

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

**ARCHITECTURAL** **DESIGN** **SPECIFICATION** **CSE** **4316:** **SENIOR** **DESIGN** **I** **SUMMER** **2020**

**TEAM** **HYDRO** **BLUETOOTH** **HYDROMETER**

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**1** **INTRODUCTION**

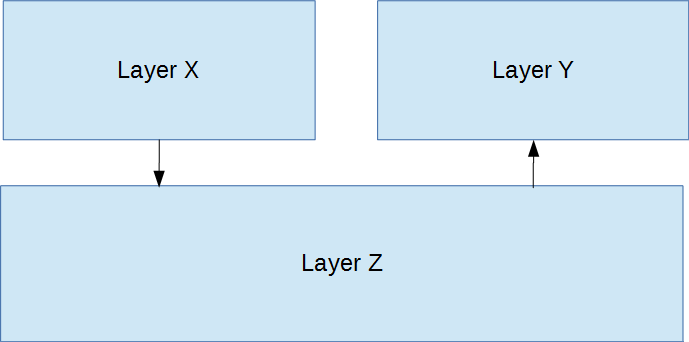
Fermentation is an important process of brewing beer. Key part of brewing beer with a certain taste and density requires fermenting beer at the right temperature for a certain period of time. For home-brewers, it can be tedious to keep track of temperature and density of beer during the fermentation process.

"Bluetooth Hydrometer" is a device designed to help home-brewers keep track of temperature and density of beer during the fermentation process. It floats on the beer inside the fermenting vessel while sending data to a smartphone via Bluetooth.

Bluetooth Hydrometer consists Arduino-nano with 9-axis inertial measurement unit (IMU) and temperature sensor. Temperature sensor reads temperature while IMU reads relative position when the device is floating. Arduino gets analog input from sensors and process data to get actual temperature and specific gravity of beer. Specific gravity is obtained from relative position of hydrometer inside the fermentation vessel. Once the process is done, data are sent to a smartphone via Bluetooth.

Temperature and density data are stored in a database for future reference and analysis. Mobile app provides visual interface to home-brewers at real time providing current temperature and specific gravity of beer.

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**2** **SYSTEM** **OVERVIEW**

Overall system consists of three major layers, Sensors, Controllers (Hardware/Software) and UI/UX. Each layers has separate functions and interface with each other for data input and output. Sensors layer provide analog data to Controllers for further processing. After analyzing datas from sensors, Controllers provide digital datas to UI/UX for providing relevant information to user with good visual interface.

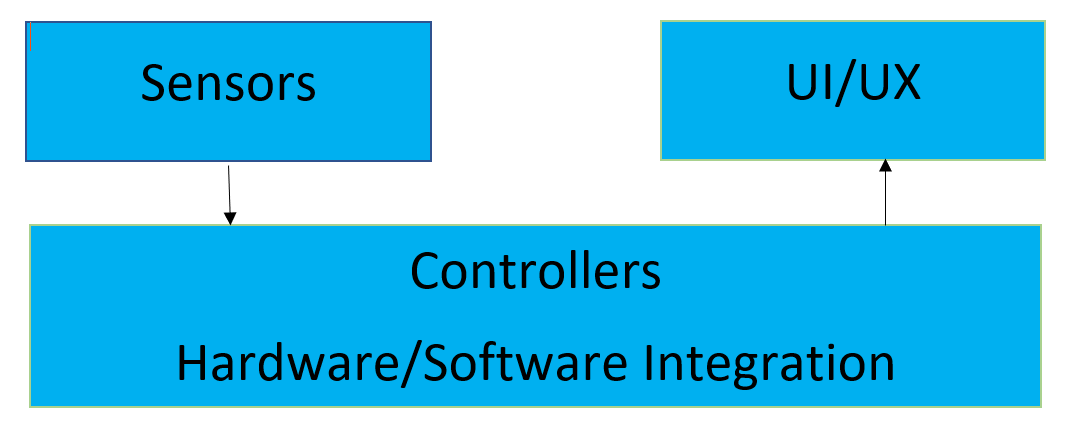


Figure 1: A simple architectural layer diagram

**2.1 Sensors**

Sensors layer for Bluetooth Hydrometer device mainly consists of two sensors, temperature sensor and 9-axis IMU sensor. Sensors are essential parts of Bluetooth Hydrometer which measure temperature and specific gravity of beer; which are the main requirements of the project. Temperature sensor provides analog temperature read whereas, IMU provides relative position of Bluetooth Hydrometer during floatation. Temperature data and position data are read by Arduino nano in Controllers layer. Sensors, therefore provides necessary input data to Controllers.

