific gravity throughout the brewing process to estimate how many sugars can be converted to alcohol.

3.1.2   SOURCE

The requirement was expressed by Chris Conly and his brewing team.

3.1.3   CONSTRAINTS

The main constraint for this requirement will revolve around the timing of the brew and whether or not a brew will be available to perform the desired measurements on. Also, with the given limitations in place per government and university orders of social distancing, key testing for the given requirement may be hindered.

3.1.4   STANDARDS

3.1.5   PRIORITY

The priority of this requirement is critical as without it the product, i.e., the Hydrometer, will not work and be a failure.

3.2   MEASURING TEMPERATURE OF THE BREW

3.2.1   DESCRIPTION

Hydrometer will measure the temperature throughout the brewing process to ensure the brew remains at the correct temperature during the most active phase of fermentation.

3.2.2   SOURCE

The requirement was expressed by Chris Conly and his brewing team.

3.2.3   CONSTRAINTS

The main constraint for this requirement will revolve around the timing of the brew and whether or not a brew will be available to perform the desired measurements on. Also, with the given limitations in place per government and university orders of social distancing, key testing for the given requirement may be hindered.

3.2.4   STANDARDS

3.2.5   PRIORITY

The priority of this requirement is **critical** as without it the product, i.e., the Hydrometer, will not work and be a failure.

3.3   SENDING MEASUREMENTS TO MOBILE APPLICATION

3.3.1   DESCRIPTION

Hydrometer, once finished with measurements, will send critical measured data to the mobile application to be analyzed by the user.

3.3.2   SOURCE

The requirement was expressed by Chris Conly and his brewing team.

3.3.3   CONSTRAINTS

The main constraint for this requirement will revolve around the timing of the brew and whether or not a brew will be available to perform the desired measurements on. Also, with the given limitations in place per government and university orders of social distancing, key testing for the given requirement may be hindered.

3.3.4   STANDARDS

3.3.5   PRIORITY

The priority of this requirement is **high**. The project will result in a success and have desired basic functionality without this requirement but will lack optimal functionality.

4 Packaging Requirements

This section outlines packaging requirements. The requirements listed here are how the hydrometer will appear upon delivery to the end-user, the accessories included in the package, and the setup and installation guide.

4.1 Software Installation and Device Instructions

4.1.1 Description

The user will download source code by cloning the product repository on their host machine. The product repository will store the product README where instructions on hardware setup, mobile application installation and host server code setup can be found.

4.1.2 Source

The requirement was decided upon by group consensus.

4.1.3 Constraints

The cloning of the product repository will depend on access to the Github server and its ability to clone on the user's host machine.

4.1.4 Standards

Not applicable.

4.1.5 Priority

The priority of this requirement is **critical** as without it the product, i.e., the Hydrometer, will not work and be a failure.

4.2 Hardware Delivery

4.2.1 Description

Hydrometer hardware will be delivered to the user fully assembled and ready for use.

4.2.2 Source

The requirement was decided upon by group consensus.

4.2.3 Constraints

The delivery of hardware will be sent to the user through means of mail courier and will depend on their speed of service due to COVID-19.

4.2.4 Standards

Not applicable.

4.2.5 Priority

The priority of this requirement is **critical** as without it the product, i.e., the Hydrometer, will be a failure.

5 Performance Requirements

This section outlines performance-related requirements. The bluetooth hydrometer relies heavily on communication between the user's mobile application control, reliability of the battery module, and optimization of communication between the application and module.

5.1 Battery Usage

5.1.1 Description

The battery must be able to be kept on for a total of 2 months minimum. When turned off and the bluetooth module is off, no battery power must be consumed.

5.1.2 Source

This is a bare necessity requirement for operation, as the hydrometer must be able to stay on for a long enough total time to last for the duration of short checks along the period of a brew.

5.1.3 Constraints

The 9V battery module is a set 1,200mAh capacity, so the load must be small enough to sustain power for the required length of time.

5.1.4 Standards

Not applicable.

5.1.5 Priority

This requirement is important for having the use load remain low, but not critical as the hydrometer is a device that does not require much power for basic operation and will already last a long enough time for several checks.

5.2 Speed Of Setup

5.2.1 Description

Turning the module on will take no longer than 60 seconds to set up with the mobile application. By pressing a button in the application for turning on the hydrometer, a signal should be sent to the web server to indicate power and data to start to be read in. This is excluding the time to assemble the hydrometer and place it in the brew container.

5.2.2 Source

This is a group requirement for the end user. Having the hydrometer respond to the control application in a reasonable amount of time is essential to having the user experience be quick.

5.2.3 Constraints

The 9V battery module is a set 1,200mAh capacity, so the load must be small enough to sustain power for the required length of time.

5.2.4 Standards

Not applicable.

5.2.5 Priority

This is critical to using the hydrometer, as taking longer than 60 seconds to just turn on the device would become a burden to the user for a time-sensitive project like brewing.

5.3   ACCURACY OF RESULTS

5.3.1   DESCRIPTION

Reading the specific gravity will return a calculated sugar level result to the user that is correct with less than a 5% error. Multiple readings will be continuously sent to the server, where all the data will be processed to return a specific gravity answer to the user through the mobile application.

5.3.2   SOURCE

This is a project requirement, as the whole point of the device is to give a reading of one measurement, the sugar level.

5.3.3   CONSTRAINTS

To measure any tilt, a baseline angle of tilt must be noted as a neutral starting position. The code will include an initial reading of tilt at the start of the brew.

