iSeeU

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Abstract

The current consumer privacy framework in U.S. law is outdated, allowing corporations to invade a user's privacy using technology without consequence. In 2013 & 2020, the U.S. Government Accountability Office reported this issue to Congress, yet nothing has changed (Cackley 2020). iSeeU plans to change this by demonstrating to the public how powerful technology already is in invading user privacy, specifically facial recognition technology.

The choice to focus on facial recognition technology is an intentional one by the authors, as rather than conquer the impossible task of addressing every single technology that can invade a person's privacy, focusing on facial recognition makes more sense as it is the most unavoidable in the authors' opinion since it does not require a person to have or use anything.

iSeeU uses facial recognition technology to target the user with advertisements based on demographic information determined from the user's image. iSeeU then explains how no legal controls on this technology prevent it from being abused (Cackley 2020). iSeeU finishes by asking the user to take two specific actions. The first is to bring awareness to the issue by sharing iSeeU with their social networks. The second is to ask the user to contact their congressional representatives to ask for legal controls on this technology, hopefully leading to a much-needed update to the consumer privacy framework in U.S. law.

Introduction

Project Summary:

This project is designed to demonstrate the ethical and privacy ramifications of facial recognition technology and bring it to the public's attention. This project illustrates how robust facial recognition is and how concerning it is that it can be used to deliver targeted advertising without any legal restrictions (Cackley 2020).

To accomplish this, a website has been built. A user will use this website to provide a picture of themselves. The image will then be parsed by an online facial recognition service to determine the user's demographics. This demographic information will then be used to deliver targeted advertisements to the user. The user will then be informed on how the technology used for the product works and its current legal status. The user will then be asked to take action to put controls on facial recognition technology.

Problem Statement:

In the past decade, technology has quickly and significantly enriched almost every human's life, with "the number of people who own a smart and feature phone… making up 62.17% of the world's population" (Agha 2021, p.54). While this has led to a lot of conveniences, it has also led to increasing ethical and privacy violations, such as retail stores tracking their customers via "data gathered from cell towers, ambient Wi-Fi, and GPS… [and] Bluetooth Beacons" (Kwet 2019). Unfortunately, this is a global issue since "Every minute of every day, everywhere on the planet, dozens of companies — largely unregulated, little scrutinized — are logging the movements of tens of millions of people with mobile phones" (Thompson 2019). Even if one does not own a cellphone themselves, their privacy is still violated, making it impossible for "individuals to remain anonymous in public" (Cackley 2020).

This is doubly true and concerning when it comes to "facial recognition technology [which] may collect or store facial images, posing varying levels of risk" (Cackley 2020). Facial recognition technology is already being used in the wild by commercial and government entities. For example, it is being used to advertise to you in malls without your consent and knowledge (Networld 2020).

While there has not been much outcry from the public about this, this may be because they are not aware of the lack of laws protecting them from such data being abused, especially for American citizens. In the United States, "there is no comprehensive federal privacy law governing the collection, use, and sale of personal information by private-sector companies" (Cackley 2020). This lack of objection may also be because people do not realize how ubiquitous this technology already is, not genuinely noticing how "in the 21st century, we live in a world packed with closed-circuit video cameras, facial recognition systems, … smartphones with location tracking, and widespread monitoring of our electronic communications" (Leong 2019). And this is a problem that will only worsen as technology becomes more prevalent and powerful,

particularly facial recognition systems, as “the global facial recognition technology market… is projected to grow” in revenue from $3 billion in 2019 to $7 billion by 2024 (Cackley 2020).

The hope is that a much-needed public discourse will be started by bringing the power and consequences of facial recognition technology to people’s attention. A discourse on how to put controls on this technology so that it is used humanely before facial recognition technology is allowed to infringe upon our lives without consequence. Ideally, a discourse that will finally lead to implementing the U.S. Government Accountability Office’s 2015 suggestion “that Congress consider strengthening the consumer privacy framework to reflect changes in technology and the marketplace” (Cackley 2020).

Solution:

iSeeU is a website built to demonstrate the power and consequences of facial recognition technology already available to the public today.

iSeeU is designed to respect user privacy as much as possible, requiring the user’s consent before any facial recognition occurs. After the user has consented, iSeeU captures the user’s picture or has the user upload one. The picture is then securely sent to a dedicated facial recognition service to be parsed. The service will respond with the demographic information determined about the picture’s subject.

iSeeU uses the information to deliver targeted advertising to the user. The advertisements are displayed on the sides of the image the user submitted. Below the advertisements, iSeeU states the exact information that the facial recognition service determined about the user and why these specific advertisements were targeted to the user.

iSeeU then highlights how such a product was built with a small budget and team before asking the user to imagine what companies with a much larger budget and team could create. iSeeU further clarifies that no data is stored permanently but that U.S. law currently does not require this of the creators of iSeeU.

iSeeU ends by presenting the user with two ways to fight the problem at hand. The first way asks the user to spread awareness of the issue by sharing iSeeU on their social networks through easy-to-use share buttons. The second way asks the user to contact their senators through a simple form to protest the lack of a “consumer privacy framework [in U.S. law that] reflect[s] changes in technology and the marketplace” (Cackley 2020) of today’s world.

Project Source:

The project idea was conceived by the team’s lead developer, Umer, as he is very passionate about privacy and technology. He felt there is a need for this project since the legal framework around privacy in the United States is severely lacking. A point that others have frequently raised in recent times, such as the U.S. Government Accountability Office, which

stated: “that Congress consider strengthening the consumer privacy framework to reflect changes in technology and the marketplace” (Cackley 2020).

The initial requirements analysis for the project was done as a team, with us discussing the project idea extensively amongst ourselves. These requirements were refined by examining the project idea with multiple faculty advisors.

The project team was formed through team members knowing each other from previous courses.

Discussion

Project Objectives/Goals:

The hope is that our project solution will make people more aware of facial recognition technology's ethical and privacy ramifications and convince them to take action to protect their privacy.

Major features/goals:

- Bring feelings of apprehension within people when they use our product.
- Target specific advertisements toward people by using facial recognition.
- Educate people on the ethical and privacy ramifications of facial recognition technology and its use.
- Inform people about the lack of legal controls on technology regarding consumer privacy.
- Increase privacy awareness by demonstrating what technology can do automatically without much human input.

Project Scope:

Our team has developed a functional website informing users of facial recognition technology's ethical and privacy ramifications. The website does this by utilizing the following features and functionality:

- First, obtaining a user's informed consent by informing them of the capabilities and intent of the product before any facial recognition occurs.
- Offering to capture a user's picture through the user's webcam.
    - Alternatively, have a user upload a photo of their choice.
- Using an online facial recognition service to analyze the user's image to determine their demographic information.
    - Additionally, showing the user the exact information the service deciphered from their picture.
- Targeting advertisements to the user based on the demographic information received from the facial recognition service.
- Allowing users to quickly increase awareness of the issue by having easy-to-use social share buttons.
- Having a contact form users can use to quickly contact their congressperson about this issue.
- Using AWS for the backend and hosting so the application is stable and quick to load, no matter where the user is.
- Using React JS for the frontend so that the application can run entirely in the browser. Allowing anyone who visits the URL to use the product, whether on a smartphone, laptop, or desktop.

