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

Architectural Design Specifications
CSE 4316: Senior Design I
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Back
Burner
Brew

Team Friendship
Back Burner Brew

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Revision History

Revision	Date	Author(s)	Description
0.1	10.01.2015	GH	document creation
0.2	10.05.2015	AT, GH	complete draft
0.3	10.12.2015	AT, GH	release candidate 1
1.0	10.20.2015	AT, GH, CB	official release
1.1	10.31.2015	AL	added design review requests

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1 INTRODUCTION

The "Back Burner Brew" is built with the sole purpose of brewing large batch of beer in the home environment. This product provides home brewers with a low-cost electric home brewing system that allow them to have precise control over the brewing process. The brewing process can be automated with the help of micro-controllers like the ESP32 which is then hosted to a local website or an app interface.

ESP32 is a micro-controller that can receive data such as current temperature of the water or mash from the heat sensors located inside the kettles which can be converted to either analog or digital input. The heating coil can be controled using the input from the user as per their desired either to increase or to decrease the temperature. The electric pump can also be controlled by the user through micro-controllers to regulate the flow of the water in the kettles. The user will be able to communicate with the brewing system through a web interface or app interface.

The user should expect to input desired commands, controls, and specific settings such as temperature and length of time by a easily accessible touchscreen. The touchscreen will be attached to a Raspberry Pi that will handle communications between the user and the various sensors and heating elements. The user can expect that whichever temperature they set for their desired application, that the temperature will remain constant.

The intended audiences for this product would be home brewers or person interested in brewing beer only. Provided that the user manual would be present in the product, any person who wants to brew beer in his local environment can easily use this product. This product is made focusing on how effortless can the brewing process gets simply with the use of micro-controller.

2 System Overview

This section will describe the overall structure of the Back Burner Brew. The Brew System Vessel layer is where the brewing process will take place and could function as its own brewing system without the automation. All the other layers are built on top of the Brew System Vessel layer and will be used to automate the brewing process.