5.3.4   STANDARDS

Not applicable.

5.3.5   PRIORITY

This is the highest priority requirement of the project, as incorrect readings will hinder the resultant brew and may cause the user to take too long or too short of a time to end the brew.

6 SAFETY REQUIREMENTS

This section details the safety requirements to the bluetooth hydrometer use. The risk factors of the hydrometer being a low-voltage electrical device is that it may pose a slight electrocution risk to the end-user, and a short-circuit may damage the electronic components of the hydrometer including the main Arduino board.

6.1 REQUIREMENT NAME

6.1.1 DESCRIPTION

As the bluetooth hydrometer is going to be a device that is placed in liquid for use, it is important to ensure that the outer capsule is kept closed and sealed to the entirety of the time it is used. The user must ensure that he/she is grounded before working with the hydrometer.

6.1.2 SOURCE

This is a basic project safety requirement to make sure that the user does not get electric shocked and that the device does not become short circuited.

6.1.3 CONSTRAINTS

The user will be handling the Arduino board directly as it has no other protective covering when outside of the outer capsule.

6.1.4 STANDARDS

Not applicable.

6.1.5 PRIORITY

This is of critical importance for device use.

7 MAINTENANCE & SUPPORT REQUIREMENTS

There should be a portal for the customers to leave suggestions and feedback and report problems. There also need to be an RMA, so customers can return the product if it's defective or they simply don't want it for a refund.

7.1 USERS SHALL BE ABLE TO GET SUPPORT ON ANY ISSUES

7.1.1 DESCRIPTION

The must be a website with a portal where customers can create a profile if they wish. Customers aren't require to have a profile if they preferred not to have a profile. Customer can also either leave a suggestion or a feedback for the app through the website or through the Google Play store. The portal on the website should have an FAQ section for questions that customers generally have about the app and the hydrometer.

There should be a community section where customers can discuss among themselves, the producers of the product, and the developers of the app about any issues, concerns, or questions. The customers should also be able to report any issues directly to us through the website and we should be able to address it with them if they wish. Customers should also be able to contact customer support through email or a hot line in case they have any issues, concerns, or questions.

We must be able to create an RMA (Return Merchandise Authorization) with any customers that have issues with their product. The RMA allows the customer to send the product back if it's having issues so we can repair it and send it back to them or we can send them a another one. Each customer has a full one-year warranty coverage on the product. The warranty policy will cover the cost of repairing or replacing the product if the product fails within the one-year period due to manufacturer defect.

Customers also have the option to return the product for a full refund within 30 days if whether the product failed or if the product failed to perform what the customers expected or even if the customers simply doesn't want the product.

7.1.2 SOURCE

The source is from my own understanding of customer and technical support.

7.1.3 CONSTRAINTS

The warranty will not cover repair or replacement cost of products if it becomes defective one-year after it had been shipped. The warranty will not cover damages that aren't caused by manufacturer defect.

If a customer wanted to return a product for a full refund just because they don't want it and that the customer couldn't provide us any proof of manufacturer defect or why the product doesn't perform as the customer expected. Then the customer will be required to pay a restocking fee for return the product.

7.1.4 STANDARDS

This product is governed by Consumer Protection.

7.1.5 PRIORITY

This requirement is somewhat important. It is not something we shall worry to much about, but it's important when the products failed to perform what the customers expected.

8 OTHER REQUIREMENTS

This section details additional requirements that vary in categorization.

8.1 OPERATING SYSTEM COMPATIBILITY

8.1.1 DESCRIPTION

The bluetooth hydrometer software will be developed on Linux, Windows 10, and MacOS by different group members. The project will be written with the end user using Linux in mind. Android is required to use the mobile control application.

8.1.2 SOURCE

Each member has a different OS he/she prefers to work on, but Linux will be used for ease of collaboration. iOS is a less modular and less forgiving OS to develop for.

8.1.3 CONSTRAINTS

As each operating system may have slight variations in how programs are run or deals with external hardware, there may need additional collaboration and communication among team members to continue development.

8.1.4 STANDARDS

Not applicable.

8.1.5 PRIORITY

As it isn't known yet if the device, application, and server would work the same in other operating systems with no additional development needed, this requirement is of average or below average importance.

8.2 PRODUCT SHELL

8.2.1 DESCRIPTION

The Arduino board and components will be encased in a capsule to have it float in a brew liquid. Other than the shell, there will be no other covering or protection of the device.

8.2.2 SOURCE

This is the simplest method for allowing the device to float without superfluous features that may interfere with tilt readings.

8.2.3 CONSTRAINTS

The capsule must hold the device without having the Arduino move inside. It must also seal completely tight so that no liquid reaches the Arduino or components.

8.2.4 STANDARDS

Not applicable.

8.2.5 PRIORITY

Critical to having the device in brew at all.

8.3 LANGUAGES & ADDITIONAL SOFTWARE

8.3.1 DESCRIPTION

The bluetooth hydrometer software will be developed on Linux, Windows 10, and MacOS by different group members. Primarily, the project will be written in C, with possible additional code written in SQL should a database be required with the web server. Github will be used for remote sharing.

8.3.2 SOURCE

Android development and Arduino development are both in C.

8.3.3 CONSTRAINTS

Each team member must be able to adequately write, read, and understand C and each aspect of the project, as all software components work in tandem for full functionality.

8.3.4 STANDARDS

Not applicable.

8.3.5 PRIORITY

As conversion to different languages via modules is possible but comes with potential for multiple issues and bugs, this requirement is of above average importance.