Department of Computer Science & Engineering
The University of Texas at Arlington

System Requirements Specification
CSE 4316: Senior Design I
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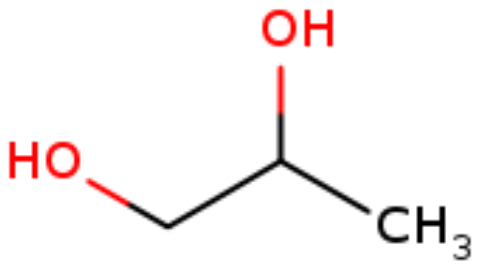

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Glycol Chiller Fermentation

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Revision History

Revision	Date	Author(s)	Description
0.1	10.15.2020	JB,AD,CG,ER,JV	document creation
0.2	10.20.2020	JB,AD,CG,ER,JV	document discussion
0.3	10.22.2020	JB,AD,CG,ER,JV	requirements discussion
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0.5	10.30.2020	JB,AD,CG,ER,JV	document additions

CONTENTS

1 Product Concept

This section describes the purpose, use and intended user audience for out Glycol-chilled fermentation system. The Glycol-chilled fermentation system is one that aids in the fermentation stage of brewing beer. During the fermentation stage of brewing, the reactions going on within the wort create heat. To deal with this heat, brewers can manually 'ice' the wort. This is cheap and effective, but requires human oversight. This makes the process of manually icing wort nonscalable. With a Glycol-chilled fermentation system, the human component of the fermentation process is substituted with this system. With our project, users will be able to perform the fermentation process without having to manually babysit the wort. Users can set a desired temperature to maintain, and our system will reach that temperature and keep the fermenting wort at that temperature.

1.1 Purpose and Use

A glycol chiller is essentially a small air conditioner that uses the refrigerant glycol to cool a container to a desired level. Normally it is used it cool wort as a part of the fermentation process of beer or other alcoholic drinks. This glycol chiller is being made for the Arlington based beer brewing team "los dioses de la cerveza" in order to streamline and automate their operations in fermenting beer.

1.2 Intended Audience

The intended audience of our glycol chiller are home-brewers, specifically the local ones. The home-brewers local to Arlington, Texas do not have many options to choose from so by providing an alternative we hope they would be interested in buying our glycol chiller. The glycol chiller is going to be built with the design that it could be used in general home brewing system setups.

2 Product Description

This section provides the reader with an overview of the Glycol Chiller system's primary features and functions. This includes key operational features regarding temperature regulation, controls, as well as desired functions for user interaction.

2.1 Features & Functions

The glycol chiller's primary function will be to keep the glycol solution in the cooler at a temperature range of 20-25 degrees F below the chiller system set point. The glycol chiller will accomplish this by using an AC unit to cool the solution. Additionally, the temperature in the chiller will be managed by a control unit that will monitor through a Bluetooth hydrometer. The control unit will also be able to adjust the temperature as needed on its own without manual operation. The glycol chiller will house the solution in a cooler that will have input/output pipes that will insulated with foam.

2.2 External Inputs & Outputs

2.2.1 Inputs

1. Power is required to run the chiller itself and it's accompanying raspberry pi control unit.
2. Wort or must is expected to be placed in the chiller to be fermented into an alcoholic beverage.
3. Manual inputs from the touchscreen display will be used to control the chiller.
4. If time allows the smartphone application will would be an alternative method of input to the touchscreen display.
5. If time allows reading a recipe would be read through recipe files that would be supplied to the raspberry pi control unit wireless or through a USB.

2.2.2 Outputs

1. Sensor data from the Bluetooth hydrometer will be displayed to the user.
2. The finished alcoholic beverage produced after fermentation is complete.
3. Pumps that will turn on to move the glycol into the fermenter through pipes and begin producing alcohol.

2.3 Product Interfaces

The system will have a miniature LED touch-screen display that will be used by the user to manually regulate temperature and power settings. An additional product interface may include a remote user interface display via a mobile device towards a semi-automated functional system. However, this feature is one for a future iteration of the system should time allow for its implementation.

3 Customer Requirements

This section covers the requirements of the customers for whom this project is intended to. The customers/users of this project are mainly local home-brewers. This section lists out the features and functions that the customer side can expect to have included in the final prototype. This comprises of the requirements either specified by the customers themselves, or the ones that, we felt, are must-haves for a market level glycol-chiller.

3.1 Production Budget

3.1.1 Description

The project should not exceed the given production budget or risk failure from lack of funds.

3.1.2 Source

Dr. Conly

3.1.3 Constraints

Broken parts could be huge impediment to fulfilling this requirement since replacements would have to be ordered. Late changes in system architecture also might a problem since more parts would have to be ordered to facilitate the change.

