Initial Project Document

Smart Mirror

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Senior Design 1

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Project Narrative

Today, technology is incorporated into every aspect of our lives in an effort to make living easier and more enjoyable for everyone. A mirror is one of the few things we can agree on that most people in America interact with on a daily basis and it's the perfect place for people to get information they might need throughout the day. The best kind of technology is one that you barely notice and yet it impacts your life everyday. That's why we want to create a mirror that will give you information when you need it but look just like any other mirror when you don't. Imagine standing in front of your mirror and it instantly recognizes you and then connects to your phone, displaying weather information, calendar alerts, the current time, and much more. Brushing your teeth and need a timer? There's an app for that. As soon as you're done you can walk away, the display turns off, and it's back to looking like a regular old mirror. Our goal is to make it as seamless an experience as possible without interfering with your daily affairs.

Our smart mirror will have many different features that aim to deliver an effortless experience for the end user and connecting to your phone is one of them. Doing this will allow it to get the information most relevant to you with a personal profile and with data from your phone while others who might also be using the mirror can have their own profile and experience as well. A great possibility with phone connectivity is having widgets on the Mirror that will let you quickly glance at information you might want such as your next appointment, most recent email or text message, and more.

Every good technology has a great method for getting user input. The computer had a mouse, ipod had the click wheel, Smartphones have a touchscreen. Now what is a good option for a smart mirror? Our smart mirror will have different sensors that allow user input in multiple ways but they all have one thing in common, not forcing you to touch the mirror. Nobody wants a dirty fingerprint stained mirror looking back at them that requires constant cleaning from repeated use. First is a optical grid that will act somewhat how a touchscreen does but while you can touch the screen using it, you will not have to as hovering your finger over the mirror surface will also work just fine. The second input type will be gesture recognition. Such as a swipe left, right, up, and down. You'll be able to do this with your hands farther away from the mirror though compared to the laser grid since it'll be using the camera or possibly IR LEDs. This will provide a simple way to maybe scroll or flip through any menu settings. We're hoping both of these combined will provide an intuitive experience for anyone using it and also make navigating any app simple.

Similar products are available from many different websites. One of those is twowaymirrors.com which sells an array of products that involve smart mirror technology. The difference is that none of these are an embedded/single board solutions with custom interfaces or don't display content to the entire mirror which can improve the look and take advantage of as much space as possible. This is, in our opinion, important to making the entire experience the best one possible.

The intended audience for our smart mirror is anyone who wants an easy to use and discrete device that'll allow them to get their morning started sooner and even provide entertainment

when needed. It can also be a good teaching tool with an app that can time a child's brushing and more apps that accomplish that.

Biometrics

We will be using facial recognition as a form of biometric authentication. Unique biometric profiles will be used as way to analyze individual physical traits of a *'user'*. This will allow the operating system to restrict/grant access to profile(s) and settings associated with individual accounts. As of 2017 the average number of people per household is **2.54**. To reduce the complexity of our learning algorithm we will not be implementing a dynamic user list; rather, we will set constraints for our system to allow for between 1 and 4 users. Each *user* will be assigned a *profile.* A *profile* will consist of a unique Bluetooth identifier, traditional passcode, calendar integration, notification system and a standard apps layout. The benefit of biometric authentication over traditional passwords is that it provides more security due to the fact that physical traits are unique to individuals. Although biometrics do provide an extra layer of security, traditional passwords must still be included as contingency for cases where users share physical traits (twins) or the system cannot process biometric features.

Software/Hardware Integration

A) *C++*

i. Our software system will be written in C++. This language was chosen because it is a partial Object Oriented Programming Language. It is a compact language and executes quickly. It has a well developed system of libraries which makes it a very versatile language. It also supports graphics and image processing (OpenGL/OpenCV) which will be a fundament component for our system.

B) *OpenCV*

i. Is a library of programming functions used for image recognition and computer vision. We will be using OpenCV as it is an open source platform that supports deep learning frameworks. Our program will detect faces in real time, track them and classify features as objects and store them in a deep learning algorithm. Every time an image is logged to authenticate a user it will 'synapse' will be create and the weight will be updated. This will increase the chance of recognizing unique users.

C) Backend API

i. This will be used for our backend to communicate with whatever OS or external system we sync to. The chosen language for this will based on the OS we will be sending data across.

