Group 36

Indoor BLE Security System

Senior Design 1

Initial Project Document

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Project Narrative Description

Bluetooth 4.1 and Bluetooth 5.0 are used in everyday technology. Over the years, Bluetooth has evolved to become smarter as the applications of the technology become more diverse. There are new incentives when it comes to utilizing the increased range of Bluetooth. As Bluetooth grows, so could its applications in the implementation of security. Businesses with secure sites have added many layers to internal security through training employees on phishing, requiring keycard access to enter certain buildings, and utilizing security cameras. There must be an even smarter way to track employee/non-employee activity within a secure site. Our goal is to take the capabilities of Bluetooth and utilize them to engineer a Bluetooth tracking system along with the use of computer vision.

When completed, the Bluetooth tag tracking system will have the functionality to add another layer of security to what already exists in many large corporations. What will this mean? Along with allowing users access to buildings, the Bluetooth tag will communicate with in-range antennas to pinpoint the user's real-time location within the building. In addition, there will be a companion app developed to visualize user info and their location history.

In use of the application, there will be user privileges applied when a user is granted a Bluetooth tag. On-site security will need access to ALL facilities within the building, Executives may need access to ALL sites within the building, but everyone else's access will be based on their respective department and special access depending on their roles. These items will be managed within a secure database, intended only for database managers to access. One exception to be considered is providing guests access to the secure site. These individuals will be allowed to access facilities with temporary access. Another potential feature is executives/managers having access to activate/deactivate department guest Bluetooth tags through the companion app without having to go through security or IT to get the access granted.

Generally, Bluetooth modules and Computer Vision components are inexpensive. Our goal is to implement these Bluetooth tags in conjunction with Computer vision. An individual walking into a room with a Bluetooth tag will first be

identified with the cameras in the room. Each camera will search through a database of individuals working for the company. If a person working for the company does not have a picture on file yet (they have a Bluetooth tag, but no image tied to the tag), the system will send a flag to the security personnel. Another scenario could be an individual that could just be visiting the site for business transactions, maintenance of equipment, etc… These cases will search the database and automatically snap an image of this individual. The signal from the Bluetooth tags, communicating with the security cameras and antennas will be transmitted to the companion application and displayed on security's portal. The real time location will be transmitted by the circuit holding the antenna technology. The location transmission will only activate once the user has scanned their tag to enter a facility. Our goal is to have the ability to log user's location with accuracy to the room they are within and their timestamps.

The Bluetooth tag is intended to protect users as well as company information from being stolen. If company information is outsourced, authorities would have access to information that could save them time and resources. Data that belongs to one facility could be tracked easier because they would have access to anyone within facilities and the times related to the data accessed. The tags would eliminate false alibi's and hold individuals accountable when proprietary data is mishandled. The end goal of the Bluetooth and computer vision security system is to add more integrity to our modern security systems.

Requirements/Specifications

The project will consist of four major components:

1. BLE Beacon: These stationary beacons will be evenly placed in room to receive positional data from tag and send this information to the security software(PCB requirement made here) can be made relatively cheap

2. BLE "asset" tags: These tags will be on the moving employee/user and will be constantly transmitting their positional data out to beacons

3. Software Application: This software will give administrators access to database of facial scans as well as provide an interface for live tracking of users in secure area

- Software will also contain employee's location history with timestamps and path they took while in secure area
- Will also receive any warnings triggered by the security system detecting intruders or unidentified users
- Will allow for employee tags to be set/changed to BLE tags

4. Pan-Tilt-Zoom Cameras(made with servos): Main functionality of these cameras is to fulfill the identification requirement, which will be done through facial recognition. The goal of the cameras is to be Pan-Tilt-Zoom capable.

