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

Architectural Design Specifications
CSE 4316: Senior Design I
Fall 2021

Runtime Terrors
Turing Board

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Revision History

Revision	Date	Author(s)	Description
0.1	11.15.2021	SA	document creation

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1 Introduction

Your introduction should describe your product concept in sufficient detail that the architectural design will be easy to follow. The introduction may include information used in the first sections of your SRS for this purpose. At a minimum, ensure that the product concept, scope and key requirements are described.

2 System Overview

This section should describe the overall structure of your software system. Think of it as the strategy for how you will build the system. An architectural "layer" is the top-level logical view, or an abstraction, of your design. Layers should be composed of related elements of similar capabilities, and should be highly independent of other layers, but should have very clearly defined interfaces and interactions with other layers. Each layer should be identified individually and should be unique as to its function and purpose within the system. This section should also contain the high-level block diagram of the layers, as shown in the example below, as well as detailed descriptions of the functions of each layer.

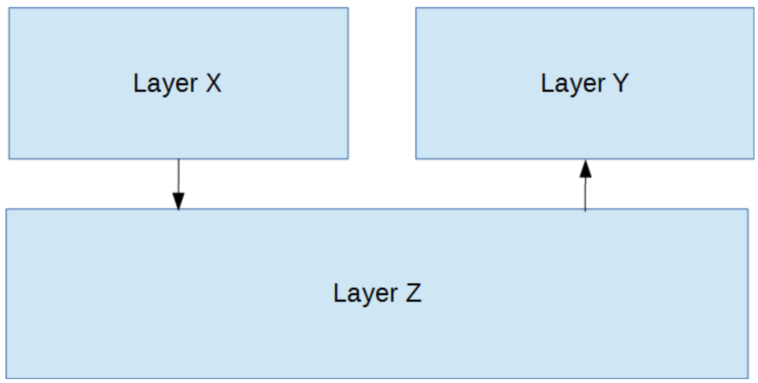

Figure 1: A simple architectural layer diagram

2.1 Layer X Description

Each layer should be described separately in detail. Descriptions should include the features, functions, critical interfaces and interactions of the layer. The description should clearly define the services that the layer provides. Also include any conventions that your team will use in describing the structure: naming conventions for layers, subsystems, modules, and data flows; interface specifications; how layers and subsystems are defined; etc.

2.2 Layer Y Description

Each layer should be described separately in detail. Descriptions should include the features, functions, critical interfaces and interactions of the layer. The description should clearly define the services that the layer provides. Also include any conventions that your team will use in describing the structure: naming conventions for layers, subsystems, modules, and data flows; interface specifications; how layers and subsystems are defined; etc.

2.3 Layer Z Description

Each layer should be described separately in detail. Descriptions should include the features, functions, critical interfaces and interactions of the layer. The description should clearly define the services that the layer provides. Also include any conventions that your team will use in describing the structure: naming conventions for layers, subsystems, modules, and data flows; interface specifications; how layers and subsystems are defined; etc.

3 Subsystem Definitions & Data Flow

This section breaks down your layer abstraction to another level of detail. Here you grapically represent 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.

