RAJALAKSHMI ENGINEERING COLLEGE

RAJALAKSHMI NAGAR, THANDALAM – 602 105

RAJALAKSHMI
ENGINEERING COLLEGE
An AUTONOMOUS Institution
Affiliated to ANNA UNIVERSITY, Chennai

CP23211 ADVANCED SOFTWARE ENGINEERING LAB

Laboratory Record
Note Book

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Semester: ……II…….……

Academic Year: ……2023 - 2024……

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Certified that this is the bonafide record of work done by the above student in the CP23211-Advanced Software Engineering Laboratory during the year 2023- 2024

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Submitted for the Practical Examination held on 22/06/2024

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REMOTE SENSING IMAGE RECOVERY AND ENHANCEMENT BY JOIN BLIND DENOSING AND DEHANCING

OVERVIEW OF THE PROJECT:

Remote Sensing Image Recovery and Enhancement by Joint Blind Denoising and Dehazing aims to significantly improve the quality of remote sensing images used in environmental monitoring, urban planning, and disaster management. By developing an advanced system that simultaneously removes noise and haze from images through sophisticated blind denoising and dehazing algorithms, the project enhances the clarity and detail of remote sensing data. This automated solution provides users with high-quality images, enabling better analysis and decision-making, and includes user-friendly interfaces for easy image upload and retrieval, as well as robust image storage capabilities.

SOFTWARE REQUIREMENTS SPECIFICATION (SRS)

EXP.NO: 1 **DATE: 20.2.2024**

CONTENTS

REMOTE SENSING IMAGE RECOVERY AND ENHANCEMENT BY JOIN BLIND DENOSING AND DEHANCING

1. Introduction

1.1 Purpose:

Remote Sensing Image Recovery and Enhancement by Joint Blind Denoising and Dehazing project is to develop an advanced system that significantly enhances the quality of remote sensing images by simultaneously removing noise and haze. These images are often degraded by various environmental factors, which can obscure critical details necessary for accurate analysis and decision-making in fields such as environmental monitoring, urban planning, and disaster management. By implementing sophisticated algorithms for blind denoising and dehazing, the project aims to provide clearer, more detailed images, thereby improving the reliability and effectiveness of remote sensing data for various practical applications.

1.2 Scope:

Remote Sensing Image Recovery and Enhancement by Joint Blind Denoising and Dehazing project involves developing a comprehensive system for enhancing remote sensing images by simultaneously removing noise and haze. This includes designing a user-friendly interface for image upload, integrating advanced algorithms for blind denoising and dehazing, and ensuring these processes work jointly for optimal results. The project also encompasses applying additional enhancement techniques to improve image clarity, developing an automated image processing pipeline, and implementing a robust storage system for easy retrieval and management of processed images. Furthermore, the scope includes extensive testing and evaluation to ensure high-quality outputs, providing thorough documentation and user support, and incorporating user feedback mechanisms to continually refine the system's performance and usability.

2. Overall Description

2.1 Product Perspective:

The product perspective for the "Remote Sensing Image Recovery and Enhancement by Joint Blind Denoising and Dehazing" project outlines its positioning and interaction within the broader context of remote sensing technology and image processing systems.

2.2 Features

2.2.1. Image Upload and Compatibility:

- User-friendly interface for uploading remote sensing images in various formats.
- Compatibility with commonly used image acquisition systems and formats.

2.2.2 Blind Denoising and Dehazing Algorithms:

- Advanced algorithms for simultaneous denoising and dehazing of remote sensing images.
- Optimization of processing parameters for different types of noise and atmospheric conditions.

2.2.3. Enhancement Techniques:

- Additional enhancement techniques to further improve image clarity and detail post-denoising and dehazing.
- Adaptive enhancement capabilities based on image characteristics and user preferences.

2.2.4. Automated Processing Pipeline:

- Automated workflow for seamless integration of denoising, dehazing, and enhancement processes.
- Batch processing capabilities for efficient handling of multiple images.

2.2.5. Image Storage and Management:

- Secure storage and retrieval system for processed images.
- Metadata handling to preserve and manage important information associated with each image.

2.2.6. Quality Evaluation and Metrics:

- Metrics and tools for evaluating the quality and effectiveness of image enhancement.
- Visual comparison tools to assess improvements in image clarity and detail.

2.2.7. User Interface and Accessibility:

- Intuitive dashboard and user interface for easy navigation and interaction.
- Support for both desktop and web-based platforms for accessibility.

2.3 User Classes and Characteristics:

- System Administrators: Proficient in system administration and maintenance. Ensure the system operates smoothly and securely.
- Developers and Technicians: Skilled in software development, algorithm implementation, and system integration. Continuously improve and update algorithms and system functionalities.

3. Specific Requirements

3.1 Functional Requirements:

3.1.1 Image Upload and Compatibility:

- **Requirement:** The system should allow users to upload remote sensing images in various formats commonly used in the field.
- **Rationale:** Users need flexibility to input images acquired from different sensors and platforms.

3.1.2 Simultaneous Blind Denoising and Dehazing:

- **Requirement:** Implement advanced algorithms that can concurrently remove noise and haze from remote sensing images.
- **Rationale:** Enhance image clarity and detail by addressing common distortions caused by environmental conditions.

3.1.3 Additional Image Enhancement:

- **Requirement:** Apply supplementary enhancement techniques post-denoising and dehazing to further improve image quality.
- **Rationale:** Ensure the processed images meet high-quality standards suitable for detailed analysis and decision-making.