- The pan-tilt function will come in handy when establishing sight of user to identify the face while user is moving into and around secure area
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- Ideally the camera will pan and tilt with the user's movements to perform faster and more accurate recognition than just a stationary camera mount

- This movement tracking can be implemented with location data from BLE tags or just through recognition algorithm

Component Specifications:

BLE Beacon:

- Will need to make multiple 2-4 beacons for tracking data
- Will need to be able to receive data from BLE tags
- Device just needs capability to receive Bluetooth data and then transmit it to Program that will process this data **BLE "asset" tags:**
- Tags will contain PCB that has a 9-axis motion sensor on board
- Will be able to transmit accurate positional data to receiver beacons
- Ideally should be small enough to mount on employee ID card or placed in pocket

- Ideally 3in x 3in **Software Application:**
- Easy to navigate interface
- ability to upload area/room layout to show accuracy
- Purpose of the application is to provide an interface in which the live positional data of the user is displayed as well as an accurate trace of their movements throughout the room.
- Database should be encrypted
- BE ABLE TO ENABLE/DISABLE certain user access remotely
- Application will be able to show data for any user stored in this database
- will display the time that transmission was initiated as well as show an interface with the path the user took.

Pan-Tilt-Zoom Cameras(made with servos):

- Cameras will be mounted on servo motors to allow for a wider range of motion
- Cameras will either have a physical zoom or digital zoom component to make facial recognition more efficient and minimize detection times
- Camera will make use of beacon data to determine
- Camera will be mounted with one or two servos depending on implementation
- direction control done through a simple microcontroller

House of Quality

Below in **Figure 1** is an illustration of our House of Quality diagram; it shows the aspects of our project that our group found important. Note that the targets for each engineering specification is a rough estimate and will become clearer as time goes by.