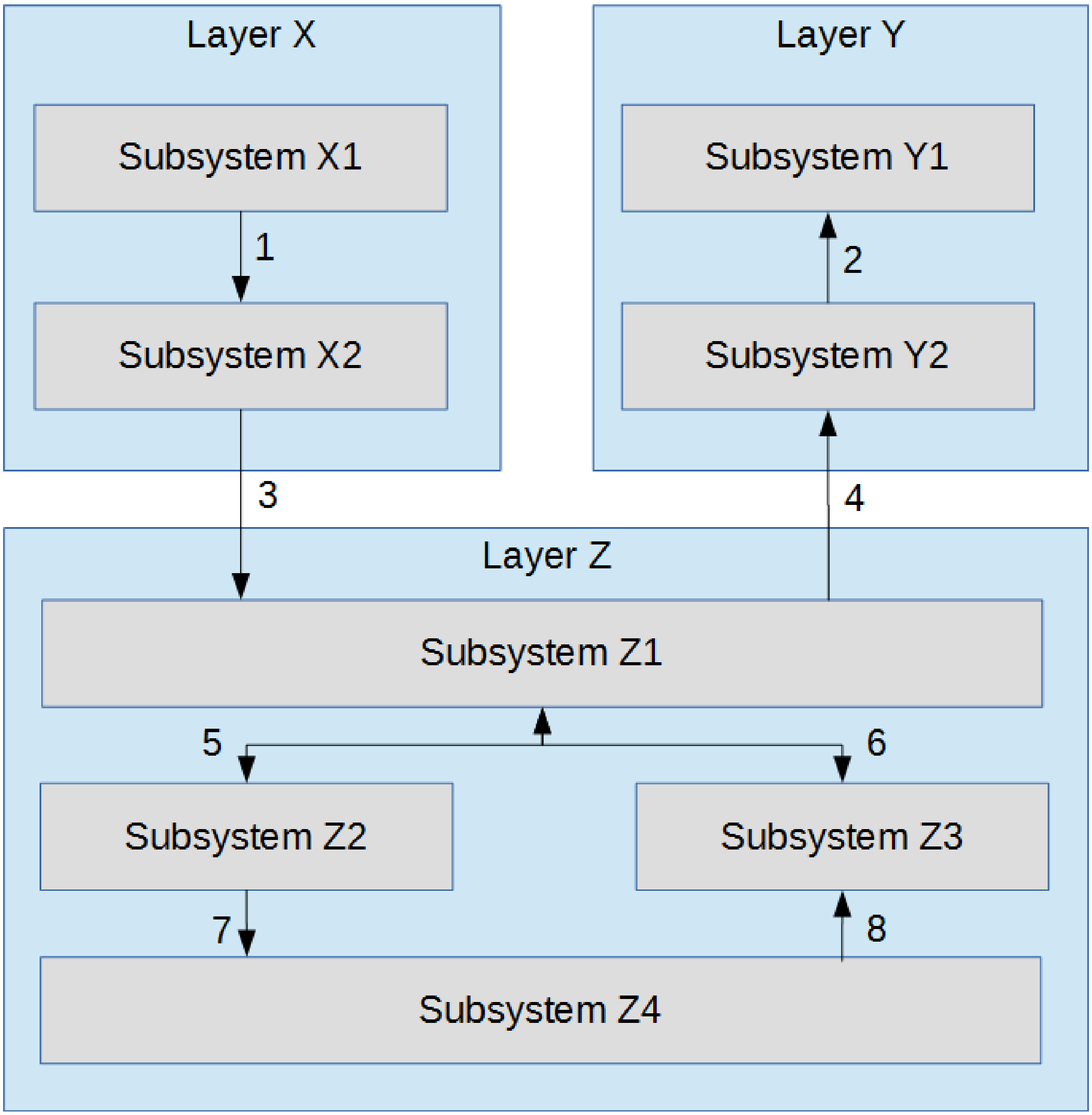

Figure 2: A simple data flow diagram

4 Computer Vision Layer Subsystems

This layer is the heart of the core autonomous functionalities of the Turing Board. We use computer vision and depth imagery to determine the board's surroundings and calculate the best path to move forward. The user will have, strapped around their ankle, an anklet-like contraption consisting of a pattern of ArUco markers for the *Follow Along* feature. This layer tracks the movement of the user through the anklet to determine how to instruct the combination of motors to move so as to follow the user at an appropriate pace. It is also responsible for detecting possible obstacles when operating on its own to find the user as part of the *Summon* feature.

4.1 RGB Imagery Subsystem

RGB Imagery of the front of the board is used as input in making various position specific calculations pertaining to navigation.

