Satellite Image Change Detection
(SICD)

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Submitted to the faculty of Department of Computer Software Engineering,
Military College of Signals, National University of Sciences and Technology, Islamabad,
in partial fulfillment for the requirements of B.E Degree in Software Engineering.

June 2022

In the name of ALLAH, the Most benevolent, the Most Courteous

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is carried out by

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under my supervision and that in my judgement, it is fully ample, in scope and excellence, for the degree of Bachelor of Software Engineering in Military College of Signals, National University of Sciences and Technology (NUST), Islamabad.

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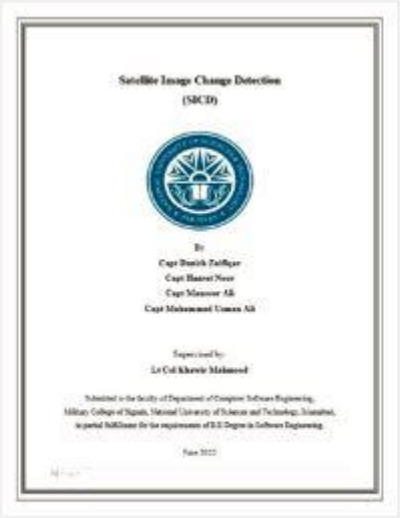
Satellite Image Change Detection
(SICD)

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ABSTRACT

SICD is primarily a machine learning based project that include data analysis and data visualization of images (that will be taken from satellite) of different dates. It will have a dashboard, on which there will be an option to upload two images of different dates and a button to select whether to detect roads or buildings from the image. In this project, we will build a Satellite Image Change Detection System which will take two images of different dates as an input and find the changes between two images. Initially in our project we are training our model for detection of roads in two images and show them side by side to see the change related to roads. The system will be deployed on a website where GUI will be displayed for input of two images. Our model will be trained using tensor flow where training, testing and validation of the dataset will be done. The system will take images and will detect roads and display the roads in grey scale image. We will add option for buildings detection in the interface so that in future, anyone can deploy model related to building detection on website after training the dataset. This project is web-based application so we will be able to access the system from anywhere if we have the IP address for that website.

Table of Contents

List of Figures

CHAPTER 1

INTRODUCTION

Chapter 1 : Introduction

Studies have shown that there remain only few landscapes on the Earth that are still in their natural state. Due to anthropogenic activities, the Earth surface is being significantly altered in some manner and man's presence on the Earth and his use of land has had a profound effect upon the natural environment thus resulting into an observable pattern in the land use/land cover over time. Viewing the Earth from space is now crucial to the understanding of the influence of man's activities on his natural resource base over time. In situations of quick and often unrecorded land use change, observations of the earth from space provide objective information of human utilization of the landscape. Over the past years, data from Earth sensing satellites has become vigorous in planning the Earth's features and infrastructures, handling natural resources and learning environmental change.

1.1 Overview

Remote sensing change detection (CD) is commonly defined as a process to identify differences in geographical surface phenomena over time. CD is also defined as a process to identify significant differences in sequential pixel appearances due to the emergence, disappearance, movement, or shape alteration of objects. The detection process includes the observation and evaluation of differences over time to document the spectral and temporal progression of biophysical and physical phenomena. Remote sensing is defined as the science and art of obtaining information about an object, area or phenomena through the analysis of data acquired by a device that is not in contact with the object, area, or phenomena under investigation. The changes on the surface of the earth occurs due to disasters, deforestation, change in coarse of river, urbanization etc. The earth's surface changes are divided into two categories i.e., land use and land cover. The term land use stands for

the purpose for which the specific piece of land is used for e.g., agriculture, urbanization, mining, etc. The term land cover stands for the features which are present on the earth's surface for e.g., buildings, pavement, trees etc. If the change detection of the earth's surface is done timely and accurately then the relationship and interaction between natural phenomena and humans can be better analyzed and understood as a result of which better management and use of resources can be done. Change detection involves the application of multi-temporal datasets to quantitatively analyze the changes of land cover classes. The change detection can be done by traditional methods and by using remote sensing technologies. The traditional methods are expensive, time consuming and not so accurate whereas all these problems do not infer with remote sensing technology.

1.2 Objectives of SICD

SICD project is primarily be focusing on machine learning using deep learning and data visualization techniques to detect roads, buildings and changes in two different images. This tool will help intelligence agencies, students, land development authorities and military to find out the desired detection and changes from the image uploaded by using SICD.

1.3 Problem Statement

Pakistan is a developing country and its cities Islamabad, Karachi, Lahore, Multan, Rawalpindi and Peshawar have witnessed remarkable expansion, growth and developmental activities such as building, road construction and deforestation since its inception in 1947 just like many other cities in Pakistan. This has therefore resulted in increased land consumption and a modification and alterations in the status of her land use land cover over time without any detailed and comprehensive attempt to evaluate this status as it changes over time with a view to detecting the land consumption rate and also make attempt to predict same and the possible changes that may occur in this status

so that planners can have a basic tool for planning. It is therefore necessary for a tool such as this to be carried out for Islamabad and other cities and this will avoid the associated problems of a growing and expanding city like many others in the world.

1.4 Proposed Solution

The major goal of our proposed solution is to identify any changes made in the area in terms of roads in Pakistan. A web base application will be made to identify the selected change in the image. The proposed Satellite Image Change Detection is capable of learning and extracting the roads from the image.

1.5 Working Principle

The project mainly works on the principles of image processing merged with machine learning algorithms. The project is divided into different modulus and every module is inter-woven with the next module. The list of modules is as under:

- Datasets and annotations
- Dataset training and processing
- Road extraction
- Grey Scale Road Output
- GUI presentation

1.5.1 Datasets and annotations:

The integral part of the project is the preparation of datasets. The dataset comprises of images of various type of roads, buildings and railway tracks along with labels for roads. Road dataset is of main importance in our project.

1.5.1.1 Custom Road Dataset:

This project uses a custom build dataset of roads along with their masking for its use. The images are gathered, filtered and annotated to obtain coordinates of the object of interest.

1.5.2 Dataset training and processing:

The prepared dataset is used as input to train object detection models using machine learning.

1.5.2.1 U-NET Model for Segmentation:

Image segmentation is a computer vision task that segments an image into multiple areas by assigning a label to every pixel of the image. It provides much more information about an image than object detection, which draws a bounding box around the detected object, or image classification, which assigns a label to the object.

Segmentation is useful and can be used in real-world applications such as medical imaging, clothes segmentation, flooding maps, self-driving cars, etc.

There are two types of image segmentation:

- **Semantic segmentation:** Classify each pixel with a label.
- **Instance segmentation**: Classify each pixel and differentiate each object instance.

U-Net is a semantic segmentation technique originally proposed for medical imaging segmentation. It's one of the earlier deep learning segmentation models, and the U-Net architecture is also used in many GAN variants such as the Pix2Pix generator.

The model architecture is fairly simple: an encoder (for down sampling) and a decoder (for up sampling) with skip connections. As **Figure 1** shows, it shapes like the letter U hence the name U-Net.

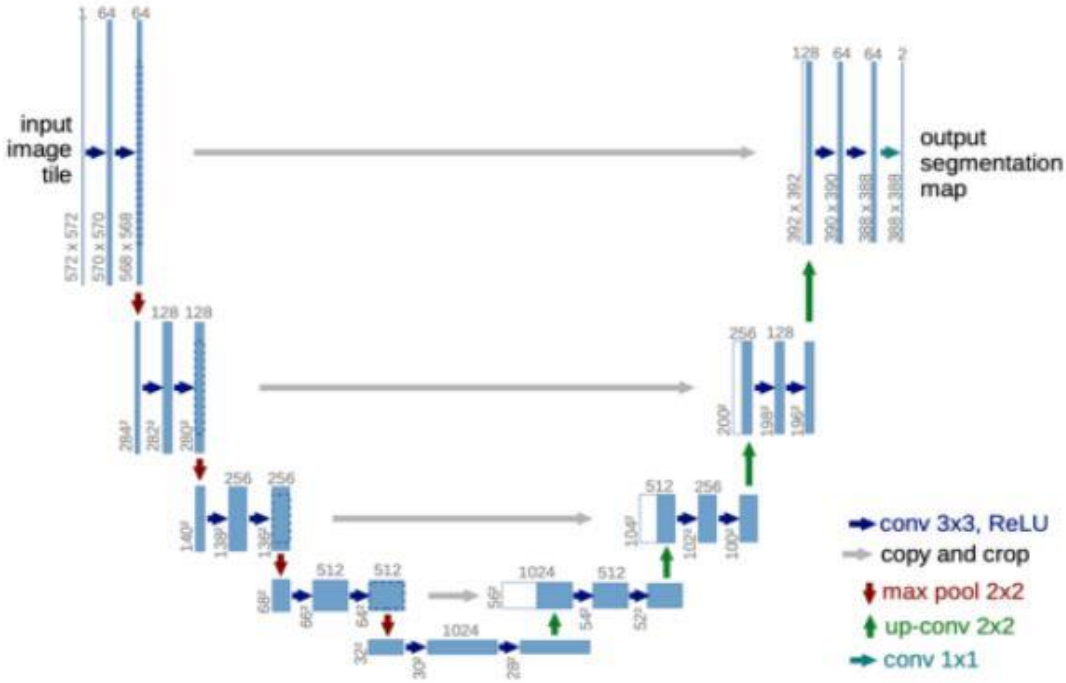


Figure 1: U-Net architecture (image source: **U-Net paper**).