Quick Project Timeline:

Table 1: Project Timeline

Task#	Task Name	Duration	Start Date	End Date
1	Team Contract	4 Weeks	August 23rd, 2021	September 20th, 2021
1.1	Project Ideation	2 Weeks	August 23rd, 2021	September 6th, 2021
1.2	Project Research	2 Weeks	September 6th, 2021	September 20th, 2021
2	Design	3 Weeks	September 20th, 2021	October 11th, 2021
2.1	Create UX Mockup	1 Week	September 20th, 2021	September 27th, 2021
2.2	Create UX Prototype	2 Weeks	September 27th, 2021	October 11th, 2021
3	Development	16 Weeks (Excludes Break)	October 11th, 2021	February 28th, 2022
3.1	Sprint 1 Ideal: Test APIs	2 Weeks	October 11th, 2021	October 25th, 2021
3.2	Sprint 2 Ideal: Test Face Detection	2 Week	October 25th, 2021	November 8th, 2021
3.3	Sprint 3 Ideal: Local Prototype	2 Weeks	November 8th, 2021	November 22nd, 2021
3.4	Sprint 4 Ideal: Prototype User Testing	2 Weeks	November 22nd, 2021	December 6th, 2021
	WINTER BREAK		December 6th, 2021	January 3rd, 2022
3.5	Sprint 5 Ideal: Add sharing features	2 Weeks	January 3rd, 2022	January 17th, 2022
3.6	Sprint 6 Ideal: Deploy to Server	2 Weeks	January 17th, 2022	January 31st, 2022
3.7	Sprint 7 Ideal: Production Ready	2 Weeks	January 31st, 2022	February 14th, 2022
3.8	Sprint 8 Ideal: Bug Fixing & Unit Tests	2 Weeks	February 14th, 2022	February 28th, 2022
4	Testing & Quality Assurance	2 Weeks	February 28th, 2022	March 14th, 2022
4.1	Production User Testing	1 Week	February 28th, 2022	March 7th, 2022
4.2	Implement Testing Suggestions	1 Week	March 7th, 2022	March 14th, 2022
5	IT Expo Preparation	4 Weeks	March 14th, 2022	April 11th, 2022
5.1	IT Expo Poster & Presentation	1 Week	March 14th, 2022	March 21st, 2022
5.2	Rehearse IT Expo Presentation	3 Weeks	March 21st, 2022	April 11th, 2022
6	IT Expo Presentation	1 Day	April 12th, 2022	April 12th, 2022

Technologies Used:

- AWS – Amazon Web Services is used to power the backend.
- AWS Amplify – AWS service used to host website.
- AWS API Gateway – AWS service used to power API to communicate with AWS Lambda.
- AWS Lambda – AWS service used to provide the serverless backend to handle AWS Rekognition® requests securely.
- AWS Rekognition® – AWS service used for facial recognition using machine learning.
- CSS – Style sheet language used to write the styles of a website.
- GitHub – Host for Git repository used to share code among the team.
- HTML – Markup language used to write the content of a website.
- JavaScript – Core programming language of the web.
- Microsoft Visual Studio Code – IDE particularly appropriate for JavaScript projects.
- NPM – Node package manager used to make maintaining libraries hosted on the NPM registry easily.
- Node.js – JavaScript runtime providing backend capabilities.
- React – JavaScript framework to speed up UI development.

Technical Architecture Diagrams

Infrastructure Diagram

The infrastructure diagram below demonstrates the technologies that the frontend and backend of iSeeU use to function. A brief description of the infrastructure diagram:

- The Frontend is powered by React JS.
- The Backend is powered by Amazon Web Services (AWS).
    - AWS Amplify hosts iSeeU and serves it to the user when they visit the iSeeU domain.
    - AWS API Gateway manages the API used to send the image to a Lambda instance securely.
    - AWS Lambda is the serverless backend that spins up an instance when API Gateway sends it an image to process.
    - AWS Rekognition® is the facial recognition service that a Lambda instance uses to parse an image.
    - All AWS services mentioned log basic metrics (containing no user-identifiable information) to AWS CloudWatch for debugging purposes.