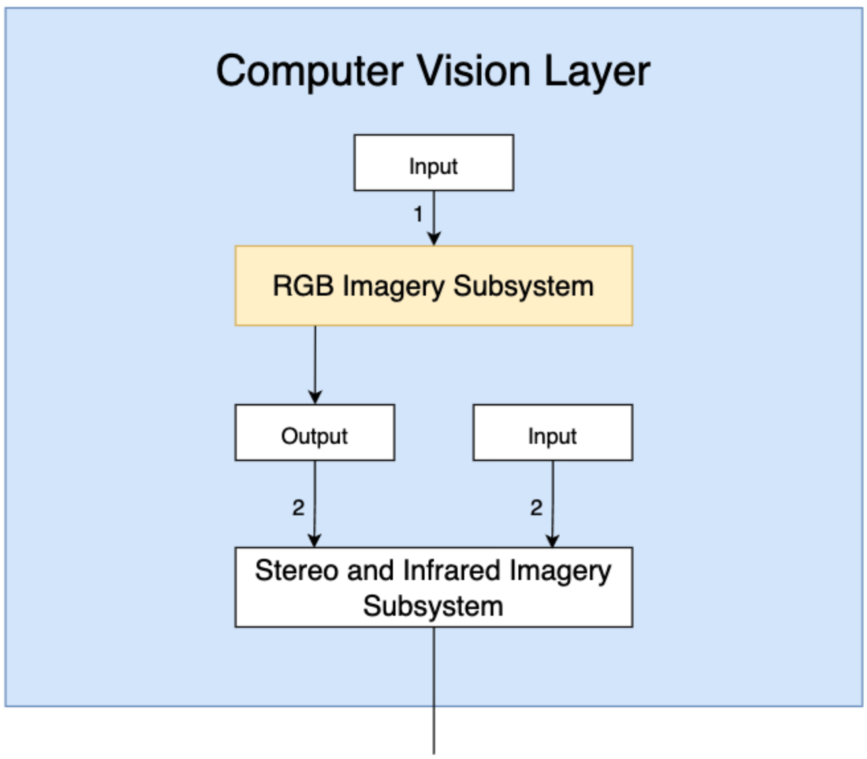

Figure 3: RGB Imagery subsystem description diagram

4.1.1 Assumptions

This layer is triggered by the user via the native iOS/Android application. It is assumed that the layer is being called upon in terrain with sufficient lighting conditions so that the RGB camera is able to produces images of good quality. For the *Follow Me* feature, it is assumed that the user has their anklet put on and proceeds to start with the anklet within the frame of the camera.

4.1.2 Responsibilities

RGB imagery is responsible for powering the *Follow Along* and the *Summon* features. For the *Follow Along* feature, this subsystem calculates the position of the user in 1D space along the horizontal axis to determine whether to turn left, right, or straight. For the *Summon* feature, this subsystem is responsible for helping identify patterns for possible obstacles ahead.

4.1.3 Subsystem Interfaces

Each of the inputs and outputs for the subsystem are defined here.

Table 2: RGB Imagery Interfaces

ID	Description	Inputs	Outputs
1	RGB Imagery	RGB Frame	Position of target object(s)

4.2 Stereo and Infrared Imagery Subsystem

Stereo and Infrared Imagery of the front of the board is used as input in making various depth specific calculations pertaining to navigation.

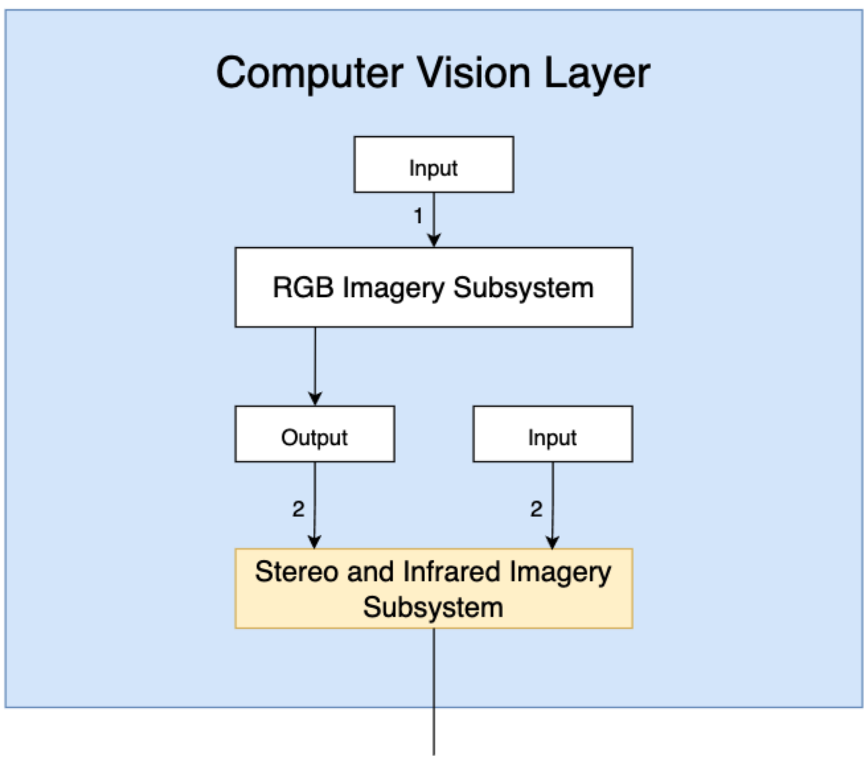

Figure 4: Stereo Imagery subsystem description diagram

4.2.1 Assumptions

This layer is triggered by the user via the native iOS/Android application. It is assumed that the layer is being called upon in terrain with sufficient lighting conditions so that the RGB Stereo cameras are able to produces images of good quality. For the *Follow Me* feature, it is assumed that the user has their anklet put on and proceeds to start with the anklet within the frame of the cameras.

4.2.2 Responsibilities

Stereo and Infrared imagery is responsible for powering the *Follow Along* and the *Summon* features. For the *Follow Along* feature, this subsystem calculates the position of the user in 1D space along the longitudinal axis to determine whether to move forward or stay put. For the *Summon* feature, this subsystem is responsible for helping identify how far objects detected by the RGB module are.