1.5.3 Road Extraction:

The roads are extracted on the basis of road tracks detected from the image and will be according to the labels available in the dataset.

1.5.4 Greyscale Road Outputs:

The extracted outputs, the roads available on the area of image, is used in decision making. The roads will be displayed as an output in greyscale image in which roads will be showed in white on black image.

1.5.5 GUI presentation:

The visual demonstration of the project is done through the aid of GUI (Graphical User Interface).

1.6 Objectives

1.6.1 General Objectives:

"To build an innovative state of the art software integrated hardware prototype powered by Machine Learning (ML) and Internet Protocol (IP) techniques, providing a smart administrative tool to detect the changes in two different images."

1.6.2 Academic Objectives:

- Development of a smart change detection tool (Detection of roads in our study)
- To implement Machine Learning techniques and simulate the results
- To increase productivity by working in a team
- To design a project that contributes to the welfare of society

Chapter 2 contains the Requirement specifications of the project.

Chapter 3 contains the design document and GUI display.

Chapter 4 contains the quality assurance of the project

Chapter 5 includes the conclusion for the project

Chapter 6 highlights the future work needed to be done for the commercialization of this project.

CHAPTER 2

LITERATURE REVIEW

CHAPTER 2 : LITERATURE REVIEW

A new tool is made by studying the different research papers written on the remote sensing change detection. Literature review is an important step for development of an idea to a new product. Likewise, for the making of new tool related to the change detection, a detailed study of the research papers written for this is necessary. Our research is categorized into the following.

- Industrial Background
- Existing solutions and their drawbacks
- Research Papers

2.1 Industrial background

Now a days one of the main issue is the changing state of the earth. Roads, buildings and railway lines etc has totally changed the map and nature of the earth. The detailed study to find the changes made now days in the area is basic need for planning for LDAs (Land Development Authorities), Military agencies and different other organizations, as discussed in the problem statement, that increases need for a tool to automatically detect the roads, buildings and changes in specific time.

Specifically talking about Pakistan, it has witnessed remarkable expansion, growth and developmental activities such as building, road construction, deforestation and many other anthropogenic activities since its inception in 1947 just like many other countries in world. It is therefore necessary for a tool such as this to be carried out for Islamabad and other cities and this will avoid the associated problems of a growing and expanding city like many others in the world.

2.2 Existing solutions

There are many research papers on this study but no solution has yet been made to solve this issue. Different papers show different ways of machine learning to solve this problem but no paper has given the solution in form of tool. There is a technique used to detect the edges as shown below but we will use U-Net Segmentation technique to train the model for the tool.

2.2.1 Systems using edge detection techniques

To detect roads, different detection techniques can be used to detect roads and measure their densities to find changes. Different edge detection techniques are hence being provided for this purpose including Robert, Sober, Prewitt and Canny. Each of the techniques has its own advantages along with the disadvantages. However, many other techniques are being provided now which has replaced detection using these filters because of their less effectiveness.

CHAPTER 3

REQUIREMENT ANALYSIS

CHAPTER 3 : REQUIREMENT ANALYSIS

3.1 Purpose

This project finds its scope wherever there is road, a building and a railway track. It is an innovating state of the art software integrated hardware prototype powered by machine learning and image processing techniques, providing a smart administrative tool to extract the roads from the uploaded image and extraction of railway tracks and building (will be done in future) in order to find the changes found in the area. The aim of this project is to produce a land use land cover map of Islamabad at different epochs in order to detect the changes that have taken place particularly in the built-up land and subsequently predict likely changes that might take place in the same over a given period. The purpose of remote sensing techniques is to monitor and analyze environmental issues at the global, national, and regional level. The purpose of change detection is to analyze the variability in the images related to a specific area that is captured over a distinct period of times. In this technique satellite images taken on the earth's surface are analyzed to identify the spatial and temporal changes that have occurred naturally or manmade. Real-time prediction of change provides an understanding related to the land cover, environmental changes, habitat fragmentation, coastal alteration

3.2 Project Scope

This project finds its scope wherever there is road, a building and a railway track. It is an innovating state of the art software integrated hardware prototype powered by machine learning and image processing techniques, providing a smart administrative tool to extract the roads from the uploaded image and extraction of railway tracks and building (will be done in future) in order to find the changes found in the area.

3.3 Overall Description

3.3.1 SICD Perspective

This SICD will be useful in following perspective:

- Easily accessible to all intended users
- It can be useful for area land studies
- Improvements can be made in SICD as per public feedback
- New features can be added

3.3.2 SICD Functionalities

Functional Requirements

- Detection of roads in greyscale image
- It will have option for roads and building detection
- Data visualization of resulted roads (in greyscale) and buildings (in rectangular box)
- User Interface will be managed and maintained by Django
- Have an option to reuse the page multiple times

Non-Functional Requirements

- **Requirements for Performance**
    - Must have PC or mobile phone available

- **Safety and Security Requirements**

There is not any specific security requirement as this is an open web application. Any user can access this for the detection of roads from the image. There is no need for registration so there is no need for security.

- **Software Quality Attributes**
    - It is easy to use/operate
    - It is easy in understanding
    - Its maintainability is easy
    - It has an accuracy of up to 97%
    - It is compatible with any windows/Linux/iOS (compatibility)
- **Usability**

Usability is an important criterion in the development of SICD. When a user chooses an option for detection of roads the model will detect the road from the image. The GUI for data visualization is easy as it will show results in grey scale image.

- System is easily accessible to all intended users

3.3.3 Operating Environment

This is a web-based application. The software and technologies used are mentioned below:

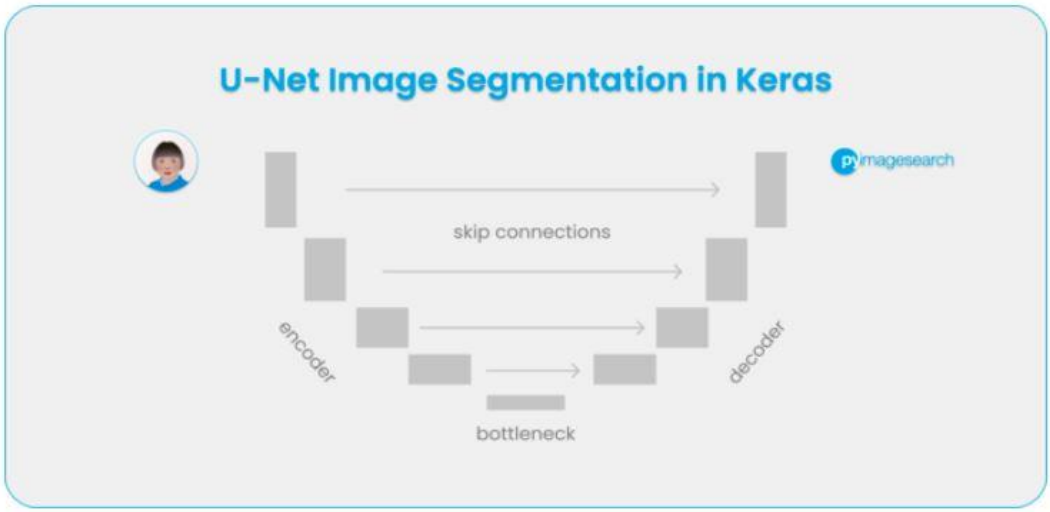
1. **Development Technologies**
    - Python
    - TensorFlow
    - UNET Model
2. **Deployment Technologies**

- G unicorn
- Nginx
- Docker
- Git & GitHub

3. **Cloud Infrastructure**
    - Google Compute Engine instance with 4 virtual CPUs & 16 Gb RAM

3.3.4 Developing

The most important module in this project is training and testing of the dataset. We have used UNET model for the image preprocessing and segmentation of roads.



UNET Model for Image Segmentation

Key Features

- Can support any kind of system even a mobile phone
- Result will be shown in greyscale image i.e., roads will be marked in white on black background

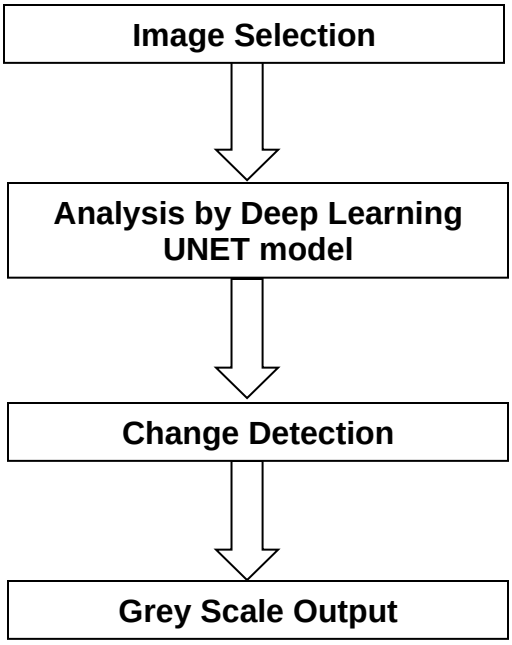


Figure 2

3.3.5 User Documentation

Final delivery of the product will be a web application that will be deployed on Django. User documentation will be delivered with the final product. User manual that will have diagrams, text and instructions for better understanding of the tool SICD.