3.1.4 Automated Processing Pipeline:

- **Requirement:** Develop an automated workflow that seamlessly integrates

denoising, dehazing, and enhancement processes.

- **Rationale:** Improve operational efficiency by reducing manual intervention and streamlining image processing tasks.

3.1.5 Image Storage and Retrieval:

- **Requirement:** Provide a secure storage system for storing processed images and enable easy retrieval by users.
- **Rationale:** Facilitate efficient management and access to enhanced images for subsequent analysis and applications.

3.1.6 Quality Evaluation Metrics:

- **Requirement:** Define metrics and tools to evaluate the effectiveness and quality of denoising, dehazing, and enhancement processes.
- **Rationale:** Ensure transparency and reliability in assessing the performance of the image processing algorithms.

3.1.7 User Interface and Accessibility:

- **Requirement:** Design a user-friendly interface that allows intuitive navigation and interaction with the system functionalities.
- **Rationale:** Enhance user experience and usability, catering to users with varying levels of technical expertise.

3.1 Non-Functional Requirements:

3.1.2 Usability

- Design a user-friendly interface that is intuitive and easy to navigate, requiring minimal training for users.
- Enhance user adoption and satisfaction, enabling efficient interaction with system functionalities.

3.1.3 Performance

- The system should process images efficiently, aiming for real-time or near-real-time performance for denoising and dehazing operations.
- Users require timely results to support decision-making processes in dynamic environments such as disaster response.

3.1.4 Security

- Implement stringent security measures to protect sensitive data, ensuring confidentiality, integrity, and availability.
- Safeguard against unauthorized access, data breaches, and malicious attacks.

4 External Interface Requirements

4.1 User Interfaces:

- Develop a web-based or desktop application with an intuitive and user-friendly interface for uploading images, configuring processing parameters, and downloading enhanced images.
- Enhance user experience and facilitate easy interaction with the system's functionalities.

4.2 Hardware Interfaces:

Image Acquisition Devices

- Compatibility with various remote sensing image acquisition devices such as satellites, drones, and ground-based sensors.
- Ensure the system can receive input directly from different hardware sources used to capture remote sensing data.

Processing Hardware

- **Requirement:** Adequate processing power (CPU, GPU) to handle complex denoising and dehazing algorithms in real-time or near-real-time.
- Optimize system performance for efficient image processing and enhancement tasks.

Storage Devices

- **Requirement:** Reliable storage solutions (e.g., hard drives, cloud storage) to store large volumes of remote sensing images and processed data securely.
- Enable scalable storage capacity and data management capabilities for enhanced images.

4.3 Software Interfaces:

Operating Systems:

- The system must be compatible with major operating systems, including iOS, Android, Windows, and macOS.

Web Browsers:

- The web-based version of the system must support popular browsers like Chrome, Firefox, Safari, and Edge.

5 Conclusion

The integration of joint blind denoising and dehazing represents a significant advancement in the field of remote sensing. By improving image quality and reliability, this method enhances the overall utility of remote sensing data, contributing to more informed decision-making and better outcomes in various applications.

SCRUM METHODOLOGY

EXP.NO: 2 **DATE: 01.3.2024**

1. Introduction

Implementing the Scrum methodology for the "Remote Sensing Image Recovery and Enhancement by Joint Blind Denoising and Dehazing" project involves adapting its principles and practices to manage the development and enhancement of the image processing system effectively

2. Objectives

Enhance the visual quality and clarity of remote sensing images. Simultaneously perform denoising and dehazing operations on images. Develop an automated system that processes images with minimal user intervention. Implement a storage system for easy retrieval of processed images.

Product Backlog Introduction Prioritized list of features, enhancements, and tasks. Managed by the Product Owner.

3. Product Backlog

The Product Backlog includes requirements for image upload compatibility, denoising and dehazing algorithms, performance metrics, and integration with hardware and software interfaces.

4. User Stories

As a User:

- I want to apply simultaneous blind denoising and dehazing algorithms to enhance remote sensing images, improving visibility and detail.
- I want to receive notifications and updates on system status and new features to stay informed about improvements and enhancement.

5. Sprint

- A time-boxed iteration during which a set of user stories is implemented and tested.

6. Sprint Planning

Plan the work to be completed during the sprint (typically 2-4 weeks). Define sprint goals, select backlog items, and agree on the sprint scope.

7. Sprint Backlog

List of tasks to be completed during the sprint, derived from the Product Backlog and committed to by the Development Team. The Sprint Backlog includes specific tasks such as implementing API interfaces for integration, testing denoising and dehazing algorithms with different image formats, and optimizing system performance.

8. Sprint Retrospective

Reflect on the sprint process, identify strengths, areas for improvement, and plan adjustments for the next sprint. Retrospectives focus on optimizing algorithm performance, refining user interfaces for usability, and enhancing collaboration between development and operations teams.

9. Sprint Review

Demonstrate the completed work (increment) to stakeholders and gather feedback. Review the system's functionality and adapt backlog as necessary. Sprint reviews showcase advancements in denoising and dehazing capabilities, enhancement techniques, and user interface improvements based on stakeholder input

10. Software Used

- Development Platform: Integrated Development Environment (IDE), Python, GitHub, SVN, Docker, PostgreSQL, MySQL, MongoDB, User Interface.