4.2.3 Subsystem Interfaces

Each of the inputs and outputs for the subsystem are defined here.

Table 3: Stereo and Infrared Imagery Interfaces

ID	Description	Inputs	Outputs
2	Depth Imagery	Depth Frame Position of target object(s)	Optimized distance of target object(s) from camera True position of target object(s) in 2D space

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.

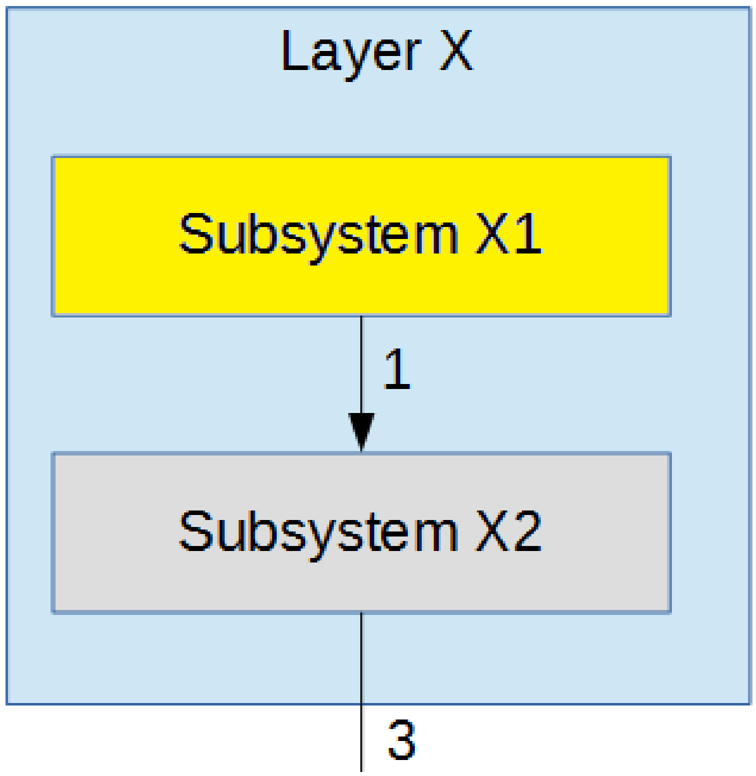

Figure 5: Example subsystem description diagram

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 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.

5.1.3 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

5.2 Subsystem 2

Repeat for each subsystem

5.3 Subsystem 3

Repeat for each subsystem

6 Z 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

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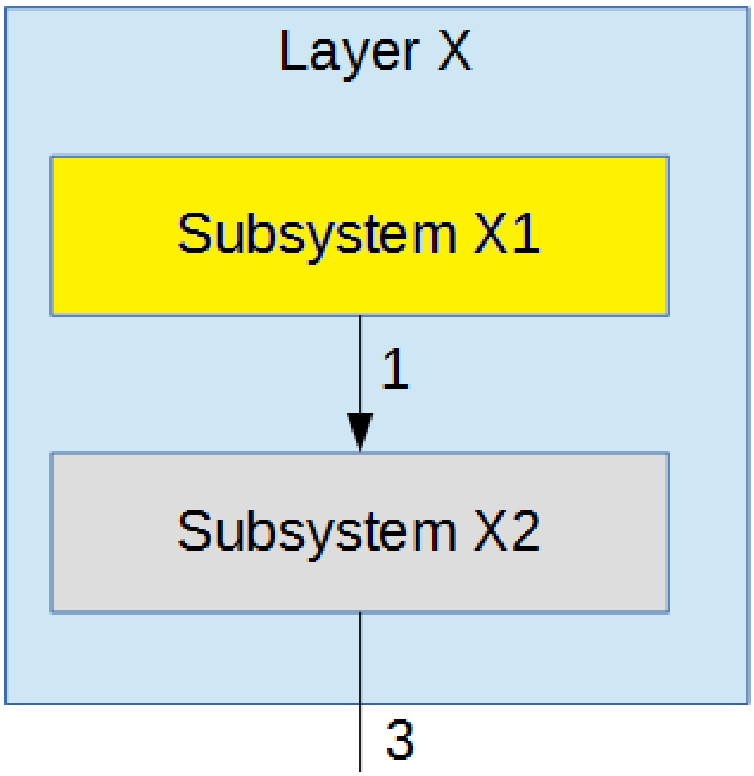

Figure 6: Example subsystem description diagram

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.

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Repeat for each subsystem

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Repeat for each subsystem

REFERENCES