3.3.6 Assumptions

a. Assumption is that the user should have some basic knowledge of computer.

b. The users are dependent on the customer support and tutorials in the start to learn about use of tool and how the system works.

c. We are presumptuous that all the users have basic knowledge of using internet as there are numerous platforms which the user might have already used.

CHAPTER 4

SICD DESIGN

CHAPTER 4: SICD DESIGN

This design document encapsulates all functional requirements and illustrates how they conceptually interact. The low-level design also reveals how these requests have been executed. The document's purpose is to provide details about the design and the design process to stakeholders. This document will assist the developer in implementing the functionality and making it easier to comprehend.

4.1 Purpose

The goal of this Design Document is to offer a detailed explanation of the system's design so that software development may start with a clear knowledge of what needs to be developed and how it should be developed. The Design Document contains the necessary information to create a detailed description of the software and system to be constructed. The goal of this article is to offer a design view of the SICD as well as full explanation of it. It will describe the system's goal and characteristics, as well as the system's interfaces, what the system will perform, its complete process in detail, the limitations under which it must work, and how the system will react to inputs and outputs. This paper is primarily meant for the system's stakeholders and developers.

4.2 Project Scope

The Scope of project is to initially take two images from the user and let him choose the desired attribute that need to be filtered and will give output in greyscale image. The system for now will only detect roads from the image but will be able to identify buildings and a difference image for both an image from the user and find the desired attributes as selected by the user.

4.3 System Overview

4.3.1 SICD Perspective

This Design document outlines all of our functional requirements and shows how they abstractly connect to one another. The low-level design also shows how we've been implementing and how we'll be implementing all of these requirements. For the time being, this low-level design does not address any non-functional criteria that our system has, as stated in the SRS Document.

4.3.2 Description of System Architecture

The overall architecture of the system is explained in this part, as well as the introduction of numerous components and sub systems. It is mainly supported by System Architecture diagram which shows an insider's perspective of the system by describing the high-level software components that performs the major functions to make the system operational.

4.3.3 Structure and Relationships

This section ponders upon the interrelationships and dependencies among various components. It is mainly described by a diagram which is further augmented by explanatory text. UML Class diagram also helps us understanding the system structure.

4.3.4 UML Class Diagram

UML Class diagram further manifests the description of low-level components of the software that include data storage and state details, thus making the system adequately comprehensible.

4.3.5 UI Issues

The key concepts of the product's user interface are presented in this section. The part is explained by an overall graphic that is supplemented with explanatory text, but doesn't go into technical specifics. Moreover, Activity Diagrams, Sequence Diagrams and UI diagrams also elaborate the user interface issues in a more intelligent manner.

4.3.6 Diagram of Activity

Activity Diagrams use a workflow-based method to represent the system's overall operation. They're a great way to illustrate how different stages are engaged in significant tasks inside a system that utilizes a flow chart design without having to go into the technical intricacies.

4.3.7 Diagram of Sequence

Sequence diagrams depict how various elements are engaged in the completion of a system's operation. They have a distinctive structure that allows the reader to observe how many objects are employed in relation to how long they take to complete a system need.

4.3.8 UI Design

Few images of GUI are present in this section that prototype the way a user shall be communicating with the system to get the desired results.

4.4 System Architecture

In this section, the overall architecture of the system is discussed, including the introduction of various components and subsystems. It is mainly supported by System Architecture diagram which

shows an insider's perspective of the system by describing the high-level software components that perform the major functions to make the system operational.

4.5 Modules Overview

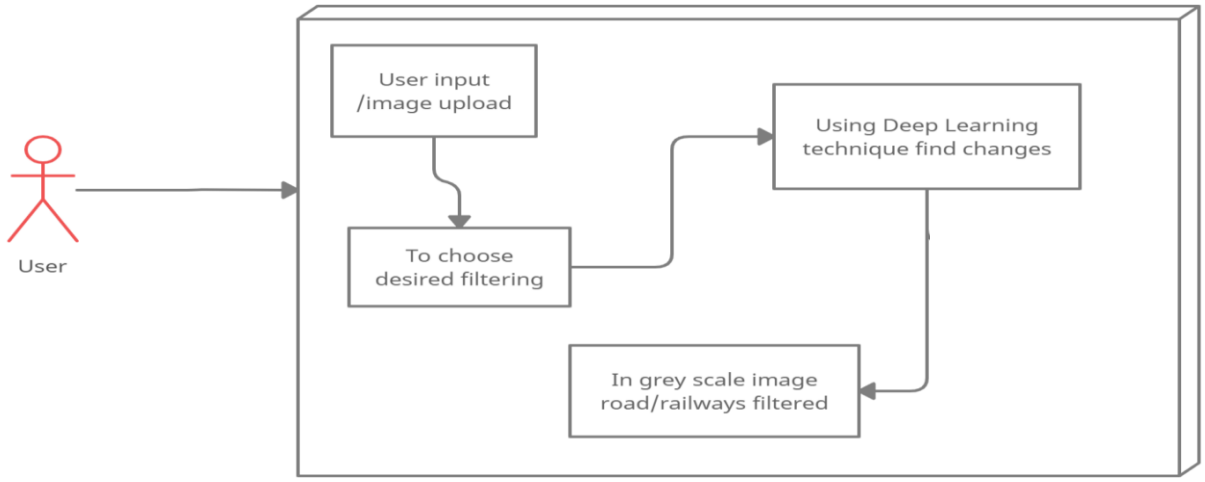


Figure 3 – Abstract Diagram

Description of Diagram

The System will be built around three primary modules: "Users", "Filtering choice", "Change Extraction tool", "Data Visualizer". It will also have submodules, as depicted in the accompanying abstract diagram. The abstract picture depicts the entire system, from how people interact with it to how data is processed in databases. The Abstract diagram's sub modules are described in further detail below.

4.5.1 Users

Users of the SICD will access the back-end system and then choose inputs/ images to be filtered according to his requirement. The user in this is basically the main and only user

who can use SICD. User can be anyone and do not need to be a registered user and can use application. Firstly, user give two same images of different dates as his input on which he has to choose desired filtering. These images will then be processed by the filtering algorithm to find the changes and finally result will be shown in the form of greyscale image for both and a difference image of both. User can be anyone, Intelligence agencies, Land Development Authorities and Government bodies.

4.5.2 Choosing Desired Filtering/Processing

User will choose the desired detection in the image by choosing the option shown on the screen. Back-end system will then provide a platform to the user to interact and consume the services of the SICD in an effective and more manageable manner.

4.5.3 Change Detector

Change detector will process the images by using one hot encoding and deep learning technique to find the desired changes as selected by the user and provide the facility to reuse it.

4.5.4 Data Visualizer

This will visualize data (the resultant from change detector) in the form of a greyscale image for both the images and a resultant difference of both the images (future work).

4.6 Block Diagram

The principal parts of the SICD are shown in the figure and their relation is defined by the connection between them. The details of all the modules are also given below:

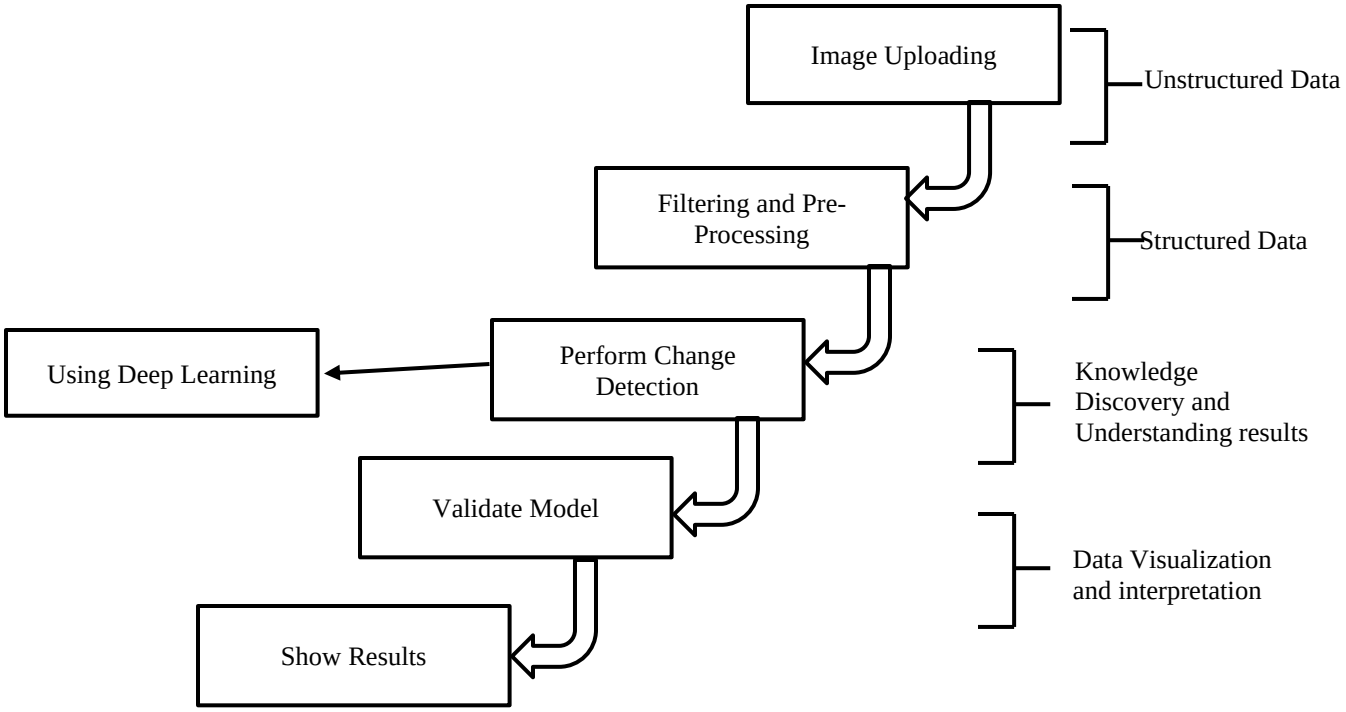


Figure 4 – Block Diagram

4.6.1 Block Diagram Description

- SICD will find roads, railway lines and buildings
- User can input an image of different dates
- It will only be used for detecting changes in an image
- Results from change detector will be visualized

4.7 Use-Case Diagram

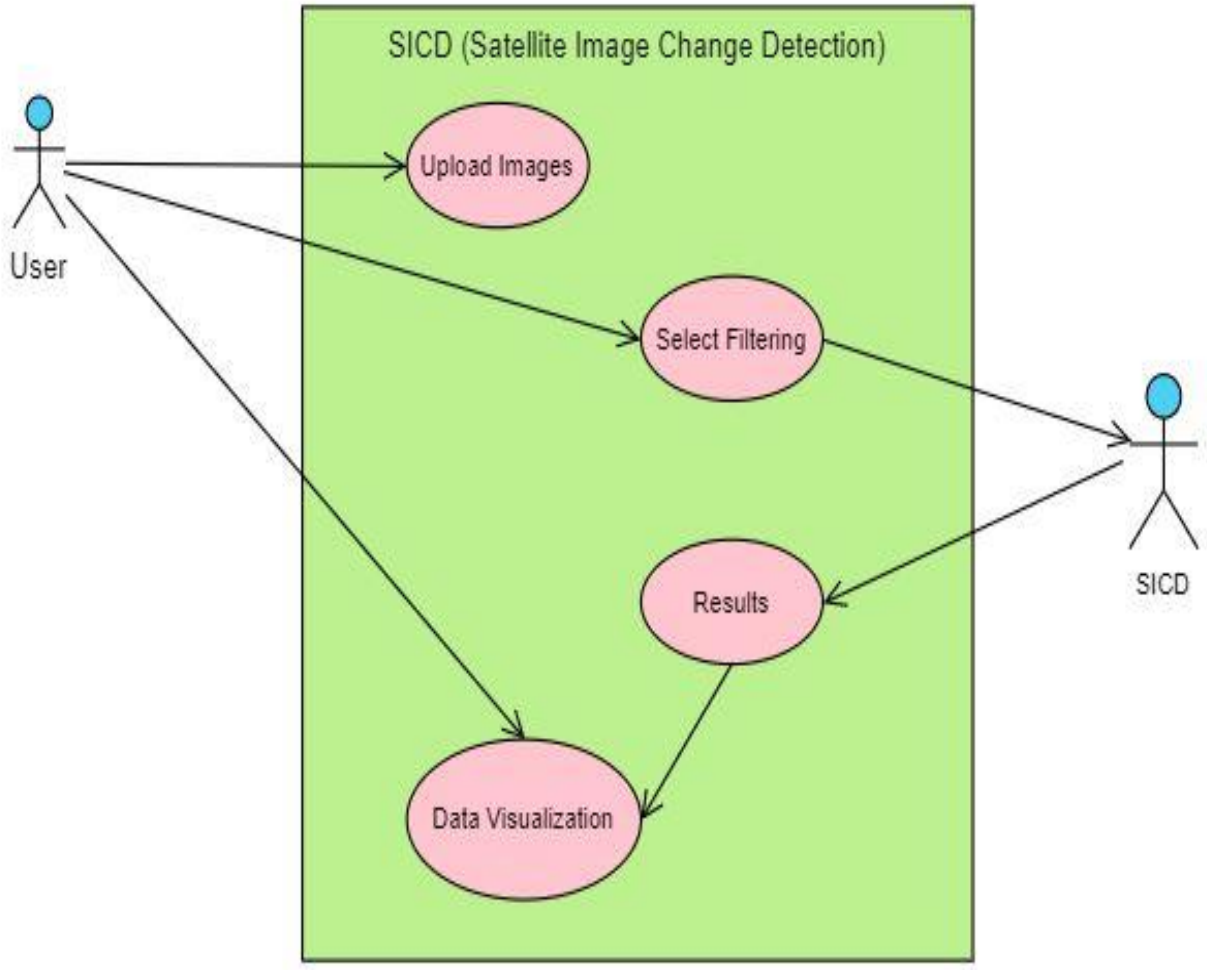


Figure 5 – Use Case Diagram

User will upload images of different dates in which he wants to detect roads or buildings. User will choose option from road and railways that needs to be filtered out. SICD tool will process the result and a greyscale output image will be displayed to the user.

4.8 Class Diagram

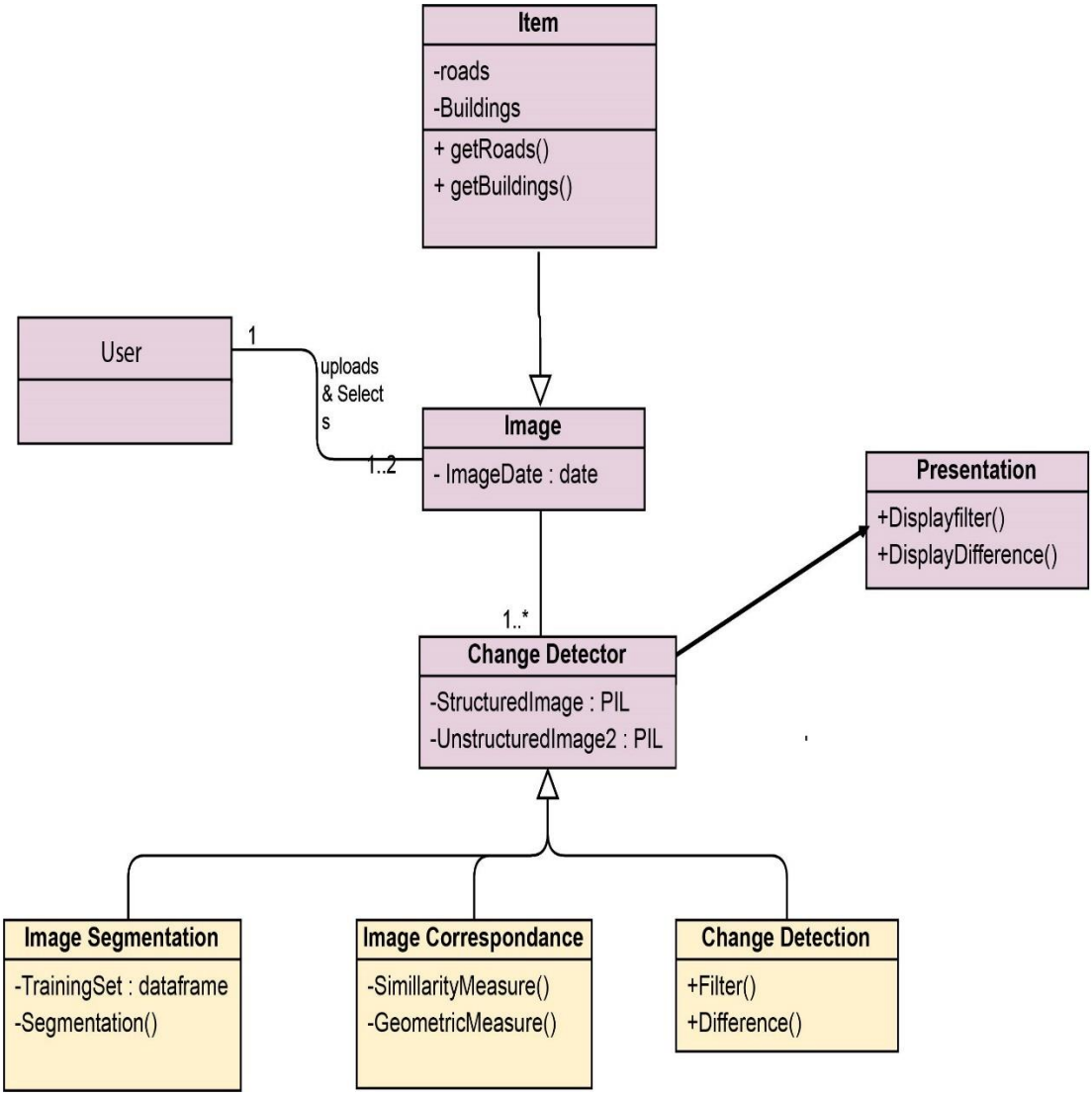


Figure 6 - Class Diagram

Class Name	Description
User	User class contains all the information related to user management. It has aggregation with the other classes of user categorization and the functions that performs all the user management functions.
Change Detector	This Class will take the image uploaded by user and will perform different operations using deep learning and give desired filter selected by user and a difference of both the image uploaded by users.
Image Segmentation	Image segmentation mainly has the role of classifying each pixel of an image into meaningful classes that refer to specific objects. The main deep learning architecture that is used for image segmentation, and generally speaking for image processing, is the Convolutional Neural Network (CNN).
Image Correspondence	This class is used to find a similarity measure that helps us to know that the masks are extracted from the same geographic region despite of the applied transformation. We use SIFT image matching algorithm to detect the interest points in both masks
Change Detection	After computing the similarity measure between the pair of masks and checking that the views correspond to the same scene, we try to find the overlapping regions, scale transformation and difference of image between the pair of masks
Presentation	This class will be responsible for data visualization

