DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
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SYSTEM REQUIREMENTS SPECIFICATION
CSE 4316: SENIOR DESIGN I
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GOOD NEIGHBORS
DISASTER SURVEY DRONE

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REVISION HISTORY

Revision	Date	Author(s)	Description
0.1	10.07.2022	DP	Document Creation
0.1	10.24.2022	AR, CS, DP, FG, MV, PD	First Draft Complete
0.2	05.10.2023	CS	Updated Images and Requirements

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LIST OF FIGURES

1 PRODUCT CONCEPT

This section describes the purpose, use, and intended user audience for our disaster drone insurance claim system that the Good Neighbors Team develops.

1.1 PURPOSE AND USE

In certain disaster scenarios sending a person to check on an insurance claim might be impractical or infeasible depending on the where damage is and how much damage occurred. The purpose of this project is to help State Farm develop and test the idea of creating something where a State Farm insurance Specialist or State Farm Agent would not have to be physically at the insurance claim site to validate the extent of the damage and file a claim. We going are going to be working with a team of electrical engineers who will build a drone that can fly around the disaster site and take photos of the site. Then we (the computer science engineering team) will develop an application that can use photogrammetry software to create a three-dimensional model and render that model into a virtual reality environment. Then, once in the virtual environment, the insurance agent will be able to walk around and take pictures of certain damage points as if they were at the insurance claim site in person. This will then be uploaded to a website that will automate the process of creating the insurance claim document.

1.2 INTENDED AUDIENCE

This application will not actually be used by State Farm agents. The purpose of this system is to provide research and a proof of concept to State Farm. At the end of this project, State Farm will look at the final result and decide if this technology is worth investing further resources into.
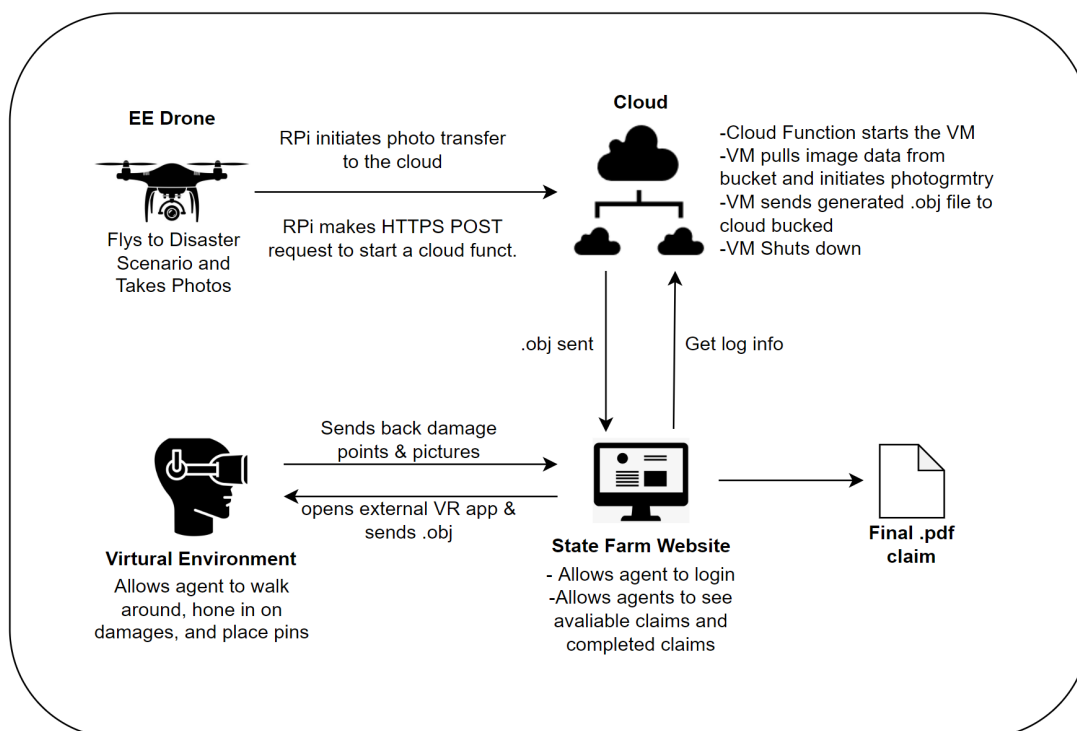
Figure 1: Product Concept Diagram

2 PRODUCT DESCRIPTION

This section provides the reader with an overview of the Disaster Survey Drone project. The primary operational aspects of the product, from the perspective of end users, maintenance and administrators, are define here. The key features and functions found in the product, as well as critical user interactions and user interfaces are describe in detail.