**2.2 Controllers**

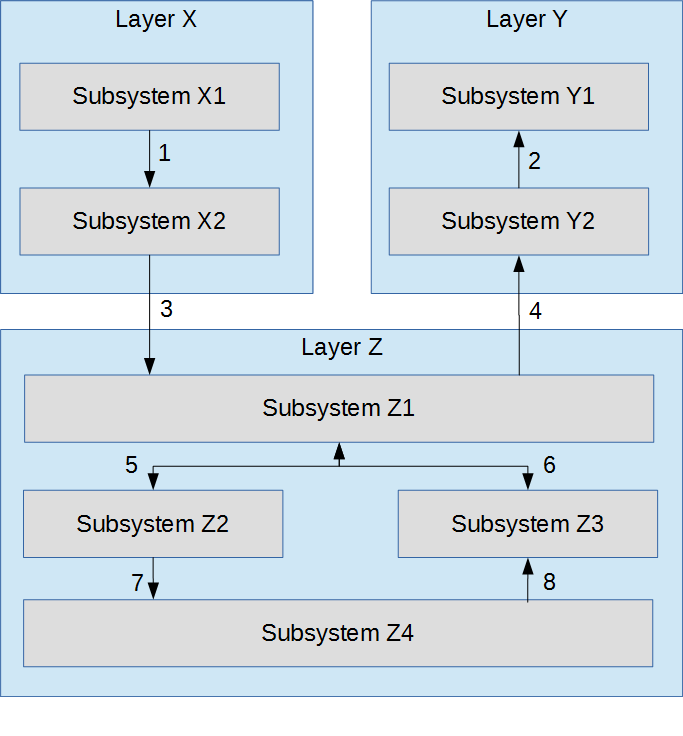
Arduino nano 33 BLE is the heart of Bluetooth Hydrometer device. Nano is low-powered bluetooth enabled microcontroller which can read analog as well as digital inputs from sensors. Sensors provide critical analog data for temperature and relative position of hydrometer. Nano then process analog data and provides actual temperature and specific gravity (depending on relative position) to UI/UX.

Nano is programmed to handle analog data from sensors and provide output to UI/UX layer.

**2.3 UI/UX**

UI/UX is another important layer that provides user interface to user by providing actual data. Temperature and specific gravity data are visually and graphically presented to user through a mobile app or through a website. Data from Controller are stored in a database and are analyzed through a software.

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**3** **SUBSYSTEM** **DEFINITIONS** **&** **DATA** **FLOW**

This section breaks down your layer abstraction to another level of detail. Here you grapically repre-sent the logical subsytems that compose each layer and show the interactions/interfaces between those subsystems. A subsystem can be thought of as a programming unit that implements one of the major functions of the layer. It, therefore, has data elements that serve as source/sinks for other subsystems. The logical data elements that ﬂow between subsystems need to be explicitly deﬁned at this point, beginning with a data ﬂow-like diagram based on the block diagram.

Figure 2: A simple data ﬂow diagram

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**4** Sensors

**4.1** **Temperature Sensor**

Figure 3: Example subsystem description diagram

**4.1.1** **ASSUMPTIONS**

Any assumptions made in the deﬁnition of the subsystem should be listed and described. Pay particular attention to assumptions concerning interfaces and interactions with other layers.

**4.1.2** **RESPONSIBILITIES**

Each of the responsibilities/features/functions/services of the subsystem as identiﬁed in the architectural summary must be expanded to more detailed responsibilities. These responsibilities form the basis for the identiﬁcation of the ﬁner-grained responsibilities of the layer’s internal subsystems. Clearly de-scribe what each subsystem does.

**4.1.3** **SUBSYSTEM** **INTERFACES**

Each of the inputs and outputs for the subsystem are deﬁned here. Create a table with an entry for each labelled interface that connects to this subsystem. For each entry, describe any incoming and outgoing

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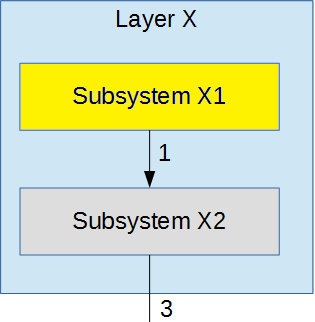
data elements will pass through this interface.

Table 2: Subsystem interfaces

|  |  |  |  |
| --- | --- | --- | --- |
| ID | Description | Inputs | Outputs |
| #xx | Description of the interface/bus | input 1 input 2 | output 1 |
| #xx | Description of the interface/bus | N/A | output 1 |

**4.2** **SUBSYSTEM** **2** Repeat for each subsystem **4.3** **SUBSYSTEM** **3** Repeat for each subsystem

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**5** **Y** **LAYER** **SUBSYSTEMS**

In this section, the layer is described in some detail in terms of its speciﬁc subsystems. Describe each of the layers and its subsystems in a separate chapter/major subsection of this document. The content of each subsystem description should be similar. Include in this section any special considerations and/or trade-offs considered for the approach you have chosen.