4.9 Activity Diagram

4.9.1 User Management

The diagram below shows how user log into the system and are presented with different interfaces depending on their category.

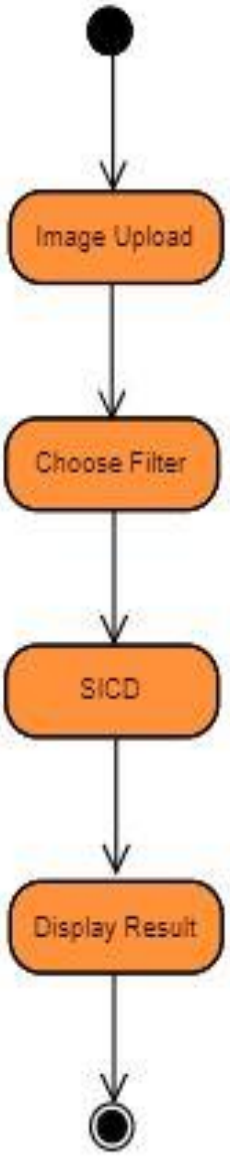


Figure 7-a – Activity Diagram User

4.9.2 Change Detection

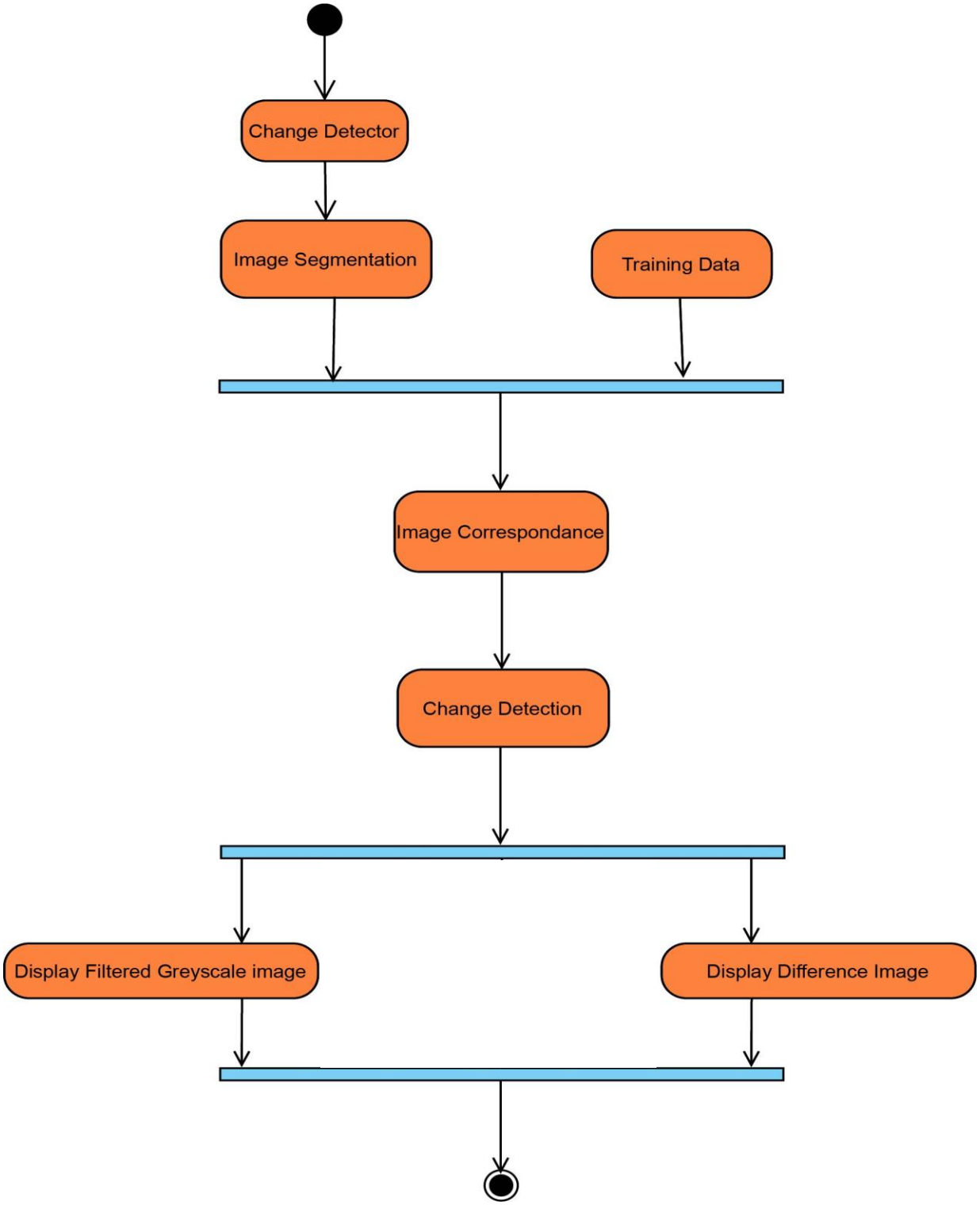


Figure 7-b – Activity Diagram CD

4.10 Sequence Diagram

All the effort is focused for change detection in satellite image. This sequence diagram depicts the procedure involved in the change detection.

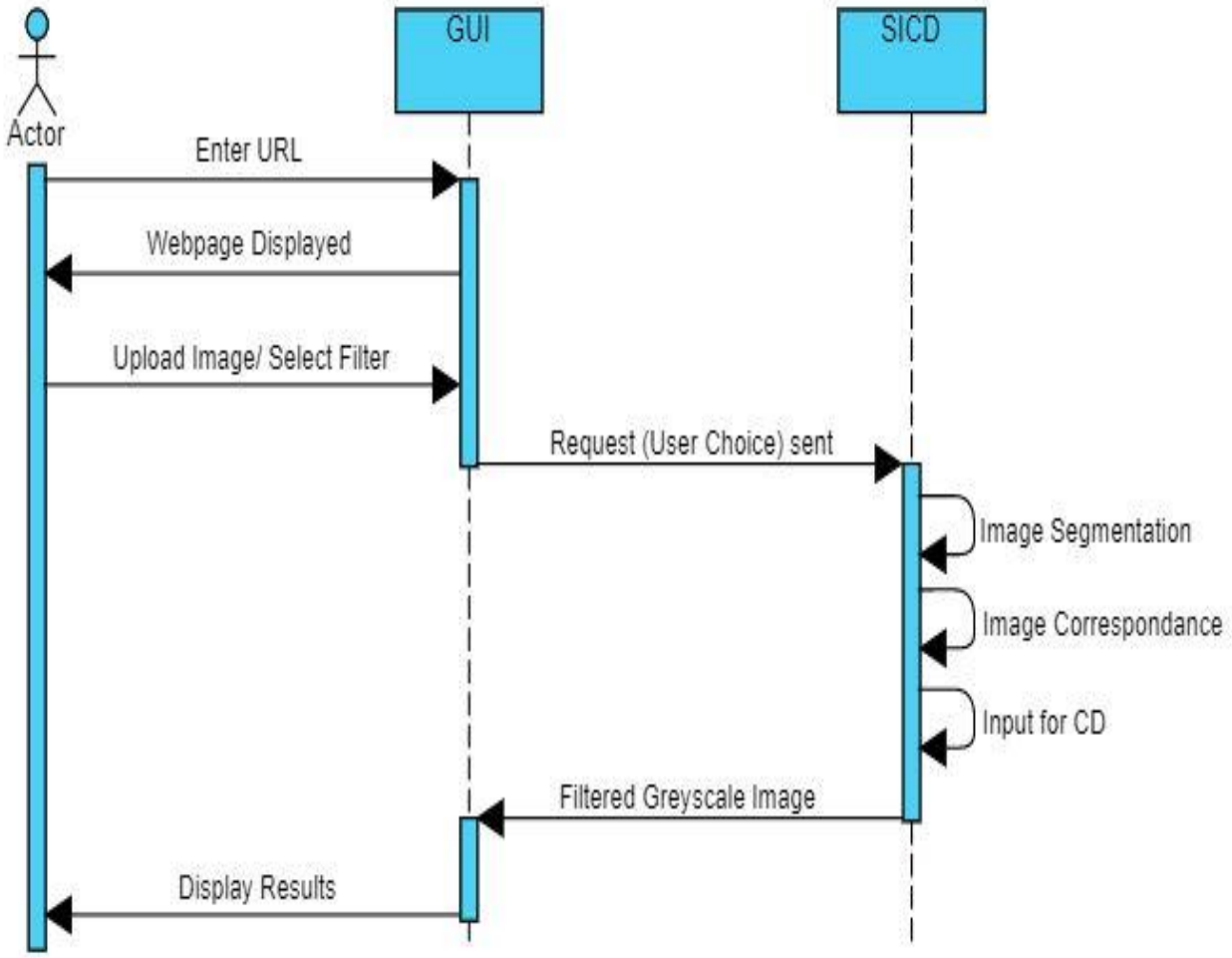


Figure 8 – Sequence Diagram SICD

4.11 User-Interface Design

The system under construction will feature a basic and simple user interface with a very short learning curve and little training to function at optimal efficiency.

