**VISVESVARAYA TECHNOLOGICAL UNIVERSITY**

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A Report on

**Digital Image Processing AAT-3 (21EC722)**

On

Digital Image Processing Techniques using JavaScript Code

Submitted in the partial fulfillment of the requirement of AAT-3 for VII Semester Digital Image Processing

Submitted by

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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING CERTIFICATE**

This is to certify that this Seminar Report on **“Digital Image Processing Techniques using JavaScript Code**” the domain of Digital Image Processing (21EC722) is carried out by **Mr.Vinay Bhat (1NC21EC115)** in partial fulfillment for the VII Semester, Digital Image Processing (21EC722) course AAT-3 requirement through seminar presentation and report submission during the academic year 2024- 2025.

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**ABSTRACT**

Image processing plays a crucial role in modern technological applications, including medical imaging, security surveillance, remote sensing, and digital photography. Often, raw images captured by devices contain imperfections such as noise, blurriness, and low contrast, which degrade their quality. Image sharpening and enhancement techniques are essential for improving image clarity, reducing noise, and highlighting critical features.

This project presents a web-based application for interactive image processing, enabling users to enhance and modify images directly in their browser. By leveraging HTML, CSS, and JavaScript, the application provides a user-friendly interface with sliders to adjust various image attributes such as opacity, brightness, contrast, saturation, grayscale, and blur. Additionally, users can customize the background color dynamically and save the modified images as downloadable files. The real-time processing ensures immediate feedback, making the tool both practical and engaging for users without requiring specialized software or advanced technical knowledge.

The project demonstrates the potential of browser-based solutions for performing complex image processing tasks, offering accessibility and convenience for a wide range of users, including content creators, educators, and designers. By integrating modern web technologies, the application provides a foundation for further advancements, such as incorporating AI-driven enhancements or expanding compatibility for mobile platforms. This innovative approach bridges the gap between professional-grade image processing software and lightweight, easily accessible web applications.

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**CHAPTER-I**

**INTRODUCTION**

Digital images are a fundamental part of modern life, used in a wide array of fields ranging from entertainment and social media to critical sectors like medical imaging, satellite mapping, and security. However, despite the rapid advancements in digital imaging technology, raw images often suffer from various quality issues, such as noise, blur, low contrast, and insufficient sharpness. These imperfections can significantly hinder the ability to interpret and analyze the image effectively, making it essential to apply image enhancement techniques that improve visual quality and highlight key features.

Image processing refers to the manipulation of an image to enhance its quality or extract useful information. The two primary goals of image enhancement are to make the image more suitable for human interpretation and to facilitate automated analysis. Image sharpening and enhancement are key subdomains of image processing that are specifically focused on improving the perceptual quality of an image by enhancing edge details, increasing contrast, and reducing noise. Image sharpening emphasizes high-frequency components, particularly edges and fine textures, while enhancement adjusts overall brightness, contrast, and visibility to make subtle features more prominent.

The sharpening of an image typically involves methods such as unsharp masking, high-pass filtering, and Laplacian edge enhancement. These techniques focus on improving edge clarity by increasing contrast along boundaries within the image, which is particularly important in fields like medical imaging, where identifying small anomalies is critical, or in remote sensing, where geographic features must be clearly defined.

Image enhancement, on the other hand, involves techniques that adjust the overall appearance of an image to improve its clarity and visibility. Common methods include histogram equalization, which adjusts the global contrast of an image, and adaptive histogram equalization (CLAHE), which optimizes contrast in local regions of an image. These enhancement methods are useful in applications such as low-light imaging, where images might otherwise appear too dark or unclear for analysis, and in fields like satellite imaging, where visualizing geographic features under varying lighting conditions is crucial.

**The project objectives include:**

1. Applying sharpening techniques such as unsharp masking and Laplacian filtering to enhance edge details
2. Implementing enhancement techniques like histogram equalization and CLAHE to improve contrast and visibility.
3. Analyzing the results to demonstrate the improvements in image quality across different domains, including medical imaging, satellite data, and digital photography.

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**CHAPTER-II**

**METHODOLOGY**

The project methodology is divided into the following stages:

1. **Data Acquisition:** The dataset includes grayscale and color images sourced from publicly available databases. These images represent diverse scenarios, such as medical scans, natural landscapes, and urban environments. The variation in resolution and image quality ensures that the algorithms are tested under a wide range of conditions.
2. **Preprocessing:** Before applying sharpening and enhancement techniques, the images undergo preprocessing to remove noise. Filters like Gaussian and median filters are used to minimize high-frequency noise and salt-and-pepper noise, ensuring a clean input for subsequent processing.
3. **Image Sharpening:**

**Key sharpening techniques implemented include:**

* **Unsharp Masking:** Enhances edges by subtracting a blurred version of the image from the original.
* **Laplacian Filtering:** Detects and highlights edges by applying a second-order derivative filter.
* **High-Boost Filtering:** Amplifies high-frequency components to improve edge details further.

