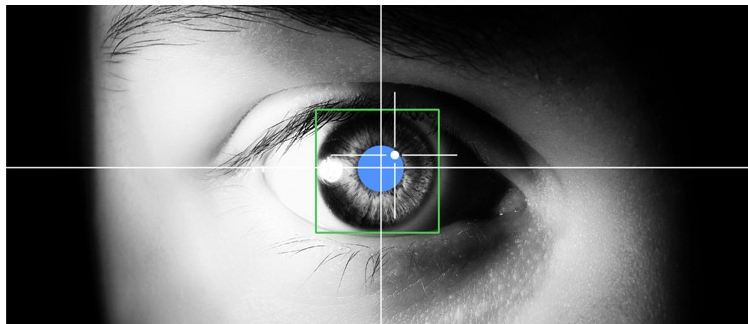


Department of Computer Science & Engineering  
The University of Texas at Arlington

Architectural Design Specification  
CSE 4316: Senior Design I  
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Eye Tracker

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## Revision History

Revision	Date	Author(s)	Description
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## Contents

1	Introduction	5
2	System Overview	6
2.1	Layer X Description . . . . .	6
2.2	Layer Y Description . . . . .	6
2.3	Layer Z Description . . . . .	7
3	Subsystem Definitions & Data Flow	8
4	X Layer Subsystems	9
4.1	Subsystem 1 . . . . .	9
4.2	Subsystem 2 . . . . .	10
4.3	Subsystem 3 . . . . .	10
5	Y Layer Subsystems	11
5.1	Subsystem 1 . . . . .	11
5.2	Subsystem 2 . . . . .	12
5.3	Subsystem 3 . . . . .	12
6	Z Layer Subsystems	13
6.1	Subsystem 1 . . . . .	13
6.2	Subsystem 2 . . . . .	14
6.3	Subsystem 3 . . . . .	14

## List of Figures

1	A simple architectural layer diagram . . . . .	6
2	A simple data flow diagram . . . . .	8
3	Example subsystem description diagram . . . . .	9
4	Example subsystem description diagram . . . . .	11
5	Example subsystem description diagram . . . . .	13

## List of Tables

2	Subsystem interfaces . . . . .	10
3	Subsystem interfaces . . . . .	12
4	Subsystem interfaces . . . . .	14

## 1 Introduction

This product shall have three layers that work in unison to track the pupil of the user. The three layers in our system are the Software layer, Daughter Board, and the Cypress CX3. The three layers will be discussed more in the coming sections.

## 2 System Overview

The system consists of three major layers which are: The Daughter Board Layer, The Cypress CX3 Layer, and the Software Layer. The Daughter board is the main interface between the MIPI camera module and the Cypress CX3. It contains the OmniVision 5640 sensor that interfaces to the cypress CX3. The Cypress CX3 layer provides the interface between the MIPI camera and the USB. This layer is what communicates with the computer and the Daughter board. It uses USB to power the device and transfer the data to a computer. The Software layer takes input from the Cypress Interface, processes that data, and tracks the pupil movement in real time. Various Computer Vision algorithms such as the Canny Edge Detector, Gaussian Smoothing, and the Random Sampling Consensus are implemented by the software layer to accurately track the pupil movement.

