EE3005.01 Homework 6

(Image Processing)

Homework Assignment: Exploring Feature Extraction in Image Processing

Objective: The objective of this homework assignment is to self-learn of feature extraction techniques in image processing, their significance, and practical applications.

Tasks:

1. Research and Review:

- Research and review different techniques used for feature extraction in image processing, including pixel intensity-based methods, edge detection, texture analysis, radiomic features*, corner detection, Scale-Invariant Feature Transform (SIFT), and Convolutional Neural Networks (CNNs).
- Explore the underlying principles, strengths, and limitations of each technique.
- Identify real-world applications where each technique is commonly employed.

2. Case Studies:

- Select at least two case studies or research papers that demonstrate the application of feature extraction techniques in image processing.
- Summarize the objectives, methodology, and findings of each case study.
- Discuss how feature extraction contributed to the success of the research or application.

3. Practical Implementation:

- Choose three feature extraction techniques.
- Implement the chosen techniques using a programming language of your choice (e.g., Python with OpenCV or MATLAB).
- Apply the technique to a set of sample images and visualize the extracted features.

4. Critical Analysis:

- Compare and contrast the performance of different feature extraction techniques in terms of accuracy, computational complexity, and robustness to variations in image data.
- Discuss scenarios where certain techniques may be more suitable than others based on the nature of the image data and the requirements of the application.

5. Discussion Questions:

- Reflect on the challenges and limitations associated with feature extraction in image processing.
- Consider the future directions and emerging trends in feature extraction techniques, such as deep learning-based approaches and multimodal fusion.
- Discuss potential ethical considerations or societal implications related to the use of image feature extraction technology in various domains.

Submission Guidelines:

- The number of group members should be at most 3. One submission is enough per group.
- The entire report should be in a single Word document, including MATLAB code and images. ***Beside the report you must upload a presentation file for your report.***
- Include the images and the source code for each steps with their explanations.
- Write a comprehensive report discussing your observations, insights, and any challenges faced during the implementation.
- Your reports will be checked by an AI detector. You will receive a grade of zero if AI is detected. Even if you use it only for grammar correction, the AI detector may detect AI. For your information.

Additional Resources:

- Provide a list of recommended readings, tutorials, or online resources for further exploration of feature extraction in image processing.

* https://pyradiomics.readthedocs.io/en/latest/features.html