Bilkent University

Department of Computer Engineering

CS 452

Systems Analysis and Design Project

Project Plan Report

Flood Zone Surveillance Application

10.04.2017

Section 1 / Group 4

- Alperen Kaya — 21201393
- Ertan Aday — 21202360
- Sarp Tuğberk Topallar — 21301366
- Umut Mücahit Köksaldı — 21402234

Course Instructor

- Bora Güngören

System Proposal for Flood Damage Surveillance System

System Request—Flood Damage Surveillance System

Project sponsor: Disaster and Emergency Management Presidency

Business Need: The project has been initiated to improve the effectiveness and speed of the first response and the post-flood relief activities by incorporating a flood monitoring system. Furthermore, the system will provide a better means for the insurance companies to efficiently service their customers. The system will employ a drone which will fly over flood zones and take continuous multi-spectral photographs to be sent back to the operations center of the Presidency.

Business Requirements:

• Aerial multi-spectral photography of flood zones via surveillance drones

• Secure and quick communication and image transfer between surveillance drones and headquarters

• Multi-spectral image processing and flood damage related interpretation of images within one hour to enable preparation of quick response to the natural disaster

• Fast and controlled access to the flood reports by DEMP employees and insurance workers both

Business Value:

We expect this platform to lead to improvements in how the Presidency analyzes and responds to the floods that take place in the country. The improvements will lead to increased public happiness resulting from the improvement of a government service. In addition, the project is expected to enable the Presidency and the insurance companies in providing better relief activities and post-flood service for the victims of the flood, possibly decreasing the injuries and life loss emerging from this natural disaster as well as limiting the damage to the urban areas resulting from the flood. Lastly, as part of a better equipped first-response team, the losses of equipment that can occasionally take place is expected to be reduced. The tangible value that could come from such a prospect is estimated as follows:

- Cost of a typical LARC-V land/sea vehicle: $50,000
- Cost of a typical robust military truck: $15,000

We expect that after the changes are implemented, the loss ratio of these vehicles will be reduced by half each month, seeing that there is one of each vehicle lost every two months, this number will be reduced to loss every four months.

Total savings: $195,000 annually

Special Issues or Constraints:

• Increased staff with relevant technical knowledge to operate the drones and experts with the ability to interpret the multi-spectral photography will be needed.

• Image processing algorithms will need to be developed or bought in accordance with flood zone observation and interpretation experts.

Feasibility Analysis

Technical Feasibility

This project comes with many IT areas that were previously unfamiliar to the Disaster and Emergency Management Presidency. The analysts in the Presidency are not overly familiar with developing a business plan which includes aerial drone photography, multi-spectral imaging and image processing; hence, they will have trouble analyzing and devising the project's implementation and integration into the current as-is business system. Furthermore, operation of aerial drones with photographic capabilities is a foreign concept for the Presidency, and multi-spectral image processing and interpretation is also a new notion. The department's overall unfamiliarity with the procedure implies a high level of risk. The size of the project is considerably small, at most two drones should be sufficient for the surveillance of the monthly floods, and a high-performance computer will be able to receive and process the multi-spectral images rapidly. While the project size is small in terms of technical equipment, it is not as small when we consider the training the technical staff would need to receive in order to properly operate the newly integrated system. All points in consideration, the project is considered medium risk in terms of its size.

Economic Feasibility

The main concerns to be analyzed when considering economic feasibility of the project are the implementation and the operational costs related to the drones and image processing. First of all, drones need to be acquired that are equipped with cameras. Second, the cameras need to be properly calibrated or extended to support multi-spectral photography, which will require the purchase of such sensors. Third, a high-performance computer needs to be established at the headquarters and connected to the drone cameras for high speed image acquisition. Moreover, the drones and the computer back at headquarters need to be manned, operated and performed maintenance on by technically capable personnel, all of which are costly operations. Lastly, these drones may malfunction and get damaged or broken during an operation, which will yield another cost item for us to consider: the cost of replacing broken drones. A table detailing the cost-benefit analysis can be found below.

Item of interest	Economic value
2 Aerial drones with photographic capability	$3,000
High-performance computer	$4,000
Recruitment and training of staff	$8,000
Multi-spectral image processing algorithm	$10,000
TOTAL DEVELOPMENT COSTS	**$25,000**
Labor: Computer operations	$20,000 / year
Labor: Staff	$100,000 / year
Drone maintenance and flight cost	$4,000 / year
TOTAL OPERATIONAL COSTS	**$124,000 / year**
Technical equipment recovery	$195,000 / year
Projected urban damage prevention	$100,000 / year
TOTAL BENEFITS	**$295,000 / year**

From the table, it is observed that the after one year this project will have gained the department a total of $146,000. The calculated return on investment after one year is 146,000 / 149,000 = 0.98.

The break-even point for the project will happen within the first year, approximately in two months, assuming that there happens at least one flood every month. All things considered, the project is economically feasible because of its high return-on-investment point and the short time it takes to break-even, alongside the tangible and intangible values it will bring to the Presidency.

Organizational Feasibility

From an organizational perspective, the project has high risk. The goals of the system align with that of the Presidency, which is increasing effectiveness and precision while dealing with a flood; however, the way that the project tries to accomplish these goals is unfamiliar to the department. To start with, the department does not contain any personnel with the required technical expertise to operate the drones. Furthermore, the department is also going to need to obtain an image processing software suiting to their needs of processing multi-spectral imagery. Putting aside the lack of technical knowledge within the department, there is also the organizationally foreign aspect the proposed new system. Since the Presidency has not employed any of the proposed aspects of

IT in a flood disaster evaluation, it will be difficult to have the staff use these new ways of assessment and interpretation, instead of just going back to the way they were familiar with. Normally, with a strong analysis team, the change management can be arranged and supervised to make sure the department successfully migrates to the new system. However, the analysis team is also unfamiliar with the foreign concepts that are introduced with this project proposal, so their capabilities of directing and supervising the implementation of the project and the migration of the department will be difficult. Nevertheless, with enough managerial support behind it, which this project has because it has been initiated by the department itself, the project can be realized. To sum up, the project is considered to be medium to high risk in terms of organizational feasibility.

Project Effort Estimation

Unadjusted Actor Weighting	
External System with well-defined API (drones)	1
Human (5)	15
Unadjusted Use Case Weighting	
Average (1)	10
Complex (2)	30
UUCP = 56	

Technical Complexity Factors	
Response time objectives (5)	5
Complex internal processing (5)	5
Easy to install (5)	2.5
Ease of use (5)	2.5
Concurrency (5)	4
Special security objectives	5
Special user training required	5
TCF = 0.6 + (0.01 * 29) = 0.629	

Environmental Factors	
Familiarity with system development process	0
Application experience	0
Object-oriented experience (4)	4
Lead analyst capability (3)	1.5
Motivation (3)	3
Requirements stability (2)	2
Difficulty of programming language (2)	-2
EF = 1.4 + (-0.03 * 8.5) = 1.145	

Adjusted use case points (UCP) = 40.33

Person hours = 806.62

Staffing the Project

There have been seven roles identified that need to be filled for the project.

Project Manager: Oversees the project to ensure that it meets its objectives in time and within budget.

Infrastructure Analyst: Ensures the system conforms to infrastructure standards at the Presidency and that the Presidency infrastructure can support the new system.

Systems Analyst: Designs the information system using a technology focus.

Business Analyst: Designs the information system using a business focus.

Programmer: Code system and image processing algorithms.

All project team members will report to the Project Manager.

Workplan

The tentative workplan for the project is included in the list below.

I. Institutional Modeling

- a. Inception
  - 1. Understand current department situation
  - 2. Uncover departmental process problems
  - 3. Identify potential projects
- b. Elaboration
- c. Construction
- d. Transition

II. Requirements

- a. Inception
  - 1. Identify appropriate requirements analysis technique
  - 2. Identify appropriate requirements gathering techniques
  - 3. Identify functional and nonfunctional requirements
  - 4. Analyze current systems
  - 5. Create requirements definition
    - A. Determine requirements to track
    - B. Compile requirements as they are elicited II.a.5.A
    - C. Review requirements with sponsor II.a.5.B
- b. Elaboration
- c. Construction
- d. Transition

III. Analysis

- a. Inception
  - 1. Identify flood evaluation processes
  - 2. Identify use cases
- b. Elaboration
- c. Construction
- d. Transition
- e. Production

IV. Design

- a. Inception
  - 1. Identify potential classes
- b. Elaboration
- c. Construction
- d. Transition

e. Production

V. Implementation

a. Inception
b. Elaboration
c. Construction
d. Transition
e. Production

VI. Test

a. Inception
b. Elaboration
c. Construction
d. Transition
e. Production

VII. Deployment

a. Inception
b. Elaboration
c. Construction
d. Transition
e. Production

VIII. Configuration and change management

a. Inception
    1. Identify necessary access controls for developed artifacts
    2. Identify version control systems for developed artifacts
    3. Identify aspects of change to transition department's flood evaluation system
b. Elaboration
c. Construction
d. Transition
e. Production

IX. Project management

a. Inception
    1. Create workplan for the inception phase
    2. Create system request
    3. Perform feasibility analysis
        A. Perform technical feasibility analysis
        B. Perform economic feasibility analysis
        C. Perform organizational feasibility analysis
    4. Identify project size
    5. Identify staffing requirements