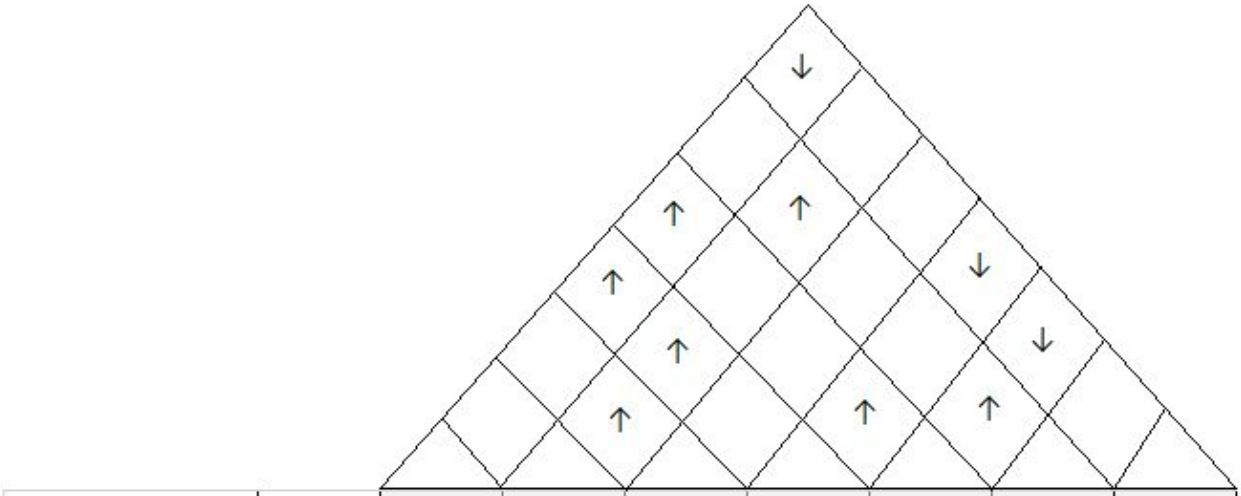
Requirement Specifications

1	A two-way mirror will be used.
2	The mirror will have bluetooth capabilities to connect to mobile phones.
3	The mirror will display things such as, temperature, and tweets.
4	The mirror will have sensors to detect motion for gestures.
5	The mirror will have an optical-frame for touch screen capabilities.
6	The mirror will have wifi to be able to access things like twitter and netflix
7	The software interface must have a black background to give the appearance that the mirror is the display.

Possible Project Constraints

Since this project is in its early stages, there is yet any major constraints that comes to mind. However, one possible issue is the overall cost of the project. Since it's the summer semester is may prove difficult to find sponsors willing to sponsor this project. This may mean that we might have to downgrade some of the parts or it may be difficult to add more functionalities the smart mirror. Another possible constraint is time, with the amount of functions that we are adding to the smart mirror it may prove difficult to deliver all the promised functionalities in time.