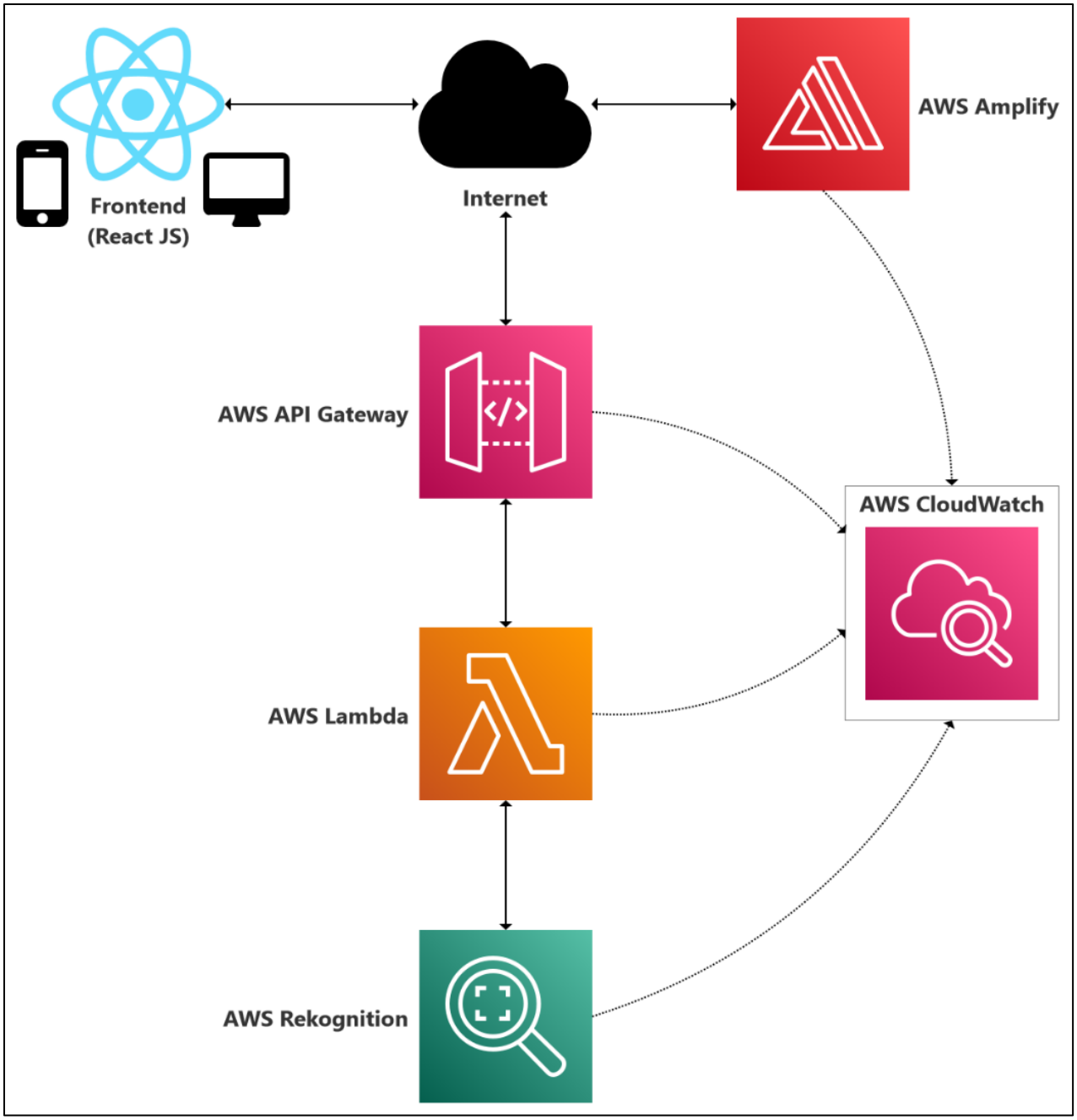


Figure 1: Infrastructure Diagram

Flow Diagram

The flow diagram below walks through the possibilities of how a user can navigate iSeeU, essentially showing all the actions a user can take.

In the diagram below, the solid blue lines represent the ideal flow a user should follow. The dotted orange lines represent possible alternative flows that a user can follow. The dashed red lines represent an exception/error that may require “walking back” in the flow.

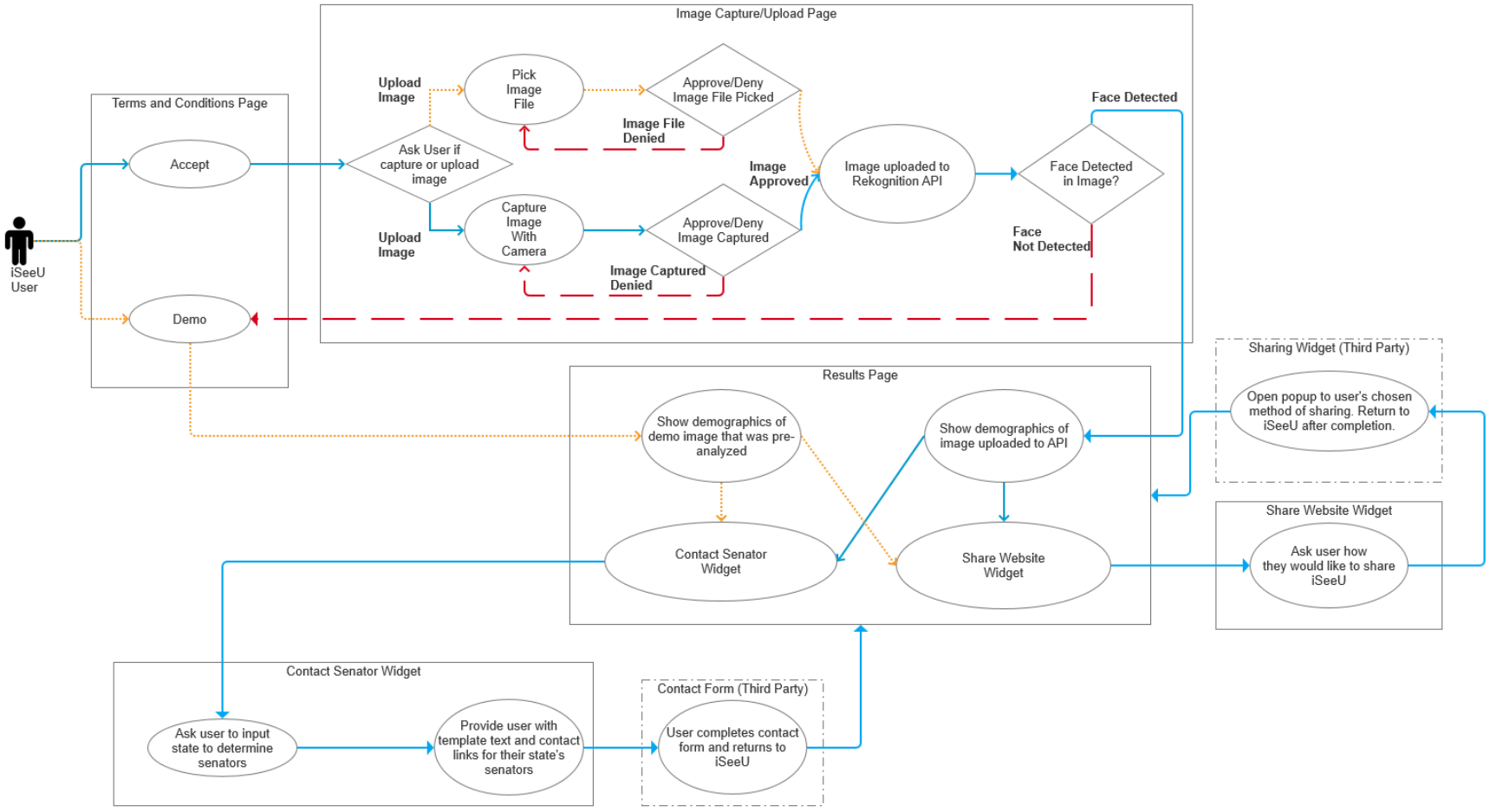


Figure 2: Flow Diagram

User Personas:

Below are the user personas for the iSeeU project. These user personas capture a summary of the types of people who could be visiting the iSeeU website. They are made up of a mixture of backgrounds and personalities. User personas help guide the project's development by providing direction that helps shape the project's strategy. The four personas described here will ensure that the right questions are being asked about the fundamentals of the design of iSeeU and who it is targeted towards.

Table 2: User Persona #1

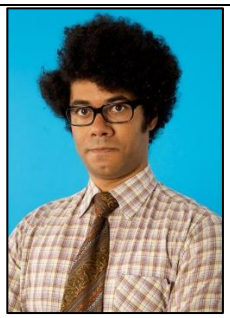
<table>
<tr><td colspan="2">User Persona: 1</td></tr>
<tr><td rowspan="4"> 
Image Source: https://imgur.com/lx3mI</td><td>Title
The Technology Nerd</td></tr>
<tr><td>Name
Linus</td></tr>
<tr><td>Age
25</td></tr>
<tr><td>Gender
Male</td></tr>
<tr><td>Behavior</td><td>Linus is proficient with technology, needing no guidance to use day-to-day applications.
Linus understands the privacy implications of using certain technologies, such as social media, but he doesn't go out of his way to avoid them as he feels there is more benefit than cost to them.
Linus works for a tech company that builds websites for clients.</td></tr>
<tr><td>Pain</td><td>Linus does not want to be hindered by having his "hand be held" when navigating websites.</td></tr>
<tr><td>Needs & Goals</td><td>Linus wants to finish what he needs on a website quickly.
Linus wants technology to make his life more convenient, even if it compromises his privacy, only if it is done with his consent and to his benefit.</td></tr>
</table>

Table 3: User Persona #3

User Persona: 2	
 *Image Source: https://en.wikipedia.org/wiki/File:Ned_Flanders.png*	**Title** The Tech Phobic
	Name Ned
	Age 45
	Gender Male
Behavior	Ned doesn't own a smartphone, as he fears it compromises his privacy, but this is based on emotion rather than evidence. Ned works for a paper-making company where the policy is not to have webcams on any work laptops.
Pain	Ned is uncomfortable with using technology, as he feels he doesn't truly understand what is happening.
Needs & Goals	Ned would like to learn more about the actual evidence of how technology is being used to compromise people's privacy rather than relying on gut feelings. Ned likes to be guided slowly through any website he uses and be thoroughly informed on what any actions he takes will do before he does them.