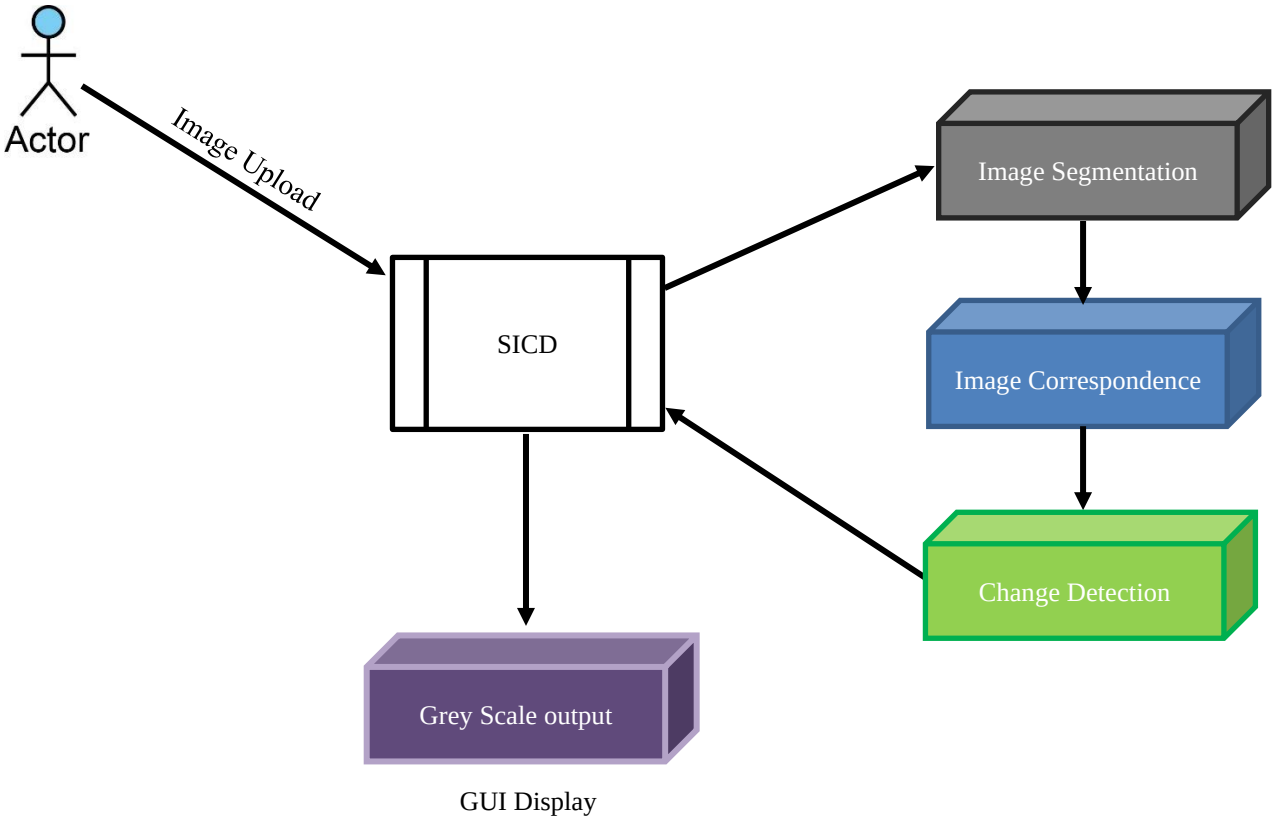


Figure 9 – User Interface

4.11.1 Main Page

This is the initial screen that will be shown for the home page once URL is entered. Proceed to SICD button will be to direct the user to a new page for image uploading and filtering.

Figure – 10 Main Page

4.11.2 Image Upload screen

In this user will be able to upload image and select the desired attribute as per his/her requirement. Re-use button is to return the user back to image uploading page for further use.

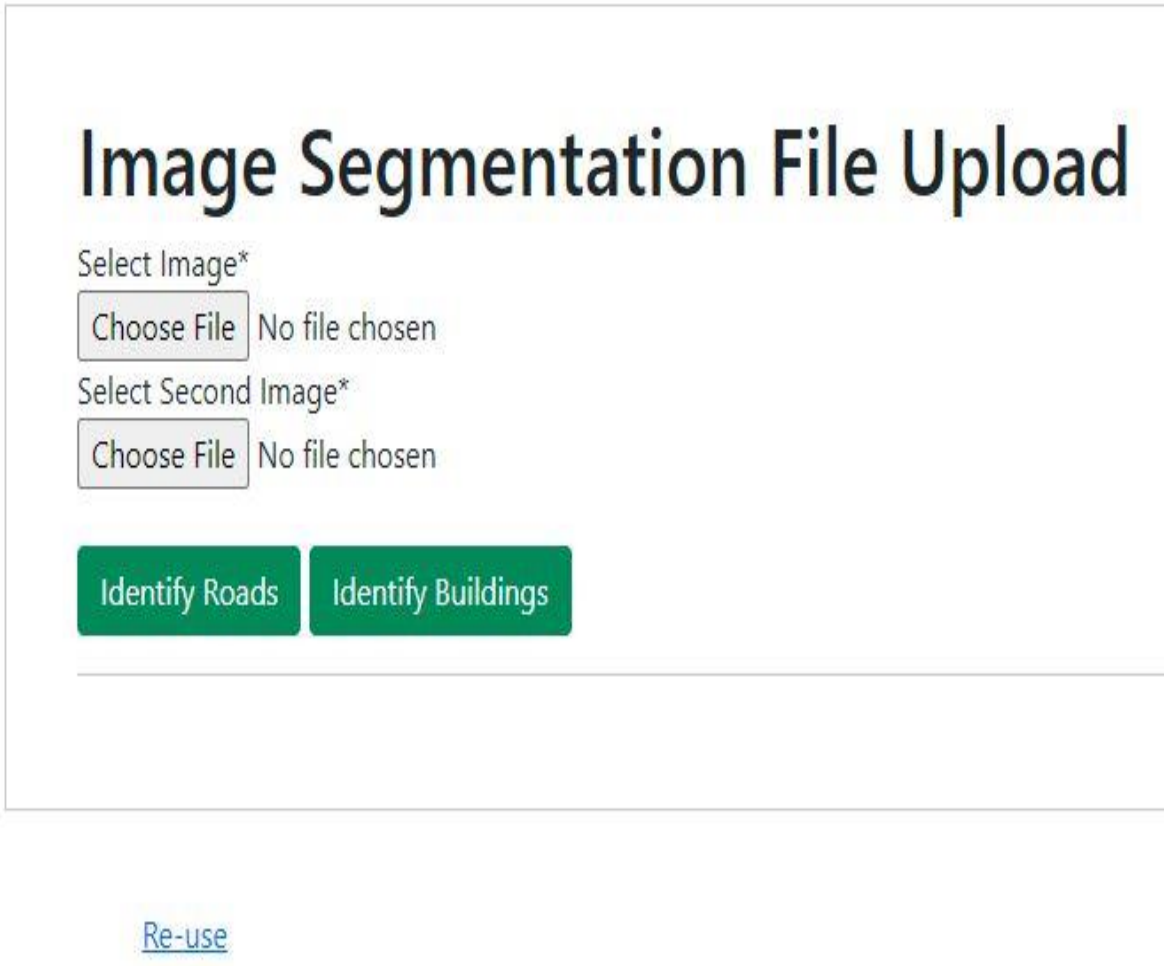


Figure 11 – Image Upload

4.11.3 Final Output

As we are only doing the roads detection so only roads can be filtered by this tool in greyscale image as shown below. Two images can be of two different dates to see the results side by side to compare the area roads. Final output for the image will be shown as below.

