Project Synopsis Presentation

Comparative analysis of various haze removing techniques

A Project Presentation – I
submitted in partial fulfillment of the requirements for the degree of

BACHELOR OF TECHNOLOGY
IN
INFORMATION TECHNOLOGY

Presented By:

Anamika [1903818]
Bhavana [1903825]
Mamta Gupta [1903842]
Poonam Rani [1903851]

Under the guidance of

Mr Rajesh Kochher

DAVIET
Dayanand Anglo-Vedic Institute of Engineering and Technology

Department of Information Technology
DAV Institute of Engineering & Technology
Jalandhar

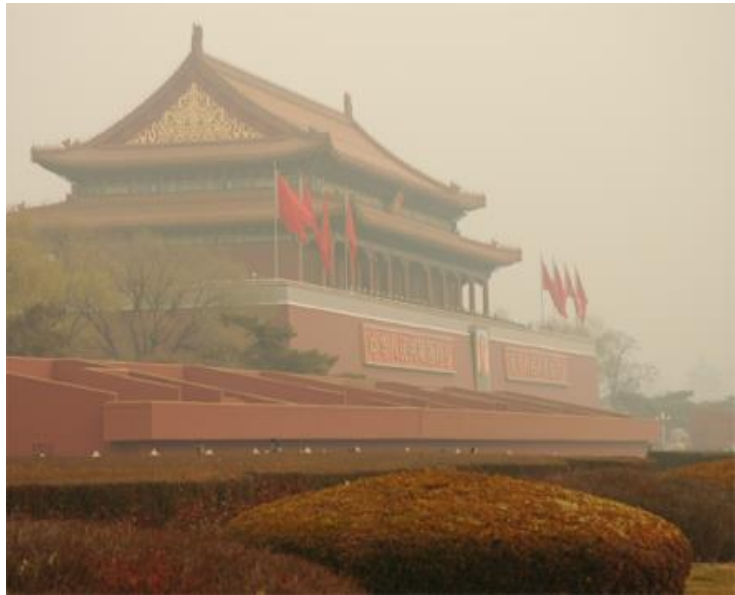
Introduction

Artificial Intelligence – Artificial Intelligence is wide ranging branch of computer science which is concerned with building smart machines capable of performing tasks that typically require human intelligence. It can also be explained as the ability of computer or a robot controlled by a computer to do task that are usually done by humans because they require human intelligence.

Machine Learning- Machine learning (ML) is a type of artificial intelligence (AI) that allows software applications to become more accurate at predicting outcomes without being explicitly programmed to do so. Machine learning algorithms use historical data as input to predict new output values.

Image processing- Image processing is the process of transforming an image into a digital form and performing certain operations to get some useful information from it. The image processing system usually treats all images as 2D signals when applying certain predetermined signal processing methods. There are following main types of image processing:

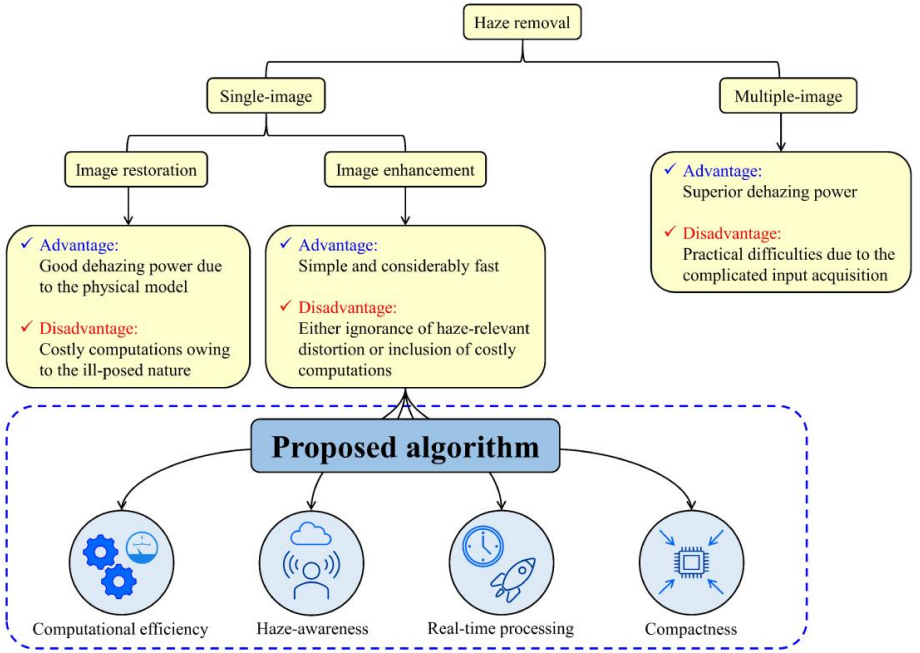
- Visualization - Find objects that are not visible in the image
- Recognition - Distinguish or detect objects in the image
- Enhancement - Create an enhanced image from the original image
- Pattern recognition - Measure the various patterns around the objects in the image.



Introduction

Image Enhancement- Image enhancement is the process of bringing out and highlighting certain features of interest in an image that has been obscured. This can involve changing the brightness, contrast, etc. Image enhancement can also be defined as the procedure of improving the quality and information content of original data before processing. Common practices include contrast enhancement, spatial filtering, density slicing, and FCC. Contrast enhancement or stretching is performed by linear transformation expanding the original range of gray level. Spatial filtering improves the naturally occurring linear features like fault, shear zones, and lineaments. Density slicing converts the continuous gray tone range into a series of density intervals marked by a separate color or symbol to represent different features. Image enhancement Increases the quality of the image.