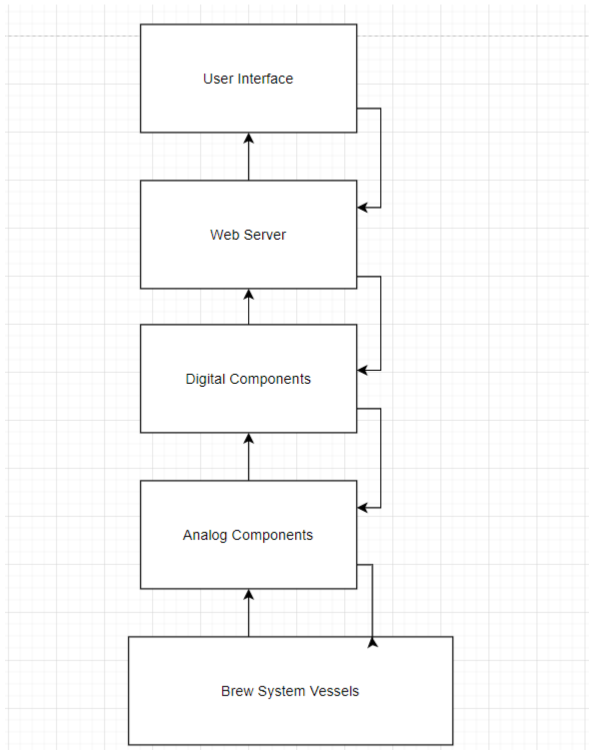

Figure 1: Simple ADS

2.1 Brew System Vessel Layer

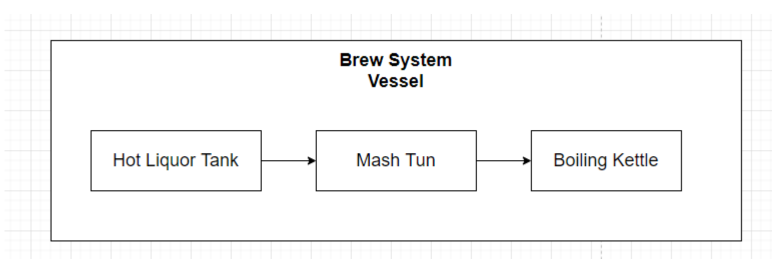

Figure 2: Brew System Vessel Layer

The Brew System Vessel Layer is where the brewing process will take place and does not have any software involved. This layer would be enough for a brewer to make their own beer without any automation. This layer is comprised of the mash tun, hot liquor tank(HLT), and the brewing kettle. The HLT will control the temperature of the liquid inside the mash tun by heating the liquid through a coil inside the HLT. The mash tun is where the mashing process begins and the grain is added to the water.

The boiling kettle is where the liquid will be boiled for a set amount of time and then sent to a chiller and fermentation kettle.

2.2 Analog Components Layer

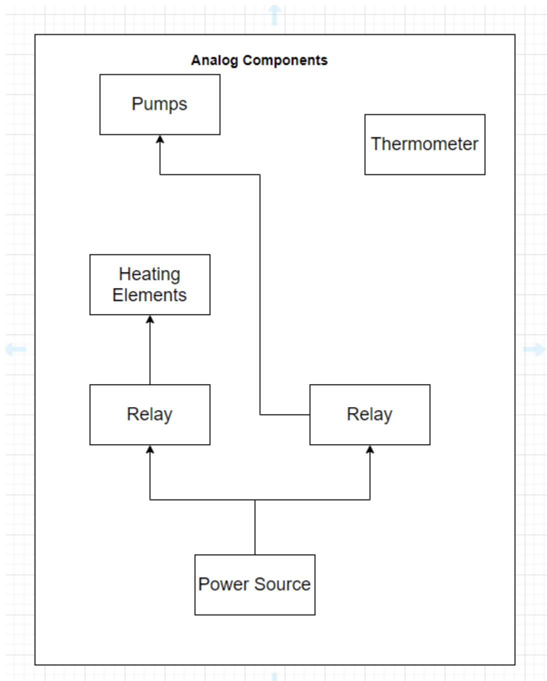

Figure 3: Analog Components Layer

The Analog Components Layer is comprised of pumps, thermometers, relays, heating element, and the power source. The pumps are controlled by the relays and will be activated when it is time for the liquid inside the kettles to be moved to the next stage of the brewing process. The pumps and heating elements will be controlled by the ESP32's which will send a signal to the relays to activate the components. The thermometers will send data to the ESP32's which communicate to the Raspberry Pi.

2.3 Digital Components Layer

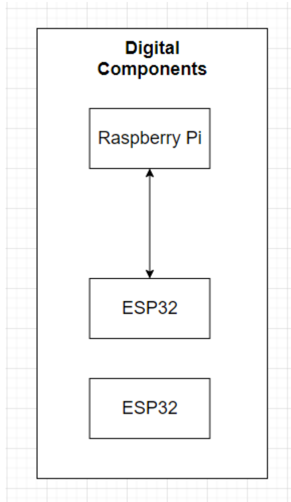

Figure 4: Digital Components Layer

The Digital Components Layer is made up of the ESP32's and the Raspberry Pi. The ESP32 will receive data from the thermometer and will send the data to the Raspberry Pi. The Raspberry Pi will send the data to the web server and any instructions recieved from the web server will be sent to the ESP32's. The ESP32's will send a signal to the relay and activate the pumps and heating elements depending on which step of the brewing process it is in.

2.4 Web Server Layer

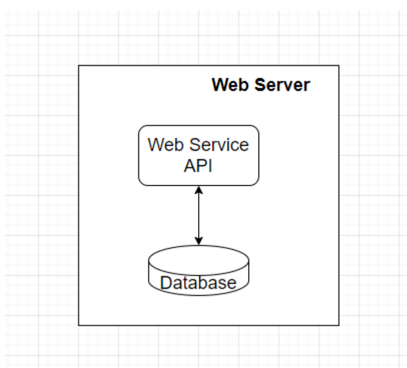

Figure 5: Web Server Layer

The Web Server Layer will be where all the data will be stored and instructions will be sent out from. The web server will receieve data from the Raspberry Pi and will store the data in a database. The web server will then decide what actions the system must take in order to meet the criteria set by the brewer. The two primary actions that web server will control is activating the heating elements and the pumps. Conditions such as water temperature and the amount of time spent on a specific step of the brewing process will be receieved from the User Interface Layer and will be maintained by the web server.