11. Conclusion

Remote Sensing Image Recovery and Enhancement by Joint Blind Denoising and Dehazing" aims to significantly improve the quality and usability of remote sensing data through advanced image processing techniques. The adoption of the Scrum methodology ensures a structured approach to development, emphasizing iterative progress, stakeholder collaboration, and responsiveness to evolving requirements. Key roles like the Product Owner, Scrum Master, and Development Team play critical roles in driving the project forward, ensuring alignment with user needs and delivering valuable increments of functionality with each sprint.

USER STORIES

EXP.NO: 3 **DATE: 12.3.2024**

As a Researcher:

User Story 1: I want to upload remote sensing images in various formats (e.g., TIFF, JPEG) so that I can analyze and enhance them using the system's denoising and dehazing algorithms.

Acceptance Criteria:

- The system should support uploading of images from different sources and formats.
- Uploaded images should be processed seamlessly without loss of quality.

User Story 2: I want to integrate the system with existing GIS and remote sensing platforms via APIs for seamless data exchange and workflow integration.

Acceptance Criteria:

- The system should provide well-documented APIs for data retrieval and integration.
- Integration should enable automated data transfer and synchronization with external systems.

As a User

User Story 1: I want to apply simultaneous blind denoising and dehazing algorithms to enhance remote sensing images, improving visibility and detail.

Acceptance Criteria:

- The system should integrate algorithms that effectively reduce noise and haze from images.
- Enhanced images should demonstrate improved clarity and fidelity suitable for detailed analysis.

User Story 2: I want to receive notifications and updates on system status and new features to stay informed about improvements and enhancement.

Acceptance Criteria:

- The system should notify users of completed processing tasks and system updates.
- Notifications should be customizable and delivered through preferred communication channels

As a GIS Analyst

I want to visualize side-by-side comparisons of original and enhanced remote sensing images to evaluate the effectiveness of denoising and dehazing processes.

Acceptance Criteria:

- The system should provide a user-friendly interface for comparing images before and after processing.
- Users should be able to toggle between original and enhanced views for detailed examination.

As a System Administrator

I want to monitor and optimize the performance of denoising and dehazing algorithms to ensure efficient processing of large volumes of remote sensing data.

Acceptance Criteria:

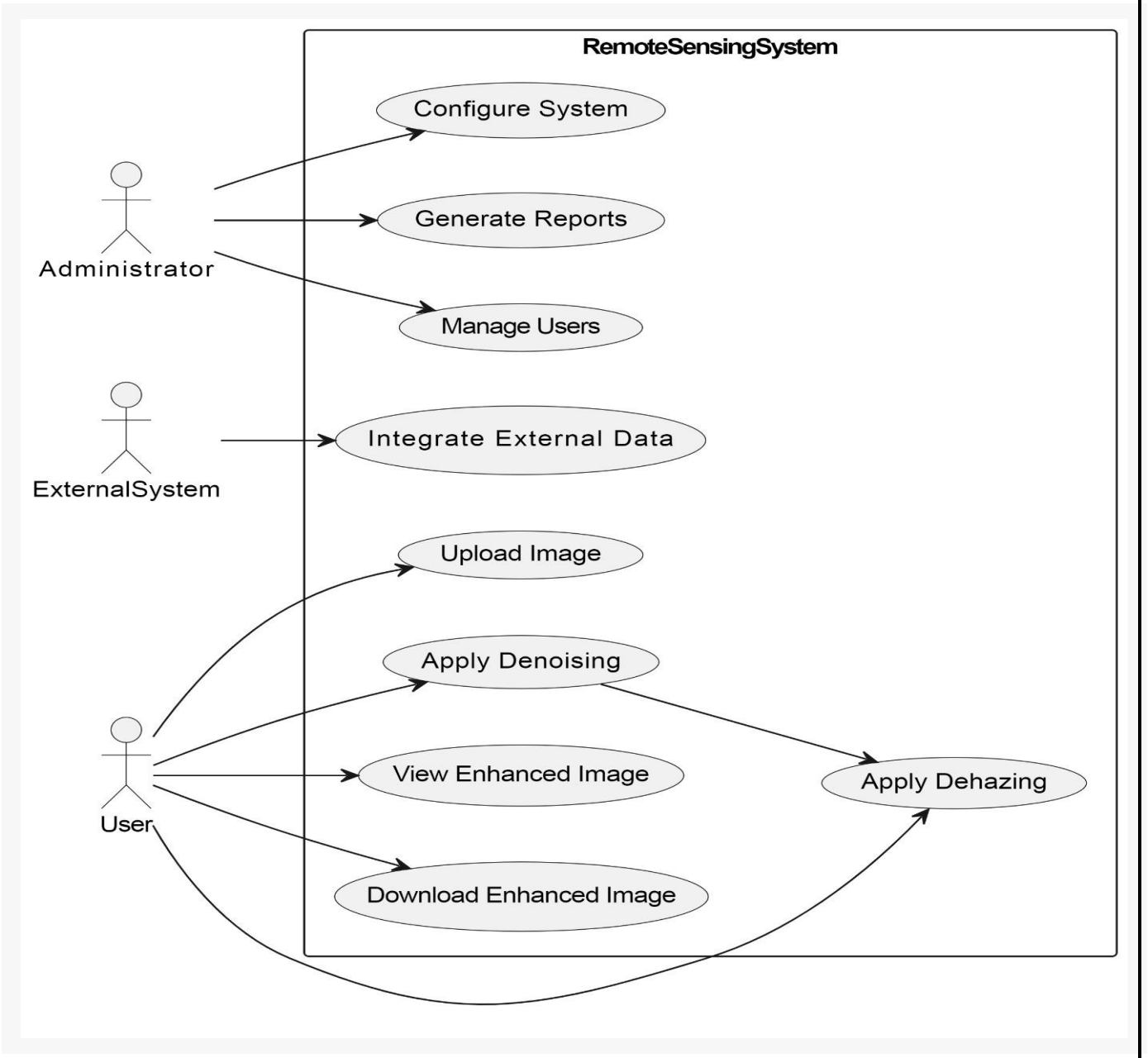
- The system should include performance metrics (e.g., processing time, resource utilization).
- Administrators should have access to tools for tuning algorithm parameters to achieve optimal results.

