VISÃO POR COMPUTADOR

Code: 322121

Main Scientific Area: Tecnologic innovation

Lecturer: João Luís Gomes da Fonseca

Language of Instruction: Portuguese

Regime: S1

Contact Hours: 60h Total Workload: 48h

ECTS: 6,0

Objectives

The goal of this curricular unit is to provide the student with the fundamental concepts associated with the design and implementation of computer vision and image processing solutions. In this module, emphasis on image filtering, enhancement, segmentation and analysis will be given, making use of different frameworks and libraries of functions for processing and visualization of images. This curricular unit incorporates a module focused on technological solutions in lighting, optics and image acquisition hardware. Student's theoretical training is complemented in the laboratory through practical projects that integrate the different concepts that are covered.

Learning Outcomes

Students who successfully complete this curricular unit should be able to:

1. Understand the context and importance of computer vision in the different sectors of society.

2. Analyze a specific problem of computer vision and identify the different underlying technological challenges both at the level of hardware and software solutions.

3. Understand and evaluate the different technological solutions in terms of lightning, optics, image acquisition hardware, and image processing hardware.

4. Identify, discuss and evaluate image processing and analysis techniques, namely segmentation, noise reduction/removal, and feature extraction techniques.

5. Design and implement image processing and analysis algorithms, specifically of image enhancement, image segmentation, image analysis, texture analysis, and motion analysis techniques.

Course Contents

1. Introduction

1.1. General concepts (light, color, electromagnetic spectrum and human vision)

1.2. Computer vision systems

1.3. Image acquisition sensors

1.4. Scanning (sampling and quantization)

1.5. Digital image (spatial resolution, tonal resolution and temporal resolution).

2. Lighting techniques, filters and lenses

2.1. Lighting (front lighting, backlighting, structured and strobe lighting)

2.2. Filters (colored glass, interference filters, neutral density filters and polarizers)

2.3. Lenses (lens types, focal length and diaphragm)

2.4. Typical applications

3. Image representation

3.1. Binary, grayscale and color images

3.2. Color spaces (RGB and HSV)

3.3. Transformation of color spaces

3.4. Representation of information through color scales

4. Image Processing

4.1. Image operations (point-to-point, local or global operations)

4.2. Segmentation (per threshold or per color)

4.3. Morphological operators (erosion, dilation, opening and closing)

4.4. Histograms (histogram calculation and histogram equalization)

4.5. Blobs and labeling

4.6. Contour detection (Roberts, Prewitt and Sobel)

4.7. Noise reduction/removal (combination of images, spatial filters)

4.8. Motion detection (difference between images and background subtraction)

5. Image Analysis

5.1. Coding and representation of regions (chain code, polygonal approximations)

5.2. Dimensional analysis

Recommended Bibliography

• “Digital Image Processing”, R.C. Gonzalez e R. E. Woods, 4ª edição, Pearson, 2017.

• “Processamento Digital de Imagens”, Ogê M. Filho e Hugo V. Neto, Brasport, 1999.

• “Robotics, vision and control”, Peter Corke, Springer, 2011

Learning and Teaching Methods

The syllabus was defined considering the objectives of the curricular unit. Therefore, the first and second objectives are addressed in section 1 of the syllabus; objective 3 is discussed in section 2 of the syllabus; and objective 4 and 5 are addressed in sections 3, 4 and 5 of the syllabus. The goals 2 to 5 shall also be addressed in laboratory through the execution of group works and presentation of their outcomes.

Assessment Methods

The final grade of the students is obtained on the basis of the following elements:

· 1st practical work - minimum grade 9 - Presentation and oral defense (individual)

· 2nd practical work - minimum grade 9 - Report and oral defense (individual)

· 2nd practical work - minimum grade 9 – Report, presentation and oral defense (individual)

· Global test -- minimum grade 9.5

Final grade = 1st practical work x 0.20 + 2nd practical work x 0.20 + 3rd practical work x 0.30 + Global test x 0.30

According to the equation of the normal season the student shall be approved in the curricular unit when the grade is greater than or equal to 9.5. Otherwise the student may retake the exam in the recourse or special season if he/she has obtained a minimum grade in the practical work.