

# APPM4058A & COMS7238A: Digital Image Processing Course Projects

**Hand-out date: May 18, 10:00**  
**Hand-in date: June 25, 23:55**

## 1 Instructions

- Honours students and Masters students have different requirements, read the relevant sections carefully.
- Hand in the electronic files and source code on Ulwazi. Read Section **Hand-Ins** for further instructions.
- The following due dates are necessary to be met:
  - **Due Date 1: May 23, 18:00** Your project selection is to be finalised. It is important to send through your selection(s) as early as possible.
  - **Due Date 2: June 25, 23:55** Hand in the requested deliverable (see Section **Hand-Ins**).
- Please fill in this form of your choice(s), and group member(s) where applicable: (In the case of a group project, only one group member is requested to fill in the form. )
  - Honours students: <https://forms.gle/4unZshFeH6EFZ2b58>
  - Masters students: <https://forms.gle/weZveQhwLgSWMN976>
- We will restrict the number of groups allowed to work on the same project depending on how students are going to select their projects. In the case of multiple groups working on the same project, the results from different groups will be compared against each other in the process of marking.
- Respect and adhere to academic integrity.

## 2 Overview

The aim of this assignment is to apply Digital Image Processing techniques to real world problems.

You will be required to choose your own dataset (unless otherwise specified.) This is a good skill to have and marks will be deducted for data that is too simple or if your implementations do not generalise to multiple examples.

Presentation — Each group is requested to submit a short presentation video of 10-15 minutes to present their project, and demonstration where necessary.

Report and source code — A report must be written and submitted alongside your code that includes:

- A description of the problem domain.

- A detailed description and walk through of your approach.
- Reasons for various choices and steps in your approach.
- Which algorithms are used from the DIP course, or extensions.
- For items above, you may include key parts of your source code to explain your solutions for various problems you encountered.
- Examples of input and output produced by your program.

**Acquiring necessary dataset is part of your project. Such dataset is expected to be general and unbiased within the scope of your project.**

## 3 Projects for Honours Students

All honours students may either:

- Choose a project from the lists below.
- Propose your own project (This must receive approval before you begin.)

You may choose to work alone or in a group.

- If you choose an **easy** project, you must **work alone**.
- If you choose an **intermediate** project, you may work in a group with a **max of 2 persons**.

### 3.1 Projects - Easy

1. **Background Replacement:** Separate the foreground and background of known subject matter and both replace and blur the background. Your output should be the processed image.
2. **Blink Detection:** Blink detection given a cropped image of a face. Your output should be if the person in the image is blinking or not.
3. **Content Based Image Resize:** Implement content based image cropping and resizing that uses a known foreground. Your output should be the cropped or resized foreground.
4. **Count Fingers:** Count the number of fingers on a colour image of a cropped hand, although you don't need to handle the case where fingers are together and touch. Your output should be the number of fingers held up.
5. **Haze Removal:** Remove fog from images, haze must be moderate so background details can still be recovered. Various processing techniques should be applied to recover these details. Your output should be the processed image.
6. **Segment Clouds:** Segment clouds from colour images of a landscape. Your output should be a segmented labelled image corresponding to different cloud regions.
7. **Simple Style Transfer:** Histogram equalisation based style transfer between colour images. Should support multiple different modes of operation corresponding to operating on different colour spaces (RGB, HSL, etc.) (at least 3). Your input should be two images (input and target) and the mode, while the output should be your stylised input according to the target.

8. **Human Skin Detection:** Detect and output areas of skin in colour images. Your output should be a binary image of skin regions. Investigate human color skins of different races; and with a focus on detecting facial area and four limbs of a person.
9. **Plant Leaf Image Classification:** Given a set of reference leaf image set, identify which class a test leaf image belongs to.
10. **Barcode Detection:** Detect barcodes at the back of books. Your detector should be able to handle various images including both grayscale and color images, and the output should be a binary image of barcode.
11. **Cartoon-ify:** A system to generate various effects for colour images. At least 3 different artistic effects should be implemented using different approaches as part of the effect pipelines, with one effect aiming to cartoon-ify the image, i.e., a camera image turned into an image with cartoon effect.

### 3.2 Projects - Intermediate

1. **License Plate Detection and Segmentation:** Detect the license plate from an image of vehicle and perform segmentation on the number plate. The result you obtain from this process should be ready for recognition task that is usually to follow. Design approaches that handle images taken in varying environments, including different illumination condition such as non-uniform illumination or poor illumination; and different weather condition such as rainy or foggy.
2. **Intelligent Traffic Lights:** System that monitors the number of cars parked in-front of a traffic light for use in an intelligent traffic light system. This should not detect objects that are too small, generating false positives such as pedestrians on sidewalks.
3. **Iris Segmentation:** Detect the average colour of the iris in an image of an eye. Your output should be one of the 6 most common natural eye colours: Brown, Hazel, Blue, Green, Gray, Amber.
4. **Sudoku Solver:** Read Sudoku puzzles given as images from a standardised source (for example the same newspaper, with the same font, scanned in exactly the same way each time, with even lighting). The output should be text that can be passed to some Sudoku solving program or library.
5. **Playing Card Crop and Warp:** Implement an approach to detect the corners and crop out the interior of a playing card from an image (possibly taken at minor angles) and warp it to its original shape (you can use a library for the warping).

## 4 Projects for Masters by Coursework Students

All masters students must **work alone** and may either:

- Choose a project from the list below.
- Propose your own digital image processing research paper (or section of that paper) that you will re-implement (This must receive approval before you begin.)
  - A good example is replicating '3D histogram matching' for colour images from the paper "Color Style Transfer Techniques using Hue, Lightness and Saturation Histogram Matching".

## 4.1 Projects

1. **Ball Trajectory:** Calculating the trajectory of multiple different colour balls given multiple frames. The output should be the position, velocity and size of each ball at between pairs of frames.
2. **CAPTCHA Solver:** Solve simple CAPTCHA problems from a synthetic dataset. Backgrounds with gradients, fixed length words and characters, random thin lines. Your output should be the original text.
3. **South African Coin Detection and Recognition:** Given a set of South African coins with different Rand values, identify each coin, and output the number of coins for each Rand value.
4. **License Plate Detection and Recognition** Detect the license plate from an image of vehicle and perform recognition of the number plate. The result you obtain from this process should be the license plate text. Design approaches that can handle images taken at different angles. You may work on South African licence plate dataset or a public dataset available.
5. **Paragraph Extraction:** Program that attempts to straighten a page of text paragraphs, as well as extract all the different paragraphs and output separate sub images corresponding to each for further processing. Pages may be non-uniformly lit.
6. **Puzzle Solver:** Program that can solve a simple jigsaw puzzle when given an image (with uniform lighting and background) containing separated puzzle pieces. The output should be the stitched together puzzle.

## 5 Hand-Ins

Submit requested presentation video, report, and source codes via provided links on Ulwazi course site.

- Presentation video, named “<student\_no>\_presentation.pdf”.
- Your PDF report, named “<student\_no>\_report.pdf” (For example: “0000000\_report.pdf”, must be written in double column, single line spacing, 10pt font size, and the page numbers not exceeding 6. Using Latex to write your report is recommended.
- A Turnitin report.
- Your source code folder “<student\_no>\_src.pdf” containing your python or matlab code.
  - All code must be clearly commented.
  - Code must generate the appropriate images and graphs included in your report when run.
  - You must include a README file with a detailed description of how to run your code and the structure of your source code folder.