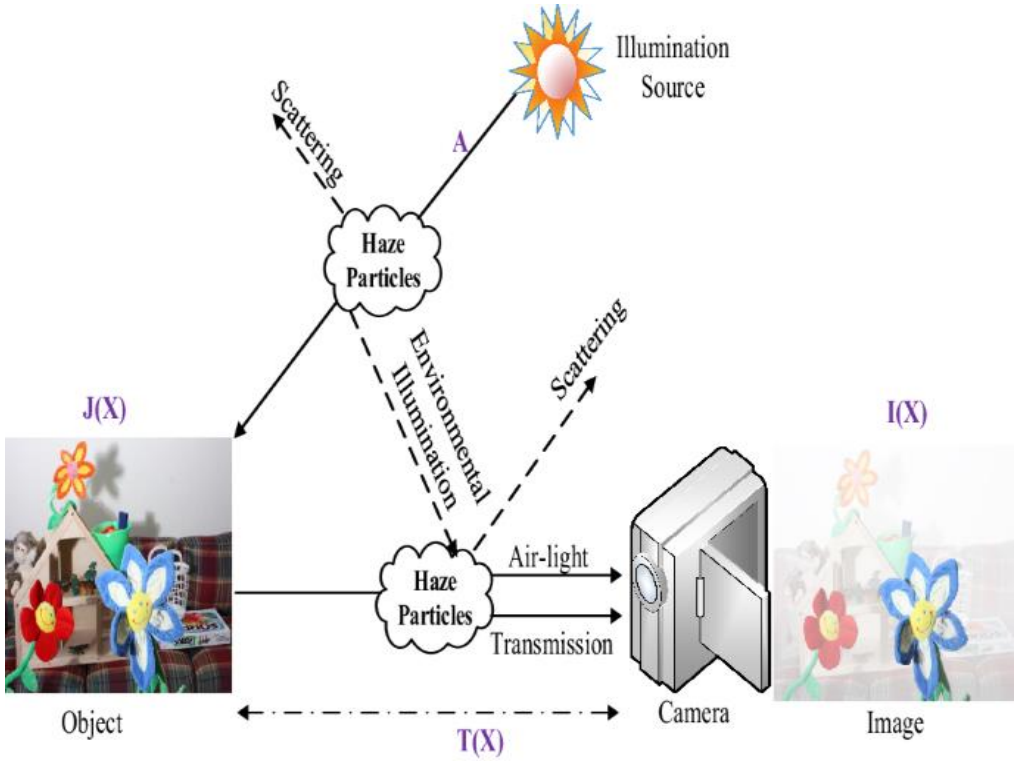
Haze-Haze can be defined as a fine dust, smoke, or light vapor causing lack of transparency of the air. It can also be defined as a cloudy appearance in a transparent liquid or solid.
Along with the rapid growth of human–computer interaction technology and intelligent assistant systems, the demand for cameras and intelligent surveillance systems for executing real-time recording and monitoring in private or public areas continues to increase. Haze (or fog, mist, and other atmospheric phenomena) is a main degradation of outdoor images, weakening both colors and contrasts.



Introduction

Haze removal- Haze Removal can remove slight to extreme cases of haze affecting an image. Its most typical use is for landscape photography where the haze causes low contrast and low saturation, but it can also be used to improve images taken during rainy and foggy conditions.
The large quantities of the suspended particles in atmosphere cause scattering of light before it reaches the camera which corrupts the outdoor image quality. Haze attenuates the reflected light from the scenes and blends it with additive light in atmosphere.

Haze removal techniques- Haze removal techniques tend to improve this reflected light (i.e. scene colors) from mixed light. The constancy and strength of the visual system can also be improved by using this effective haze removal of image.



Introduction to project

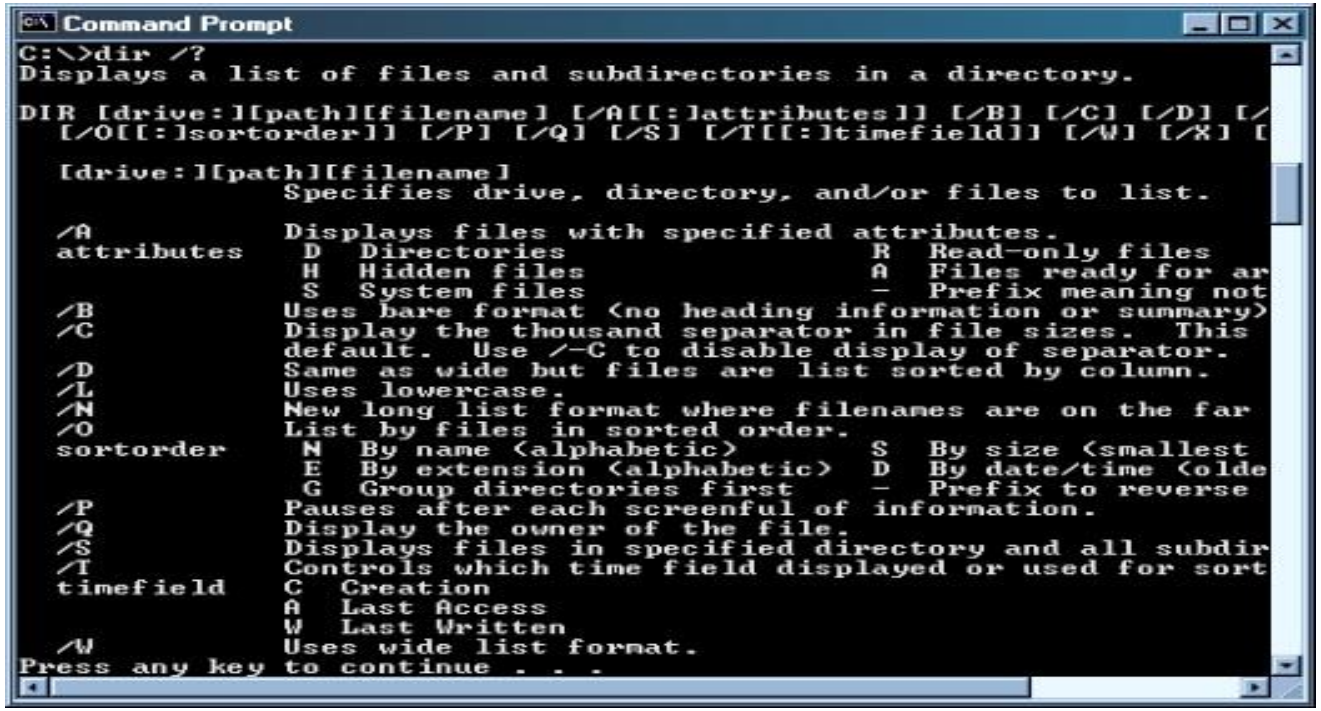
Our project proposes to make a graphical user interface(GUI) based application that removes haze from the input image. It will allow user to compare the quality of image produced using four different haze removal techniques, namely-