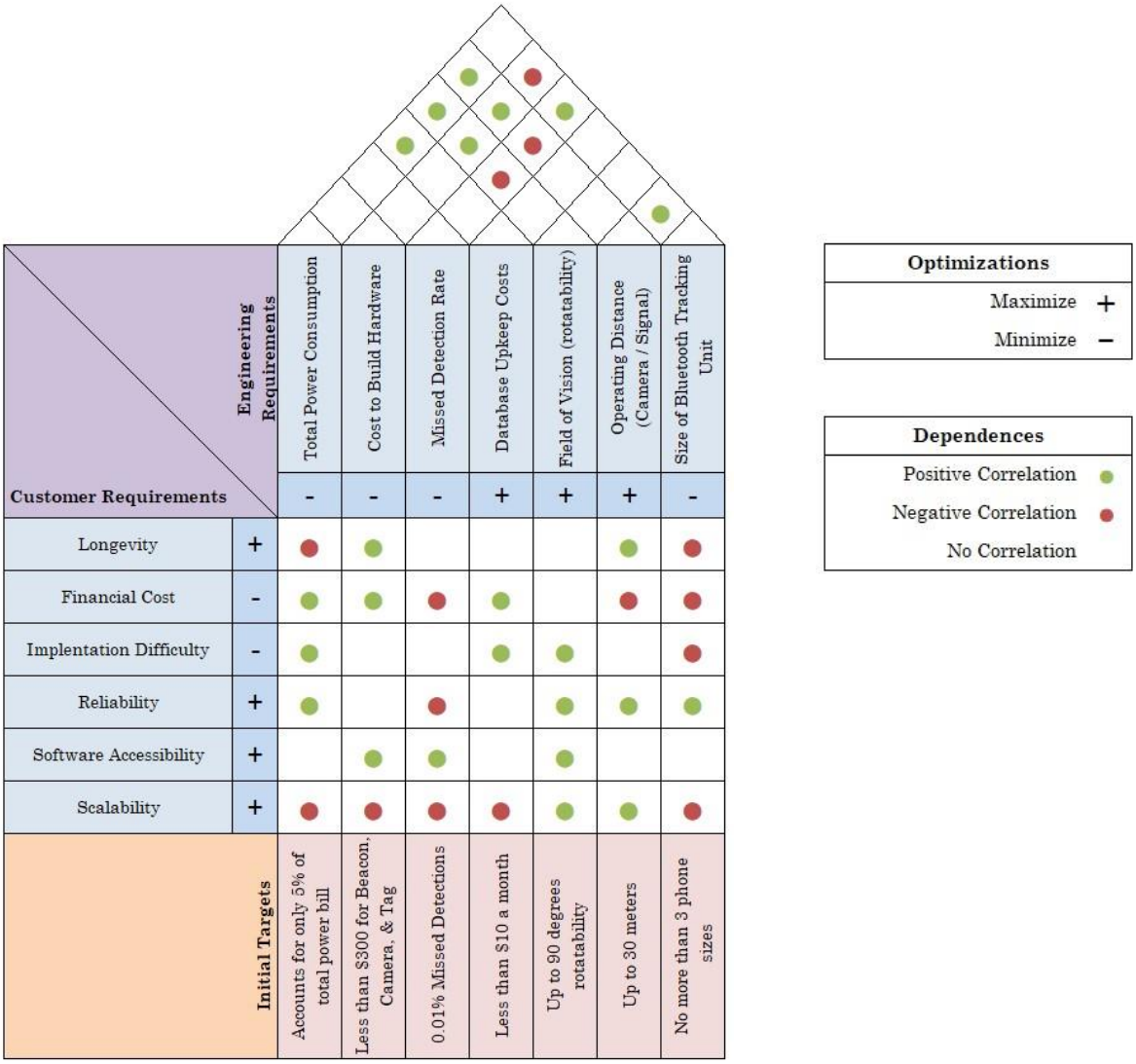

Figure 1: House of Quality

Block Diagrams - Project Overview

General Project overview:

Figure 2, seen below, displays the basic idea of our project. We basically are creating a security system that keeps track of indoor location using BLE.. Doing this will allow us to acquire real time data of where the tags are when they enter into a highly secure area. As you can see below, depending on where the user is trying to go within the building will determine if the tags start being tracked by the beacons we will have set up. If the tag is picked up in the secure area then the BLE tracking system will kick in and start storing the information into the database, deploying the information to the admin center we plan to create.

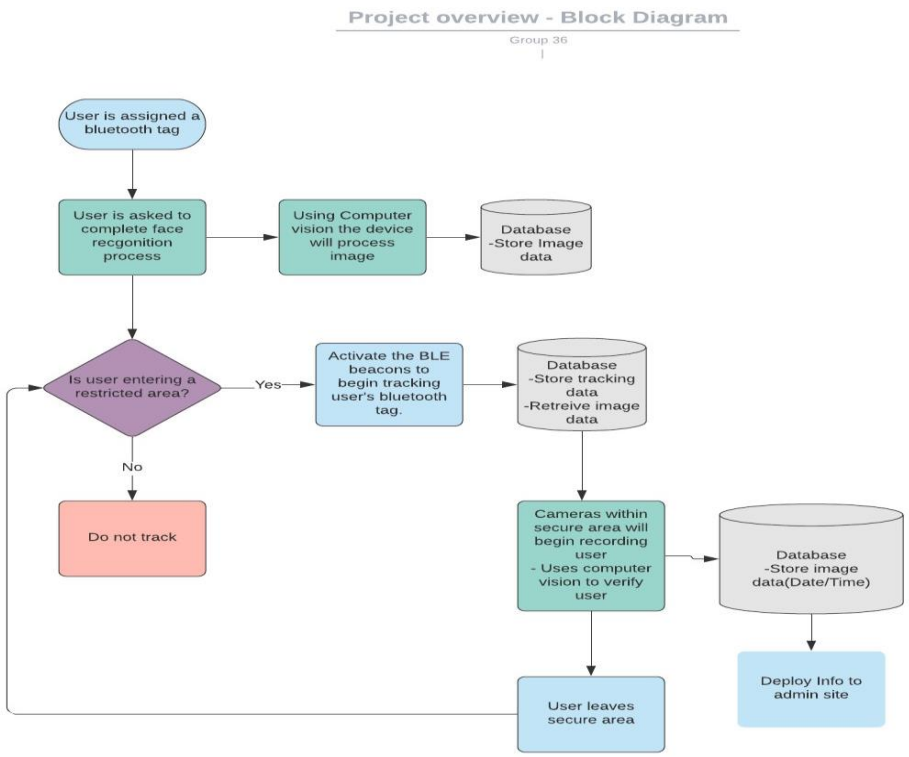

Figure 2: Project Overview

Hardware overview

We plan on splitting up our projects in two parts, hardware and software. For the hardware side of everything, we have a basic idea of what we are working with but of course more research needs to be done. We are pretty sure that we will be using a BLE tech due to them being less expensive and previous research done on this topic. The beacons/antennas are the most important part of the hardware. The beacons will have to produce a signal strong enough to pick up the bluetooth tag in any location within the secure room.. Below you will see the basic general workflow of the hardware side of this project. Isaiah and Aundre will be the ones primarily responsible for the hardware aspect, Christian and Dylan will be assisting as well with the BLE tracking enabler and

database system to store the information. Everything in figure 3 still needs further research.