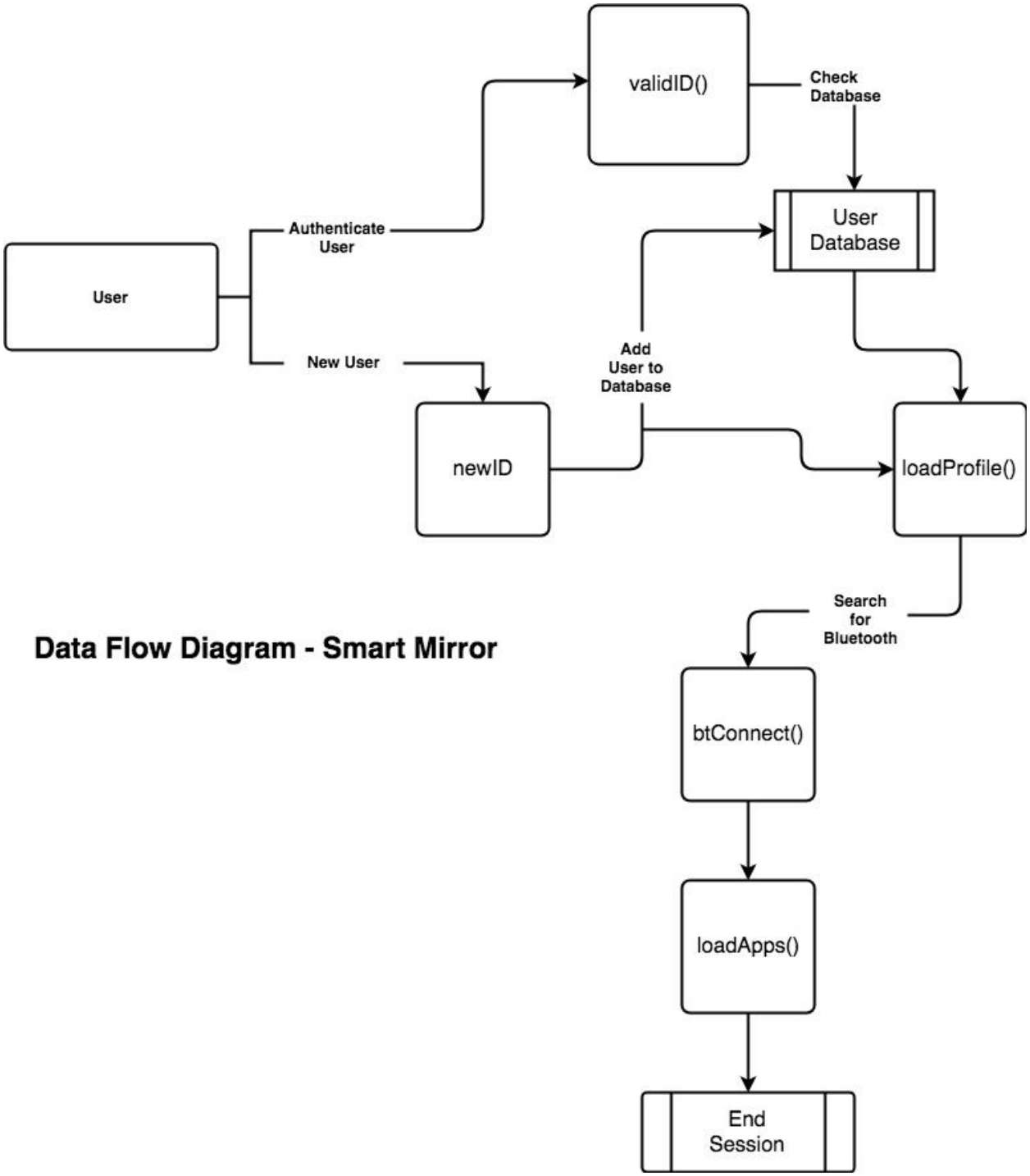
House of Quality



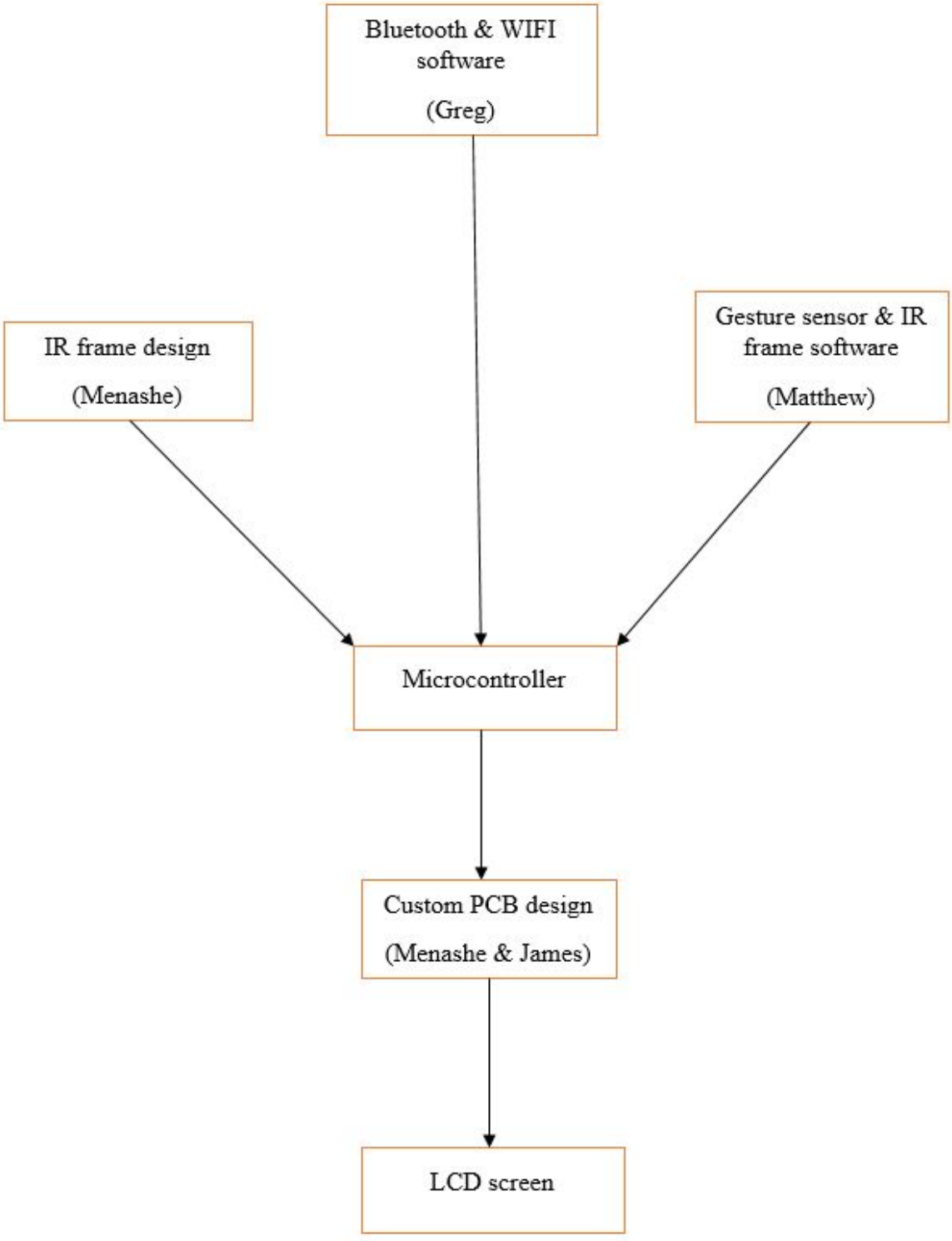
		Optical touch grid	Motion control	Facial recognition	Social media connectivity	Phone connectivity	Environmental measurements	Installation
		+	+	+	+	+	+	-
Cost	-	↑↑	↑	↑	↑	↑		↓
Usability	+	↑	↑	↑	↑	↑	↑	↓
Power consumption	-	↑			↑	↑		
Mirror size	+	↑↑						↑↑
Targets for Engineering Requirements		Resolution		High accuracy	Twitter, Facebook, Netflix	Bluetooth functionality	Temperature, humidity	>5 minutes

Block Diagrams

Data Flow Diagram



Data Flow Diagram - Smart Mirror


Bluetooth & WIFI software
(Greg)
IR frame design
(Menashe)
Gesture sensor & IR frame software
(Matthew)
Microcontroller
Custom PCB design
(Menashe & James)
LCD screen

Budget and Funding

Our project will be self funded and based on some internet research we believe that it's possible to stay at or under $550.

Device	**Quantity**	**Cost estimate**
Two-Way Mirror	1	$50 - $100
Monitor/Tv	1	$150 - $200
Processor/micro-controller	1	<= $10
Camera	1	<= $20
Wifi chip	1	<= $10
Bluetooth Chip	1	<= $10
Optical Touch Grid	N/A (multiple light sources)	$75 - $100
Gesture Sensor	1	<= 20
Custom PCB	3	$30 - $50
Power Supply	1	$15 - $30
Total Cost	**N/A**	**$390 - $550**

Project Milestones

Milestone Name	**Duration**	**Week**
Senior Design 1		
Brainstorm for project ideas	3 weeks	5/14 - 6/4
Divide and conquer project report	5 days	6/4 - 6/9
60 page documentation report	~ 4 weeks	6/9 - 7/6
Design PCB & order all necessary items for project	~ 2 weeks	7/6 - 7/19
100 page final report	~ 2 weeks	7/6 - 7/20

Senior Design 2		
Building project prototype	~ 4 weeks	8/20 - 9/20
Test and adjust prototype	TBA	TBA
Finalize prototype	TBA	TBA
Peer presentation	TBA	TBA
Final report	TBA	TBA
Final representation	TBA	TBA