6. Compute cost estimate
7. Create workplan for first iteration of the elaboration phase
8. Assess inception phase

b. Elaboration

c. Construction

d. Transition

e. Production

X. Environment

a. Inception

1. Acquire and install CASE tool
2. Acquire and install programming environment
3. Acquire and install configuration and change management tools
4. Acquire and install project management tools

b. Elaboration

c. Construction

d. Transition

e. Production

XI. Operations and Support

a. Inception

b. Elaboration

c. Construction

d. Transition

e. Production

XII. Infrastructure Management

a. Inception

1. Identify appropriate standards and enterprise models
2. Identify reuse opportunities, such as patterns, frameworks, and libraries
3. Identify similar past projects

b. Elaboration

c. Construction

d. Transition

e. Production

Requirements Analysis

Nonfunctional Requirements

1. Operational requirements
    - 1.1 The system will need to operate on Windows computers and the images will be processed on a high-performance computer connected to the clients inside DEMP
    - 1.2 The system will integrate with the current DEMP systems
    - 1.3 The system will automatically back-up each flood case evaluation report
    - 1.4 The drones will be able to cover the entire city they are operating in, in terms of range and signal strength
    - 1.5 The drones will be able to safe-land in water should there be a malfunction during the flight over flood areas
2. Performance requirements
    - 2.1 The system must be available 24 hours daily (365 days per year)
    - 2.2 Multi-spectral images taken with the drones will be able to be processed in under an hour
    - 2.3 Response time between the drone operator and the drone movements will be less than a second
3. Security requirements
    - 3.1 The drones will be operating on a secured channel through a designated frequency to be safe from interception by outside sources
    - 3.2 The images will be transferred over a secure channel to prevent outside package-sniffing or interruption
    - 3.3 The integral system will provide controlled access and present only the relevant options / information to the personnel using the system, be it DEMP employee or insurance worker
4. Cultural and political requirements
    - 4.1 The system will comply with the regulatory, departmental and ethical rules within DEMP

Functional Requirements

1. Operate the drone
    - 1.1 DEMP Employee logs in to the application
    - 1.2 The application displays the main menu with the option to see available drones
    - 1.3 DEMP Employee requests to see the available drones
    - 1.4 The drones are listed before the DEMP Employee with their current status of availability
    - 1.5 The employee requests to operate an available drone
    - 1.6 Employee is given control of the drone with the specific control mechanisms and instructions shown on the display
2. Take multi-spectral photography
    - 2.1 While operating the drone, the employee requests to take a photography
    - 2.2 The mounted camera on the drone is notified and takes a photo
    - 2.3 The employee is given a preview of the photo to approve of its transfer to the image processing unit in DEMP
3. View past case reports
    - 3.1 DEMP Employee or insurance worker logs in to the system
    - 3.2 Application displays menu with the option to view past case documents
    - 3.3 User chooses to view the past case documents
    - 3.3 User specifies the date of the disaster and chooses one of the past archived cases
    - 3.4 User is presented with a screen to view the images and the report documents related to the case they have chosen
4. Work on an existing active case
    - 4.1 DEMP Employee logs in to the system
    - 4.2 Application displays menu with the option to view active case documents
    - 4.3 User chooses to view an active case
    - 4.4 User is presented with the active use case documents
5. Create a new case
    - 5.1 DEMP Employee logs in to the system
    - 5.2 Application displays menu with the option to create a new case
    - 5.3 User chooses to create a new case
    - 5.4 User is taken to the active case scene of the newly created case
6. Add a new document to an active case
    - 6.1 DEMP Employee logs in to the system
    - 6.2 Application displays menu with the option to view an active case
    - 6.3 User chooses to view an active case

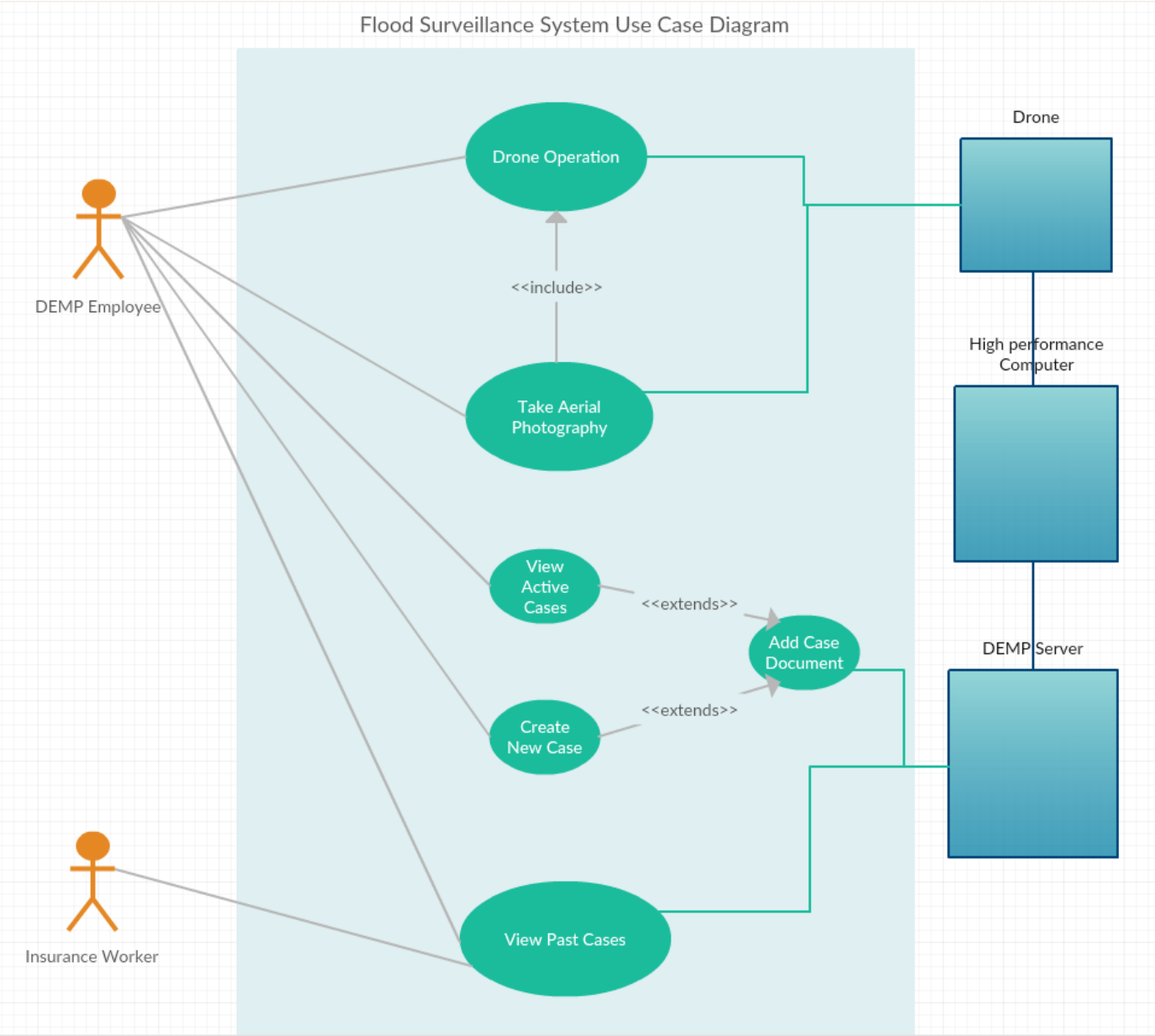
6.4 User is displayed the active case screen with the option to add document to the case 6.5 User chooses to add a new document 6.6 User is given the option to choose a multi-spectral image from the HIP Computer or to add a case report 6.7 User chooses which file to add and uploads it to the DEMP servers for other employees to view

Key Performance Measures

The measures to be looked at while inspecting how this project helps the Presidency achieve their goals include the consideration of both quantitative and qualitative benefits we get from the project. First off, we want this project to increase public happiness with regards to the flood relief activities provided by both our Presidency and the insurance companies. To that end, the implemented project should be able to address the issues of improving the respond time to a flood event, which is one of the most important points when it comes to measuring the performance of the Presidency's services. Furthermore, we also want this project to decrease the losses of the Presidency when it comes to equipment. The quantitative aspect of the two key measures comes into effect while we consider the savings we would get in terms of flood equipment if we were to implement this project.

If these two measures are consistently achieved as a result of the project's integration into the Presidency's systems, then the project will satisfy the identified key performance measures entailed.

Functional Modeling



Use Case Descriptions

Use Case Name: Drone Operation	**ID:** 1	**Importance Level:** High
Primary Actor: DEMP Employee	**Use Case Type:** Detail, Essential	
Stakeholders and Interests: DEMP Employee wants to navigate the drone in order take different pictures of a flood zone. DEMP wants to process the images in order to improve flood related activities and services		

Brief Description: This use case describes how a DEMP Employee operates the drones in the air that belong to DEMP.
Trigger: DEMP Employee requests access to an available drone **Type:** External
Relationships: *Association:* DEMP Employee, Drone *Include:* *Extend:* *Generalization:*
Normal Flow of Events: 1. DEMP Employee logs into the system 2. DEMP Employee requests access to an active drone 3. DEMP Employee gains access to the drone and controls it
Subflows:
Alternate/Exceptional Flow:

Use Case Name: Take Aerial Photography	**ID: 2**	**Importance Level:** High
Primary Actor: DEMP Employee	**Use Case Type:** Detail, Essential	
Stakeholders and Interests: DEMP Employee wants to take photos of a flood zone using the drones. DEMP wants to process the photos in order to improve flood related activities and services		
Brief Description: This use case describes how a DEMP Employee can take photographs with the drones.		
Trigger: DEMP Employee requests the drone to take a photo while operating it **Type:** External		
Relationships: *Association:* DEMP Employee, Drone *Include:* Drone Operation *Extend:* *Generalization:*		
Normal Flow of Events: 1. DEMP Employee logs into the system 2. DEMP Employee requests access to an active drone 3. DEMP Employee gains access to the drone and controls it 4. DEMP Employee requests the drone to take a photo of its current hovering position		

5. Photo preview is displayed before the user for approval
6. Once approved, the photo is sent to the high-performance computer

Subflows:

Alternate/Exceptional Flow: If disapproved, the flow of events will return to step 3 where the user is controlling the drone, thus can request another photo to be taken

Use Case Name: View Active Cases	**ID: 3**	**Importance Level:** High
Primary Actor: DEMP Employee	**Use Case Type:** Detail, Essential	

Stakeholders and Interests: DEMP Employee wants to view and work on an active flood disaster case.