As a Decision-Maker

I want to download enhanced remote sensing images in standard formats for further analysis and reporting.

USE CASE DIAGRAM

EXP.NO: 4 **DATE: 19.3.2024**



NON-FUNCTIONAL REQUIREMENTS

EXP.NO: 5 **DATE: 29.3.2024**

1. Performance

The system should process and enhance remote sensing images within a reasonable time frame, depending on the size and complexity of the image. It should handle multiple image processing requests concurrently to support a scalable number of users. Optimize CPU, memory, and storage usage to efficiently perform denoising and dehazing algorithms.

2. Security

Ensure that sensitive data, including uploaded images and processing results, are securely stored and transmitted. Enforce role-based access control (RBAC) to restrict system functionalities based on user roles (e.g., user, administrator). Require secure authentication mechanisms (e.g., username/password, multi-factor authentication) for user access.

3. Usability

Provide an intuitive and responsive user interface that allows users to easily upload, process, and download enhanced images. Offer comprehensive documentation including user guides and system manuals to assist users and administrators. Ensure adequate training resources and support channels to assist users in utilizing the system effectively.

4. Reliability

The system should be available for use during designated operational hours with minimal downtime. Implement mechanisms to recover from failures gracefully and ensure continuity of service. Provide informative error messages and logs to aid in diagnosing.

5. Scalability

The system should scale horizontally to handle increasing numbers of users and image processing demands. It should scale vertically to accommodate larger image sizes and more complex processing algorithms.

6. Maintainability

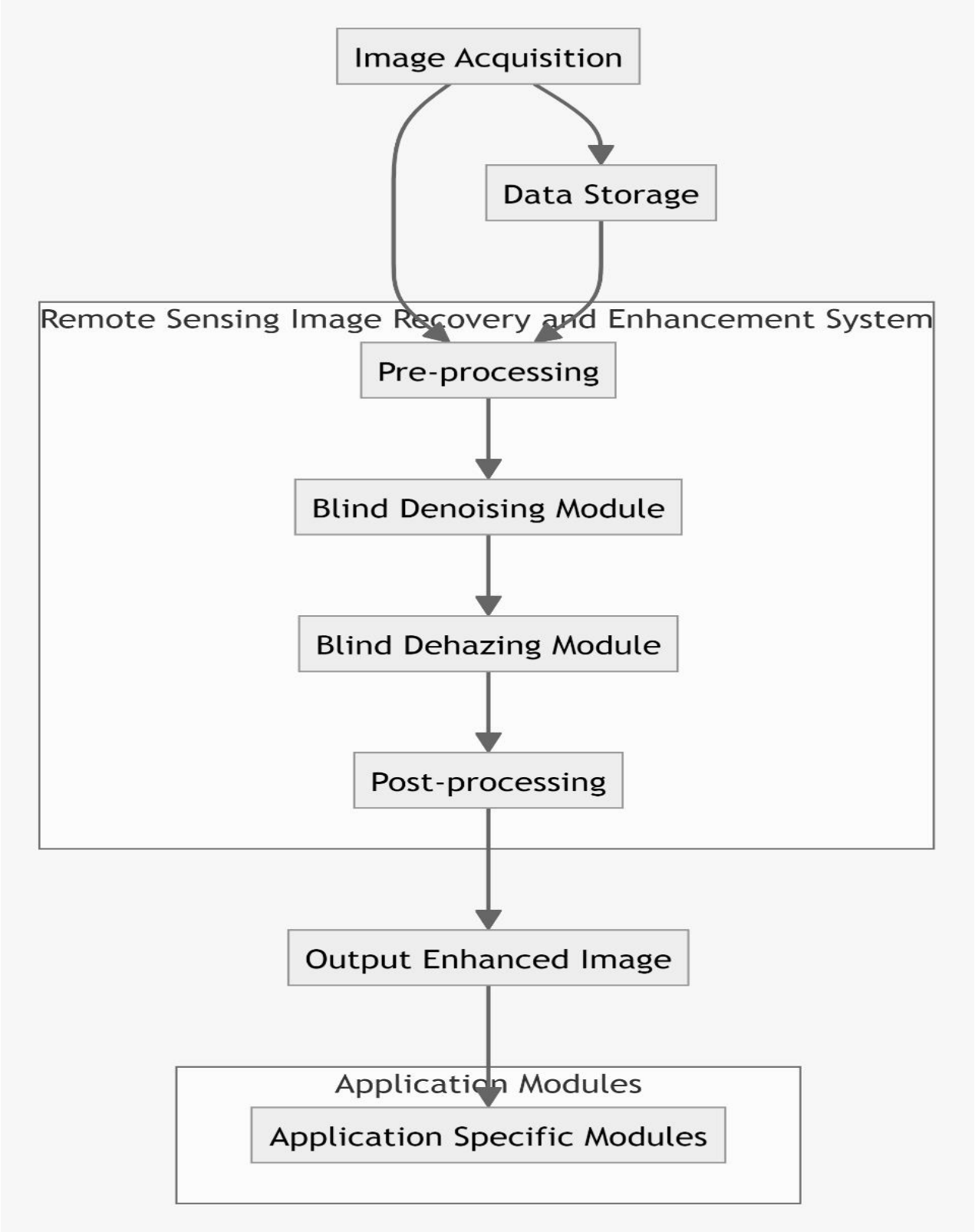
The code base should follow standard coding practices and be well-documented to facilitate understanding and modifications by different developers. Modular design principles should be applied, allowing individual components to be updated or replaced without affecting the entire system.