1. **Image Enhancement**

**Enhancement methods applied include:**

* **Histogram Equalization:** Redistributes pixel intensities to improve contrast.
* **CLAHE (Contrast-Limited Adaptive Histogram Equalization):** Enhances local contrast, particularly in images with varying brightness.
* **Gamma Correction:** Adjusts brightness levels by altering the pixel intensity values.

**CHAPTER-III**

**APPLICATIONS**

The techniques developed in this project for image sharpening and enhancement using MATLAB have a wide range of practical applications across various industries. These applications highlight the importance of image processing in enhancing visual quality and providing more accurate data for analysis. Some of the key areas where these techniques can be applied include:

**1. Medical Imaging:**

In the healthcare sector, medical imaging is critical for diagnosing conditions such as cancer, brain disorders, and cardiovascular diseases. Images like X-rays, MRIs, and CT scans often suffer from noise, blur, or low contrast, which can make it difficult to detect small anomalies. By using image sharpening and enhancement techniques, the clarity and visibility of critical details can be improved, aiding doctors in accurate diagnosis and treatment planning. For example, enhancing the sharpness of an X-ray image can help identify fractures or tumors that might be missed in a low-quality image.

**2. Remote Sensing and Satellite Imaging:**

Remote sensing technology, including satellite and aerial imagery, is crucial for monitoring land use, weather patterns, environmental changes, and disaster management. Images captured by satellites can sometimes be blurry, low in contrast, or affected by atmospheric conditions. Image sharpening and enhancement techniques improve the quality of satellite images, making it easier to analyze geographical features, detect changes in vegetation, or monitor urban development. Enhanced images also help in disaster response efforts by providing clearer views of affected areas, facilitating quicker decision-making.

**3. Security and Surveillance:**

Surveillance cameras are often used in low-light or variable lighting conditions, leading to grainy or blurry footage. Enhancing these images is essential for law enforcement and security personnel to identify individuals or objects clearly. Image sharpening techniques can highlight details like facial features, vehicle license plates, and other important characteristics in surveillance footage, even when the original image quality is poor. Furthermore, improving the contrast of surveillance images aids in detecting intrusions or suspicious activities, especially in areas with low visibility.

**4. Forensic Analysis:**

Forensic image analysis plays a critical role in criminal investigations, where photographs or video footage serve as vital evidence. Low-quality images, such as those taken in poor lighting or from distant sources, can make it difficult for investigators to discern crucial details. Image enhancement techniques can help improve the quality of forensic images, making it easier to identify individuals, objects, or locations involved in a crime. Techniques like

unsharp masking and edge enhancement are particularly useful in highlighting small features that may be critical to an investigation.

**5. Digital Photography:**

In photography, enhancing the sharpness and contrast of an image can improve its aesthetic quality, making it more visually appealing. Photographers often use image enhancement techniques to adjust the brightness, contrast, and sharpness of an image, particularly in post-processing. Whether it’s removing noise from low-light shots or enhancing the details of a landscape photo, image enhancement techniques allow for professional-quality images to be created from ordinary photographs.

**CONCLUSION**

This project successfully demonstrates a user-friendly and interactive image processing application built using HTML, CSS, and JavaScript. It allows users to upload an image and apply various adjustments, such as opacity, brightness, contrast, saturation, grayscale, and blur, through intuitive slider controls. Additionally, users can dynamically change the background color and save the modified image as a downloadable file.The platform's design ensures seamless functionality and responsiveness, providing real-time updates to image styles and background colors. The integration of sliders and the color picker enables users to experiment with different visual effects effortlessly, enhancing the accessibility and practicality of image processing for non-expert users.

By leveraging modern web technologies, this project highlights the potential of browser-based image editing tools to perform complex operations without requiring external software. This capability opens up opportunities for applications in graphic design, social media content creation, and educational tools.Future enhancements could include adding support for additional filters, integrating AI-based tools for automated suggestions, and expanding compatibility for mobile devices. This project demonstrates the power of image processing in building engaging and functional applications, contributing to the growing field of accessible image editing solutions.

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