Brief Description: This use case describes how a DEMP Employee could view an active flood disaster case.

Trigger: DEMP Employee requests to view active (ongoing) cases
Type: External

Relationships:
Association: DEMP Employee, DEMP Server
Include:
Extend: Add Case Document
Generalization:

Normal Flow of Events:
1. DEMP Employee logs into the system
2. DEMP Employee requests to view active cases
3. DEMP Employee is provided a list of active cases
4. DEMP Employee chooses a case from the list
5. Details of and options about the case are presented to the DEMP Employee

Subflows:

Alternate/Exceptional Flow:

Use Case Name: Create New Case	**ID: 4**	**Importance Level:** High
Primary Actor: DEMP Employee	**Use Case Type:** Detail, Essential	

Stakeholders and Interests: DEMP Employee wants to open a new case about a newly developed flood disaster.

Brief Description: This use case describes how a DEMP Employee could create a new disaster case for other employees to collaborate on.

Trigger: DEMP Employee requests to create a new case from the main menu **Type:** External
Relationships: *Association:* DEMP Employee, DEMP Server *Include:* *Extend:* Add Case Document *Generalization:*
Normal Flow of Events: 1. DEMP Employee logs into the system 2. DEMP Employee requests create a new case 3. DEMP Employee is asked the specifics of the new case 4. DEMP Employee provides initial information about the case 5. The user is taken to the active case screen of the newly created case
Subflows:
Alternate/Exceptional Flow:

Use Case Name: Add Case Document	**ID: 5**	**Importance Level:** Medium
Primary Actor: DEMP Employee	**Use Case Type:** Detail, Essential	
Stakeholders and Interests: DEMP Employee wants to add a document that is relevant to the case he/she is currently viewing.		
Brief Description: This use case describes how a DEMP Employee could add a new document to an active case.		
Trigger: DEMP Employee requests to add a document to an active case via the case screen **Type:** External		
Relationships: *Association:* DEMP Employee, DEMP Server *Include:* *Extend:* *Generalization:*		
Normal Flow of Events: 1. DEMP Employee logs into the system 2. DEMP Employee requests to view active cases 3. DEMP Employee is provided a list of active cases 4. DEMP Employee chooses a case from the list 5. Details of and options about the case are presented to the DEMP Employee		

6. DEMP Employee chooses to add a document to the active case
7. The system presents the option to add a report or a photo
8. DEMP Employee specifies which file he/she wants to add
9. The file is added to the active case folder

Subflows:

Alternate/Exceptional Flow: The user can also reach an active case screen by choosing to create one, rather than selecting from the active cases

Use Case Name: View Past Cases	**ID: 6**	**Importance Level:** Low
Primary Actor: Insurance Worker	**Use Case Type:** Detail, Essential	

Stakeholders and Interests: Insurance Worker wants to view past cases to adjust the insurance coverage accordingly
DEMP Employee wants to view past cases for archiving and informational purposes

Brief Description: This use case describes how an insurance worker or a DEMP employee will view past case details of a flood disaster

Trigger: Insurance worker or DEMP Employee requests to view the list of past disaster cases
Type: External

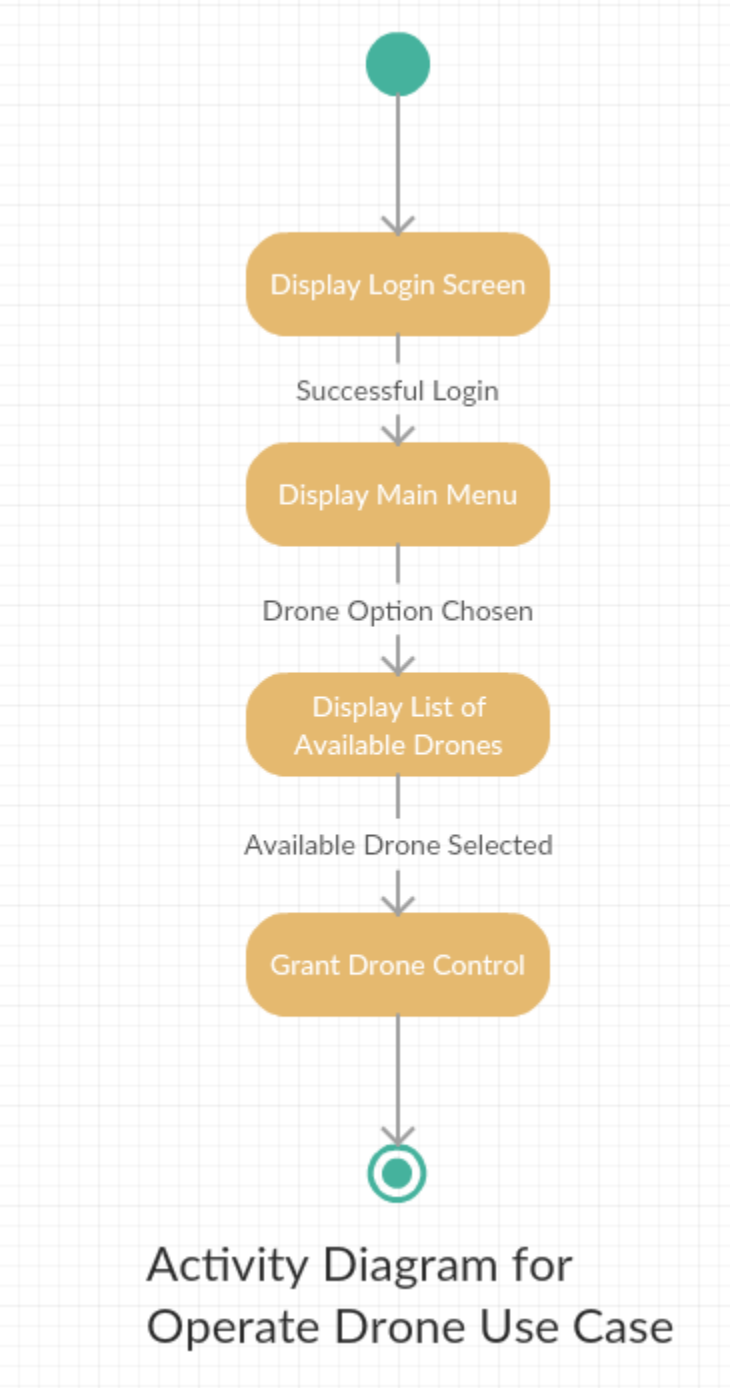
Relationships:
Association: DEMP Employee, Insurance Worker, DEMP Server
Include:
Extend:
Generalization:

Normal Flow of Events:
1. Insurance Worker logs into the system
2. Insurance Worker requests to view past cases
3. Insurance Worker is provided a list of past cases
4. Insurance Worker chooses a case from the list
5. Details of and options about the past case are presented to the Insurance Worker

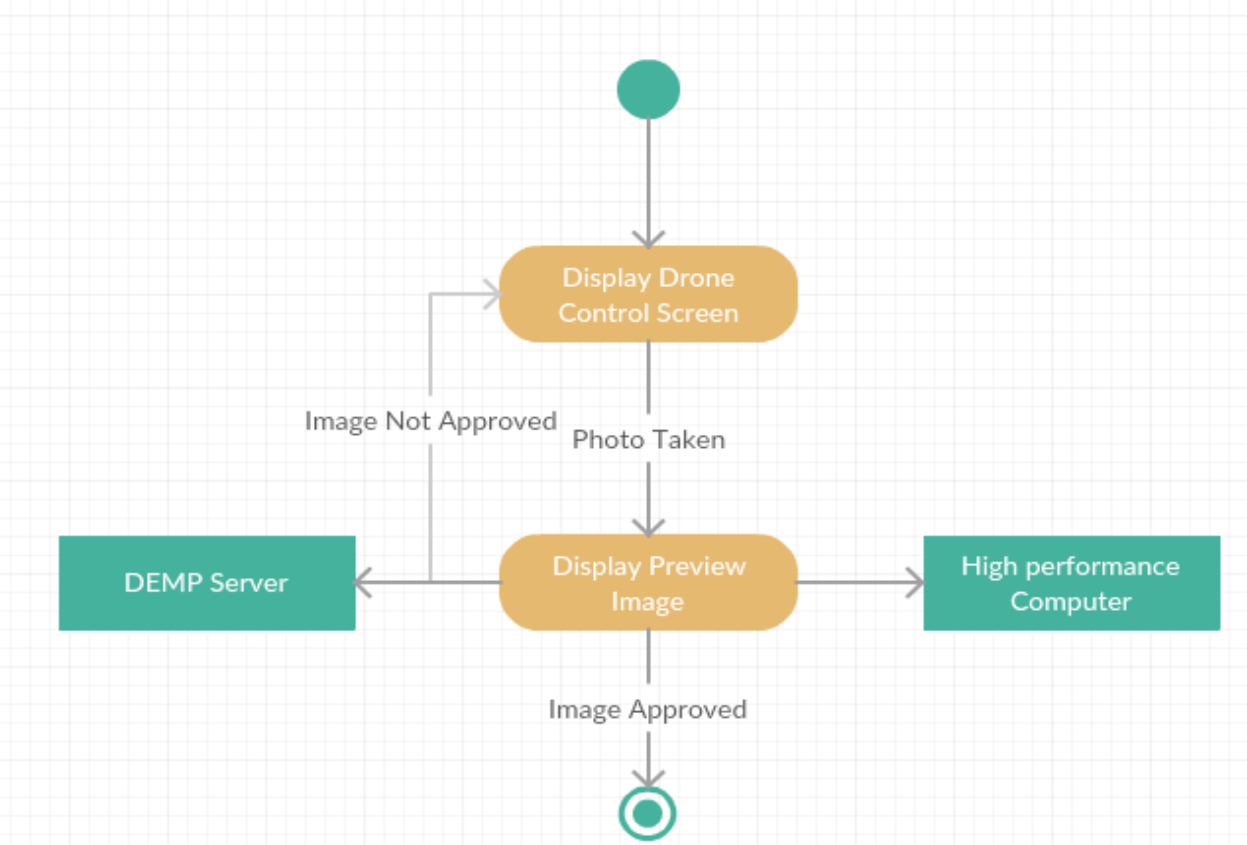
Subflows:

Alternate/Exceptional Flow:

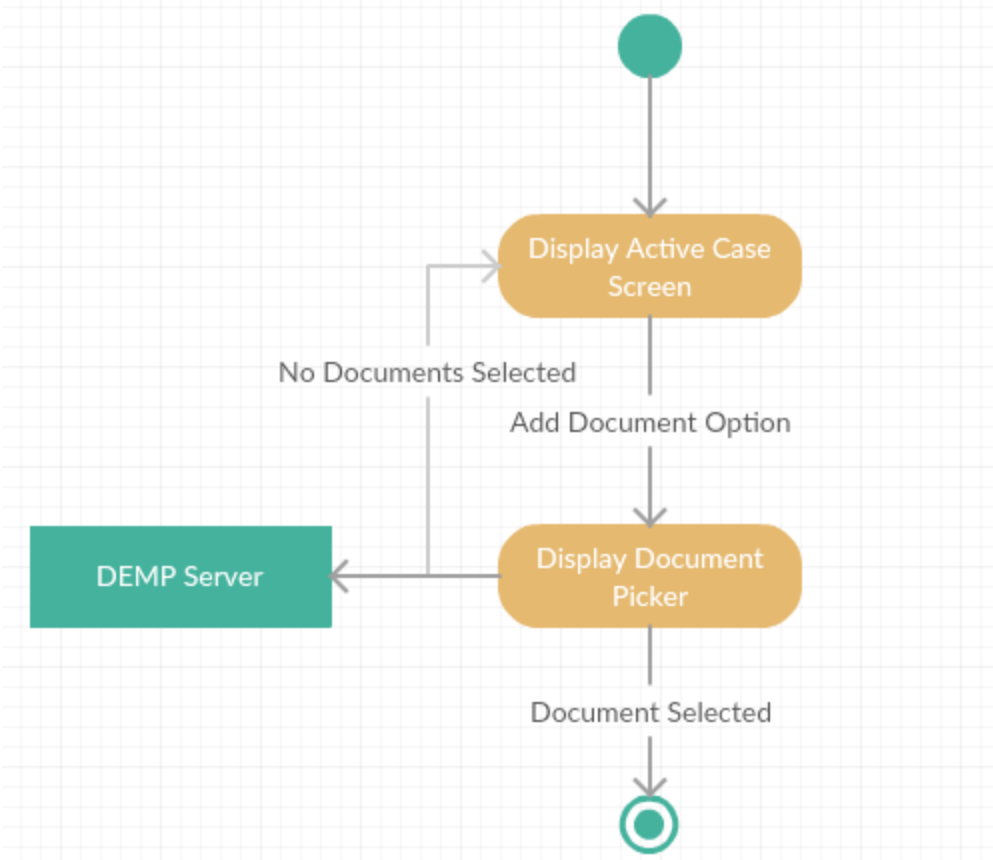
Activity Diagrams



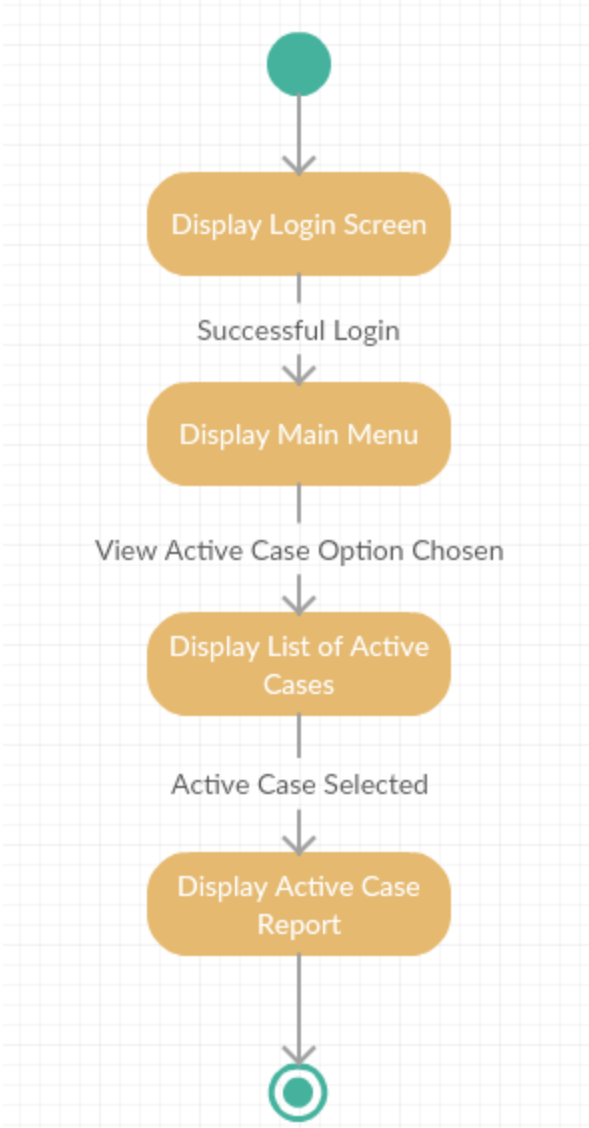
Activity Diagram for Operate Drone Use Case



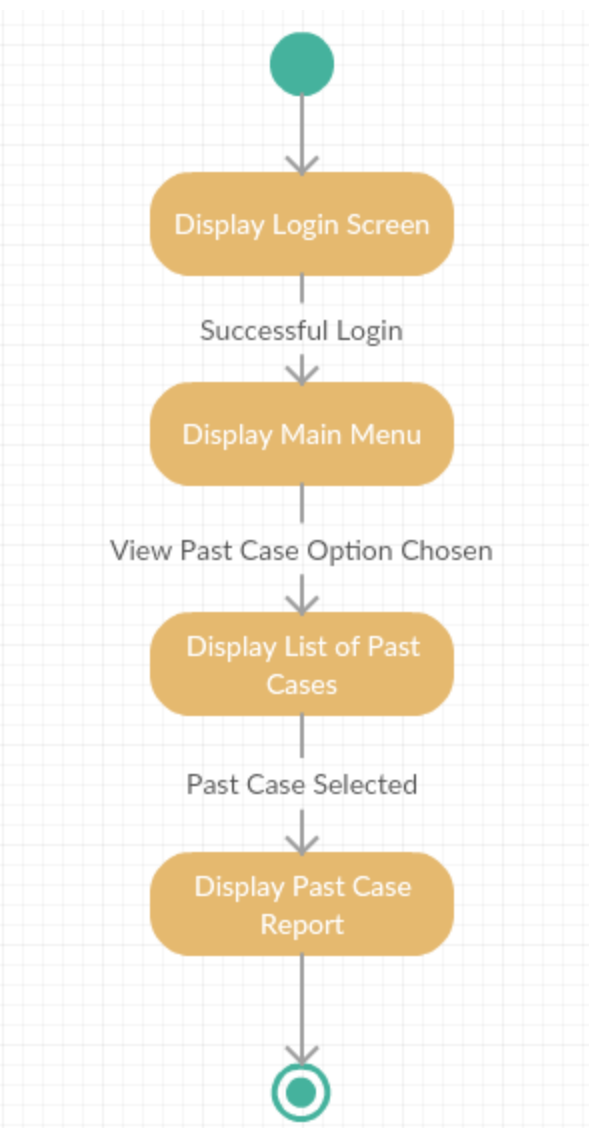
Activity Diagram for Take Aerial Photo Use Case