7. Compliance

Adhere to data protection regulations (e.g., GDPR, HIPAA) regarding the handling and storage of sensitive information. Ensure algorithms and processes align with ethical guidelines for handling potentially sensitive content like hate speech or inappropriate

OVERALL PROJECT ARCHITECTURE

EXP.NO: 6 **DATE: 09.4.2024**



Components:

Image Acquisition: Capture remote sensing images using satellites, drones, or other aerial devices. Data Sources: Multispectral, hyperspectral, thermal, and optical sensors.

Data Storage: Store raw remote sensing images and intermediate processing results.

Technology: Cloud storage, databases, or local storage systems.

Pre-processing: Prepare images for processing by performing initial adjustments such as resizing, format conversion, and preliminary noise reduction.

Techniques: Normalization, contrast adjustment, and initial filtering.

Blind Denoising Module: Remove noise from the images without prior knowledge of the noise characteristics. Machine learning-based denoising algorithms, wavelet transforms, and statistical methods.

Blind Dehazing Module: Remove haze and improve image clarity, enhancing visibility and detail. Atmospheric scattering models, deep learning-based dehazing algorithms, and image enhancement techniques.

Post-processing: Final adjustments to enhance the image quality further, such as sharpening, color correction, and fine-tuning.

Techniques: Histogram equalization, unsharp masking, and edge enhancement.

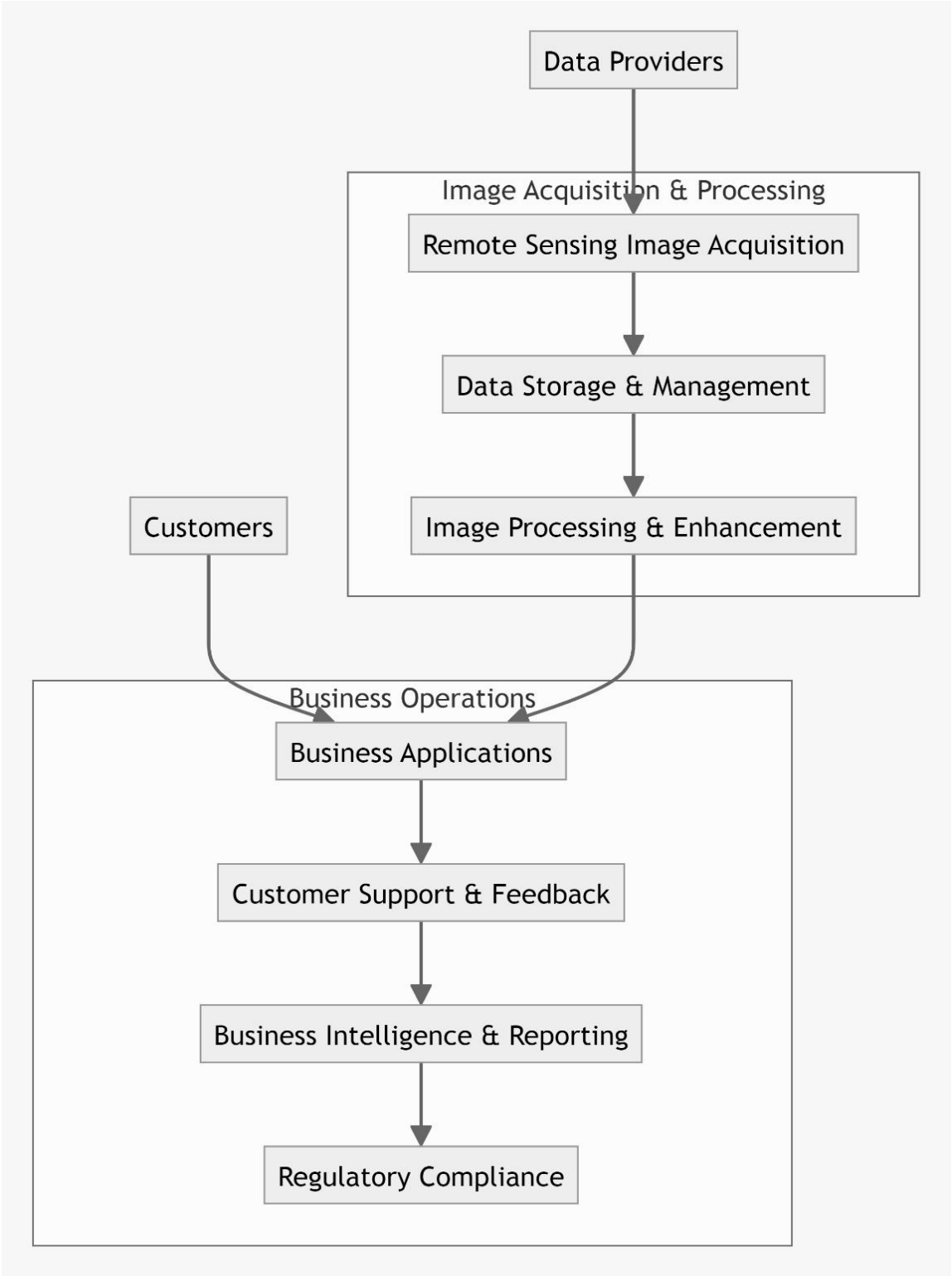
Output Enhanced Image: Provide the final enhanced image ready for application-specific use. Various image formats (e.g., TIFF, JPEG, PNG).