- CLAHE
- Mix-CLAHE
- Bilateral Filtering
- Trilateral Filtering

The user can try all these techniques separately on the image by selecting the option and then he can decide which result obtained is best for him. This will allow the users to get a haze free image and compare the image obtained based on various parameters.

Existing system study/Literature Review

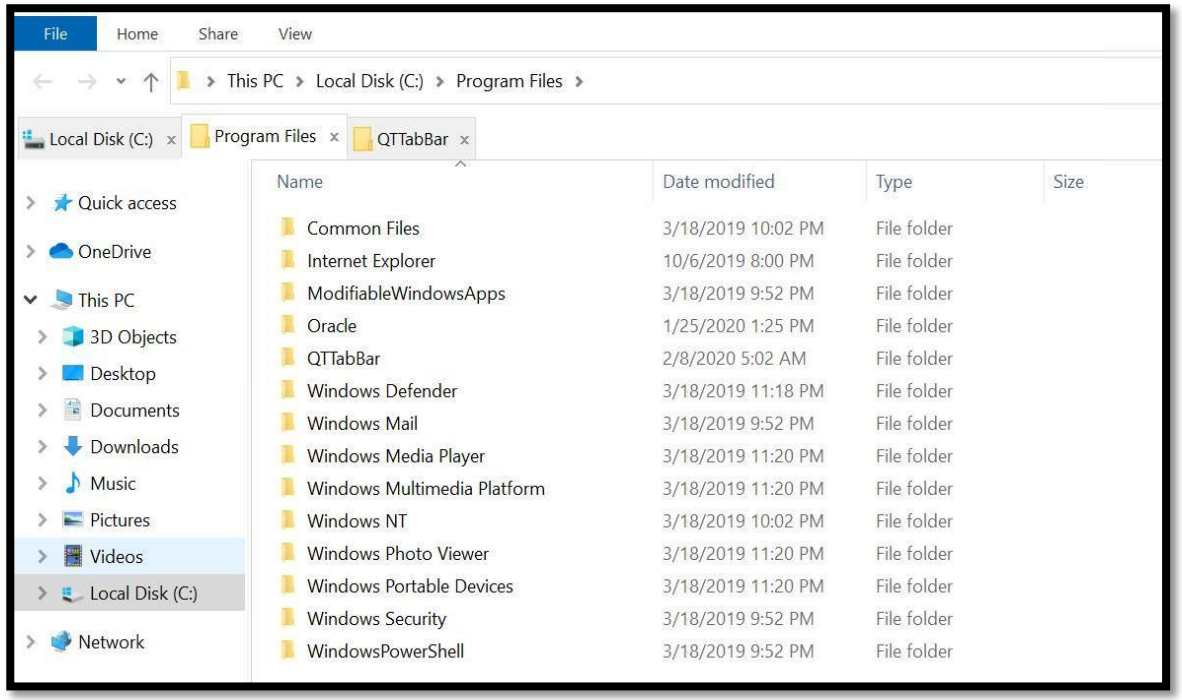
- Yes, there are existing systems which are already working on haze removal techniques. The existing system do not allow user to compare different techniques, they just show the results which sometime may not be required by the user.



The application run in following steps:-

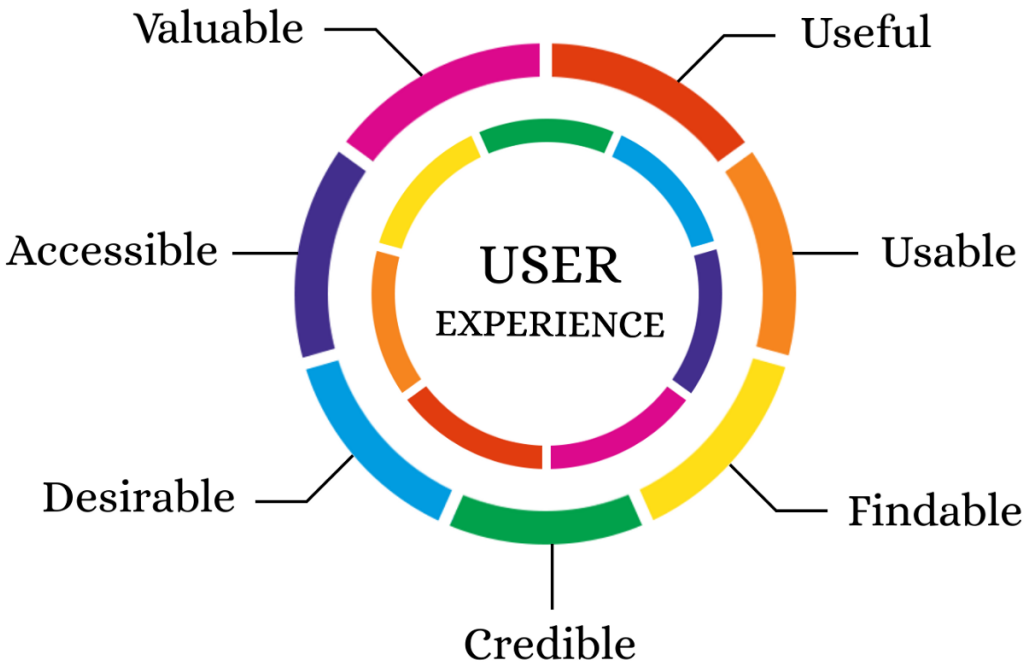
- First the user uploads the image in the system .
- After uploading, the user selects the technique for haze removal.
- Now the user can download image for viewing and see the results.
- In the current system, if the user is not satisfied by the results then they have to run the same steps to process the image.