2.5 User Interface Layer

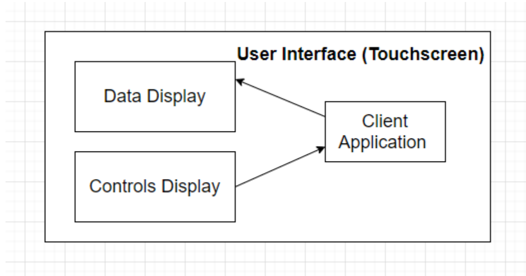

Figure 6: User Interface Layer

The User Interface Layer will be where the user can set the conditions of the brewing system, as well as see the temperatures of the different kettles and the time remaining on the current step in the brewing process. The brewer will have a user interface which will allow them to set the temperatures of the HLT and the mash tun. The boiling kettle will not be set a specific temperature, instead the heating element will be set to a power output set by the brewer. Once the brewer has entered their desired conditions, this data will be sent to the web server through the client applciation.

3 Subsystem Definitions & Data Flow

The Back Burner Brew system will consist of five different subsystems: brew system vessels, analog components, digital components, web server, and the user interface. The brew system vessels will be operated through the analog components. The analog components will send data to digital components. The analog components will be controlled by the digital components based on what is input to the user interface or certain conditions that are predefined such as keep water a certain temperature. The web server will be the intermediary between the user interface and the digital components. The web server will also store all data associated with the brewing process such as temperature or time spent on specific tasks.