Table 4: User Persona #3

User Persona: 3	
 *Image Source: https://www.gravatar.com/avatar/?s=96&d=mm*	**Title** The Privacy Conscious
	Name Edward
	Age 35
	Gender Male

Behavior	Edward is very privacy-conscious, going as far as not to have any social media accounts. Edward is outspoken about how technology is being used to compromise people's privacy and tries to inform people about this. Edward works with fellow privacy advocates at the Electronic Frontier Foundation (EFF).
Pain	Edward strongly dislikes it when a website makes him compromise his privacy to use it.
Needs & Goals	Edward would like to be able to direct people to a website that shows them how their privacy is being infringed without their consent and knowledge through technology.

Table 5: User Persona #4

User Persona: 4	
 *Image Source:* *https://thispersondoesnotexist.com/*	**Title** The I Have Nothing to Hide
	Name Kim
	Age 20
	Gender Female
Behavior	Kim believes that "she has nothing to fear since she has nothing to hide" when technology infringes her privacy. Kim believes that technology is only used to her benefit and that any fears of it being used to her detriment are exaggerated. Kim is the social media marketing manager for her company.
Pain	Kim is having difficulty finding a way to advertise her company to a more targeted audience.
Needs & Goals	Kim wants to easily share anything she finds intriguing with her followers on social media.

Use Cases:

Below are three specific use cases identified for tasks the users can perform on iSeeU. These use cases provide an outline from a user's point of view and how the iSeeU system behaves in response to the user's requests. This provides valuable information on how the iSeeU system should behave and will help in identifying what could go wrong.

Use Case #1

Table 6: Use Case #1

Use Case ID	**1**
Use Case Name	Upload or Capture Image
Description/ End Objective	The user arrives at the iSeeU website and agrees to the Terms & Conditions. The user then uploads a photo captured on the user's device or an existing image containing a face they pick to upload. The user is then presented with demographic information determined from the photo uploaded and targeted with advertisements based on that information. The user is then asked to contact their congressperson or share the website.
User/Actor	iSeeU User
Trigger	User visits the iSeeU Website.
Frequency of Use	Once
Preconditions	The user has a device that is connected to the internet. The user has a device that can upload images.
Basic Flow	1. The system presents the user with the Terms & Conditions required to use the website. 2. The user accepts the Terms & Conditions. 3. The system then presents the user with the choice to capture an image of a face using their device's camera or pick an existing image containing a face. 4. The user then either captures or picks an existing image containing a face and uploads it. 5. The system then analyzes the image uploaded for demographic information about the person in the image. 6. The system then presents the user with demographic information it could ascertain from the image. The system shows targeted advertising to the user based on ascertained demographic information. The system explains to the user that this was done using facial recognition and the potential harm of such technology. 7. The system prompts the user to either contact their congressperson or share the website with others
Alternate Flow	AF1 User declines the Terms & Conditions after Step 1 of Basic Flow.

	1. The system presents the user with a demo page with demographic information on it that was obtained from a pre-analyzed image. The system shows targeted advertising to the user based on the demographic information ascertained from the pre-analyzed image. The system explains to the user that this was done using facial recognition and the potential harm of such technology. 2. The system prompts the user to contact their congressperson or share the website with others.
Exceptions	EX1 The user picks an image where a face couldn't be detected during Step 4 of Basic Flow. 1. The system notifies the user that no face was detected in the image picked. 2. The system prompts the user to pick another image and returns them to the start of Basic Flow Step 4. EX2 The user chooses to capture an image in Step 3 of Basic Flow, but their device does not have a functioning webcam. 1. The system notifies the user that their webcam is not functioning. 2. The system prompts the user to upload an image instead and continues at Step 4 of Basic Flow.
Postconditions	The user's captured/selected image is analyzed for demographic information.

Use Case #2

Table 7: Use Case #2

Use Case ID	**2**
Use Case Name	Contact Congressperson
Description/ End Objective	After performing the "Upload or Capture Image" Use Case, the user is asked to contact their congressperson to create a robust consumer privacy framework in U.S. law to prevent technology from abusing privacy. The user is redirected to the appropriate congressperson's website to do so after being given a template message to copy/paste.
User/Actor	iSeeU User
Trigger	The user finishes the "Upload or Capture Image" Use Case.
Frequency of Use	Once
Preconditions	The user has met the preconditions of the "Upload or Capture Image" Use Case. The user has followed the basic flow of the "Upload or Capture Image" Use Case.
Basic Flow	1. The system requests the user provide the state they reside in.

	2. The user provides the state they reside in. 3. The system presents the user with a template they can copy/paste into a message to their representative. 4. The user copies the template provided by the system. 5. The system provides the user with a button to open the contact form on their respective congressperson's site. 6. The user completes the contact form on the congressperson's site.
Alternate Flow	AF1 The user does not copy the template by the system in Basic Flow Step 4. 1. The system still provides the user with a button to open the contact form on their respective congressperson's site; the user manually inputs their text to message their congressperson.
Exceptions	*N/A*
Postconditions	The user has contacted their congressperson(s).

Use Case #3

Table 8: Use Case #3

Use Case ID	**3**
Use Case Name	Share Site
End Objective/ Description	After performing the "Upload or Capture Image" Use Case, the user is asked to share the iSeeU website with others to spread awareness about the issue in question.
User/Actor	iSeeU User
Trigger	The user finishes the "Upload or Capture Image" Use Case.
Frequency of Use	Once
Preconditions	The user has met the preconditions of the "Upload or Capture Image" Use Case. The user has followed the basic flow of the "Upload or Capture Image" Use Case.
Basic Flow	1. The user clicks one of the share buttons provided, likely of their social network of choice. 2. The system presents a pop-up to the user's preferred social network share widget. 3. The user completes the share widget.
Alternate Flow	AF1 The user chooses to copy share text rather than share directly to a social network site. 1. The system presents a share button to copy share text quickly. 2. The user clicks this button.

	3. The user manually shares the website with their contacts rather than completing a share widget.
Exceptions	*N/A*
Postconditions	The user has shared the website with their contacts or social media networks.

Use Case Diagram:

The use case diagram below shows how iSeeU actors interact with the iSeeU system. This diagram graphically illustrates the use cases we have identified previously and how the iSeeU actors will interact with these use cases.