Now, this involves a lot of human time and effort which is not User Friendly.



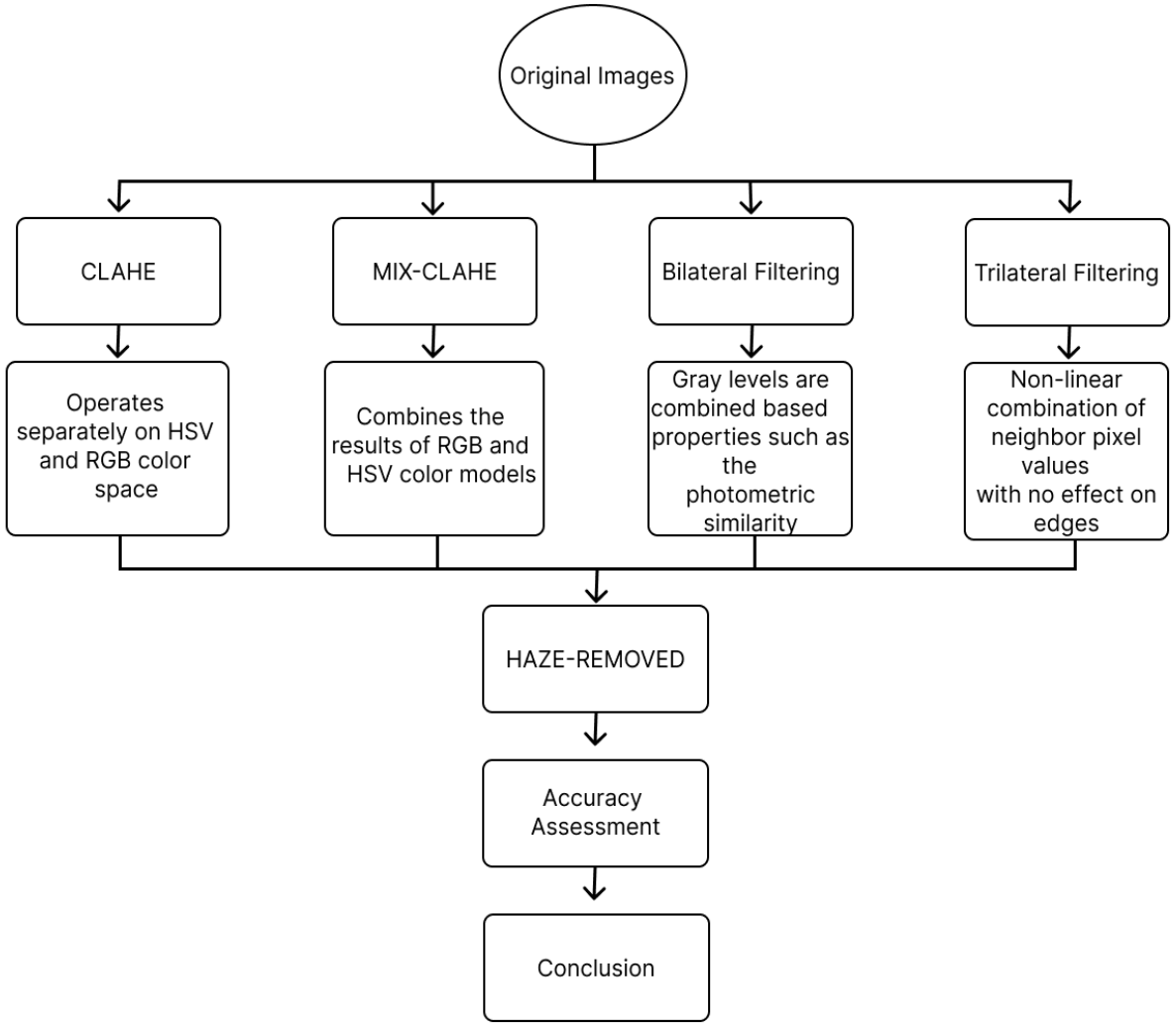
Research Gap

- The Major Problem/flaw we observed in this system is that they just work on a system which does not compare the different techniques. Therefore we will make it easier for users to compare the quality of image obtained using different techniques.
- Existing systems are inbuilt. We have added and developed a Graphical User Interface(GUI) system which will help the user to interact with the system easily and the user gets more options to choose from.
- Therefore we will make a user-friendly application where users can use various haze removal techniques easily.



Problem formulation

- The problem on which we are going to work is Haze removal and Image processing using 4 different techniques.
- In this project we will develop a Application which will provide a Graphical User Interface.
- The user can compare the quality of Image obtained using each technique.



Performance Requirements

Static numerical requirements:
The no. of simultaneous users to be supported is highly dependent on the services we use and servers upon which we host applications. As we are using apache tomcat server which can handle up to 200 concurrent users and as of now, we will host our application on a server that has a single CPU with 2 CPU cores. So, approximately 500 to 700 visitors may access and interact at the same time.

Dynamic numerical requirements:
Common image processing tasks can be classified into the following categories: neighborhood operations (both linear and nonlinear), statistical computations, and transformations.
• the quantity of data involved -- 256 Kbytes for a single 512×512 image frame, • the input / output data requirements (30 frames per second for RS-170)

Objectives

The objective of the project named as Comparative Study of various haze removing techniques are given below:

1. To study various techniques of haze removal.
2. To implement **four haze removal techniques- CLAHE, MIX-CLAHE, Bilateral Filtering, Trilateral Filtering.**
3. To **compare** above mentioned techniques using different **parameters** like- **PSNR, MAE, MSE.**
4. To develop **GUI** based application.