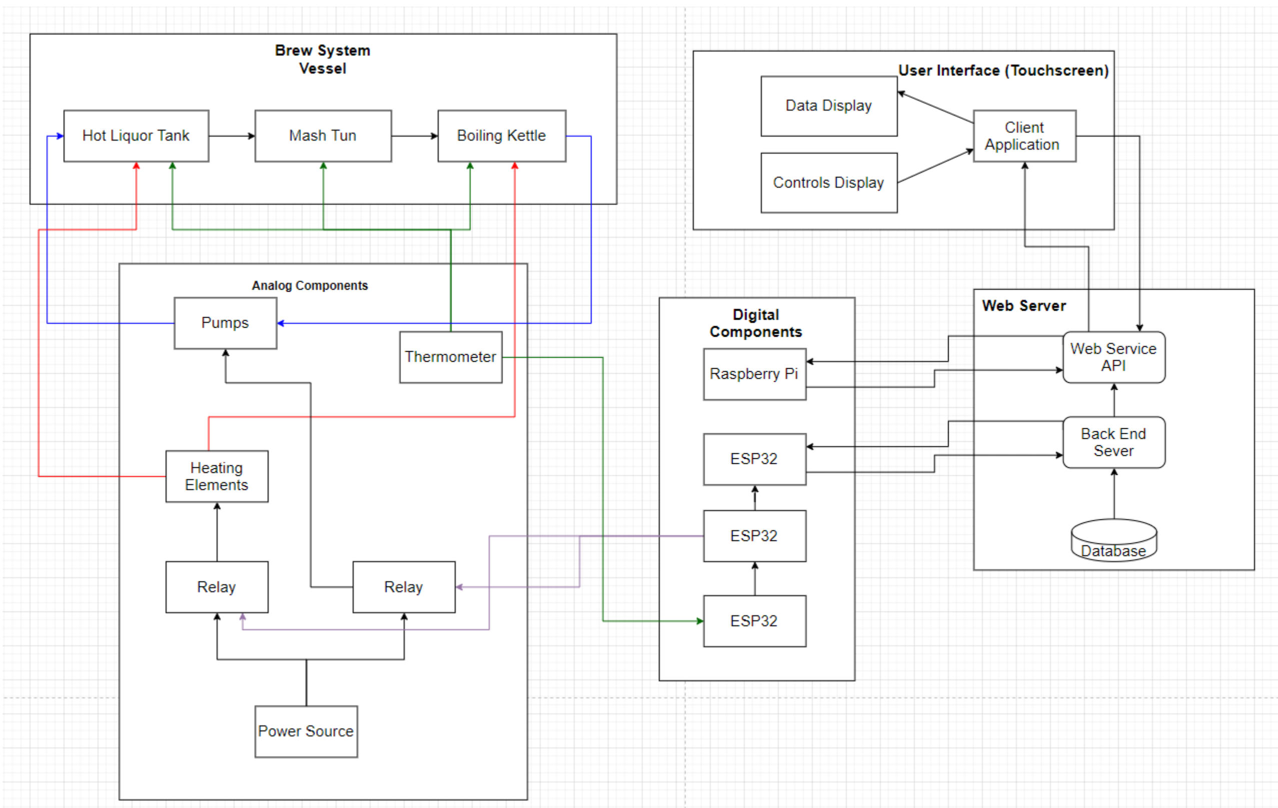

Figure 7: Subsystem Diagram for the Back Burner Brew device.

4 Brew System Vessel 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.

4.1 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.

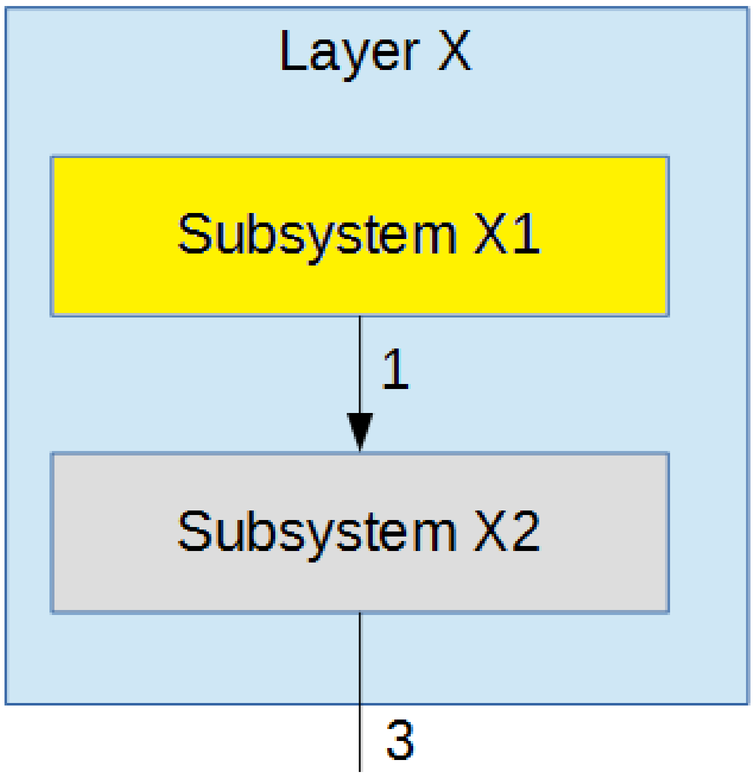

Figure 8: Example subsystem description diagram

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 describe 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