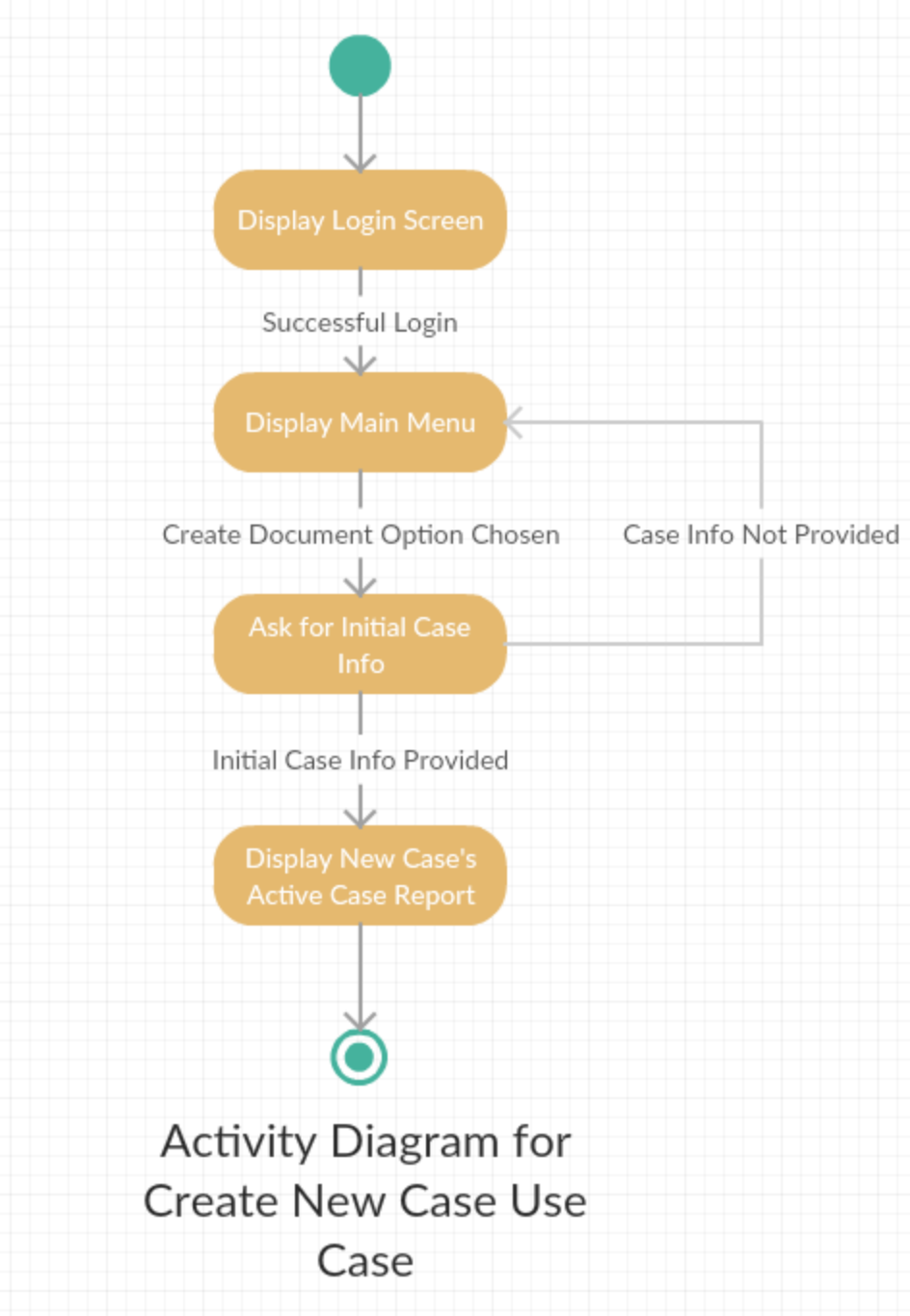
Activity Diagram for Add Case Document Use Case



Activity Diagram for View Active Case Use Case



Activity Diagram for View Past Case Use Case



Activity Diagram for Create New Case Use Case

Class Name: Drone **ID: 1** **Type:** Concrete, Domain
Description: A drone used to take photographs of a flood zone **Associated Use Cases:** 1, 2
Responsibilities: Change Location, Receive User Input, Capture Image
Collaborators: - , -, Case Document
Attributes: ID (int), Position (double, double, double), Controller (DEMP Employee)
Relationships: *Association:* Case Document *Include:* DEMP Employee *Extend:* *Generalization:*

Class Name: Case **ID: 2** **Type:** Concrete, Domain
Description: Representation of a flood disaster case **Associated Use Cases:** 3, 4, 5, 6
Responsibilities: Know Case Documents, Know Case Status, Change Case Status
Collaborators: Case Document, -, -
Attributes: ID (int), Status (text), Documents (Case Document [])
Relationships: *Association:* *Include:* Case Document *Extend:* *Generalization:*

Class Name: DEMP Employee **ID: 3** **Type:** Concrete, Domain
Description: Representation and information related to a DEMP Employee using the system **Associated Use Cases:** 1, 2, 3, 4, 5, 6
Responsibilities: Create Case, Add Case Document, Operate Drone, Take Aerial Photo, View Past Cases, View Active Cases
Collaborators: Case Document, Drone

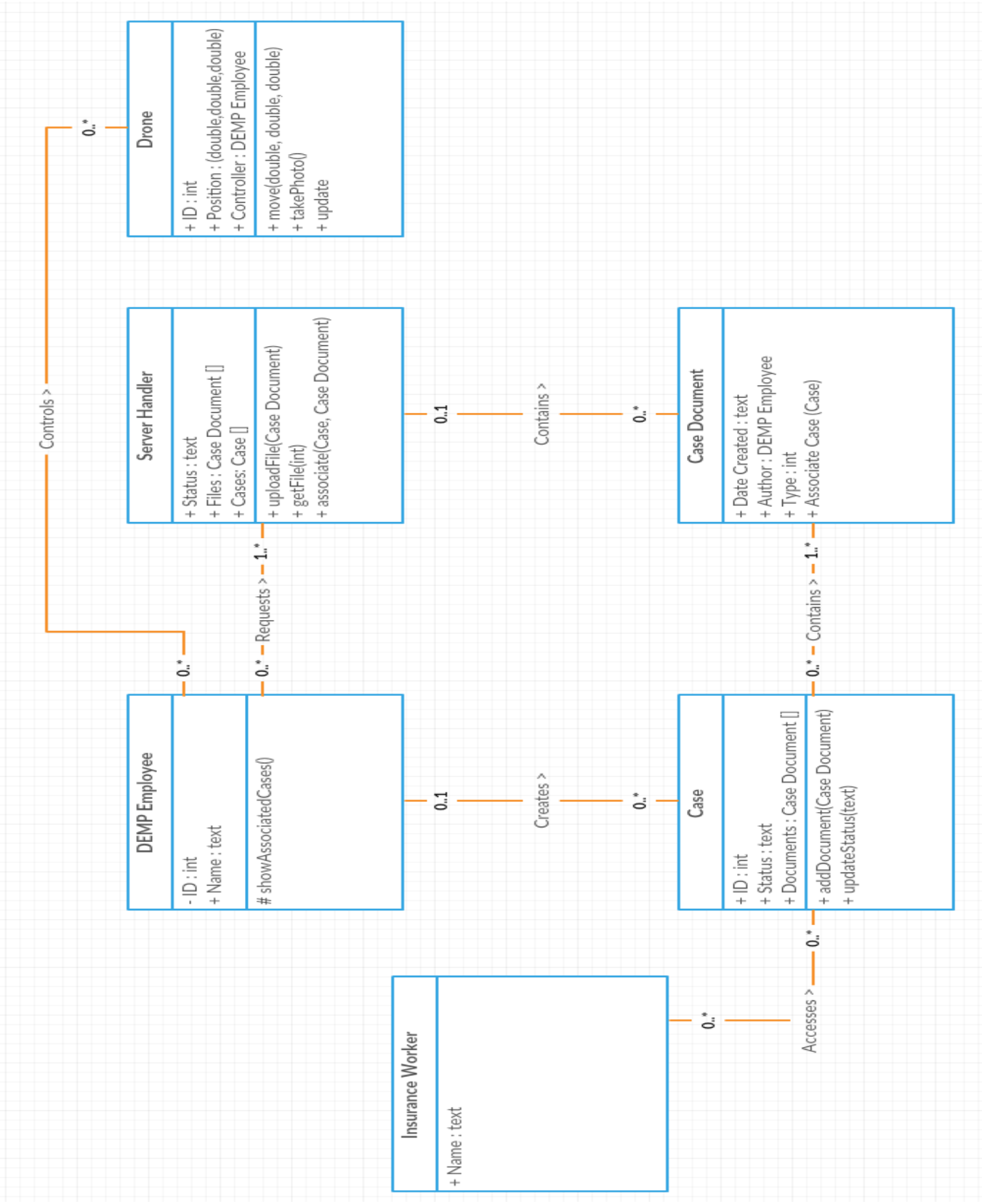
Attributes: ID (int), Name (text)
Relationships: *Association:* Case Document, Case *Include:* *Extend:* *Generalization:*

Class Name: Server Handler	**ID: 4**	**Type:** Concrete, Domain
Description: Representation of the interaction interface inside DEMP Server **Associated Use Cases:** 3, 4, 5, 6		
Responsibilities: Present Active Cases, Create Case, Add Case Document, Present Past Cases		
Collaborators: Case, Case, Case Document, Case		
Attributes: Status (text), Files (Case Document []), Cases (Case [])		
Relationships: *Association:* Case Document, Case *Include:* Case Document, Case *Extend:* *Generalization:*		

Class Name: Case Document	**ID: 5**	**Type:** Concrete, Domain
Description: Representation of a case document related to a flood case **Associated Use Cases:** 3, 4, 5, 6		
Responsibilities: Know Case Information		
Collaborators: Case, Case, Case Document, Case		
Attributes: Date Created (text), Author (DEMP Employee), Type (int), Associate Case (Case)		
Relationships: *Association:* Case Document, Case *Include:* DEMP Employee *Extend:* *Generalization:*		

Class Name: Insurance Worker	**ID: 6**	**Type:** Concrete, Domain
Description: Representation of an insurance worker that might use the system to access past case files **Associated Use Cases:** 6		
Responsibilities: View Past Cases		
Collaborators: Case		
Attributes: Name (text)		
Relationships: *Association:* Case *Include:* *Extend:* *Generalization:*		