Methodology

1. CLAHE

Contrast limited adaptive histogram equalization(CLAHE) . It is used for contrast enhancement of images. This method doesn't require any weather information before the process of fogged image.

i) Convert input image from RGB format to HSV color space. This image conversion is required as human sense colors in same way as colors are represented in HSV format.

ii) CLAHE is used to process the value component without affecting hue and saturation of image. The method uses histogram equalization to a contextual region.

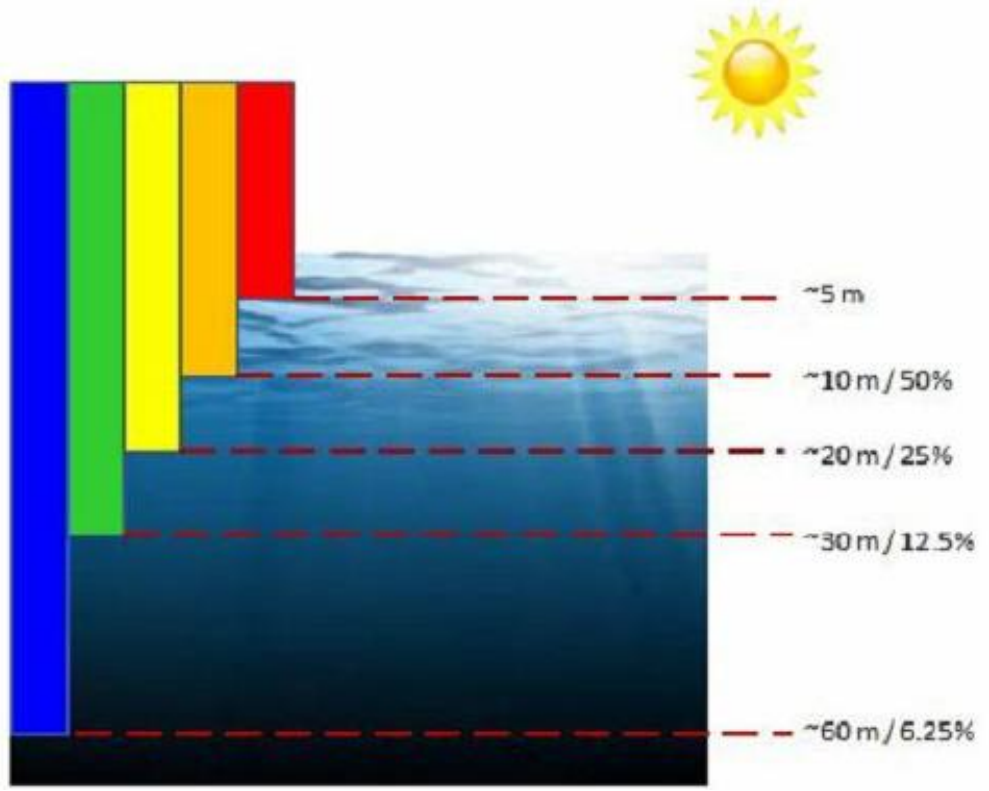
Each pixel of original image is in the center of the contextual region. The original histogram is clipped and the clipped pixels are redistributed to each gray level. The new histogram is different from the original histogram, because each pixel intensity is limited to a user-defined maximum.

In last step, the input image processed in HSV format is converted back in RGB format.

Methodology

2. **MIX – CLAHE**

- This method can be used to improve underwater image details, it is based on CLAHE.
- The visibility of the underground image is improved by this method.
- It produces the maximum PSNR and the minimum MSE values. Thus, this method is able to classify the coral reefs.
- This Figure shows absorption of light by water . By 10 meter increase in depth the brightness of sunlight will decrease to half. All blue light continues to greater depth whereas all red is reduced by 50% from the surface. This is because the most underwater images are conquered by green-blue coloration.
- It combines the results of RGB and HSV color models.
- The method aimed to enhance the contrast of the image while preserving the natural look of underwater image.



Methodology

3. **Bilateral Filtering**

- Bilateral filter smooth the image along with preserving its edges.
- It is simple and non iterative.
- By the bilateral filter, gray levels are combined based on properties such as the photometric similarity and geometric closeness, the preference is made based on the values closer compared to distant values in both range and domain.
- The filter is used to smooth edges towards piecewise constant solutions. Bilateral filter does not provide stronger noise reduction.