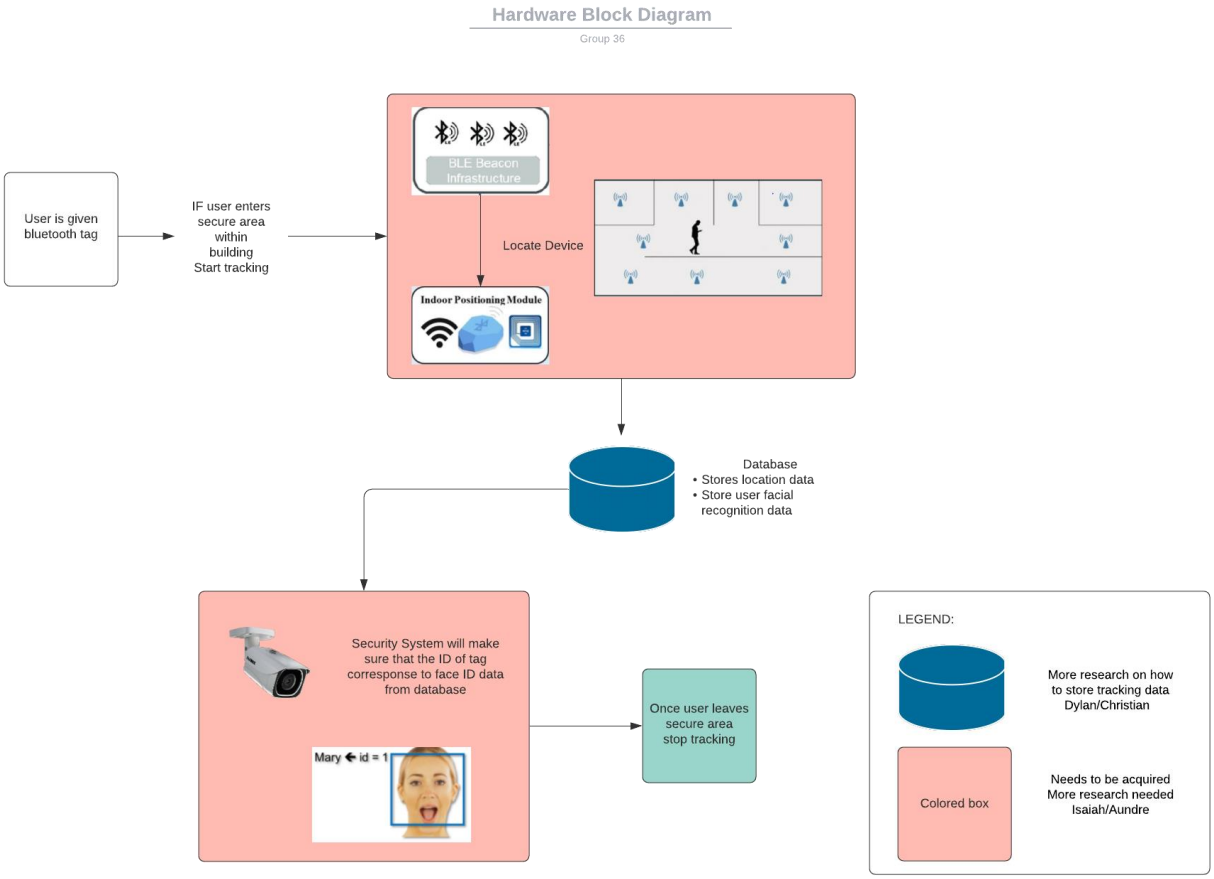

Figure 4: Hardware Overview

Software Overview

The second aspect to this project is the software side. We want to make this data accessible for users who have admin privilege and oversee the building, for example security, building manager and executives. Christian and Dylan will be primarily responsible for this aspect of the project. We want to create an admin center where users have to login to get access to the trackers data. From here the admin has access to view tracking data and to assign/remove tags from corresponding members of the organization. Figure 4 displays the work flow for this particular application.