Class Diagram



Database Selection and Design

DEMP will collect aerial photos continuously thus have to store many images and process these images very quickly to plan the first response then create the reports to provide to the insurance companies. Since multi-spectral images are fall into the category of complex data the selected object persistence format will have to be able to support it. ORDBMSs, OODBMSs, or NoSQL can support the data type of need. The type of application system DEMP will use is reading this image data after aerial photography is completed the photos will not be altered but they will be processed to extract data for emergency response or reports. In this type of application systems ability of decision making outshines the ability of transaction processing so in this manner NoSQL comes a little in front of the ORDBMSs and OODBMSs. The problem domain classes of the DEMP is special images with larger size and damage reports with a more manageable size. Since the data collected by DEMP can be used later on for insurance it is convenient to store reports with the images. A document oriented NoSQL solution will fit to this purpose because they have flexibility on the stored document schemes. Furthermore, a document oriented NoSQL database will be preferable at this point because the damage reports will probably fall short of 16MB document limit of a database solution like MongoDB and the image files can be stored in the database with GridFS which is like a virtualization of a file system within the database. Usually it is preferable to store images on a filesystem instead of a database but in this specific case backup capability of a database solution and extract the more precise info from the multi spectral image using chunks of GridFS to be processed or used in insurance reports is a considerable tradeoff for filesystem performance. More optimizations can be made to the system by adding related information chunk indexes into the document as a field or if the system begins to be completely overwhelmed and if the connection bandwidth will not be a problem a storage solution like Amazon S3 Combined with indexed metadata of the huge files (i.e. images stored on S3 paths in DB) can be used and in this case import from the chunked system will be easily accomplished.

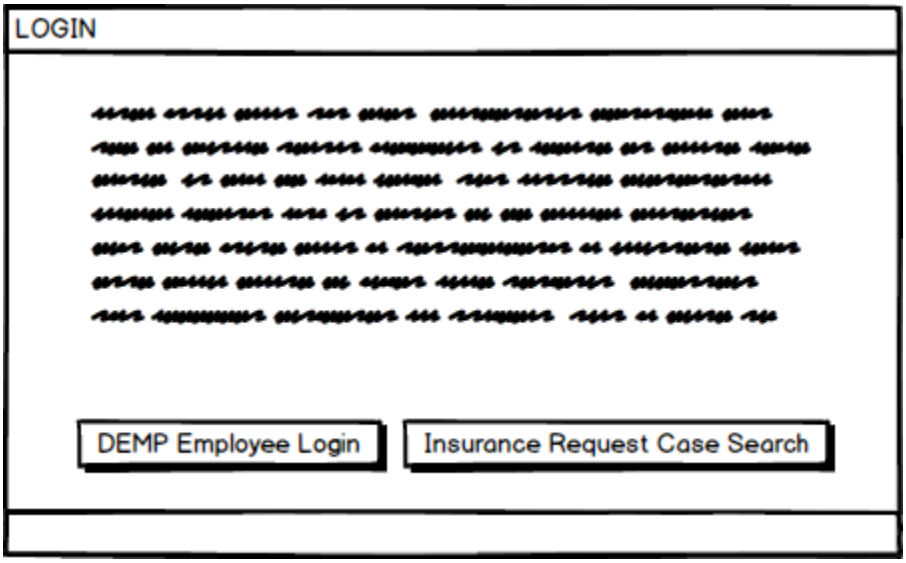
To sum up, the project database will be that of a document oriented NoSQL database, and the database will be implemented inside the DEMP Server object associated with the Server Handler class in the Class Diagram, in order to hold the case documents such as images and reports, and the case instances themselves. The database will operate with the principle of *eventual consistency*, as the case files will need to be synchronized across all collaborators working on an active report.

UI Design

Mockups and General Overlay

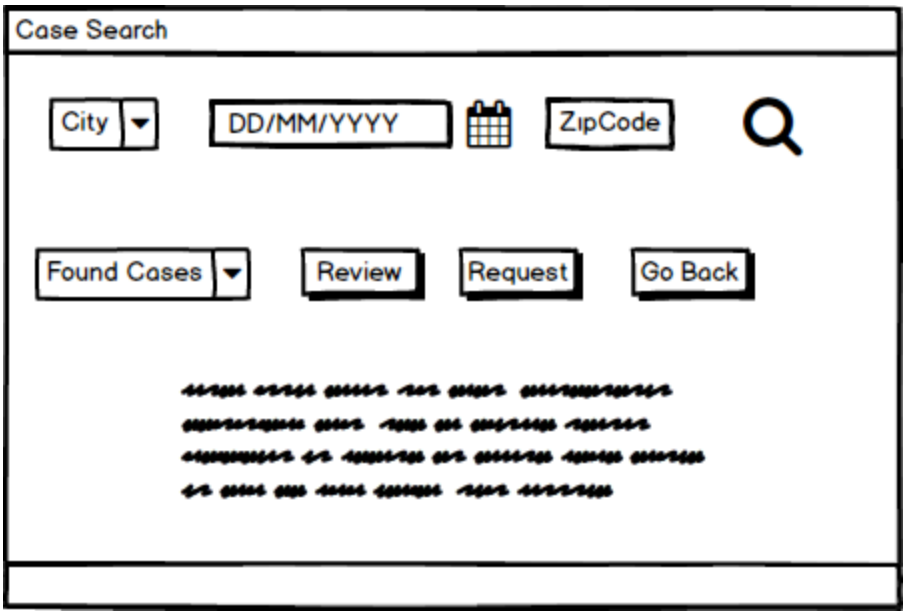
Welcome:

DEMP welcome screen that can be used by both employees within the DEMP and also insurance workers outside the DEMP which may claim reports and images from DEMP. Usage terms and necessary warning are made then a user can select the access type.



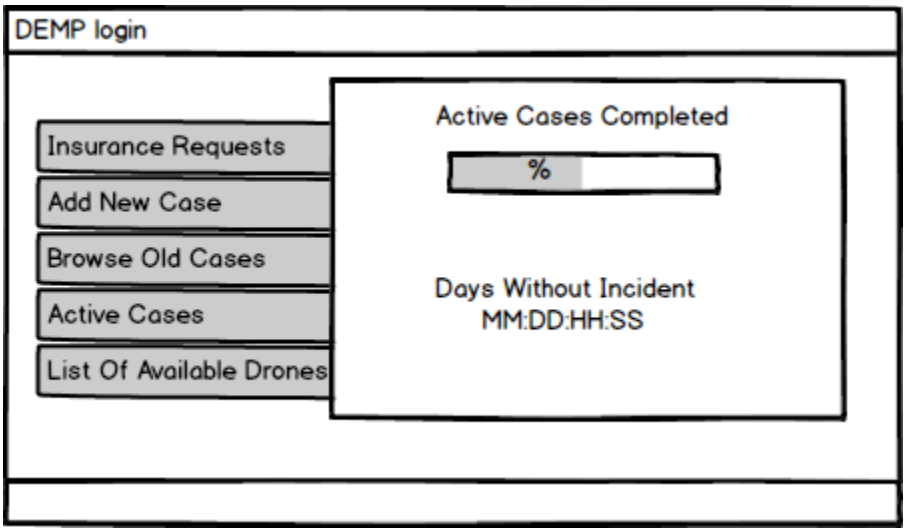
Insurance worker:

DEMP insurance search screen provides a limited outside view for the insurance workers. They can search a case by giving the necessary information about location and time. System provides alternative cases about the query and the insurance worker can preview the cases by review button if the insurance worker decides that the information gathered by DEMP will be useful than they can make a request. Request button navigates them to a pop-up screen which they can fill-out their contact information. On the bottom information about average response time for the request and legal terms about DEMP documents are displayed.

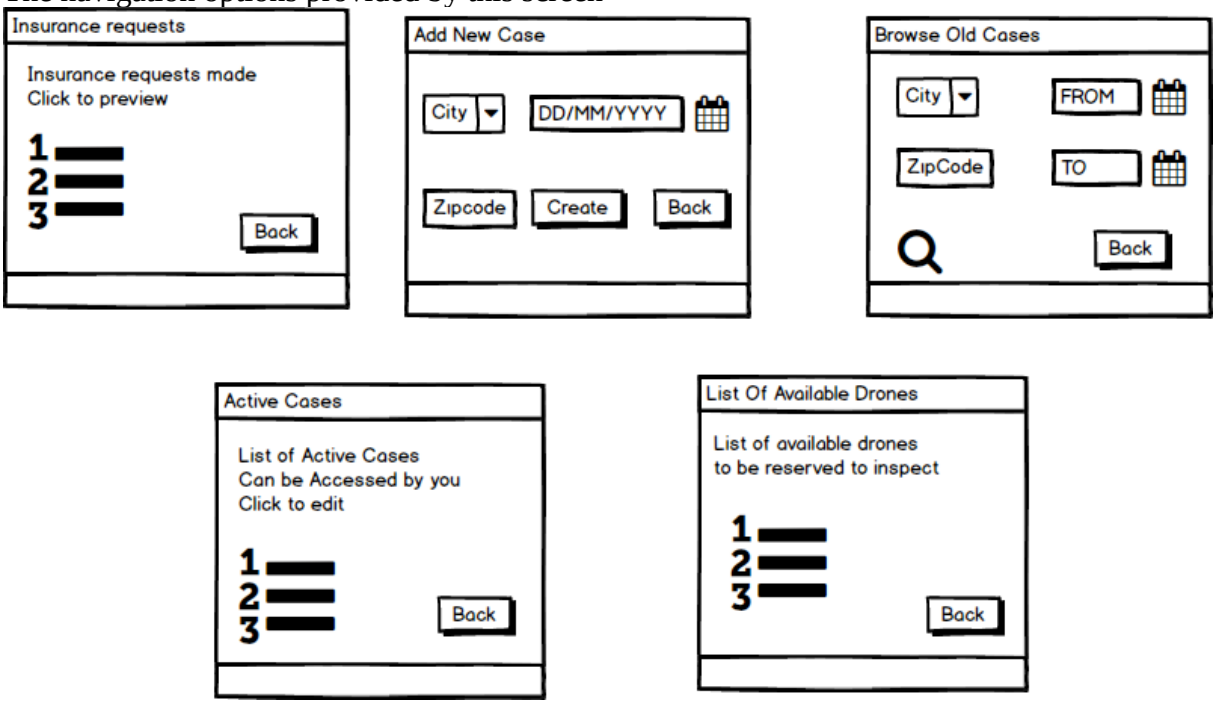


DEMP employee:

DEMP employee can login to system after providing their credentials and first screen they see after login provides them with their completion percentage and days without incident. The menu on the left provides navigation for the insurance requests that are waiting to be confirmed, creating new cases, inspecting old cases, the active cases needs to be worked on and lastly the list of available drones can be used at this instant.