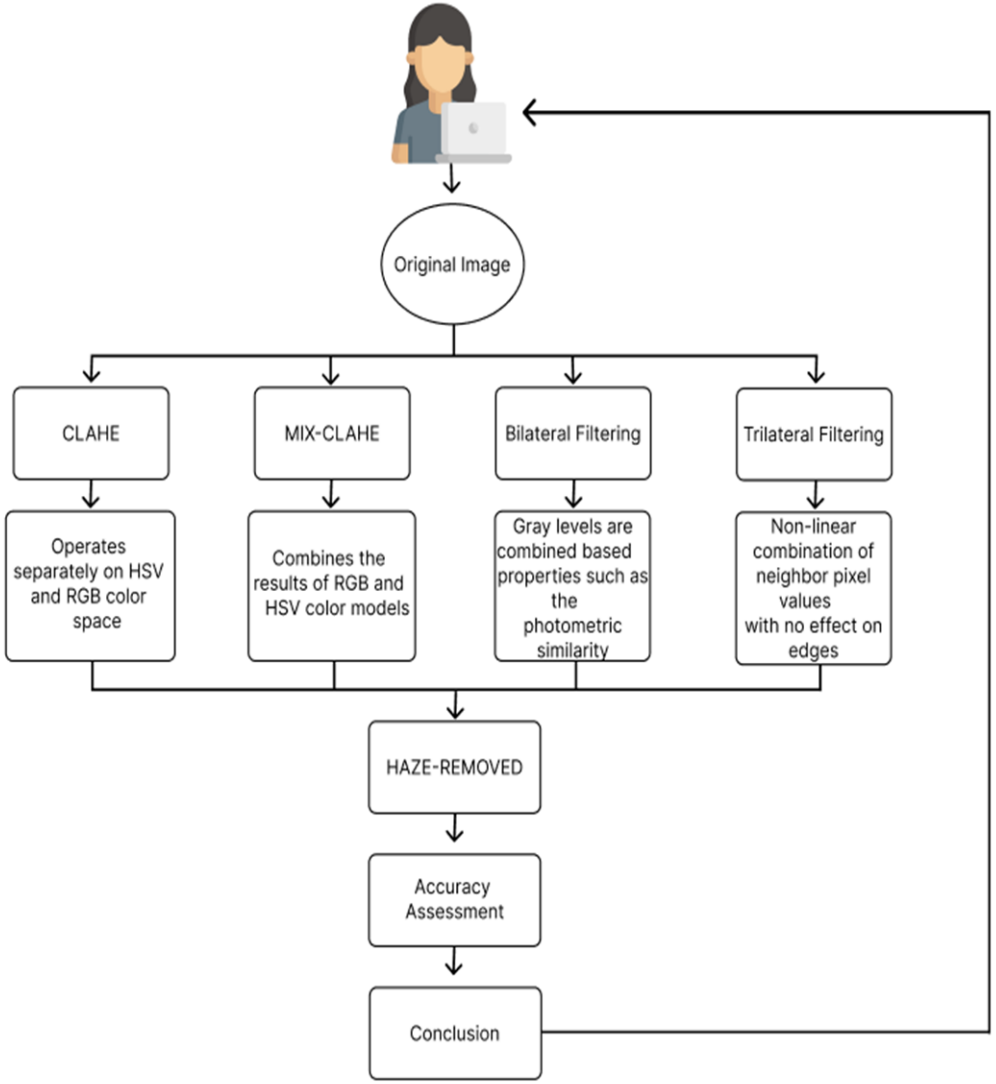
Methodology

4. **Trilateral Filtering**

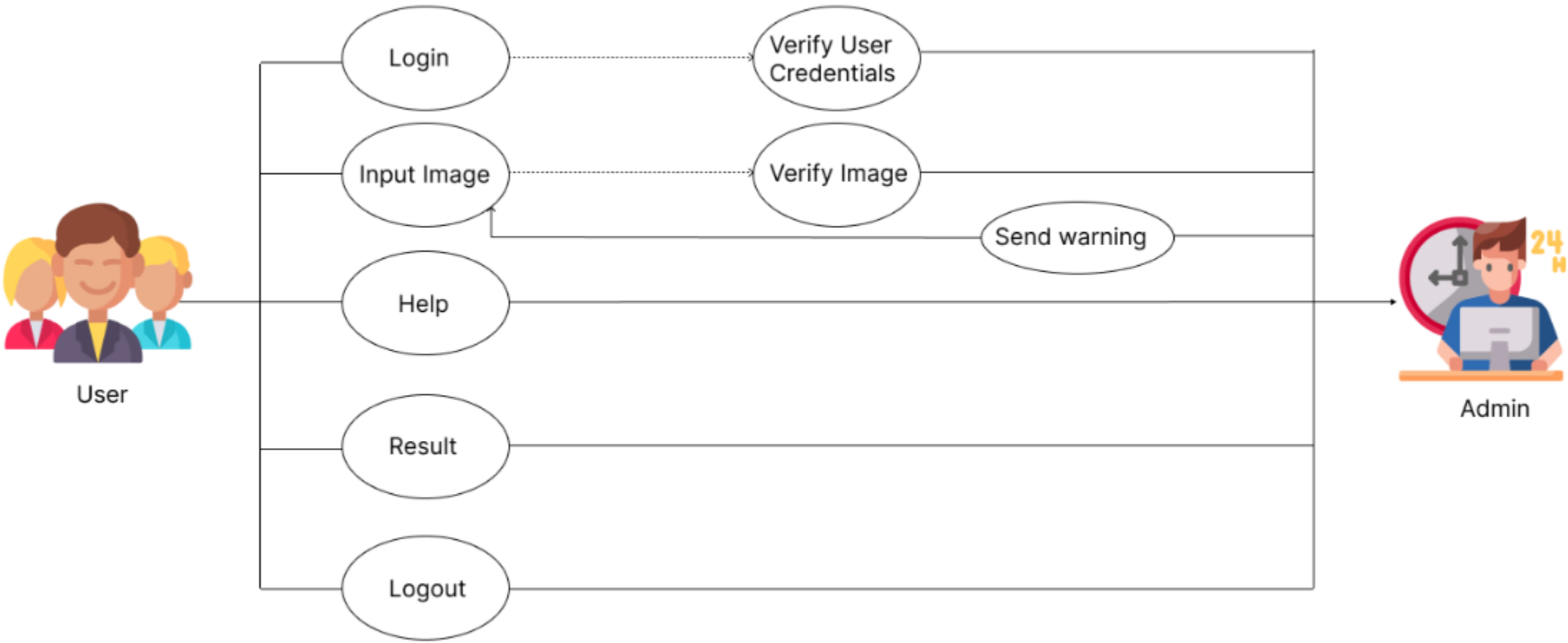
- This filter smooth images, by using a non-linear combination of neighbor pixel values with no effect on edges.
- In this method average weighted values replaces the each pixel value of its neighborhood pixels. The allotted weighted value of each neighbor pixel will decreases as the distance in the image plane and distance on the intensity axis increases.
- The filter is faster in comparison with other methods.
- For pre-processing it uses the histogram stretching and equalization of histogram for post-processing.
- Histogram stretching and equalization are required to effectively increase the contrast of image.
- The algorithm used here is independent of fog's density so it can be used for the images taken in dense fog weather conditions.