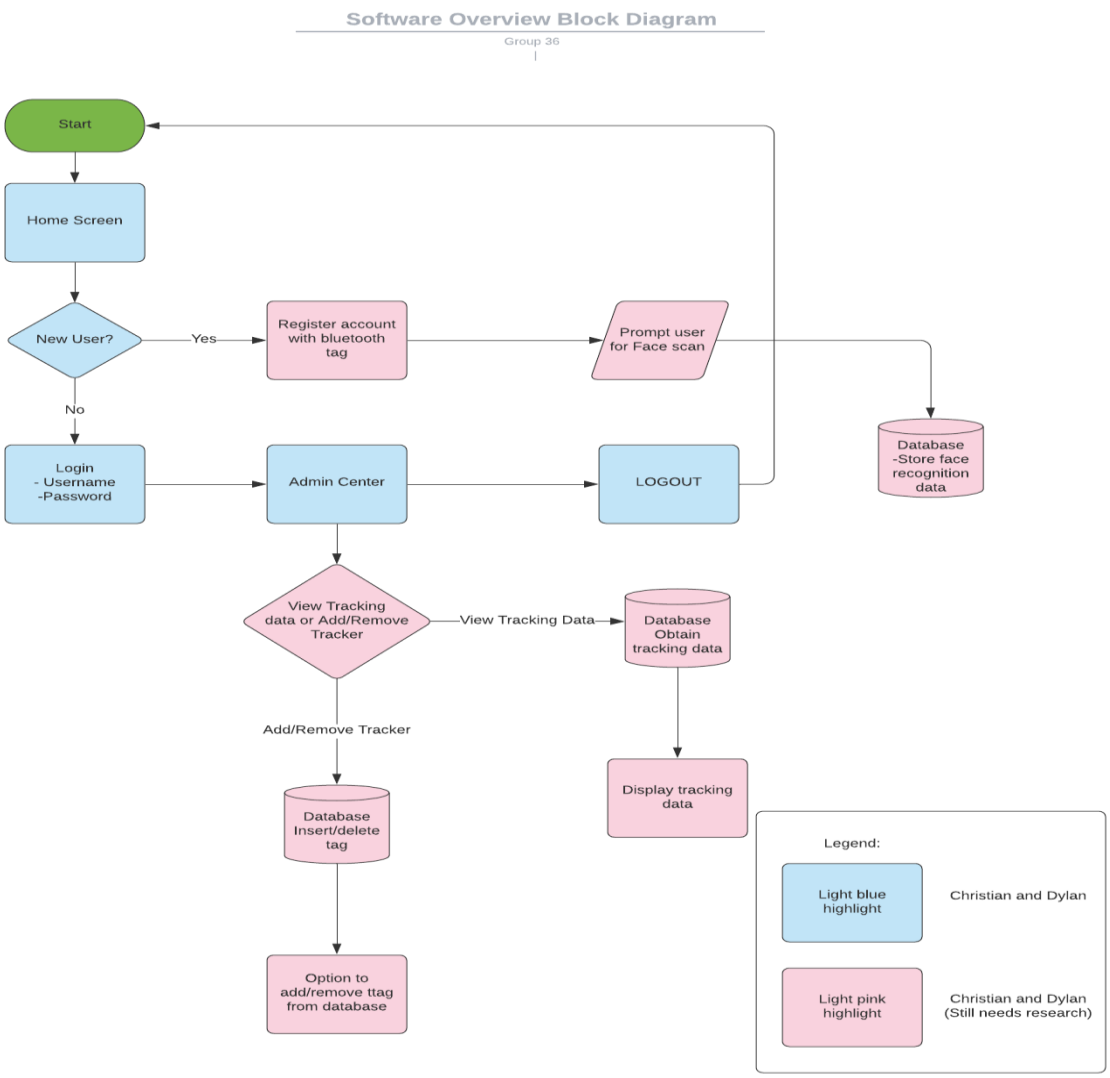

Figure 4: Software Overview

Project Budget/Financing

Estimated project budget and financing:

Project is not sponsored, and the budget will be completely self-funded by the members of our group.

Item	Est. Price

Microcontroller for camera x 1	$6-$20
Microcontrollers for receivers 2-4	$20-$40
Central Microcontroller(Hub)	$20-$30
Custom PCB boards for tags	$50-$110
Wiring pins for microcontroller	$10-$20
Camera(s) used for facial rec.	$15-$22.50
Mount for cameras and Beacons	$20-$30
2x Servos for mounting	$8-$20
Batteries w/ accessories	<$30
Circuit elements (breadboard,resistors,leds,etc)	self-sourced
Total(estimate)	$170-$380

Table 1: Budget Table

Project Milestones

Figure 5 and **Figure 6** are our target milestones for the next 2 semesters.