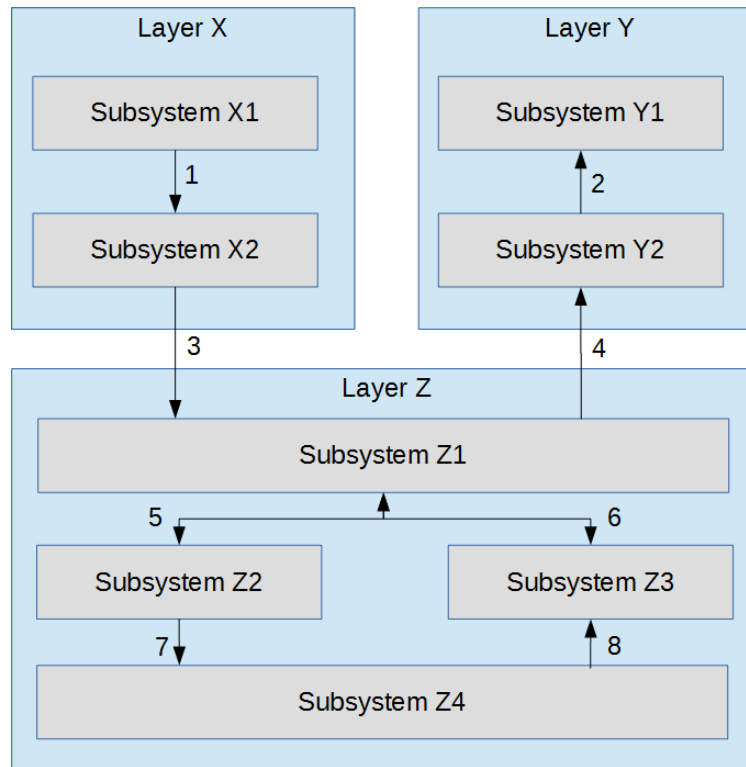


Figure 1: A simple architectural layer diagram

### 2.1 Software Layer Description

The software layer makes use of the OpenCV library and implements the entire program in C++ language. It consists of three major subsystems. The first subsystem is the Input subsystem. It gets input from the interface provided by the Cypress CX3. A video stream from a device (or a disk for test purposes) is read and stored into a CV::Mat structure. This structure will later be passed onto the processing subsystem. The goal of the processing subsystem is to filter out all the noise (anything but the pupil) and it does so utilizing readily available OpenCV algorithms which shall be discussed in detail later in the document. The final layer is the display layer which gathers information from the processor and displays the final result (fitted ellipse) into the original video stream.

## 2.2 Daughter Board Description

The daughter board is a board that is used to interface between the camera module and the Cypress CX3. This board uses a high-speed rugged ground plane socket (Base BRD Connector) to transfer the data that the camera captures to the CX3. In order for the camera module (pcDuino Camera Module) to function properly the daughter board needed a new camera connector, since the original connector is not compatible. We replaced the old connector with the Panasonic connector (AXK824145WG). The purpose of the new camera connector is to interface the camera with the Base BRD Connector. The daughter board contains the OmniVision 5640 that is interfaced through the 2-lane MIPI interface.

## 2.3 Cypress CX3 Description

The Cypress CX3 is a MIPI to USB interface. This controller is fully functional with any image sensor that is compliant with a MIPI Camera Serial Interface (OmniVision 5640). The Cypress CX3 is used to control the communication between a computer and the device, since it uses a USB connection to power the device and transfer the data that it collected. Also in order for the device to store the data read from the camera module, it uses EEPROMS in order to prevent losing data in cases the device loses power. Then the device will transfer its data to the computer via USB. The Cypress CX3 is also connected to the MIPI camera.

### 3 Subsystem Definitions & Data Flow

This section breaks down your layer abstraction to another level of detail. Here you graphically represent the logical subsystems 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.