Note: Since iSeeU only has one actor, the user, the use case diagram is relatively simple.

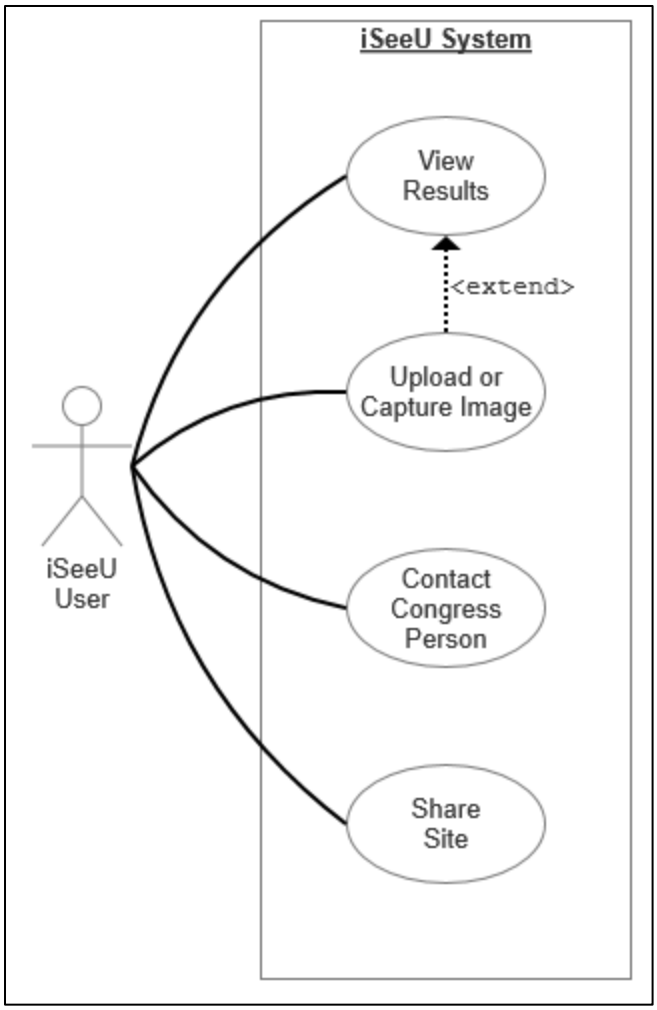


Figure 3: Use Case Diagram

Software Testing Plan:

Software Testing Overview

This section describes how the iSeeU software was unit tested to ensure all significant features were accounted for and that as many bugs as possible could be found and fixed. Since the iSeeU project is primarily written in JavaScript, the JavaScript testing framework Jest was used to run these tests and calculate test coverage.

Software Testing Methodology

Two separate approaches were taken to ensure that the goals outlined above for testing were met.

To ensure that the software was as bug-free as humanly possible, Jest's coverage calculation was used to ensure all meaningful lines of code were covered. If a meaningful line was not covered, a unit test was written or updated as applicable to cover it.

To ensure that the software met users' needs, tests were written focusing on how our software is used rather than how it is implemented. Meaning only what the end-user could see or interact with was tested. Thus, simplifying testing while making it more maintainable.

Scope of Software Testing

- Test code related to Use Case #1 – "User Uploads Image."
- Test code related to Use Case #2 – "Contact Congressperson."
- Test code related to Use Case #3 – "Share Website."
- Test other meaningful lines of code.

Objectives

The main objectives of this testing strategy are to ensure all significant features and use cases are accounted for and that the code is as bug-free as humanly possible.

Test Logs and Procedures

Table 9: Software Testing Logs and Procedures

iSeeU Custom React Component Being Tested	**Test Case**	**Pass / Fail (Provide Reason for Fails)**
<App/> Displays navbar across pages and container for other pages.		
	Should render navbar Title link	Pass
	Should render navbar eyes logo	Pass
	Should render navbar home link	Pass
	Should render navbar demo link	Pass
	Should render navbar upload link	Pass
<Whoops404/>		

Displays stylized 404 errors.		
	Should render 404 heading	Pass
	Should render logo	Pass
<Start/> Displays homepage.		
	Should render logo	Pass
	Should render start heading	Pass
	Should render terms & conditions heading	Pass
	Should render AWS service terms link	Pass
	Should render show modal button	Pass
	Should show/hide modal when show modal button clicked	Pass
	Should render the “Provide Image for Analysis” button	Pass
	Should render the “View Stock Image Analysis” button	Pass
<StartUpload/> Displays start page for image upload.		
	Should render upload heading	Pass
	Should render the “Take New Picture” button	Pass
	Should render the “Upload Existing Picture” button	Pass
<UploadInProgress/> Displays progress page indicating upload has started.		
	Should render progress heading	Pass
	Should render logo	Pass
<UploadWebcam/> Displays page for capturing an image to upload.		
	Should render webcam heading	Pass
	Should not detect webcam when run in the test environment	Pass
	Should render reminder about images not being stored	Pass
	Should render the “Switch to File Upload” button	Pass
<UploadFile/> Displays page for uploading an existing image.		

	Should render file heading	Pass
	Should render remind about images not being stored	Pass
	Should render the form for file upload with file acceptance criteria	Pass
	Should render Submit button when PNG file provided	Pass
	Should render Submit button when JPEG file provided	Pass
	Should render alert when PNG/JPG file is not provided	Pass
	Should render alert when a file too large is provided	Pass
	Should render the “Switch to Webcam Upload” button	Pass
<Results/> Displays page with results from image parsed, including targeted advertisements.		
	Should not render an alert when expected parameters passed	Pass
	Should render an “Error” alert when an error is detected	Pass
	Should render an “Overloaded” alert when API is overloaded	Pass
	Should render a “Demo” alert when Demo results are requested	Pass
	Should render a “Missing” alert when the uploaded image is missing a face	Pass
	Should render results heading	Pass
	Should render panel headings	Pass
	Should render the expected number of data points	Pass
	Should render the “Try Again” button	Pass
	Should render the Share buttons	Pass
	Should render contact congressperson form	Pass
	Should render Template text to copy for congressperson form	Pass
	Should render the “Copy Template Text” button	Pass
	Should render expected ad & reasoning when data says the subject is smiling	Pass

	Should render expected ad & reason when data says the subject is **not** smiling	Pass
	Should render expected ad & reasoning when data says the subject is **younger** than 50	Pass
	Should render expected ad & reasoning when data says the subject is **older** than 50	Pass
	Should render expected ad & reasoning when data says the subject is **female**	Pass
	Should render expected ad & reasoning when data says the subject is **male**	Pass
	Should render expected ad & reasoning when data says the subject is wearing sunglasses	Pass
	Should render expected ad & reasoning when data says the subject is **not** wearing sunglasses	Pass

Software Testing Review

Before starting with testing iSeeU, we researched a variety of testing philosophies to determine the best one for our use case. We settled on the philosophy of "your tests should act how your user acts", as it makes testing easy to maintain while still comprehensive. We used the React Testing Library to implement our tests, which follows this philosophy at its core. This made for an exciting but worthwhile challenge since none of the developers of iSeeU had used it beforehand.