2.1 FEATURES & FUNCTIONS

This software is primarily used for insurance agents to create insurance claims for certain areas after a natural disaster has occurred. The software will receive an image dataset from a drone to start the photogrammetry process in the cloud. The result will be a 3D model which can be used to create a 3D environment in a game engine to walk around and view the area virtually using a virtual reality headset. The application will allow the user to take screenshots which can later be viewed in the web application.

The web application will be used by the user to select a 3D model to view. It will receive screenshots from the virtual environment to create an insurance claim for the customer. The application will allow the user to make comments to the screenshot and will create a PDF file once the claim has been completed

2.2 EXTERNAL INPUTS & OUTPUTS

Inputs	Outputs
Image Dataset from drone	3D Model
Select 3D model	Create 3D environment for that model
3D environment	List of claims for property
List of claims	PDF file

2.3 PRODUCT INTERFACES

The figures below shows the web application described above.

Figure 2: Homepage

Figure 3: Selecting case

3 CUSTOMER REQUIREMENTS

This system is created for State Farm agents to ease the workflow of claims and increase the pace of service. With drone surveying technology and photogrammetry software, agents will be able to take 3D data and map it into a virtual environment that will be viewable through a virtual reality h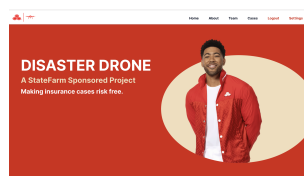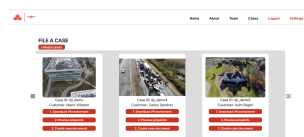eadset. Agents will be able to immerse themselves into the virtual environment and walk around areas that were affected by catastrophic events without risking their health and safety. Agents will additionally be able to zoom in and take screen shots of the client's damaged commodities – being able to set "pins" in areas that need attention. An Agent Portal will be included in order for State Farm agents to file, display, manage, and service claims.

3.1 3D VIRTUAL ENVIRONMENT

3.1.1 DESCRIPTION

The 3D virtual environment will be viewable through a virtual reality headset. Agents will be able to walk through the digitalized location and evaluate the area and it's damaged commodities. Functions of zooming in, taking screen shots, and setting "pins" to areas that require attention will also be at the agent's convenience for documentation and further assessment.

3.1.2 SOURCE

The source of the requirement is State Farm Insurance Company.

3.1.3 CONSTRAINTS

Constraints of this requirement include time for application development, system limitations, weather, obstructions, drone survey training, and quality of images that could affect the accuracy of the final product.

3.1.4 STANDARDS

The application will follow basic software industry standards to ensure consistency across platforms.

3.1.5 PRIORITY

The priority if this requirement is critical as it is relative to State Farm's application purpose.

3.2 AGENT PORTAL

3.2.1 DESCRIPTION

The Agent Portal will consist of a homepage that imitates the original design of the official State Farm website. Agents will be able to log in the portal to file, display, manage, and service claims. The Website must support basic login and account features such as create account, forgot password, and restrictions that will separate unique users from one another.

3.2.2 SOURCE

The source of the requirement is State Farm Insurance Company.

3.2.3 CONSTRAINTS

Constraints of this requirement include that there are no vulnerabilities that will cause data loss or data leaks across the platform.

3.2.4 STANDARDS

The application will follow basic software industry standards to ensure consistency across platforms.

3.2.5 PRIORITY

The priority if this requirement is critical as it is relative to State Farm's application purpose.

4 PACKAGING REQUIREMENTS

Since State Farm will not actually be using the system we create. The only thing that we will be delivering to them is a presentation reviewing our project and answering their question: Should State Farm invest resources into this technology?

4.1 REQUIREMENT NAME

4.1.1 DESCRIPTION

Requirements for the obtaining of the presentation are as follows:

4.1.2 SOURCE

A .pdf & .pptx file on a USB drive containing our presentation.

4.1.3 CONSTRAINTS

The presentation must be given online. We will need a computer and stable internet connection.

4.1.4 STANDARDS

The presentation and delivery must be professional and well organized to meet State Farm's standards.

4.1.5 PRIORITY

High

5 PERFORMANCE REQUIREMENTS

There are a certain requirements that the Photogrammetry of the object has to meet. Such requirements are listed below.