**5.1** **SUBSYSTEM** **1**

This section should be a general description of a particular subsystem for the given layer. For most subsystems, an extract of the architectural block diagram with data ﬂows is useful. This should consist of the subsystem being described and those subsystems with which it communicates.

Figure 4: Example subsystem description diagram

**5.1.1** **ASSUMPTIONS**

Any assumptions made in the deﬁnition of the subsystem should be listed and described. Pay particular attention to assumptions concerning interfaces and interactions with other layers.

**5.1.2** **RESPONSIBILITIES**

Each of the responsibilities/features/functions/services of the subsystem as identiﬁed in the architec-tural summary must be expanded to more detailed responsibilities. These responsibilities form the basis for the identiﬁcation of the ﬁner-grained responsibilities of the layer’s internal subsystems. Clearly de-scribe what each subsystem does.

**5.1.3** **SUBSYSTEM** **INTERFACES**

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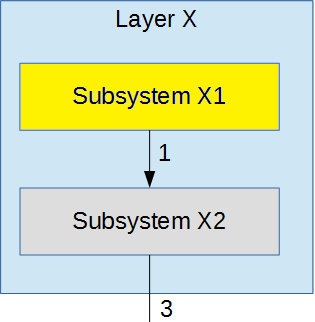
data elements will pass through this interface.

Table 3: Subsystem interfaces

|  |  |  |  |
| --- | --- | --- | --- |
| ID | Description | Inputs | Outputs |
| #xx | Description of the interface/bus | input 1 input 2 | output 1 |
| #xx | Description of the interface/bus | N/A | output 1 |

**5.2** **SUBSYSTEM** **2** Repeat for each subsystem **5.3** **SUBSYSTEM** **3** Repeat for each subsystem

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**6 Phone Layer SUBSYSTEMS**

In this section, the mobile application used to control the hydrometer will be outlined. The user will interact with the hydrometer application, which will send the request to the server.

**6.1 Control Application**

The mobile control application will be how users interact with the hydrometer after it has been placed inside a brew container. Users will be able to toggle when the hydrometer reads data and be notified of when the resultant specific gravity measurement is of the user’s chosen setting.

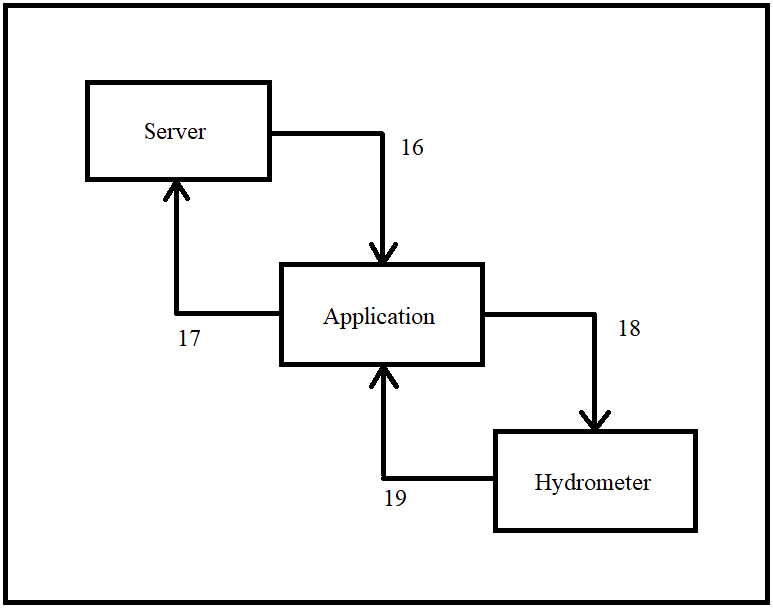


Figure 5: Mobile Phone Subsystem

**6.1.1 ASSUMPTIONS**

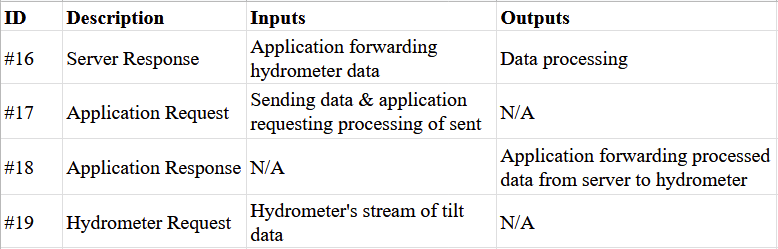
Data will be sent via bluetooth, as a constant stream of read-in tilt positions. The phone will have bluetooth capabilities, with an internet connection. The hydrometer itself will not be interacting with the server directly.

**6.1.2 RESPONSIBILITIES**

The application will be the only way for the web server and hydrometer to communicate. Data will automatically be sent from the application to the server once received. Any return data will be sent in response from the server after processing, or the next time the user loads the application.

**6.1.3 SUBSYSTEM INTERFACES**

Incoming and outcoming data elements that will pass through the mobile phone subsystem are as follows:



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