Because we added our software tests to iSeeU late in the development process, we did not get much of a chance to learn from adding it. However, the absence of unit tests made development more painful because we had to manually test the site after significant changes were made. This taught us the lesson that we should try to follow test-driven development on future projects, meaning that tests and code are written simultaneously, as it eases and speeds development significantly.

User Testing Plan

User Testing Overview

This section describes how the iSeeU project was user-tested to ensure all significant features were accounted for and that users' needs were met. The goals of this testing include establishing a baseline of user performance, identifying potential design flaws, and determining end-user satisfaction.

Purpose/Goals:

- Understand users' needs and frustrations related to users' tasks on iSeeU.

- Identify common behaviors users experience while using iSeeU.
- Determine design inconsistencies and usability problems within the iSeeU user interface.
- Establish a baseline on users' satisfaction levels with using iSeeU.
- Identify changes required to improve user satisfaction with iSeeU.
- Analyze user response & performance to determine whether iSeeU meets usability standards.

Methodology

- The team will use a form of moderated task-based user testing.
- Participants will be briefed to remotely evaluate the website via a screen-sharing technology.
- Participants will be instructed to:
    - Use a built-in webcam or connect one.
    - "Think Aloud" so that a verbal record exists of the interactions.
    - Complete various tasks
    - Complete a quick questionnaire after a group of related jobs to determine usability concerns
- The typical test should take no more than 45 minutes of a participant's time
- Ideally, the tests will be conducted via Microsoft Teams, allowing easy recording of a participant's screen and voice.

User Testing Guide

This subsection details how the actual user tests of an iSeeU were conducted step by step.

Intro

- Thank the participant for taking time out of their day to be interviewed
- Discuss the purpose of testing with the participant
    - Ensure that participants know that it is not them being tested but the actual product itself.
    - Highlight that the participant should not worry about making a mistake and just do what comes naturally.
- Ask the participant if they can do the following:
    - Consent to the session being recorded.
        - Inform the participants only their screen & voice will be recorded.
        - The recordings will not be shared publicly and will be used only for note-taking purposes.
    - Disable adblocker in their web browser or switch to a different browser without one enabled

        - This is to ensure the share buttons show
    - Connect a webcam if their device does not have one built-in.
- Inform the participant of the flow of the user test.
    - "I will be asking you a few pre-test questions to understand your background. Then, I will be having you accomplish a few tasks on the website and answer questions. When using the website, I would like you to speak aloud and be open about what you think or feel. Before we begin, do you have any questions for me?"

Pre-Testing Questions:

The purpose of pre-testing questions is to make participants feel more comfortable and understand their background to determine which user persona they fit best.

1. To get started, can you tell me what electronic devices you own?
2. Can you tell me how regularly you use your phone or laptop?
3. On a scale of 1 to 5, 1 being not confident and 5 being very confident, how would you rate your confidence level in using your phone or laptop?
4. How often do you use social media?
5. On a scale of 1 to 5, 1 being not privacy-conscious and 5 being very privacy-conscious, how privacy-conscious are you when using your devices or social media? For example, posting your image on social media or sharing personal info.
6. Anything else to add?

Tasks:

Task 1: Navigating the home page

- Please explore the home page and provide your first impressions.
- Questions:
    - What is the first thing that you noticed?
    - What are your thoughts on the language used?
    - Based on this language, what do you think this application accomplishes?
    - Can you see any buttons to click?
    - Do you feel confident that you know what the buttons do before clicking them?
    - Which button are you most likely to click first?
    - Have you seen another website similar to this?
- Notes:

Task 2: Navigate to the Upload Page

- When ready, click on the "I am ready!" button.
- Questions:
    - What are your thoughts on the language used?
    - Do you feel confident that you know what the buttons do before clicking them?

    - Which button would you click on next?
- Notes:

Task 3: File Upload

- Can you go to the “File” page?
- Questions:
    - How would you upload an image?
    - What do you think will happen if you select a file that doesn’t meet those requirements?
    - Try uploading the example file given that doesn’t meet those requirements. Is it obvious why this file is not accepted?
        - Files that do not meet the requirements:
            - Above 4 MB in size
            - Not of type PNG/JPG
- Notes:

Task 4: Webcam Upload

- If you are willing, can you go to the “Webcam” page.
- Questions:
    - What are your thoughts on the language used?
    - *Only if the user has a working webcam*
        - Can you show me how you would capture your photo?
        - Are you okay with submitting this photo? If so, could you submit it now?
    - *If the user does not have a working webcam or does not want to submit their face*
        - Can you go back to the “File” upload page?
        - Can you find an image that you would be willing to upload? You can do a Google search for an image if you like.
- Notes:

Task 5: Results Page

- Questions:
    - What do you think this page is trying to communicate to you?
    - What information can you see about your image?
    - What do you think are the images on the sides of your image?
        - What do you think about having ads specifically targeted to you based on your uploaded image?
    - What do you think of the ad reasoning text? Do you find it offensive?
    - What do you think of the language of the FAQ text?
    - What do you think of the language of the explanation text?

- Notes:

Task 6: Sharing results to social media – ***If the user's ad blocker isn't hiding buttons***

- Questions:
    - What do you think would happen if you click on one of the share buttons?
    - How do you feel about sharing this ad reasoning text on social media?
    - Is there a social media service missing that you would like a button for?
    - What is more important to you, your privacy or spreading awareness?
- Notes:

Task 7: Contacting congressperson

- Questions:
    - Can you determine how to contact your state's senators?
    - What do you think will happen when you click the contact button?
    - What does this feature mean to you?
    - How likely are you to use this functionality?
- Notes:

Post-Test Questions

End-to-End User Experience

1. How easy or difficult was it to navigate through the website?
2. What do you think about the design? Is the layout easy to use, or is it cluttered?
3. Is there anything that confuses you?
4. What did you like the most? Why?
5. What did you like the least? Why?
6. What do you think about the amount of information displayed on the results page?
7. Is there any other information you would like to be displayed?
8. In your opinion, is there anything that could be done differently?
9. Is there a feature you'd wish the website would have? If so, what?

Post-Test Questions Data

This section presents the answers to the Post-Test Questions received from user testers in an aggregated manner. Note that these user tests were done on earlier versions of iSeeU and not the final version that implements the feedback user testers gave.

Table 10: Post-Test Questions Aggregated Data

Question	Answers
1. How easy or difficult was it to navigate through the website?	Really easy. It was disorienting at first but user-friendly once used to it.