3.1.4 Priority

High

3.2 Manual Control

3.2.1 Description

The completed glycol chiller should at the very least allow for manual control of the temperature settings in order for the project to be considered a success.

3.2.2 Source

Dr. Conly

3.2.3 Constraints

Temperature sensor inaccuracies could lead to the chiller setting the incorrect fermentation temperatures.

3.2.4 Priority

Critical

3.3 Bluetooth Hydrometer

3.3.1 Description

The chiller will use a Bluetooth hydrometer for it's gravity and temperature readings in order to receive accurate data.

3.3.2 Source

Dr. Conly

3.3.3 Constraints

Temperature sensor inaccuracies could lead to the chiller setting the incorrect fermentation temperatures.

3.3.4 Priority

High

3.4 User Change Temperature

3.4.1 Description

The user will be able to interact with the system to manually adjust the temperature using a LED touchscreen and, if time allows, using a mobile app.

3.4.2 Source

Senior Design Project Requirement

3.4.3 Constraints

Improper temperature readings taken by the control unit could result in inaccurate temperature.

3.4.4 Standards

N/A

3.4.5 Priority

High

3.5 User Preset Temperature

3.5.1 Description

Using the interface, the user will be able to define 6 preset temperature settings. The temperature can be set either in degree Celsius or Fahrenheit.

3.5.2 Source

Senior Design Project Requirement

3.5.3 Constraints

N/A

3.5.4 Standards

N/A

3.5.5 Priority

Low

3.6 Store Preset Temperature

3.6.1 Description

The system will be able to store 6 preset temperatures set by the user using the touchscreen user interface.

3.6.2 Source

Senior Design Project Requirement

3.6.3 Constraints

N/A

3.6.4 Standards

N/A

3.6.5 Priority

Low

3.7 Temperature Conversion

3.7.1 Description

The system will be able to output the desired temperature in either Celsius or Fahrenheit. The user will have a choice to set the temperature in either of the two units.

3.7.2 Source

Dr. Conly

3.7.3 Constraints

N/A

3.7.4 Standards

N/A

3.7.5 Priority

Moderate

3.8 Reservoir will contain Propylene Glycol

3.8.1 Description

The system shall be filled with Propylene Glycol, a material commonly used in home brewing and professional settings.

3.8.2 Source

Dr. Conly

3.8.3 Constraints

N/A

3.8.4 Standards

N/A

3.8.5 Priority

Critical

4 Packaging Requirements

The glycol fermentation system we are developing will be packaged in a rectangular shaped enclosure and with all the circuits and components included. Additionally, the software will already be preloaded onto the Raspberry Pi. In summary, the glycol fermentation system will be fully-assembled and ready to use when completed.

4.1 Cooling Enclosure

4.1.1 Description

The Glycol fermentation system shall have an enclosure to protect damage to components. The enclosure will be made into a rectangular shape and sized to cover the size of the system.

4.1.2 Source

The requirement source is Elmer.

4.1.3 Constraints

No Constraints on this requirement.

4.1.4 Standards

N/A

4.1.5 Priority

Moderate Priority

4.2 Raspberry Pi Power Supply

4.2.1 Description

The Raspberry Pi unit shall be powered by DC, separately from the main system, using a AC to DC converter. Additionally, the DC voltage must be at the level the Raspberry Pi requires in their documentation.

4.2.2 Source

The requirement is derived by the documentation of the Raspberry Pi.

4.2.3 Constraints

No Constraints on this requirement.

4.2.4 Standards

N/A

4.2.5 Priority

High Priority

4.3 Pre-Loaded Software

4.3.1 Description

All necessary software to operate the glycol fermentation system shall come pre-loaded on to the Raspberry Pi, which will also be included in the package.

4.3.2 Source

The requirement source is Elmer.

4.3.3 Constraints

No Constraints on this requirement.

4.3.4 Standards

N/A

4.3.5 Priority

Future Priority

4.4 Final product Packaging

4.4.1 Description

Finished package will be a fully functioning glycol chiller in its enclosure with instructions included.

4.4.2 Source

The requirement source is Elmer.

4.4.3 Constraints

No Constraints on this requirement.

4.4.4 Standards

N/A

4.4.5 Priority

Critical Priority

5 Performance Requirements

The performance of our Glycol Chiller is based off of customer preference. The system must be able to properly cool Glycol down to a specific temperature and maintain that temperature. The fermenting wort will then be routed through pipes in the reservoir to cool it down to an appropriate temperature. The length of time our system will be on and activated varies for each specific recipe. Fermentation time can take anywhere from days to weeks. Our system will have to be able to work for such time periods. This system will cover all performance based requirements, and go into further detail on what they are.