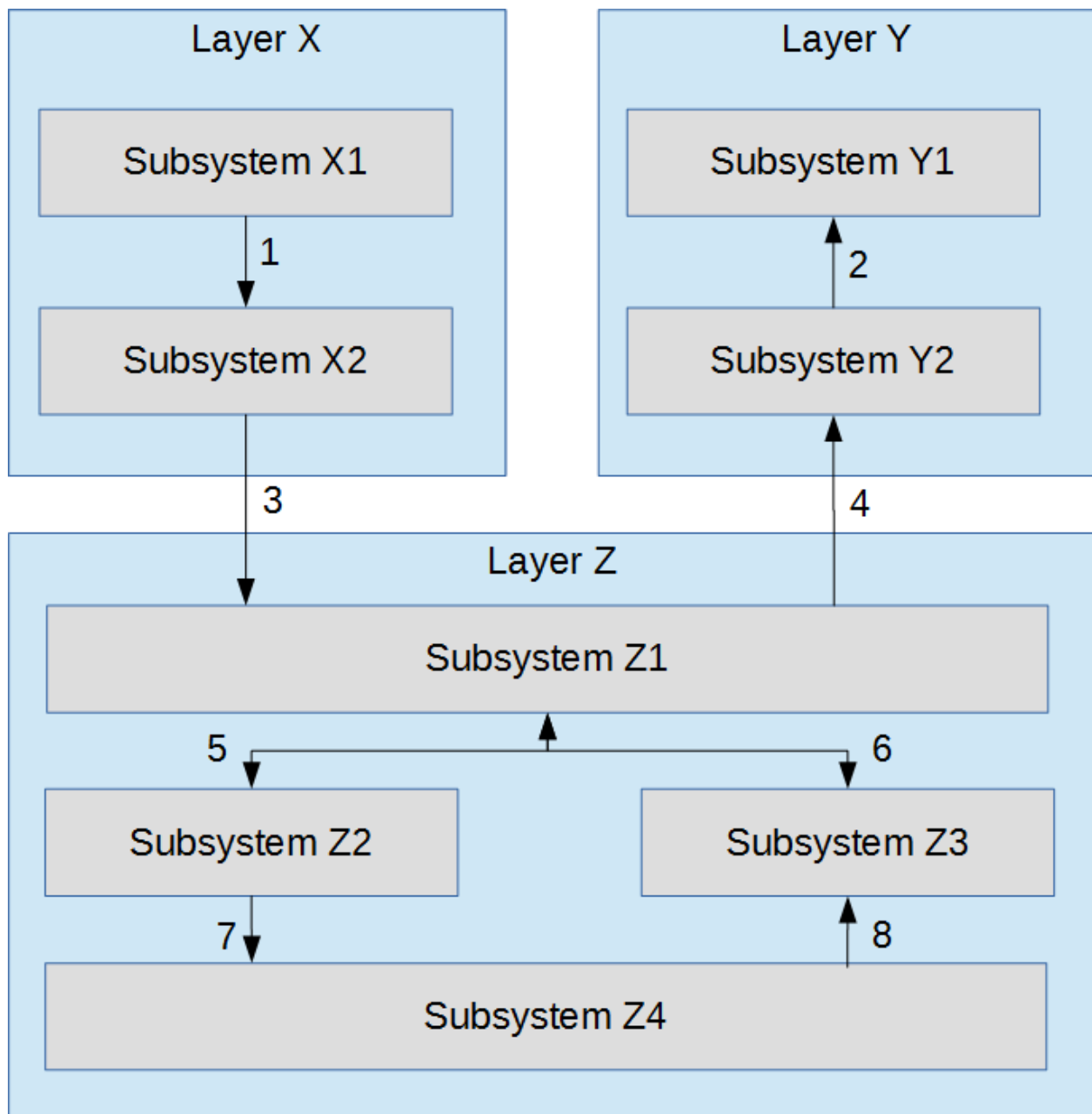


Figure 2: A simple data flow diagram



## 4 X 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.

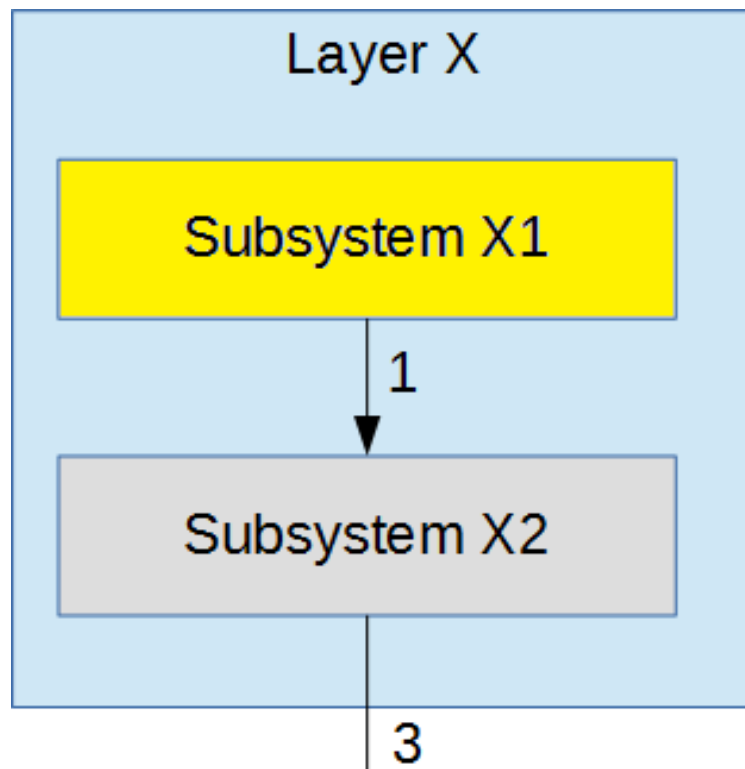


Figure 3: Example subsystem description diagram

#### 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 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 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.