2. What do you think about the design? Is the layout easy to use, or is it cluttered?	Easy to use. The results page is cluttered.
3. Is there anything that confuses you?	The demo is a little confusing at first, as it's not instantly obvious what is happening. I would like it to be clear that the image is not stored on the upload pages.
4. What did you like the most? Why?	The homepage because it was eye-catching and interactive. The results page because it was colorful, informative, and provided tools to take action. The data since I like seeing the exact data and the confidence values. The data and ad reasoning because they are relatable and make it personal. The data since it is surprisingly accurate. The simplicity of the site. I liked the explanation at the end.
5. What did you like the least? Why?	The website is creepy in some ways, such as the language used. The eyeball because it is creepy. The FAQ is lost in how flippant it is being. The numerous links – I would have preferred a graphic display that is quick to decipher. The anti-depressants ad made me uncomfortable. The explanation at the end is hard to follow since it's not separated well.
6. What do you think about the amount of information displayed on the results page?	Appropriate. I liked having it all in one place. At first, it is a lot, but it is broken up nicely and spaced out to make it less overwhelming.
7. Is there any other information you would like to be displayed?	I want to learn more about the purpose of the website. Examples of how this technology is currently being used.

8. In your opinion, is there anything that could be done differently?	The design feels a bit boxy and outdated compared to a modern website. Change the language to be a bit less sassy. Change button colors so they are consistent and it does not look like one choice is right or wrong. Have more advertisements and have them be based on the emotion identified.
9. Is there a feature you'd wish the website would have? If so, what?	I want to be able to tell the system what data it got wrong so it can learn from its mistakes. Functionality to make it easy to print the results. Different demo results to quickly see the other data points and ads.

Changes Due to User Testing

This section briefly summarizes significant changes that were made to iSeeU due to the data collected from user testing:

- Added a loading page after the user uploads an image
- Made button colors across pages consistent
- Created a navbar that has a basic sitemap to make it easy to navigate the site
- Made text of buttons more detailed, better indicating what they do before the user clicks on them
- Indicated that "Rekognition" is a trademark spelling and not a typo
- Made terms & conditions more user friendly by rewriting text to be easier to read for a layman
- Webcam capture button no longer shows when there is a webcam error
- Made advertisements more diverse
- Added buttons to make site navigation more user friendly, for example, a button to try uploading another image
- Changed color of alerts reporting errors from yellow to red
- Realigned buttons & resized images for mobile, so buttons and images are no longer covered on mobile

User Testing Review

In conducting user tests for iSeeU, we learned two key lessons about user testing.

The first lesson we learned is that user tests cannot be performed by those directly involved in developing the tested software. While course instructions had mentioned that

external parties should do the user testing, we did not think our relatively simple application required external user testing. Before conducting any user tests, we believed that iSeeU already provided a pleasant user experience and that user testing would find that no significant changes were necessary. We were wrong in this belief, as indicated by the list of substantial changes made due to user testing in the preceding section.

The second lesson we learned is that multiple rounds of user testing are necessary to reach an optimal user experience. In user testing iSeeU, we initially had planned for just one round of user testing since we deemed the application not complex enough to need more than one round. However, upon completing the first round of user testing, we noticed that we would be making many more changes than expected. This led to the consensus on the team that we needed to do another round of user testing after making the changes requested by users in the first round.

The second round of testing ended up being beneficial in two ways. The first way is that it confirmed that the changes we made after the first round were advantageous to the user's experience rather than harmful. The second way is that it allowed us to focus on more minor issues in the user experience; the first round of testing allowed us to solve the significant problems in the user experience of our application, and the second allowed us to refine it further. Thus, we could refine the user experience further to a level that we were happy with.

Learning these lessons highlighted how vital user testing is for any software's user experience.

Change Management Policy:

Overview

This Change Management Policy is based on best practices for IT Service Management (ITSM) as defined by the ITIL v4 framework. iSeeU (the Company) accepts responsibility for implementing a comprehensive Change Management Policy and Change Management Controls. All Change Management practices defined in this policy are to be approved by the Executive Leadership Team (ELT) and followed accordingly.

Definitions

- **Change** is defined as the addition, modification, or removal of anything that could affect IT services. The scope should include changes to all architectures, processes, tools, metrics, and documentation, as well as changes to IT services and other configuration items.
- **Change Management Policy** is defined as the decision to authorize or reject a proposed Change based on the completed Change Assessment. In particular, the assessment is about properly understanding the risks associated with the implementation of a Change. In this context, the Change Management Policy specifies the authorization levels required to authorize different types of Changes and other rules for assessing Changes.
- The **Change Record** contains all the details of a Change, documenting the lifecycle of a single Change. It is usually created based on a preceding Request for Change (RFC).
- A **Change Schedule** is a document within the Change Record that lists all approved Change Proposals and Changes and their planned implementation dates.
- An **Emergency Change** is a Change that must be introduced as soon as possible - for example, to resolve a major incident or implement a security patch.
- The **Executive Leadership Team** comprises decision-making and executive-level associates that approve all major organizational changes.
- A **Request for Change (RFC)** is a formal request to implement a Change. An RFC specifying the details of the proposed Change must be submitted to the ELT for every non-standard Change.
- A **Risk Rating** is a defined level of risk assigned to each change within the change management process. The change will be assigned one of 4 risk ratings: Low, Moderate, High, and Critical. These risks are defined by their association with the Company's risk appetite, which the ELT formally defines.

Policy

The Change Management Policy is governed by six stages of change within the Company:

1. Planning

All changes are to be appropriately scoped and documented within a change record and scheduled according to the planned implementation date in the change schedule portion of the change record.

2. Evaluation

Each change must be evaluated for risk within the change record. The change will then be assigned a risk rating dependent on the risk to the business or product associated with the change.

3. Approval & Communication

Before communication, a formal RFC must be completed. Each change record must be communicated and then approved by the ELT. Weekly standup meetings are the primary forum for communicating change and reviewing RFCs.

4. Implementation

Before touching production environments, changes must go through rigorous testing within test/dev/QA environments. All changes will be implemented on the requested date of change defined in the change record.

5. Documentation

All changes, reviews, approvals, and records must be properly documented and follow a retention period of 1 year.

6. Post-Change Review

All changes must go through a post-change review process where changes will be monitored, and abnormalities reported. Adjustments to changes must go through a formal RFC.

Emergency Changes

Emergency Changes are fast-tracked to the ELT through the fastest means of communication available. These changes are prioritized, and the change management process molds to each emergency change differently. These changes are to be addressed on a case-by-case basis and are not standardized.

Stakeholder Communication

Significant changes are regularly communicated to stakeholders and constituents through biweekly meetings.

Budget:

The table below illustrates the final projected real-world cost for developing the iSeeU website and application. This is based on the software used and our experiences with the product.

Table 11: Budget

Estimated Budget				
	Rate per Unit	**Unit**	**Total Cost**	**Comments**
Labor – IT	$20 per Hour	168 Hours	$3,360.00	
Software (External)	-	-	-	
AWS Rekognition	$0.001 per Image	5000 Images	$5.00	
AWS Amplify	-	-	-	
Build Minutes	$0.01 per Build Minute	100 Build Minutes	$1.00	
Data Stored	$0.023 per GB stored per month	1 GB stored per month	$0.023	
Data Served	$0.15 per GB served	2 GB served per month	$0.30	
AWS Lambda	$0.20 per Million Requests	1 Million Requests	$0.20	
AWS API Gateway	$3.50 per Million Requests	1 Million Requests	$3.50	
GitHub	N/A	N/A	$0	Free Software
Hardware (Internal)	-	-	-	-
Development PCs	N/A	N/A	$2,000.00	
TOTAL	-	-	**$5,370.03**	Rounded up to the nearest cent

Problems Encountered and Analysis of Problems Solved

During the development of iSeeU these past two semesters (Fall 2021 & Spring 2022), the group ran into multiple problems that had to be addressed, with three major ones being highlighted below.