Application Specific Modules: Utilize enhanced images for specific applications such as environmental monitoring, urban planning, disaster management, agricultural assessment, and military surveillance.

Examples: Object detection, land cover classification, change detection, and anomaly detection.

BUSINESS ARCHITECTURE DIAGRAM

EXP.NO: 7 **DATE: 19.4.2024**



Customers:

Role: End-users of the enhanced remote sensing images. They include government agencies, environmental organizations, urban planners, agricultural firms, and military organizations.

Interaction: Access and utilize enhanced images for various applications.

Data Providers:

Role: Entities that provide raw remote sensing data. These can be satellite operators, drone operators, and other data collection agencies.

Interaction: Supply raw images for processing.

Remote Sensing Image Acquisition:

Role: Capture and collect remote sensing images using various platforms (satellites, drones, etc.).

Interaction: Collect data from various sensors and transmit it to the data storage system.

Data Storage & Management:

Role: Store, manage, and organize raw and processed remote sensing images.

Interaction: Provide secure and efficient data storage solutions.

Image Processing & Enhancement:

Role: Process raw images through joint blind denoising and dehazing techniques to enhance their quality.

Interaction: Apply advanced algorithms to improve image clarity and usability.

Business Applications:

Role: Utilize enhanced images for specific business functions and decision-making processes.

Interaction: Deploy enhanced images in applications such as environmental monitoring, urban planning, disaster management, agricultural assessment, and military surveillance.

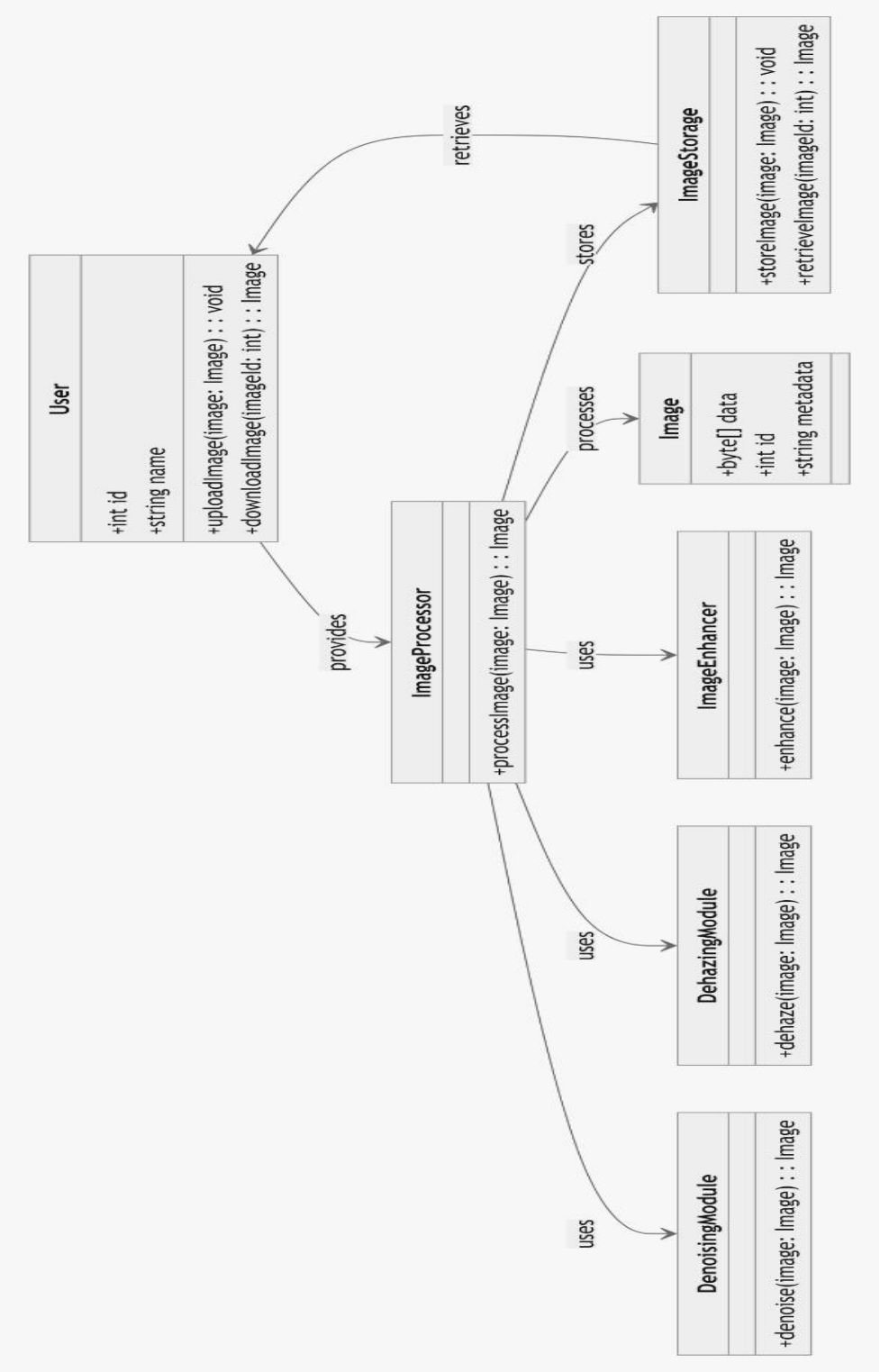
Customer Support & Feedback:

Role: Provide support to customers, gather feedback, and ensure customer satisfaction.