The navigation options provided by this screen



Clicking on a case from the insurance requests opens the Case screen and export option there can be used to extract the information to be forwarded to the insurance worker.

Adding a new case creates a new entry and navigates automatically to the case screen for the case just created.

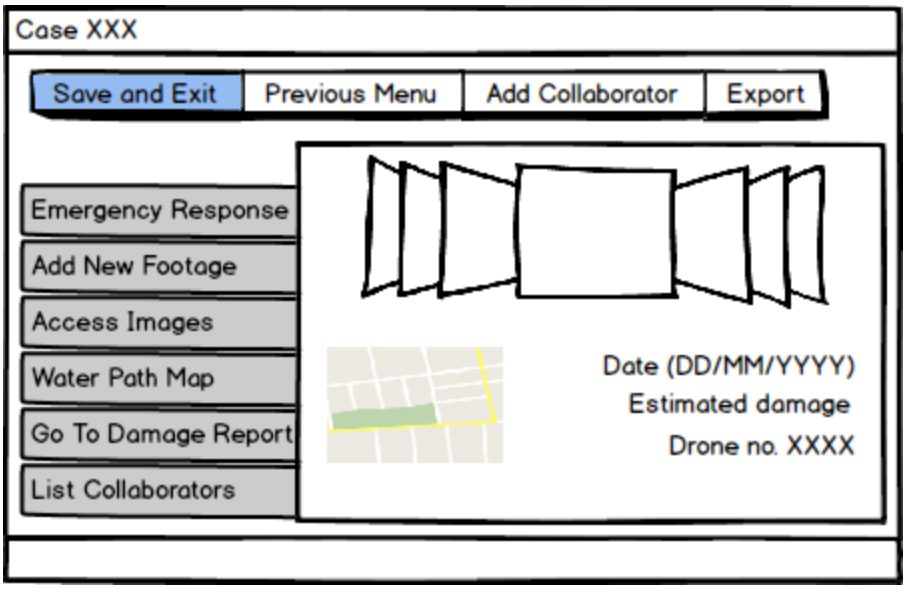
Old cases search returns a list that this query had accessed and clicking the list results takes the user to the case screen for that particular case.

Active cases does the same with old cases but skips the search query and lists the incomplete cases instead.

Available drones can be reserved to active cases if there is a need for aerial imaging need.

Case screen:

The case screen provides all the necessary options that can be needed for a case. Active cases have the emergency response option available while old cases have it greyed out. A collaborator can be invited to a case which makes it easier for huge disasters to be handled by multiple workers. Every collaborator sees the cases they are working on in the active cases menu after they login. And export button is for extracting the insurance information to be forwarded to an insurance worker upon their request. The preview screen shows the worker some details about the case this is planned for easy distinction of the cases. The recognizable images slide trough the preview screen and a little indicator on the map are also previewed for easy distinction any further information about imagery can be seen with access images button and detailed water map is in the water path map button. Also collaborators can be listed and contacted by clicking on their name after list collaborators button listed their names. New footage can be added to a case whether it is active or not.



Use Scenarios

Use Scenario 1: DEMP Employee Operates Drone

1. DEMP Employee logs into the system
2. System displays the available services
3. DEMP Employee selects to view available drones
4. System displays available drones
5. DEMP Employee chooses an available drone
6. DEMP Employee is granted access to said drone with the instructions to the control mechanisms displayed on the screen

Use Scenario 2: DEMP Employee Takes Aerial Photo

1. DEMP Employee logs into the system
2. System displays the available services
3. DEMP Employee selects to view available drones
4. System displays available drones
5. DEMP Employee chooses an available drone
6. DEMP Employee is granted access to said drone with the instructions to the control mechanisms displayed on the screen
7. DEMP Employee chooses to take a photo of the area hovered over
8. DEMP Employee is given a preview of the picture
9. If approved, image is processed and sent to DEMP databases; else, the system repeats 6-8

Use Scenario 3: DEMP Employee Views Active Case

1. DEMP Employee logs into the system
2. System displays the available services
3. DEMP Employee selects to view active cases
4. System displays active ongoing cases
5. DEMP Employee chooses an active case
6. DEMP Employee is displayed details and options about the chosen case

Use Scenario 4: DEMP Employee or Insurance Worker Views Past Case

1. DEMP Employee / Insurance Worker logs into the system
2. System displays the available services
3. DEMP Employee / Insurance Worker selects to view past cases
4. System displays archived past cases
5. DEMP Employee / Insurance Worker chooses a past case
6. DEMP Employee / Insurance Worker is displayed details about the past case

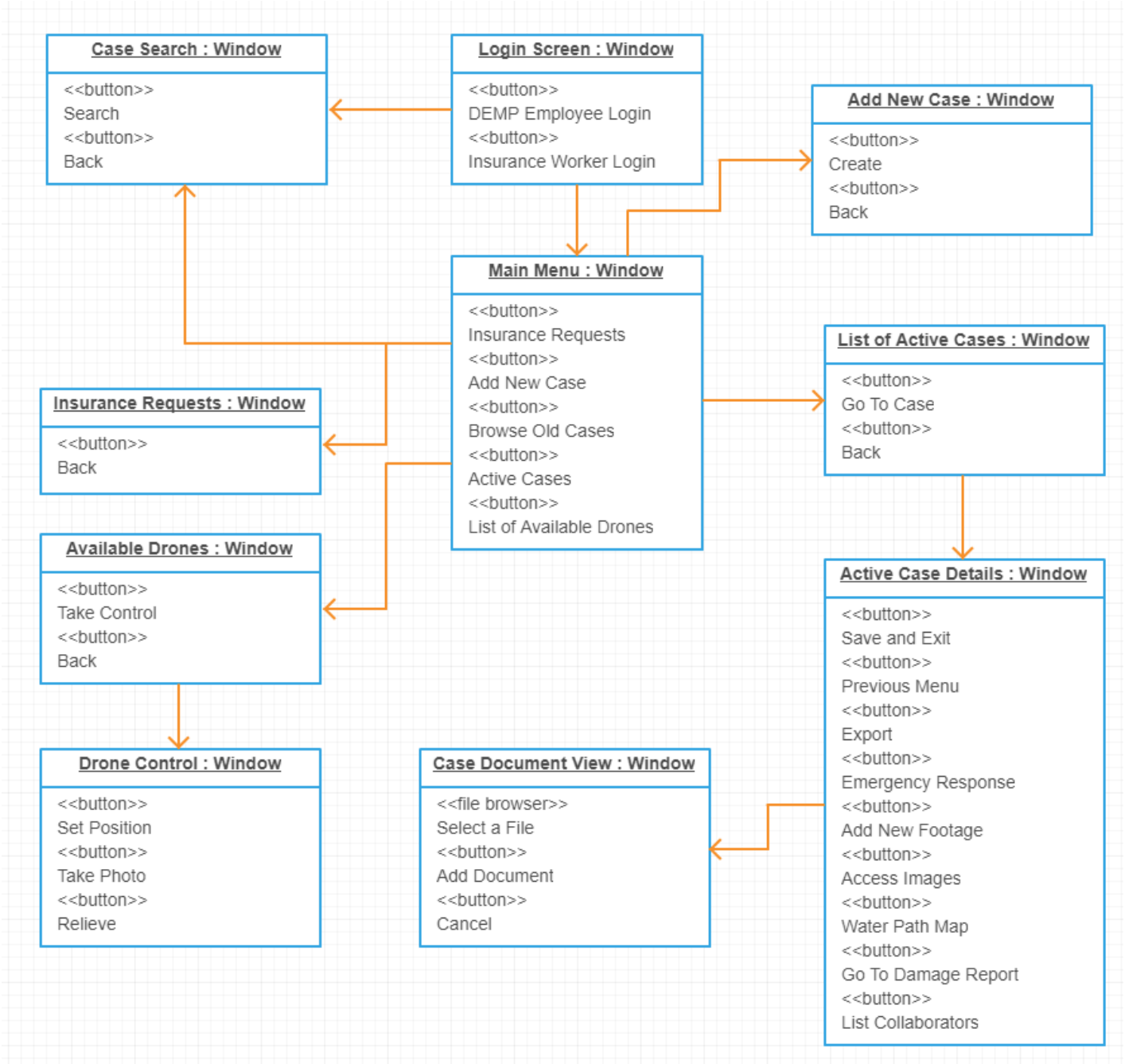
Use Scenario 5: DEMP Employee Adds Document to a Case

1. DEMP Employee logs into the system
2. System displays the available services
3. DEMP Employee selects to view active cases
4. System displays active ongoing cases
5. DEMP Employee chooses an active case
6. DEMP Employee is displayed details and options about the active case
7. DEMP Employee chooses to add a new document to the case from the list of options
8. DEMP Employee is asked to choose what type of document they wish to add along with the specifics of the document
9. DEMP Employee provides the requested information
10. Specified document is added to the active case

Use Scenario 5: DEMP Employee Creates New Case

1. DEMP Employee logs into the system
2. System displays the available services
3. DEMP Employee selects to create a new case
4. System asks for initial information about the newly formed case
5. DEMP Employee fills out the requested information
6. New case is created and DEMP Employee is presented the active case screen of the newly created case

Windows Navigation Diagram (WND)



Security Design

The security design of the system is realized with the limitations and the control mechanisms at hand.