The first problem had to do with how the group collaborated on files. Initially, the group had chosen to use Dropbox to work on files collaboratively. However, the group ran into issues when trying to edit files simultaneously, with file conflicts occurring when files were saved. This forced group members to share screens to collaborate when they wanted to edit the same file simultaneously.

The group switched to using OneDrive to work on files collaboratively to resolve this issue. There is a native integration between OneDrive and Office due to both being created by Microsoft, meaning that group members could seamlessly work on the same file simultaneously without any file conflict issues. Additionally, the use of OneDrive also enhanced collaboration as the group could now quickly leave comments to discuss changes and have detailed version histories, so there was no fear of anything being lost.

From dealing with this problem, the group learned to ensure that they thoroughly researched any software they use for collaboration, rather than just going with the software the group is most familiar with.

The second problem was addressing how the group would communicate and collaborate while attending the course in a hybrid manner due to concerns with COVID-19. Initially, there were some growing pains in doing this, such as when using Dropbox for collaborating, as mentioned above. However, eventually, the group settled on a formulated manner to coordinate their work by using five separate products: OneDrive, OneNote, Teams, Discord, and Signal.

OneDrive was used for file collaboration, as mentioned above. OneNote was used to take notes during meetings with the group's advisor. Teams was used to have meetings with the group's advisor since all faculty advisors and group members already had a university-linked Teams account. Discord was used for the group's internal communications rather than Teams. It allowed the group to communicate in a lax manner that kept a semblance of casualness that in-person communication would have while keeping the group informed on everyone's progress and plans. Signal was used for instant casual communication among the group, meaning when responses from group members were needed quickly, since the group found Signal's notifications to be more reliable than Discord and Teams.

Using this array of services, the group learned how to collaborate professionally and casually, which kept its sanity and focus.

The third problem was how the group learned how to use Amazon Web Services (AWS). Since no one in the group had familiarity with AWS nor knew what the best resources were to understand it, tackling this problem required a lot of research.

At first, the group tried using a variety of YouTube tutorials and other sources that had been suggested by people who knew AWS already. Eventually, the group settled on completing

the AWS Developer Series lectures provided via edX, an online course platform, to learn how to work with AWS. It covered all the services the group needed to learn to develop iSeeU.

Due to being unfamiliar with AWS and the plethora of services AWS offers, the group, on more than one occasion, wasted time and effort in learning AWS services that we did not use in the final product. The most significant time sink was learning AWS Elastic Beanstalk. This is because AWS Elastic Beanstalk is a rather complex service requiring an understanding of the AWS ecosystem and services it needs, such as AWS Elastic Compute Cloud and AWS Elastic Load Balancing. Learning this took up a significant chunk of the group's time in Fall 2021. All for naught, the group stumbled upon an alternative service in Spring 2022: AWS Amplify. Thankfully, it was worth switching to AWS Amplify as it was a lot simpler than AWS Elastic Beanstalk while being easier to use and more performant for our use case. Switching to AWS Amplify made development more straightforward and faster, teaching the group the lesson of doing thorough research when learning something as complex as AWS.

From learning AWS, the group has gained confidence in a prevalent technology and their self-education skills, which is a helpful skill, not just for college but also for each group member's career.

Conclusion

Over the past two semesters (Fall 2021 & Spring 2022), to keep on track in a pandemic environment, the “new normal”, the group had to develop and enhance a large variety of soft skills. Since the group attended class in a hybrid manner, due to COVID-19 concerns, the group had to put the Agile principles they had learned in class to practical use to ensure rapid development and collaboration. One way this was done by having regular stand-up meetings, meeting at a minimum of three times a week. Additionally, because there was a lot to learn and accomplish to make iSeeU a reality, the group had to master communicating regularly about what each member was learning and doing.

The group also gained and sharpened a large variety of hard skills. Since iSeeU relies heavily on Amazon Web Services (AWS), both the backend and frontend engineers of iSeeU were required to develop skills working with AWS, even though technically, it was only used for the backend. With the frontend of iSeeU being powered by the JavaScript framework React JS, the frontend engineers of iSeeU enhanced their skills with JavaScript and React JS. Additionally, the group developed knowledge of working with Axure and Mural to build designs and diagrams for iSeeU to ensure a pleasant User Interface and User Experience.

The group also learned a lot of lessons in building iSeeU. The main one is the importance of user testing. Before user testing iSeeU, we assumed that it was release-ready, and user testing would only point out minor areas for improvement. This assumption was utterly wrong, with user testing showing significant areas for improvement in unexpected ways. It surprised us how the gaps that testers pointed out were invisible to us yet impossible to miss after being mentioned – showing us that we were too close to the product to notice its flaws. In the end, it is user testing that ultimately turned iSeeU from a conceptual prototype into an exceptional product that has the potential to meet the goals we set out for it – leading us to the conclusion that user testing is a necessary part of the software development cycle, not an extra like some believe.

All the knowledge and effort mentioned above have cumulated into a version of iSeeU that the group is proud to present to the world.

References

Agha, N. I., & ZaaZa, A. (2021). The Effects of Digital Technology Usage on Children's Development and Health. Middle East Journal of Family Medicine, 19(4), 54–60. https://doi-org.uc.idm.oclc.org/10.5742/MEWFM.2021.94027.

Cackley, A. P. (2020). FACIAL RECOGNITION TECHNOLOGY: Privacy and Accuracy Issues Related to Commercial Uses. GAO Reports, 1–59. https://www.gao.gov/assets/gao-20-522.pdf.

Kwet, M. (2019, June 14). In Stores, Secret Surveillance Tracks Your Every Move. The New York Times. Retrieved September 20, 2021, from https://www.nytimes.com/interactive/2019/06/14/opinion/bluetooth-wireless-tracking-privacy.html.

Leong, B. (2019). Facial recognition and the future of privacy: I always feel like ... somebody's watching me. Bulletin of the Atomic Scientists, 75(3), 109–115. https://doi-org.uc.idm.oclc.org/10.1080/00963402.2019.1604886.

Networld Media Group. (2020, November 3). Canada mall OPERATOR cited for consumer privacy Violations, pulls facial recognition cameras. Retail Customer Experience. Retrieved September 20, 2021, from https://www.retailcustomerexperience.com/news/canada-mall-operator-cited-for-consumer-privacy-violations-removes-facial-recognition-cameras-2/.

Thompson, S. A., & Warzel, C. (2019, December 19). Twelve Million phones, one dataset, zero privacy. The New York Times. Retrieved February 13, 2022, from https://www.nytimes.com/interactive/2019/12/19/opinion/location-tracking-cell-phone.html