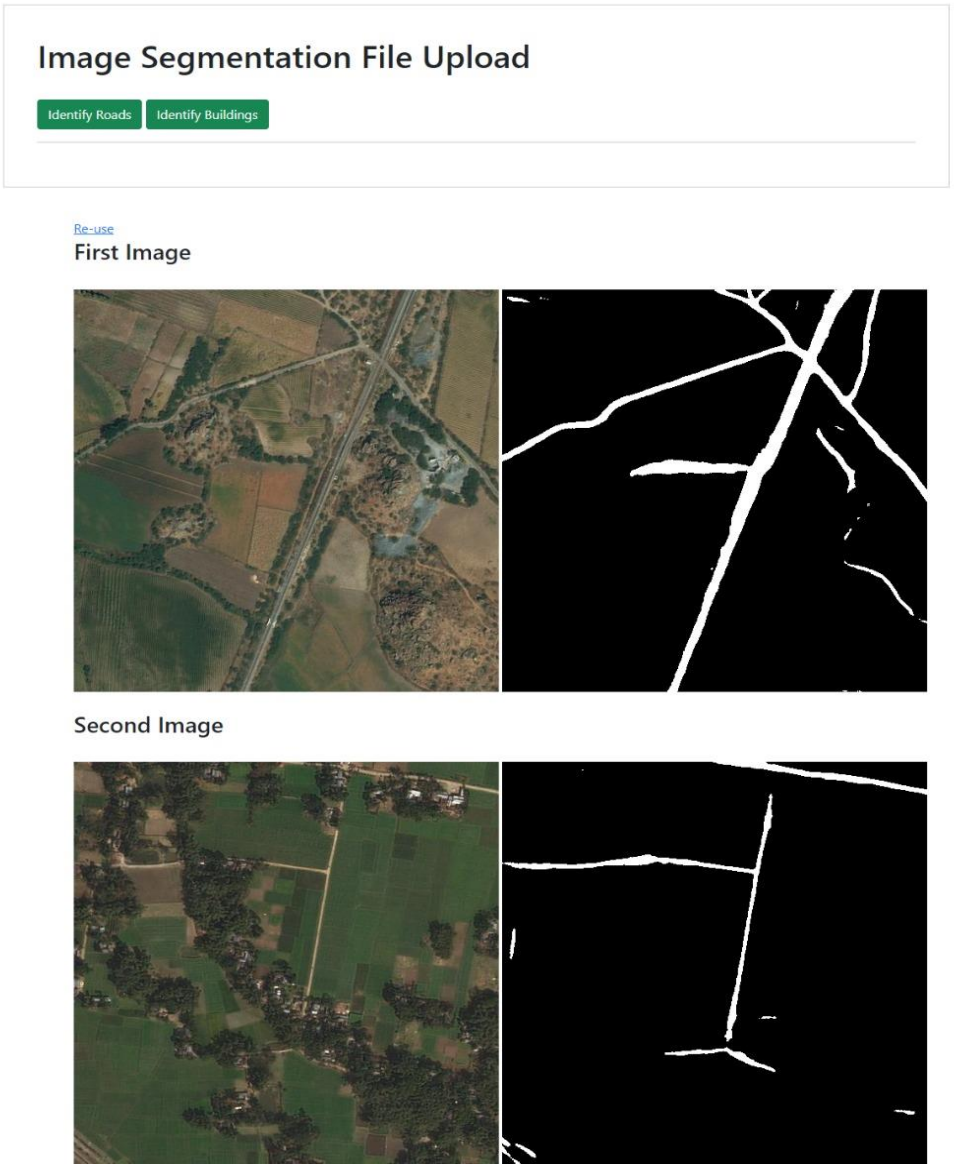


Figure 12 – Output of Tool

CHAPTER 5

QUALITY ASSURANCE

CHAPTER :5 QUALITY ASSURANCE

The relevant strategies, process and techniques utilized to design, execute and manage testing of the “Satellite Image Change Detection” are described in this test plan document. The test strategy will verify that the application’s criteria and standards are met to an approved level by the end user.

Manual testing will be used, which entails testing software without the use of any automated tools or scripts. In this scenario, the tester assumes the role of an end-user and tests the application for any abnormal behavior or bugs. All functional, application performance and use case criteria mentioned in the requirement document are covered by the test scope. Software testing can be done at any point during the development phase, depending on the testing approach used. However, after the requirements have been developed and the coding process has been done, the majority of the testing work happens.

5.1 Test Items

- Development of test scenarios
- Execute multiple tests based on the above-mentioned test scenarios that have been generated
- Inform the appropriate developer or management about any bugs
- Develop and provide test results
- Manage or incorporate adjustments at a later stage in projects development

5.2 Features Required to be Tested

Following features are used:

- User will be able to open the software page by entering URL

- User will be able to proceed to change detection page
- User will be able to upload two different images
- User will be able to select option for detection of roads
- Results for roads will be displayed in greyscale image
- Result for buildings will be shown by rectangles around buildings (will be done later)

Unit Testing: Unit testing is the responsibility of developers. Each module's component's implementation will be checked individually.

Integration Testing: The integration test case will be executed when the unit test has passed over the chosen quality level. It's critical to test the product as a black-box after all of the modules have been integrated.

Positive and Negative Testing: This method will be used in conjunction with unit and integration testing. Test cases are written in scenarios that are evident and guarantee that all functional criteria are met. Furthermore, many test cases will be presented to demonstrate how the program responds to invalid operations.

5.3 Pass or Fail Measure

Details of the test cases are specified in section Test Deliverables. Following the principles written below, a test item would be judged as pass or fail.

- Pre-conditions satisfied
- Inputs carried out as per plan
- The output matches what was specified in output => Passed

- The system does not function or does not meet the output requirements => Failed

5.4 Standard for Deferral and Renewal Requirements

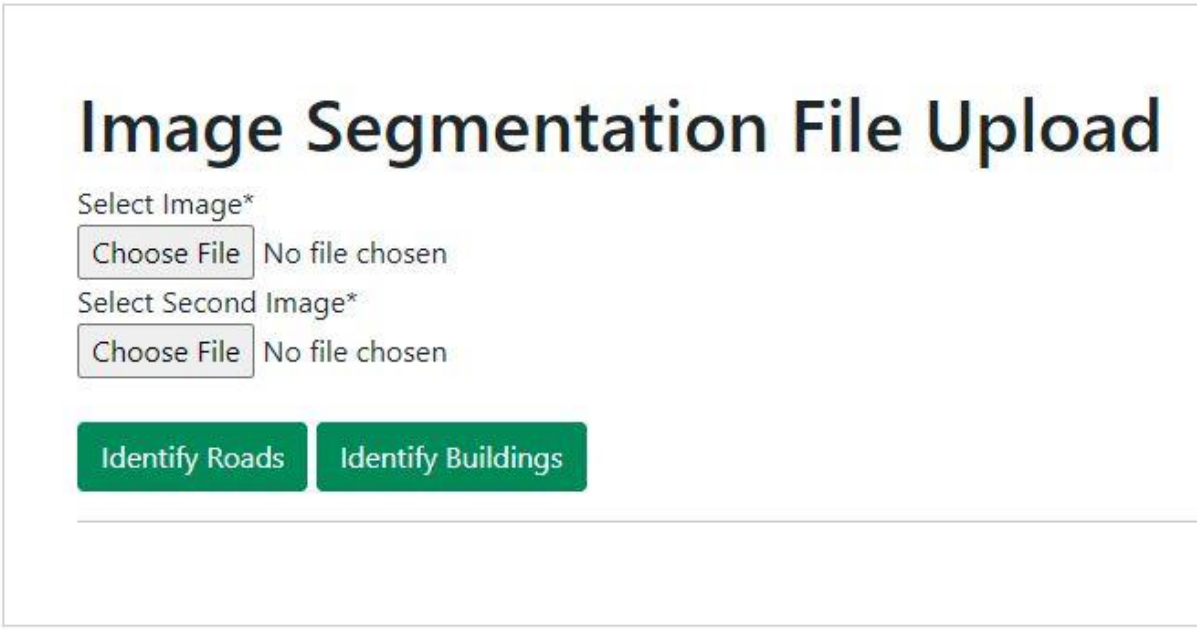
Developers can rapidly correct any flaws discovered, eliminating the need to restart the testing process from the start. However, when serious flaws prevent certain test cases from running because they are interdependent, testing must be suspended.