Interaction: Address customer queries, collect feedback, and improve services based on customer input.

CLASS DIAGRAM

EXP.NO: 8 **DATE: 30.4.2024**

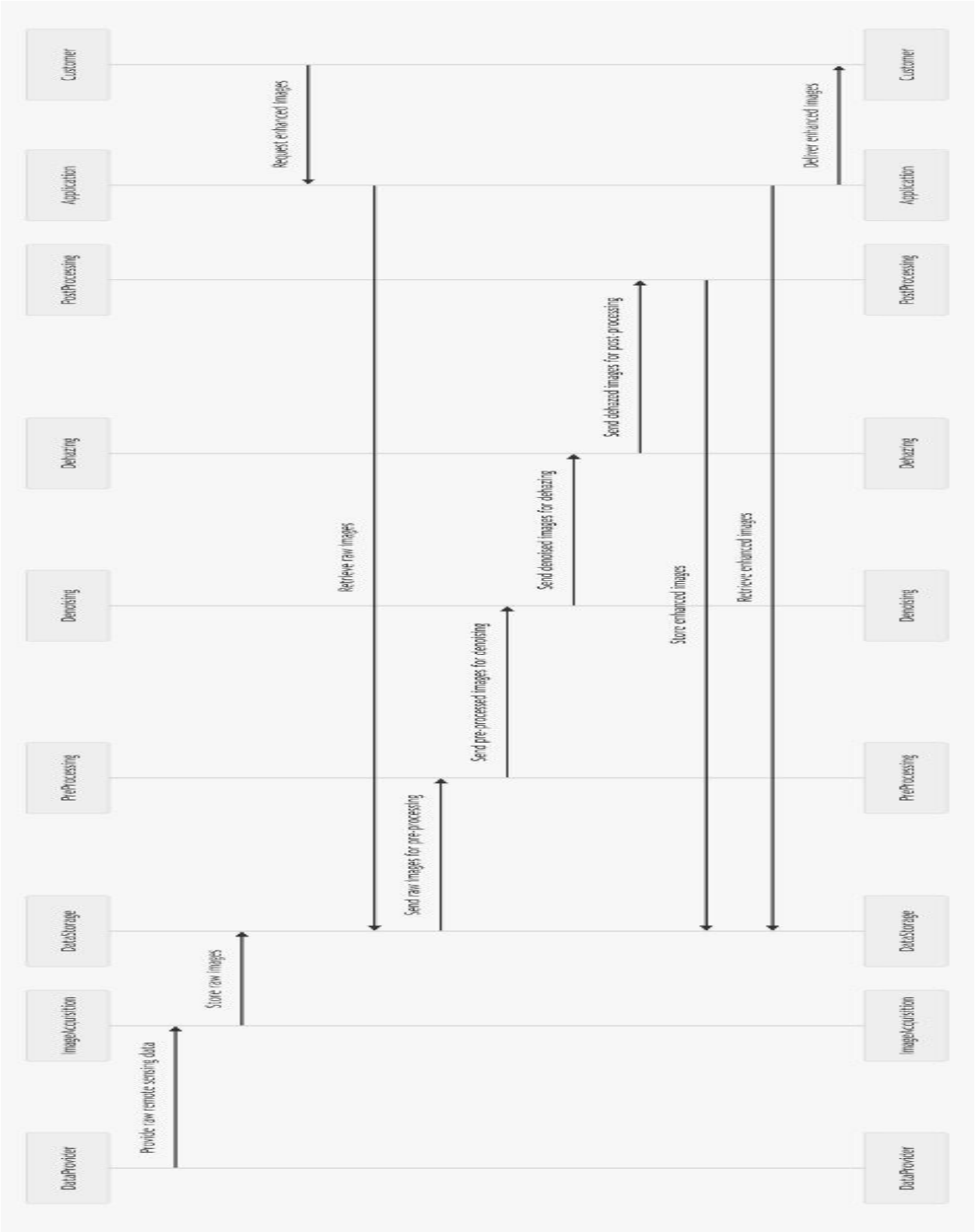


Classes:

- **User**: The user who provides the remote sensing images.
- **ImageProcessor**: The core processor that handles the denoising and dehazing.
- **DenoisingModule**: A module specifically for removing noise from the images.
- **DehazingModule**: A module specifically for removing haze from the images.
- **ImageEnhancer**: A class responsible for enhancing the image quality after denoising and dehazing.
- **Image**: The class representing the remote sensing images.
- **ImageStorage**: A class for storing and retrieving images.

