# 5ELEN021W SENSORS AND SIGNALS
# COURSEWORK
# (2024/2025)

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| **Module leader** | **Saumya Reni** |
| **Assessment** | **COURSEWORK** |
| **Weighting:** | **50%** |
| **Qualifying mark** | **40%** |
| **Description and Learning Outcomes Covered in this Assignment** | • **Using a systems approach design and develop with image sensing and acquisition tools, systems level software tools, image analysis techniques and image processing algorithms a smart sensor solution. (LO5)**<br>• **Discuss the environmental and societal impact of smart sensor applications whether positive or negative; recognise and describe legal and ethical issues related to the use of captured sensor data pertaining to individuals. (LO6)**<br>• **Communicate a technical design succinctly; understand and evaluate technical data sheets of smart sensors.(LO7)**<br>• **Produce supporting documentation through a professional report.** |
| **DUE DATE** | **Thursday 9th January 2025 at 13:00:00** |
| **DELIVERABLES** | FINAL REPORT: Report in PDF<br>• *A written report with all sections fully attempted and answered.*<br>• *Deliverables should also contain all the matlab codes and results in the form of images.*<br>• *Show your codes with proper annotations and comments.* |
| **SUBMISSION** | **Online Submission via Blackboard assignment as a PDF document in the format :** 5ELEN021W_Your Name_GroupNumber. pdf |
| **FEEDBACK** | • **Provisional release date is 03/12/2024. Formative feedback for sessions will be provided during tutorial sessions.**<br>• **The submission is followed by a formal presentation and discussion. Note: All marks will remain provisional until formally agreed by an Assessment Board.** |

Your group will be working on **Project E** with the images extracted from the given Dataset.You are required to choose 3 different images.

**Project E. Object Recognition in Medical Images**

- **Objective:** Segment and identify parasite features in Katokatz Images.

  Use appropriate morphological operations to smoother the background and noise filter. Use appropriate operation to further enhance the parasite cells in the image.

  Dataset: Data provided by ADVRG database

# Coursework Tasks [40 Marks]

# Part 1

**Design a graphic user interface (GUI) in matlab which has the following functionalities for accessing, analysing, and processing three different images of your choice:**

I. Upload the images and display [2 Marks]

II. Calculate the image contrast and return the value:
For this task you must implement **your own** function in matlab that calculates the contrast of the image using the RMS contrast measurement technique.
[5 Marks]

III. Convert the images into grayscale and display:
For this you must implement **your own** function in MATLAB that convert the image to grayscale. Note that grayscale conversion strategy involves using optimised weights for the Red, Blue and Green channels. You are not allowed to use the built-in MATLAB command 'rgb2gray' for this experiment. You have to figure out the best combination of weights for Red, Green and Blue channels which gives the maximum contrast to the grayscale image. The combinations should also be displayed in the GUI
[10 Marks]

IV. Display the histogram of the images:
For this you must implement **your own** function in MATLAB which generates the histogram of the grayscale image [8 Marks]

V. In this task you must use your project dataset. Using appropriate thresholding, binarize the grayscale images and apply a morphological filtering operation fullfill the objective of your project. To achieve your obejective, please make sure that appropriate pre-processing techniques and filtering operations are implemented to remove the unwanted noise from the images and enhance or segment the features. Wherever possible please use your own structuring elements, kernels, and masks.

[15 Marks]

# Part 2

I. Evaluate the environmental and societal impact of your project. Identify and analyse ethical concerns, make reasoned ethical choices, adhere to professional codes of conduct. [5 Marks]

II. Present your work, demonstrating the GUI followed by discussion. [5 Marks]

## *Deliverables:*

*A full report in pdf with all the results and codes.*

*Demonstrate the functionalities using screenshots of the GUI. You should also provide the entire code of the GUI with proper comments and annotations. It is recommended to provide the codes of each function separately even though they are included in the GUI code.*

*The submission is followed by a presentation where you will demonstrate your GUI and discuss the Part VI of your work.*

*For details on the rubrics, please see the mark allocation table below.*

## Mark Allocation:

| Criteria | Marks per component |
|---|---|
| **Part 1- I** | **2** |
| Codes to load and display an image | 1 |
| Demonstrate with a screenshot of the GUI for all three images | 1 |
| **Part 1- II** | **5** |
| Correct implementation of the RMS contrast measurement technique; detailed code with correct annotations | 3 |
| Demonstrate the function by calculating the contrast of an image of your choice | 2 |
| **Part 1- III** | **10** |
| Correct implementation of the weighted gray-scale conversion technique; detailed code with correct annotations | 5 |
| Measure the contrast of images created on all the weighted combinations of red, green and blue components of the image. Provide the results in a table. (There will be around 66 combinations to test at least) | 4 |
| Demonstrate the algorithms and its results using the images | 3 |
| **Part 1- IV** | **8** |
| Correct implementation of the histogram measurement function; detailed code with correct annotations | 5 |

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| Demonstrate the function using the images | | 3 |
| **Part 1-V** | **15** | |
| Use appropriate thresholding strategies to binarise the image highlighting all the foreground objects | 3 | |
| Implementation of an appropriate morphological operation to filter the image. The key is to accurately design a structuring element which when applied will not attenuate the important object features | 5 | |
| Image enhancement and feature extraction | 5 | |
| Demonstrate the algorithms and its results using the images | 2 | |
| **Part 2** | **10** | |
| Discussion on the ethical, societal and environmental implications of the project | | 5 |
| Demonstration of the work | | 5 |
| **TOTAL** | **50** | |