5.5 Test Deliverables

Following are the Test Cases:

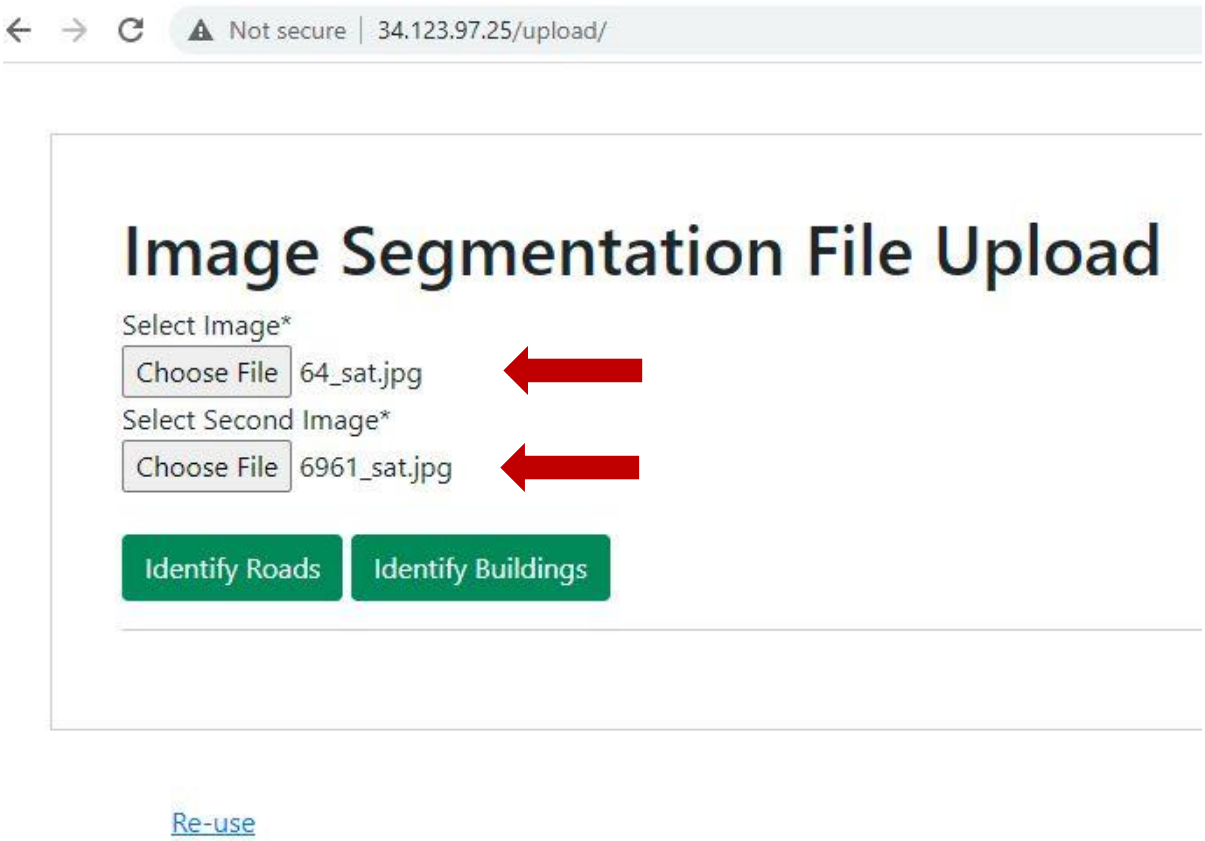
Test Case Number	1
Test Case Name	Open SICD
Description	Testing application whether it runs on web browser or not
Testing Techniques	Unit Testing, Black Box Testing
Preconditions	Web browser will be there on your system
Steps	Open web browser Enter URL of SICD
Status	Test Case Passed Successfully

Test Case Number	2
Test Case Name	Move to Segmentation
Description	Choose Images for filtering
Testing Technique	Unit Testing, Black Box Testing
Input Values	Click on “Proceed to SICD” button
Expected Output	Image Segmentation file upload page will be displayed
Actual Output	Image Segmentation page displayed
Status	Test Case passed successfully



Re-use

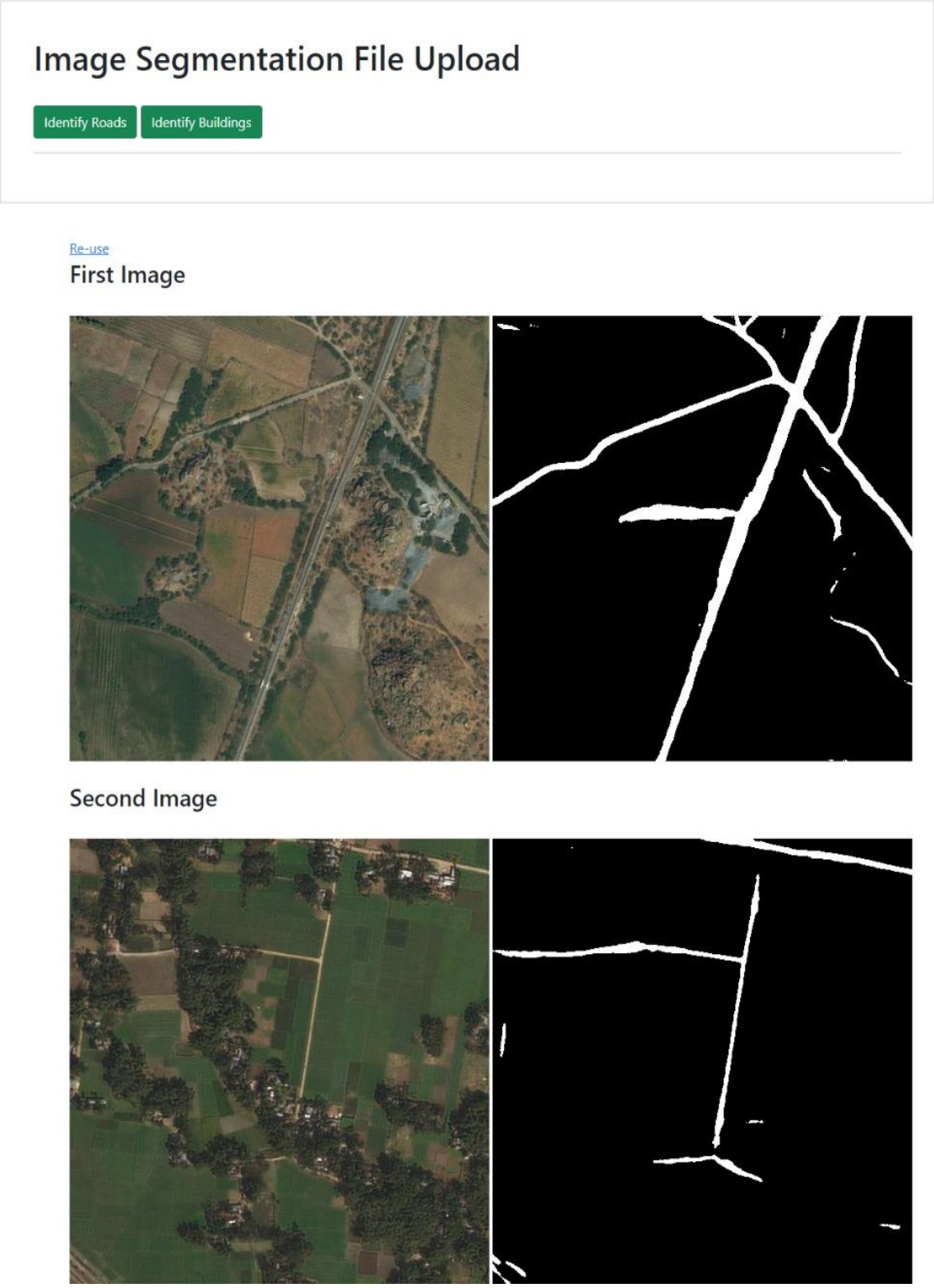
Test Case Number	3
Test Case Name	Image Selection
Description	Choose two images of different dates
Testing Technique	Unit Testing, Black Box Testing
Input Values	Click on choose image
Expected Output	Image will be uploaded
Actual Output	Image uploaded
Status	Test Case passed successfully



Re-use

Test Case Number	4
Test Case Name	Identify Roads
Description	Roads will be filtered in greyscale
Testing Technique	Unit Testing, Black Block Testing
Input Values	Click on Identify Roads button
Expected Output	Roads will be displayed in greyscale
Actual Output	Roads displayed in greyscale

Status	Test Case successfully passed



CHAPTER 6

CONCLUSION

Chapter 6: Conclusion

Studies have shown that there remain only few landscapes on the Earth that are still in their natural state and need to be studied. In this thesis, we discussed a image change detection tool that can take images as an input and filter roads from it by using deep learning. Change detection (CD) is commonly defined as a process to identify differences in geographical surface phenomena over time. The major goal of our proposed solution is to identify any changes made in the area in terms of roads in Pakistan. A web base application will be made to identify the selected change in the image. The project mainly works on the principles of image processing merged with machine learning algorithm i.e., UNET segmentation model. This system will take images of two different dates from user and will display roads (in future) as an output. This will display roads in greyscale side by side to compare both the images of different dates taken from satellite.

CHAPTER 7

FUTURE WORK

CHAPTER 7: FUTURE WORK

Future milestones that need to be achieved to commercialize this project are the following.

77.1 Identification of buildings and Railway Tracks:

The building and railway tracks are also the main part in this project that need to be identified once user clicks on identify buildings or identify railway tracks. In future model will be trained on building and railway track dataset following almost the same code as for the roads. Dataset will be available that have labels for each image in form of rectangle along the buildings and masking in greyscale for railway tracks like roads. Once the model is trained it will be able to make a rectangle alongside all the buildings and a greyscale output for railway tracks present in the image uploaded.

7.2 Difference Image:

Dataset for difference image will be trained with the same code for roads and system will be able to identify the difference amongst both the images uploaded.

7.3 Vehicle and Person Tracking:

Later in this project model can be trained for vehicle and person tracking in a live video. This requires lot of system along with a database which makes this costly but this can be done for commercial purposes.

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