System Architecture Description

1. Firstly, User have to login in our application to use haze removal techniques.
2. Then user will upload his image.
3. User has four techniques to apply on that image.
4. First technique is CLAHE, Second is MIX-CLAHE, Third is Bilateral Filtering and last is Trilateral Filtering.
5. If the user click on CLAHE method then CLAHE method will process that image and then return an image as an output.
6. User has option to choose any of the four techniques that mentioned above.
7. The same process is followed by other techniques also.
8. Then user has a option to download that dehazed image by all four techniques or by any one of four techniques according to his need.

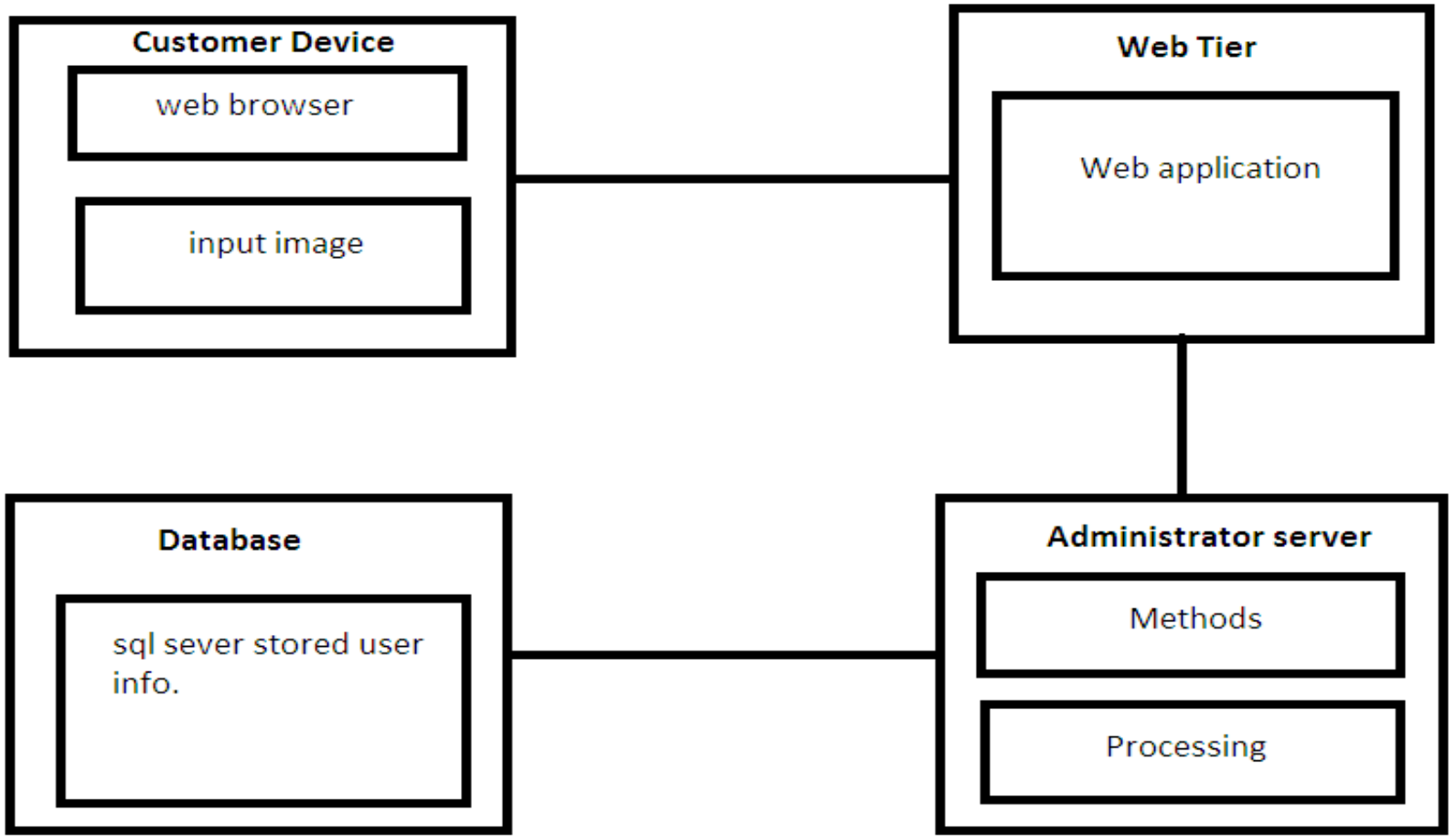


Original Image	The Image Upload by the user in which he wanted to remove the haze.
Technique	When the user uploads the image he can select any of the four techniques (CLAHE, MIX,CLAHE, Bilateral Filtering, Trilateral Filtering).
CLAHE	Operates separately on HSV and RGB color space
MIX-CLAHE	Combines the results of RGB and HSV color models
Bilateral Filtering	Gray levels are combined based properties such as the photometric similarity
Trilateral Filtering	Non-linear combination of neighbor pixel values with no effect on edges.
Haze Removed	After processing Technique the HAze from the image is removed.
Accuracy Assessment	The parameters MAE, MSE and PSNR are calculated and compared.
Conclusion	The dehaze image is now available to download to users with parameters so that he is able to compare different techniques.