5.1 Specific Gravity Based Fermentation

5.1.1 Description

The system shall be on and actively chilling the fermenting wort for a period of time, and will stop when a reading is made by the Bluetooth Hydrometer that matches the desired reading, provided by the user recipe.

5.1.2 Source

Connor

5.1.3 Constraints

The requirement will be dependent on the accuracy of the Bluetooth Hydrometer. Additionally, the requirement will only be fulfilled should the system be set up for automation and be able to read from a recipe. Otherwise, the system will not be able to automatically stop upon reading a desired specific gravity.

5.1.4 Standards

N/A

5.1.5 Priority

Low

5.2 AC Power

5.2.1 Description

The system shall run off of 120V AC. The system will be able to be plugged into a typical wall socket and run properly.

5.2.2 Source

Connor

5.2.3 Constraints

N/A

5.2.4 Standards

N/A

5.2.5 Priority

High

5.3 Single Vessel Control

5.3.1 Description

The system shall be able to chill contents of a single fermentation vessel.

5.3.2 Source

Connor

5.3.3 Constraints

N/A

5.3.4 Standards

N/A

5.3.5 Priority

High

5.4 Temperature Regulation Consistency

5.4.1 Description

For any given recipe the chiller will maintain a consistent temperature within the range of 5C to -35C with +-1C of error within the fermentation container.

5.4.2 Source

The requirement source is Janine.

5.4.3 Constraints

The power draw of the system must be satisfied by the power supply. Control unit powers the system on and off properly. Temperature readings must be accurate.

5.4.4 Standards

N/A

5.4.5 Priority

High

5.5 Temperature Reading Accuracy

5.5.1 Description

The system shall output the desired temperature reading within a 1 degree margin of error.

5.5.2 Source

The requirement source is Janine.

5.5.3 Constraints

The power draw of the system must be satisfied by the power supply. Control unit powers the system on and off properly.

5.5.4 Standards

N/A

5.5.5 Priority

High

5.6 Fermentation Reading Accuracy

5.6.1 Description

The system shall ferment the brew for a specified duration of time within a 10 minute margin of error.

5.6.2 Source

The requirement source is Janine.

5.6.3 Constraints

The timer could have deviation.

5.6.4 Standards

N/A

5.6.5 Priority

Moderate

5.7 Control Unit Temperature Management

5.7.1 Description

The control unit will properly power on and off the system on reaction to undesired temperature readings from the Bluetooth hydrometer.

5.7.2 Source

The requirement source is Janine.

5.7.3 Constraints

Inconsistent wireless communication with the Bluetooth hydrometer.

5.7.4 Standards

N/A

5.7.5 Priority

High

5.8 Time-based Fermentation

5.8.1 Description

The system shall cool the fermenting wort for a specific time period.

5.8.2 Source

The requirement source is Janine.

5.8.3 Constraints

N/A

5.8.4 Standards

N/A

5.8.5 Priority

High

5.9 Maintain Temperature inside Fermenter

5.9.1 Description

The system shall be able to change temperature of the glycol such that the fermenter can be cooled to a consistent temperature. Also, the temperature shall be maintained within a range of 1-2 degrees.

5.9.2 Source

The requirement source is Elmer.

5.9.3 Constraints

Possible constraint could be the accuracy of the temperature reading given by the Bluetooth hydrometer.

5.9.4 Standards

N/A

5.9.5 Priority

Moderate Priority

6 Safety Requirements

Safety issues for this project are mostly minor things. With that being said, this section will cover any safety requirements we find important to add.

6.1 Enclosure Internal and External Safety

6.1.1 Description

The enclosure shall be designed in such a way that prevents any sharp edges or points, on both the inside and outside.

6.1.2 Source

Connor

6.1.3 Constraints

N/A

6.1.4 Standards

N/A

6.1.5 Priority

High

6.2 Electrical Grounding

6.2.1 Description

The system shall be properly grounded, to prevent any risk of electrical shock to the user.

6.2.2 Source

Connor

6.2.3 Constraints

N/A

6.2.4 Standards

N/A

6.2.5 Priority

High

7 Future Items

7.1 Interfacing through a smartphone application

7.1.1 Description

If time allows, the chiller will be programmed to be controlled remotely via a smartphone application for android.

7.1.2 Source

Dr. Conly

7.1.3 Constraints

Inconsistent data transfer via Bluetooth and WiFi could cause receipt of corrupted commands from the smartphone application.

7.1.4 Priority

Future

7.2 Reading a recipe

7.2.1 Description

If time allows, the control unit will be programmed to read in recipes that would instruct the chiller in how to ferment a particular brew automatically. These recipes will be stored and can be reused by the user multiple times.

7.2.2 Source

Dr. Conly

7.2.3 Constraints

Using pre-existing recipe file formats could limit expressiveness of the recipes.

7.2.4 Priority

Future