5.1 PHOTOGRAMMETRY PROCESS TIME

5.1.1 DESCRIPTION

Photogrammetry must be completed in a timely manner

5.1.2 SOURCE

Good Neighbors team members

5.1.3 CONSTRAINTS

N/A

5.1.4 STANDARDS

N/A

5.1.5 PRIORITY

High

6 SAFETY REQUIREMENTS

This project is software web application that involves a flying a drone to retrieve photos for the photogrammetry process; there is no exposure to toxic chemicals; there are no breakable glass on the drone; there is no direct eye exposure to infrared/laser beams; in drone flight there are hazards including: flying in clear weather in accordance to SoCs and as a minimum need to identify buildings, trees, bodies of water, traffic that could move through flight plan, people or animals, powerlines and power infrastructure, and weather and wind. These are to be avoided and if not could lead to accidents regarding the blades of the drone.

6.1 LABORATORY EQUIPMENT LOCKOUT/TAGOUT (LOTO) PROCEDURES

6.1.1 DESCRIPTION

Any fabrication equipment provided used in the development of the project shall be used in accordance with OSHA standard LOTO procedures. Locks and tags are installed on all equipment items that present use hazards, and ONLY the course instructor or designated teaching assistants may remove a lock. All locks will be immediately replaced once the equipment is no longer in use.

6.1.2 SOURCE

CSE Senior Design laboratory policy

6.1.3 CONSTRAINTS

Equipment usage, due to lock removal policies, will be limited to availability of the course instructor and designed teaching assistants.

6.1.4 STANDARDS

Occupational Safety and Health Standards 1910.147 - The control of hazardous energy (lockout/tagout).

6.1.5 PRIORITY

Critical

6.2 NATIONAL ELECTRIC CODE (NEC) WIRING COMPLIANCE

6.2.1 DESCRIPTION

The National Electrical Code (NEC), or NFPA 70, is a United States standard for the safe installation of electrical wiring and equipment. It is part of the National Fire Codes series published by the National Fire Protection Association (NFPA). While the NEC is not itself a U.S. law, NEC use is commonly mandated by state or local law, as well as in many jurisdictions outside of the United States. The NEC codifies the requirements for safe electrical installations into a single, standardized source. The âauthority having jurisdictionâ inspects for compliance with these minimum standards. Any electrical wiring must be completed in compliance with all requirements specified in the National Electric Code. This includes wire runs, insulation, grounding, enclosures, over-current protection, and all other specifications.

6.2.2 SOURCE

CSE Senior Design laboratory policy

6.2.3 CONSTRAINTS

High voltage power sources, as defined in NFPA 70, will be avoided as much as possible in order to minimize potential hazards.

6.2.4 STANDARDS

NFPA 70

6.2.5 PRIORITY

Critical

6.3 NATIONAL AIRSPACE SYSTEM (NSA) FOR FLYING A DRONE FOR RECREATIONAL USE.

6.3.1 DESCRIPTION

The rule for operating unmanned aircraft systems (UAS) or drones under 55 pounds in the National Airspace System (NAS) is 14 CFR Part 107, referred to as the Small UAS Rule. However, if you want to fly a drone for purely recreational purposes, there is a limited statutory exception ("carve out") that provides a basic set of requirements.

6.3.2 SOURCE

FAA

6.3.3 CONSTRAINTS

Maximum flying altitudes are to be avoided as much as possible in order to minimize potential hazards.

6.3.4 STANDARDS

CFR Part 107

6.3.5 PRIORITY

Critical

7 Security Requirements

The Demo State Farm website should not be accessed by any third-party with malicious intent. Similarly, the applications, database, and stored data hosted on the Google Cloud Platform should be prevented from unauthorized access. To ensure the proper use of our web app and system, different security protocols and measures will be followed.

7.1 Data Encryption for Object Storage

7.1.1 Description

By default, the Google Cloud Storage will use Google-managed encryption key to protect the image and 3D object files. The customer will have the ability to change the encryption method to Customer-managed encryption key (CMEK).

7.1.2 Source

Team

7.1.3 Constraints

The keys location must be the same location as the bucket so the encryption key must be provided to the cloud storage.

7.1.4 Standards

Google-managed encryption key, Customer-managed encryption key (CMEK)

7.1.5 Priority

High

7.2 Firewall rules for VM Instance

7.2.1 Description

By default, all incoming HTTP and HTTPS traffic to the VM instance will be blocked to prevent unauthorized access to the VM instance. Customer will be able to change the Firewall rules to allow incoming HTTP and HTTPS traffic through Google Cloud console; however, doing so will posses risk of unauthorized VM access.