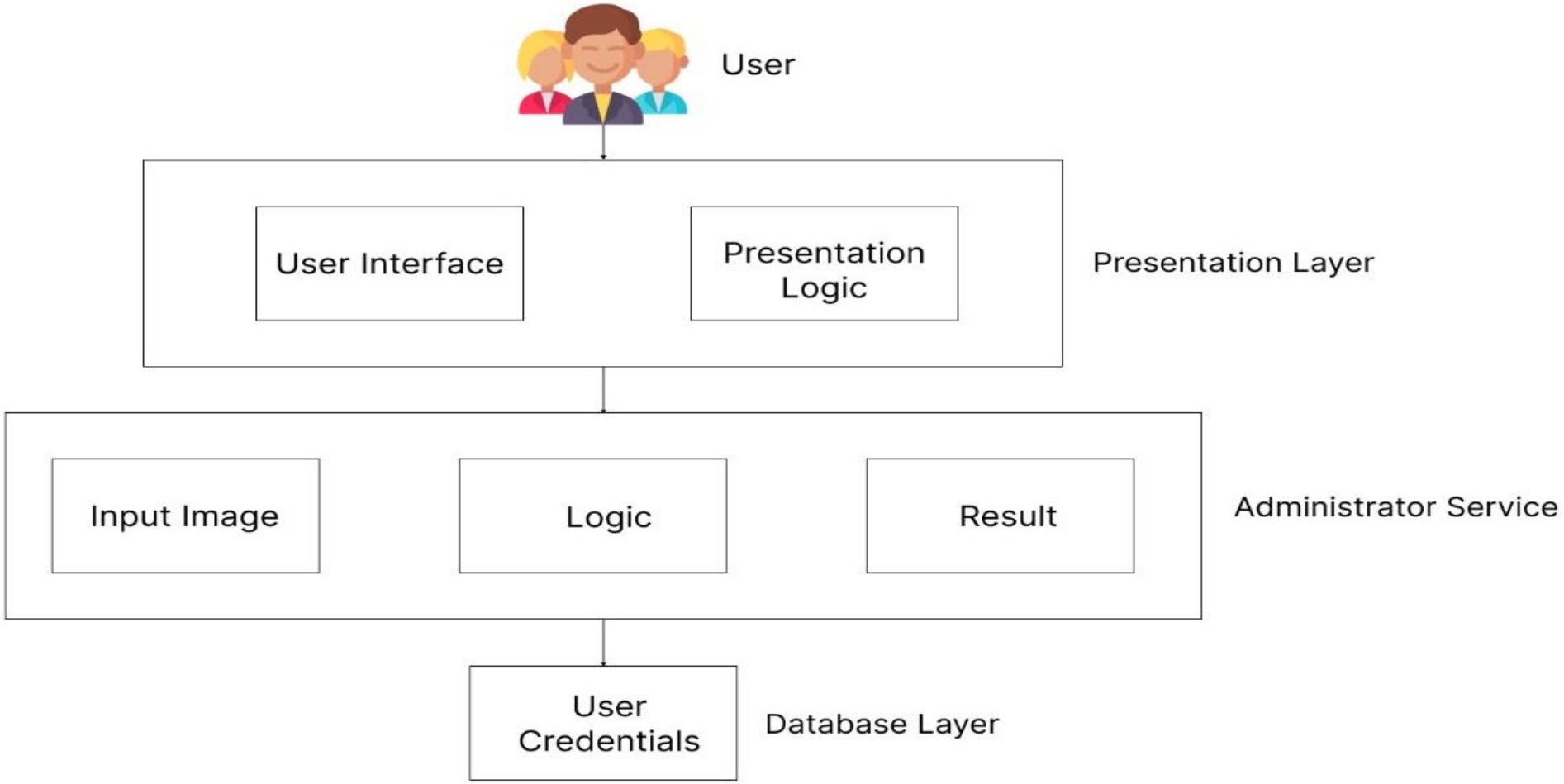
USE CASE DIAGRAM

Overview of module components



Deployment Diagram

Components Description



UML Package diagram

Database Description

- Here the main database image Record will be used where data related to user credentials will be stored.
- The tables and fields described here below in design will be used in database
- We will gather the data and then we will use MySQL database to store the data.
- MySQL is an open-source relational database management system. It helps you store users, plugin information, etc. It stores that information in “tables”.

Parameters

This system investigate into four image contrast enhancement techniques which are compared with each other using three parameters/performance metrics which are

- PSNR(Peak signal to noise ratio)
- MSE(mean square error)
- MAE(mean absolute error)

1) Mean square error (MSE)

The MSE represents the cumulative squared error between the compressed image and the original image.

$$MSE = \frac{1}{NxM} \sum_{i=0}^{N-1} \sum_{j=0}^{M-1} [X(i,j) - Y(i,j)]^2$$

Where, N and M is the height and width respectively,
X(i , j) is the enhanced image,
Y(i, j) is the original image.

Parameters

2) Peak Signal to Noise Ratio(PSNR)

The peak Signal to Noise Ratio is the ratio between maximum possible power of signal and corrupting noise that affect representation of the image. The performance of the proposed algorithms was evaluated in term of visual quality and the peak signal to noise ratio. The signal in this case is original data and noise is the error introduced . The high value of PSNR indicates the high quality of the image.

$$PSNR = 10log_{10}\left(\frac{MAX_I^2}{MSE}\right)$$

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2$$

3.) Mean absolute Error(MAE)

It is the difference between the prediction and actual enhanced image. As the name suggests, mean absolute error is an average of the absolute errors.

$$|E(x) - E(y)|$$

where E(x) is average intensity of input image

E(y) is average intensity of enhanced image

Expected outcome

- In our system, user can upload the hazy image and can use various haze removal techniques which will gives different quality of haze free image.

- It will a user-friendly application where users can compare the results from these different techniques(i.e. CLAHE, MIX-CLAHE, Bilateral Filtering, Trilateral Filtering) easily and according to their requirement can use any one method .

- This application will be GUI based user friendly application so that they can easily understand and work effectively.

Hardware and Software Requirements

- **Hardware Requirements:**

Processor: Intel ® Core™ i3-2350M CPU @2.30GHz
Installed memory (RAM): 4.00GB
System Type: 64-bit Operating System

- **Software Requirements**:

Languages:

JAVA

Software:

Matlab(13.0), NetBeans(8.2), Apache tomcat server , Xampp

Project Planning

Name of Activity	Date of Completion	Deliverables	Name of team members
Requirement Analysis	30-04-22	SRS Document	Anamika
Design	25-05-22	Design Document	Bhavana
Coding	15-10-22	Software Code (Prototype)	Mamta Gupta, Anamika
Testing	30-10-22	Test document	Poonam Rani
Implementation	25-11-22	Final project demonstration	All members

References

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Thank You