Information Technology University

Department of Computer Science

Medical Image Computing, Fall 2023

Assignment 1

Title: "Enhancing Noisy Medical Images Using Image Enhancement Techniques":

Objective: The objective of this assignment is to provide students with a practical opportunity to apply image enhancement techniques to noisy medical images, such as X-rays, CT scans, and MRI scans, in order to achieve clearer and denoised images.

Instructions:

➢ **Data Preparation:**
- ○ You have received a zip folder containing subfolders. Each subfolder will be labeled with a roll number, representing a student.
- ○ Inside each student's subfolder, you will find 5 noisy medical images in common formats like JPEG, JPG, or PNG. These images are intentionally noisy and require denoising.

➢ **Image Enhancement:**
- ○ Your task is to apply image enhancement techniques to the noisy medical images in your respective subfolder.
- ○ You can use any image enhancement method or combination of methods to denoise the images. Some common methods include:
    - ■ **Filtering with Morphological operators:** Code link.
    - ■ **Gaussian Smoothing**
    - ■ **Histogram Equalization:** Code link.
    - ■ **Gamma Correction:** Code link.
    - ■ **Spatial Filtering:** Code link.
    - ■ **Noise Reduction:**
    - ■ **Anisotropic Diffusion:** Code link.
    - ■ **Multi-Scale Image Processing:** Code link.
    - ■ **Adaptive Enhancement**: Code link.
    - ■ **Color Enhancement:** Code link.
    - ■ **Histogram Matching:** Code link.
    - ■ **Dynamic Range Compression:** Code link.
    - ■ **Linear contrast adjustment:** Code link.

- **Wavelet Transform Denoising**
- **Non-local Means Denoising**
- **Decorrelation stretch** <u>Code link.</u>
- **Unsharp mask filtering:** <u>Code link</u>.
- **Median filtering**
- **Denoising**
- **Point Processing Techniques:** <u>Reference link.</u>
- **Deep Learning-Based Enhancement (i**f you have knowledge in this area)**:** <u>Code link.</u>
  - Document the techniques you use in your Jupyter Notebook.

➢ **Notebook Submission:**
  - Rename your Jupyter Notebook file with your roll number (e.g., "RollNumber.ipynb").
  - In the notebook, provide clear and well-documented code for each step of image enhancement.
  - Include comments explaining your image enhancement choices and parameters.
  - Ensure that your code is organized and easy to follow.
  - Include a clear section at the end of the notebook that displays the denoised images for each of the 5 medical images.

➢ **Analysis Report:**
  - Write an analysis report in the form of a separate PDF document.
  - In the report:
    - Explain the image enhancement techniques you applied to denoise the images.
    - Describe any challenges you encountered and how you overcame them.
    - Discuss the impact of each enhancement technique on the quality of the images.
    - Include visual comparisons between the noisy and denoised images. ○

Parameter Sensitivity Analysis:
    - Experiment with different parameters of the image enhancement methods you applied.
      - For each noisy image, vary the parameters (e.g., kernel size, filter strength, threshold values) and discuss how these parameter changes affect the denoising outcome.
      - Provide visual comparisons to support your observations.
    - Explain which parameter settings yielded the best results in terms of noise reduction and image clarity.
  - Rename the PDF file with your roll number (e.g., "RollNumber_Report.pdf").

➢ **Submission Deadline:** All files (Jupyter Notebook and PDF report) must be submitted by the deadline: **28-09-23(Thursday)**.

Crucial Considerations:
- **Plagiarism is strictly prohibited.** Ensure that your work is original.
- Collaborative work is not allowed; each student must complete the assignment individually.
- If you have any questions or encounter technical difficulties, please contact the instructor and TA for assistance.