7.2.2 Source

Team

7.2.3 Constraints

N/A

7.2.4 Standards

N/A

7.2.5 Priority

High

7.3 SSH access to VM instance

7.3.1 Description

VM instance can be accessed through SSH using Google Cloud Console or gcloud; SSH keys are generated automatically when connecting to VM through gcloud or the Google Cloud console. VM instance

can be accessed via SSH outside of gcloud and the Google Cloud console; however, public SSH key generated via puttygen or similar application must be added to the VM instance through console. The private SSH key must be stored safely with password protection in local device to prevent unauthorized access.

7.3.2 SOURCE

Team

7.3.3 CONSTRAINTS

Public SSH key must be added to the VM instance and private key must be added to the local machine trying to access the VM

7.3.4 STANDARDS

N/A

7.3.5 PRIORITY

Medium

7.4 INDIVIDUAL ACCESS CONTROL IN CLOUD BUCKETS

7.4.1 DESCRIPTION

The buckets will be accessed by the VM, external application, and a web app. To protect the data, access to the objects will be specified by object-level permissions (ACLs) such as READER, WRITER, and OWNER. This is to prevent the buckets from being overridden by unauthorized access which may result in data loss and theft.

7.4.2 SOURCE

Team

7.4.3 CONSTRAINTS

N/A

7.4.4 STANDARDS

N/A

7.4.5 PRIORITY

High

7.5 TRIGGERING THE GOOGLE CLOUD FUNCTION OVER HTTPS

7.5.1 DESCRIPTION

The Rpi must provide proper authentication to trigger cloud function over HTTPS request. Authorized users will be managed via Cloud IAM. Authorized users must provide ID token to authenticate the access.

7.5.2 SOURCE

Team

7.5.3 CONSTRAINTS

N/A

7.5.4 STANDARDS

N/A

7.5.5 PRIORITY

High

7.6 PASSWORDS ENCRYPTION

7.6.1 DESCRIPTION

Password will be stored in the database only after encryption to protect password secrecy and prevent unauthorized access to the web app. Passwords will be encrypted using the node.js library bcrypt. The version of the library will be atleast v5.0.0.

7.6.2 SOURCE

Team

7.6.3 CONSTRAINTS

N/A

7.6.4 STANDARDS

N/A

7.6.5 PRIORITY

High

8 MAINTENANCE & SUPPORT REQUIREMENTS

The product development team will ensure customer support through detailed product documentation, source code documentation, description of development tools, and general troubleshooting documentation.

8.1 PRODUCT DOCUMENTATION

8.1.1 DESCRIPTION

Product Documentation will be provided. The product documentation will include technical information and usage. The product documentation will also include system architecture of various components as well as technical specification on dev tools and environment for the product.

8.1.2 SOURCE

Team

8.1.3 PRIORITY

High

8.2 SOURCE CODE

8.2.1 DESCRIPTION

Source code will be provided to the customer.

8.2.2 SOURCE

Team

8.2.3 PRIORITY

High

8.3 GENERAL TROUBLESHOOTING

8.3.1 DESCRIPTION

General Troubleshooting Document will be provided to restart the VM, change access control in Google Cloud, adding SSH keys, updating libraries in the VM, etc.

8.3.2 SOURCE

Team

8.3.3 PRIORITY

High

9 OTHER REQUIREMENTS

9.1 REQUIREMENT NAME

9.1.1 DESCRIPTION

Detailed requirement description...

9.1.2 SOURCE

Source

9.1.3 CONSTRAINTS

Detailed description of applicable constraints...

9.1.4 STANDARDS

List of applicable standards

9.1.5 PRIORITY

Priority

10 FUTURE ITEMS

Due to the shortage of time and unfamiliarity with the developmental process, the following requirements will be considered for future revisions.

10.1 GOOGLE MAP IMPLEMENTATION REQUIREMENT

10.1.1 DESCRIPTION

The area surrounding the object in the VR environment will be imported from Google Maps

10.1.2 SOURCE

Good Neighbors team members

10.1.3 CONSTRAINTS

Lack of Time and unfamiliarity with Unreal engine

10.1.4 STANDARDS

N/A

10.1.5 PRIORITY

Low

REFERENCES