# Course Outline

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| **Course title: Digital Image Processing and Application** | **Instructor name: Jun Albert Pardillo** |
| **Credit units: 3** | **Total hours: 54** |

## Course Description:

Digital Image Processing and Application is a course designed for 4th Year Electrical Engineering students who are interested in learning about the fundamentals of digital image processing and its applications. The course will cover the basic concepts of image processing, including image acquisition, image enhancement, image restoration, image segmentation, and image compression. The course will also focus on the practical applications of digital image processing in various fields, such as medical imaging, remote sensing, and computer vision. Students will learn how to use various software tools and programming languages, such as MATLAB, Python, and OpenCV, to implement digital image processing algorithms and analyze the results. Throughout the course, students will work on several projects that involve real-world applications of digital image processing. These projects will help students develop their problem-solving skills and gain hands-on experience in applying digital image processing techniques to solve real-world problems. By the end of the course, students will have a solid understanding of the principles of digital image processing and its applications. They will be able to apply their knowledge to solve complex problems in various fields and will be well-prepared for careers in industries such as medical imaging, robotics, and computer vision.

## Course Learning Outcomes (CLOs)

* Understand the fundamental concepts and techniques in digital image processing.
* Apply various image processing techniques for image enhancement, restoration, and segmentation.
* Utilize software tools and programming languages like MATLAB, Python, and OpenCV for implementing digital image processing algorithms.
* Analyze and interpret the results of image processing applications in various fields such as medical imaging, remote sensing, and computer vision.
* Design and execute projects that demonstrate the application of digital image processing techniques to solve real-world problems.

## Topics / Modules and Intended Learning Outcomes

1. Introduction to Digital Image Processing

* Describe the history and fundamental principles of digital image processing.
* Identify the key areas of application for digital image processing technologies.

1. Image Enhancement Techniques

* Understand and apply various image enhancement techniques to improve the visual appearance of images.
* Evaluate the effectiveness of different image enhancement methods using qualitative and quantitative measures.

1. Image Restoration Methods

* Explain the concept of image restoration and its distinction from image enhancement.
* Implement various image restoration techniques to recover an original image from a degraded image.

1. Image Segmentation Approaches

* Describe the role of image segmentation in digital image processing and its applications.
* Apply different segmentation techniques to partition an image into meaningful regions.

1. Applications of Digital Image Processing

* Identify and explain the various applications of digital image processing in fields such as medical imaging, remote sensing, and computer vision.
* Develop and implement a project that utilizes digital image processing techniques to address a real-world problem.

## Weekly Activities

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| **Week No.** | **Topic** | **Activity Description** | **Expected Output** | **Assessment Tools** |
| Week 1 | **Introduction to Digital Image Processing** | Lecture on the history and fundamentals of digital image processing. Introduction to the course structure and expected outcomes. | Students will write a summary highlighting the key points of the lecture. | Written summary evaluation |
| Week 2 | **Introduction to Digital Image Processing** | Discussion on the key areas of application for digital image processing technologies. Group activity to identify potential applications in current technology trends. | Presentation of group findings on potential applications of digital image processing. | Group presentation assessment |
| Week 3-4 | **Image Enhancement Techniques** | Lecture on various image enhancement techniques followed by hands-on lab sessions using MATLAB to apply these techniques on sample images. | Lab report documenting the application of image enhancement techniques and their effects on sample images. | Lab report evaluation |
| Week 5-6 | **Image Restoration Methods** | Introduction to image restoration techniques with practical sessions on implementing these methods using Python. Analysis of pre and post restoration quality. | Lab report detailing the implementation and effectiveness of image restoration methods. | Lab report evaluation |
| Week 7-8 | **Image Segmentation Approaches** | Exploration of image segmentation techniques followed by a project where students apply these techniques to segment images using OpenCV. | Project report and presentation on the application and results of image segmentation techniques on chosen images. | Project report and presentation evaluation |
| Week 9-17 | **Applications of Digital Image Processing** | Series of lectures and project work on the applications of digital image processing in fields such as medical imaging, remote sensing, and computer vision. Students will work in groups to develop a project that addresses a real-world problem using digital image processing techniques. | Final project report and presentation demonstrating the application of digital image processing techniques to solve a real-world problem. | Project evaluation based on report, presentation, and demonstration |
| Week 18 | **Course Wrap-up and Final Assessment** | Review of course content and final assessments. Discussion on the future trends in digital image processing and potential career paths. | Completion of final exam and submission of final project reports. | Final exam and project report evaluation |

## References

*Huang, Y. (2022). Overview of research progress of digital image processing technology.*  
Link: https://iopscience.iop.org/article/10.1088/1742-6596/2386/1/012034/meta

*Qi, Y., Yang, Z., Sun, W., Lou, M., Lian, J., & Zhao, W. (2021). A comprehensive overview of image enhancement techniques.*  
Link: https://link.springer.com/article/10.1007/s11831-021-09587-6

*Wali, A., Naseer, A., Tamoor, M., & Gilani, S.A.M. (2023). Recent Progress in Digital Image Restoration Techniques: A Review.*  
Link: https://www.sciencedirect.com/science/article/pii/S1051200423002828

*Abdulateef, S.K., & Salman, M.D. (2021). A Comprehensive Review of Image Segmentation Techniques.*  
Link: https://www.iasj.net/iasj/download/c1809f5ac0252d40

*Umbaugh, S.E. (2023). Digital image processing and analysis: computer vision and image analysis.*  
Link: https://www.taylorfrancis.com/books/mono/10.1201/9781003221135/digital-image-processing-analysis-scott-umbaugh