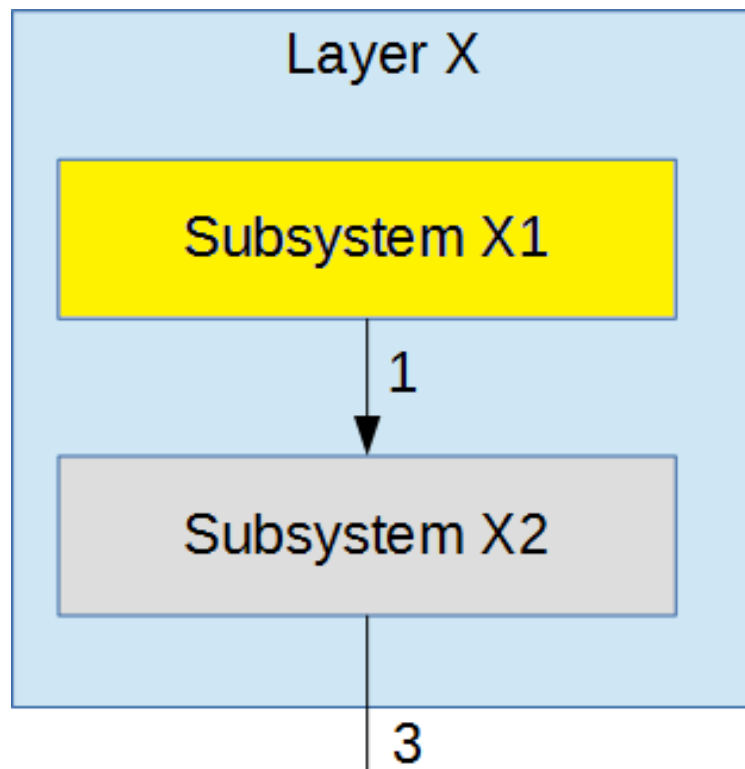


Figure 4: Example subsystem description diagram

#### 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

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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

## 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

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.

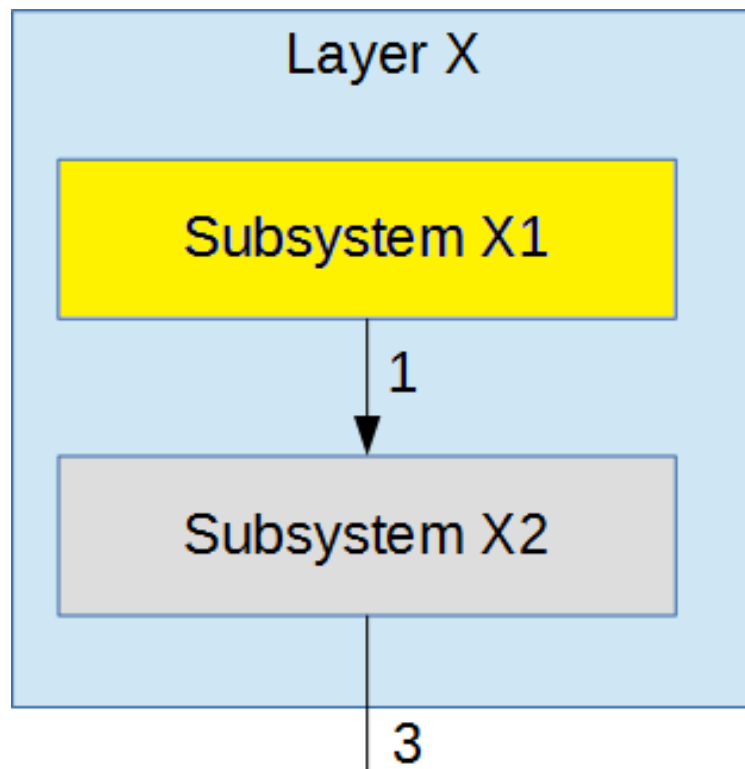


Figure 5: Example subsystem description diagram

#### 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