Senior Design 1 Milestones

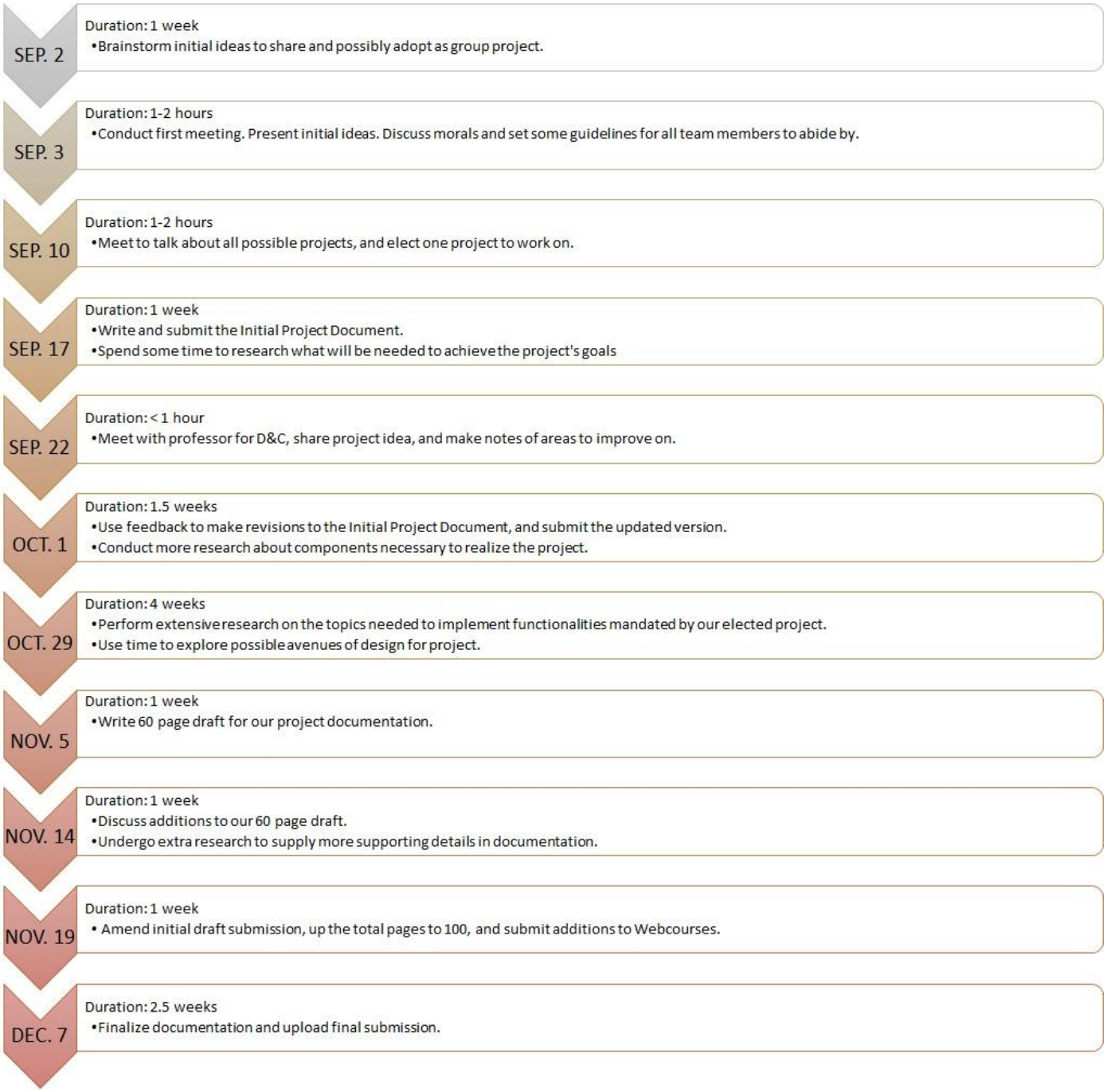

Figure 5: SD1 Milestones

Senior Design 2 Milestones

Figure 6: SD2 Milestones