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

5 Analog Components 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

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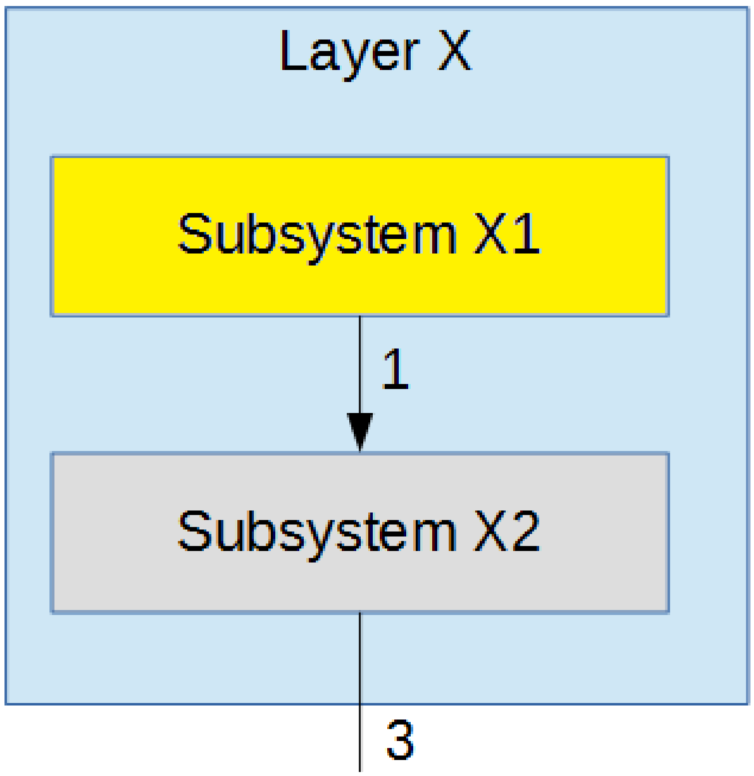

Figure 9: Example subsystem description diagram

5.1.1 Assumptions

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Table 3: Subsystem interfaces

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#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

6 Digital Components 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.

6.1 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.

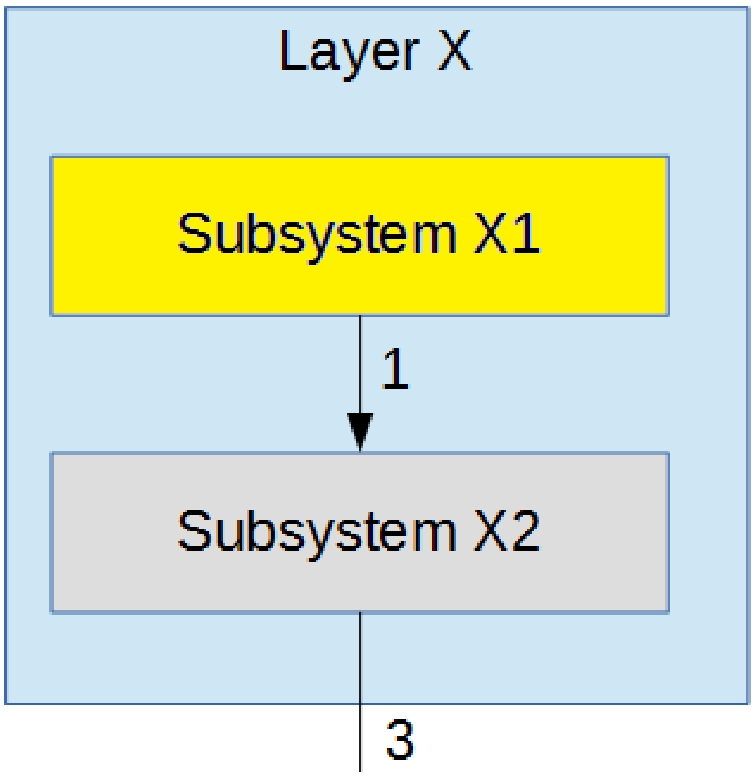

Figure 10: Example subsystem description diagram

6.1.1 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.

6.1.2 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 describe what each subsystem does.

6.1.3 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

data elements will pass through this interface.

Table 4: 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

6.2 Subsystem 2

Repeat for each subsystem

6.3 Subsystem 3

Repeat for each subsystem

7 Web Server 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.

7.1 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.