Drone Control

Interactive Controls: To start with, we need to ensure that the drone controls cannot be intercepted by outside entities. In other words, we must prevent the drones from being hijacked. As unmanned aerial vehicles operating in public spaces, these drones are extremely susceptible to outside interaction. Therefore, an attacker already has the visibility he / she needs to launch an attack on the system. Should these drones be operating on a radio frequency, then an outside entity could simply tune into the same frequency and get close enough to the drone to overpower the signal coming from the Presidency's headquarters, in order to take control of the drone and use it to their own agenda. In an attempt to prevent this, we must implement an Identification and Authentication control protocol. To elaborate, the connection between the controller and the drone must only be established after the two entities have confirmed the other's identity and the authority to take control of the device. Also, we must adhere to the rules of resilience control in order to make sure that even if there is a partition in the network, the data and the key exchange between the drone and the headquarters will not be compromised.

Process Controls: Sufficient and secure abstraction is needed in order to adhere by the privacy control mechanism and make sure that the means of accessing an asset is only known to the ones with enough authority to access it and no one else.

Image Transfer

Interactive Controls: Images will be transferred over the internet, and thus are open to any kind of traditional network attack. In order to remedy the situation, the messages should be sent over to the headquarters in an encrypted form with the key to decrypt the image provided and agreed upon by both entities.

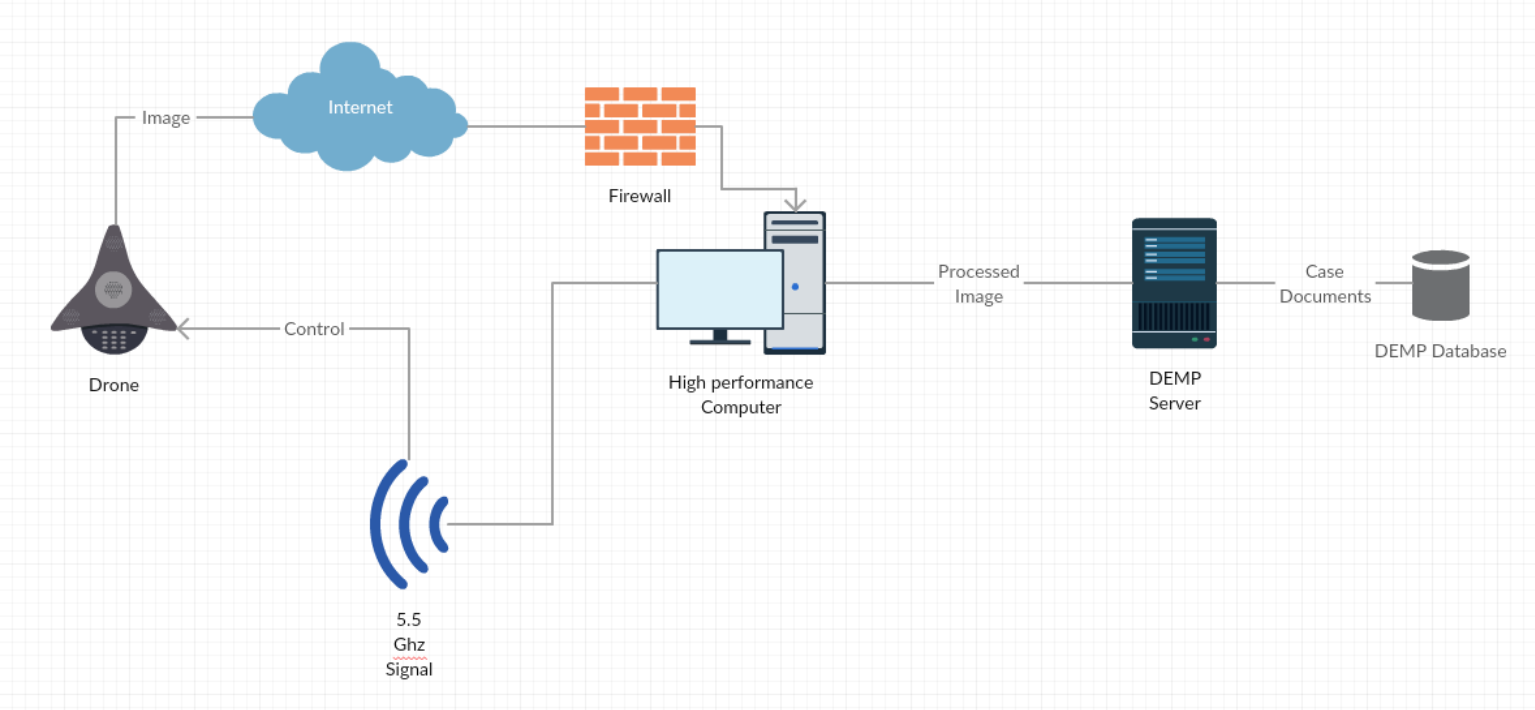
Process Controls: Only the image processing client should have access to the decryption keys needed to view the original images. In order to ensure absolute privacy, not even the DEMP employees will have access to the original images nor the security privilege to decrypt them.

Application Interaction

Interactive Controls: Only the DEMP Employees will have access to the enhanced features of the system, and they will be granted this access by entering their credentials in the form of username and password. The identification and authorization process will ensure that only those with high enough security clearance can access and modify the systems internal files.

Hardware Selection

The hardware selection of the project was done with security and infrastructural issues in mind. The system will employ a client-server based approach, with the server handling the data and the client handling the drone control operations and the image processing.



Software / Systems Construction Plan

The analysts, as a result of their unfamiliarity with the fields discussed in this project, did not focus on the programming management part of the project, but instead moved onto the documentation and test design aspect.

Documentation

The development team had been documenting their activities in order to help the technical personnel understand the work that is done better, as well as constructing a base for the staff to be trained in order to use the complex system of interacting drones and clients.

The team has developed a user reference into the high-performance computer, detailing the steps that needed to be taken in order to ensure secure operation of the drone.

Furthermore, since the interfacing application will need to be used by both DEMP employees and insurance workers alike, a common documentation needed to be built for both parties. This documentation piece was available online, as the insurance workers would not have access to the inside knowledge that might be available at the Presidency.

Another, more detailed version of the aforementioned documentation was provided on all computers that had the application installed, in order for every employee to collaborate on an active case efficiently and effectively. Detailed instructions on how to use the system including viewing an active case, creating a case and adding documents to a case were discussed at length in order to make sure as much ground as possible was covered regarding the application for flood evaluation and emergency services.

Test Design

In the analysis stage of the project, the team tested the functional, structural and behavioral models extensively by verifying their consistency and rationality.

Unit testing was done through white box testing of the classes. As integration and security were immense concerns, and considering the complexity and unfamiliarity with the new system at hand, the unit tests proved invaluable during the implementation stage of the platform.

Integration tests were developed to ensure that in the application platform, data was consistent among all employees collaborating on an active case.

System testing was used to verify that the implemented project would address all of the functional requirements as well as the non-functional requirements. As there was a flood every month, testing the system in a real-life environment was not an issue and has been helpful in precisely determining the status of the system.

Performance tests were conducted to ensure that the image transfer and processing were completed within the desired limit of one hour. This particular test was extremely important to the project as it ensure that an emergency response could be formed using the newly developed system, satisfying and remedying many of the economic concerns.

Acceptance tests were conducted using JAD sessions with the specially trained staff, the engineers and the Presidency's flood department coordinator to ensure variance of opinions.

Installation and Operations Plan

Conversion

The deployment of the Flood Zone Surveillance Platform would be in four phases. First all the equipment would be researched and purchased in order to realize the system. Then the control with the drone would be established and the security protocols regarding the solution would be developed.

Third the image processing algorithm would be developed and thoroughly tested and installed on the high-performance computer. Then the image transfer between the drone and the computer, as well as the secure encryption method would be developed. Lastly, the application for the use of DEMP employees and the insurance workers would be developed and deployed on the relevant areas. With the final phase of the project, full conversion will be achieved.

Change Management

Change management would not be a problem within the Presidency, as only a limited number of people would need to adapt to the new way of things with the drones, and the rest would only see the newly implemented system as an abstraction and an improvement on the old one. By achieving this kind of modularity, we hope to make the change process as smooth as possible. Special

personnel will be recruited either from the outside or within DEMP and these personnel will be encouraged and trained in order to use the drones and the accompanying infrastructure.

Training

There will need to be extensive training for the users of the high-performance computer and the drone operators as these two areas are extremely complex and require expertise in order to function appropriately. Furthermore, user documentations regarding the flood case viewing and operation application will be sufficient training for those who wish to benefit from the platform.

Post-Implementation Activities

After the implementation, maintenance duty will be transferred to a specially appointed person within the IT department who specializes in image processing and drone operation.

Furthermore, post implementation surveys were conducted to determine improvable processes during the implementation procedure in order to incorporate these solutions into future projects.