SEQUENCE DIAGRAM

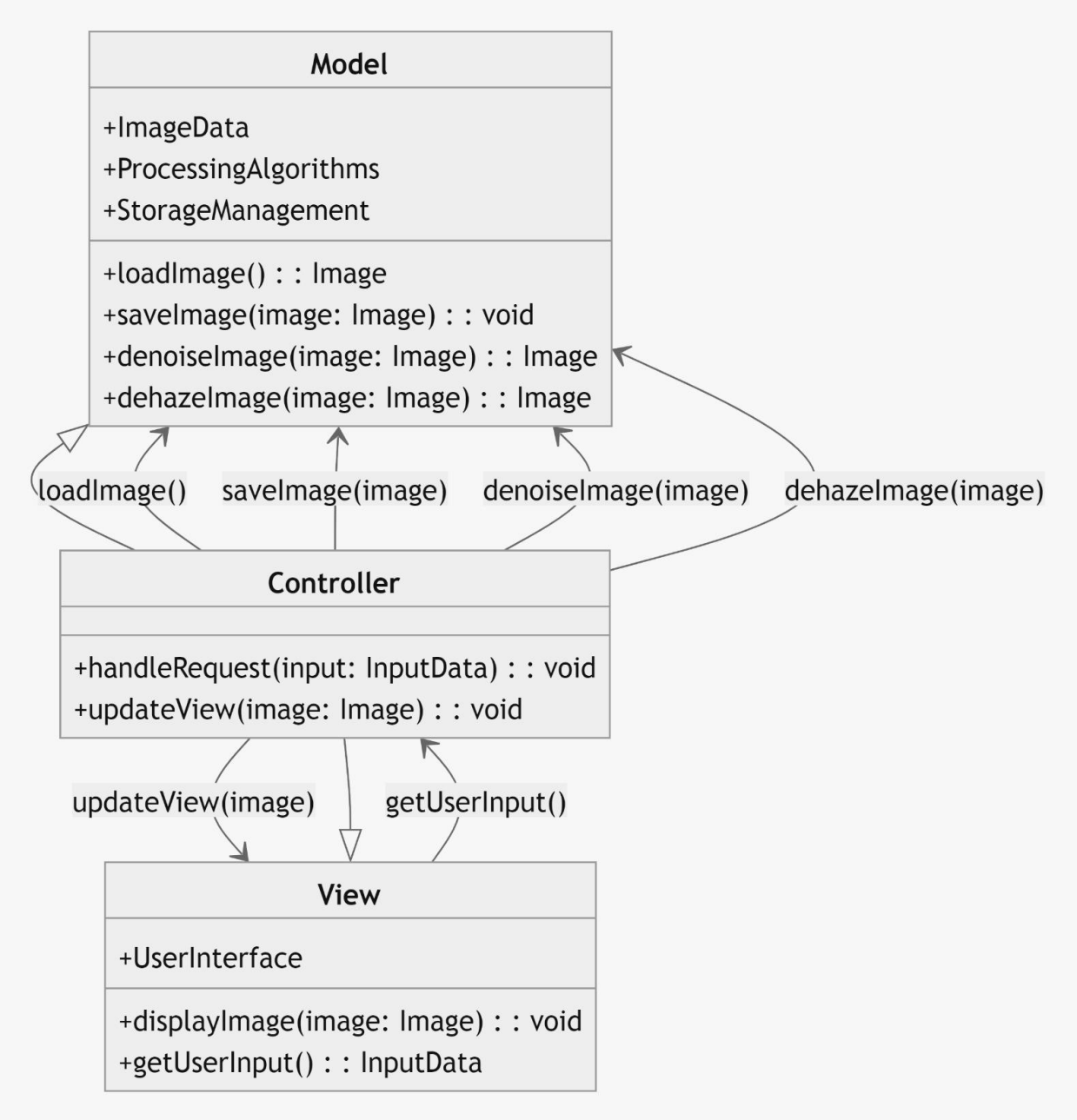
EXP.NO: 9 **DATE: 10.5.2024**



- **DataProvider:** Supplies the raw data for processing.
- **ImageAcquisition:** Captures and initially stores the raw data.
- **DataStorage:** Stores raw, intermediate, and final enhanced images.
- **PreProcessing:** Prepares images by standardizing and performing initial adjustments.
- **Denoising:** Reduces noise in the images without prior knowledge of noise characteristics.
- **Dehazing:** Removes haze to improve image clarity.
- **PostProcessing:** Performs final adjustments to enhance image quality.
- **Application:** Manages customer requests and the delivery of enhanced images.

ARCHITECTURAL PATTERN (MVC)

EXP.NO: 10 **DATE: 17.5.2024**



Model:

- **Image Data:** Manages raw and processed image data.
- **Processing Algorithms:** Implements algorithms for joint blind denoising and dehazing.
- **Storage Management:** Handles storage and retrieval of images from the database.

View:

- **User Interface:** Provides interfaces for users to upload images, request enhancements, and view results.
- **Visualization**: Displays enhanced images and possibly intermediate processing steps or results.

Controller:

- **Request Handling:** Manages user requests for image enhancement.
- **Process Coordination:** Coordinates the flow of data between the view and the model, triggering image processing tasks.
- **Response Management:** Sends processed images back to the view for user display.

Relationships:

The Model, View, and Controller components interact as follows:

- Separation of Concerns: Clearly separates the data management (Model), user interface (View), and application logic (Controller), making the system easier to manage and extend.
- Maintainability: Simplifies maintenance by allowing independent updates to the data handling, processing algorithms, and user interface.
- Scalability: Supports scalability as new image processing algorithms or user interface features can be added with minimal changes to the other components.