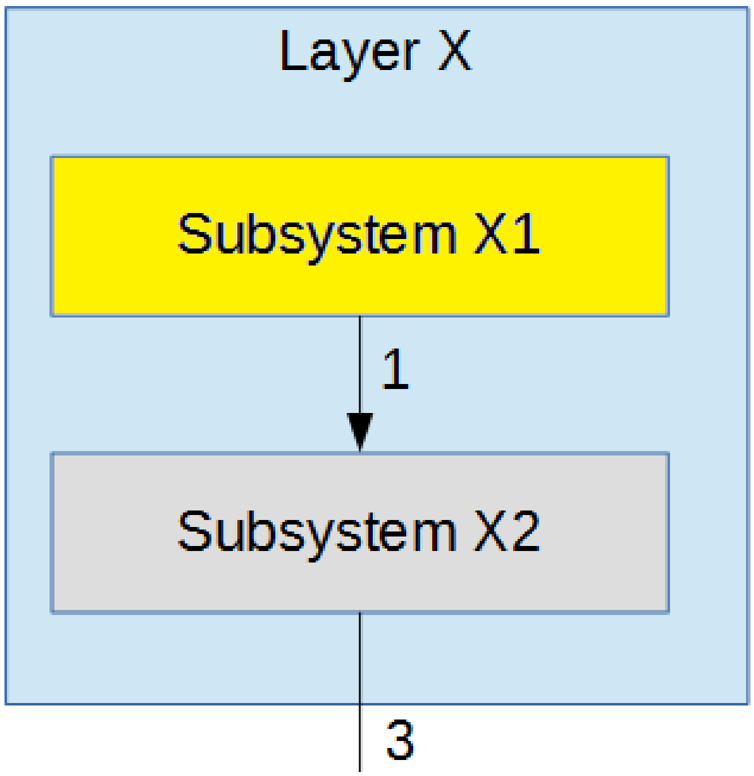

Figure 11: Example subsystem description diagram

7.1.1 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.

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Table 5: 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

7.2 Subsystem 2

Repeat for each subsystem

7.3 Subsystem 3

Repeat for each subsystem

8 User Interface 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.

8.1 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.

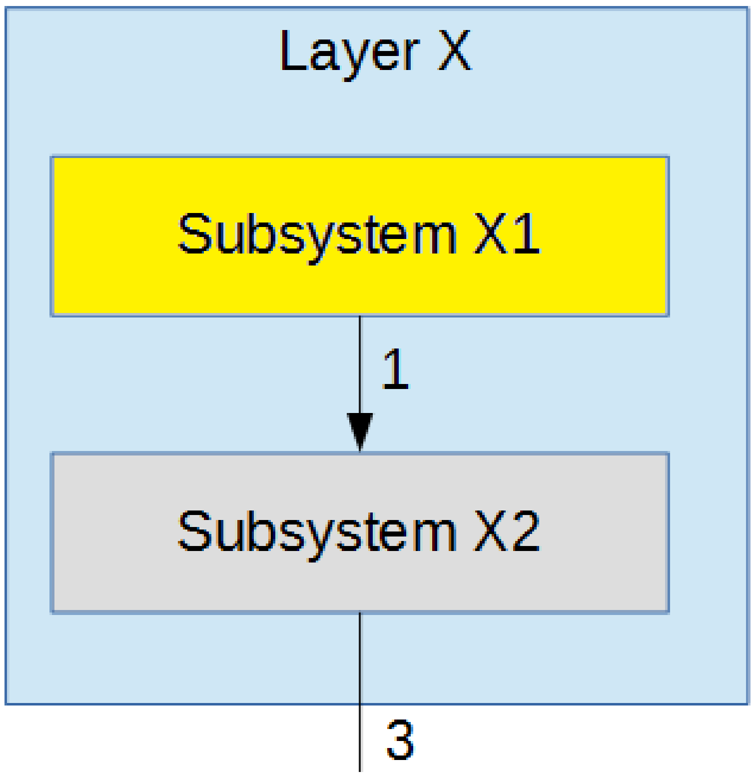

Figure 12: Example subsystem description diagram

8.1.1 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.

8.1.2 Responsibilities

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8.1.3 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

data elements will pass through this interface.

Table 6: 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

8.2 Subsystem 2

Repeat for each subsystem

8.3 Subsystem 3

Repeat for each subsystem

REFERENCES