Informatics and Computer Science	**Coursework Brief Proofing & Printing Confirmation Sheet**

Module Title **Visual Computing and Image Processing**	Module Code **21CSAI02I**
Module Leader **Dr. Maryam Al-Berry**	Semester **Two**
Proofed by **Dr. Walid Hussein**	

I hereby confirm that:

- This coursework brief has been proof-read (spelling and grammar) *
- This coursework brief assesses the ILOs for the module *
- This coursework brief follows the approved template *
- All questions (and sub questions) have their marks specified *

Signed (Proof Reader): Dr. Walid Hussein

Signed (Module Leader) Dr. Maryam Al-Berry

Informatics and Computer Science	**21CSAI02I** **Take-home Project** **2021-2022**
Module Title **Visual Computing and Image Processing**	
Module Leader **Dr. Maryam Al-Berry**	Semester **Two**
Assessment Weight **% 25 of the total course marks**	Due Date **Due date (exact day to be specified in the CW map)**

Instructions to students:

1. This is an individual take-home project.
2. Each student should choose one of the described ideas.
3. The test cases will be provided on the e-learning system.
4. Each student should submit a 1000-1200 words report along with the code.
5. Submission: The submission is via the e-learning system.
6. Assessment: Assessment will be on the code and report submitted, in addition to scheduled individual discussion.
7. Feedback: Phase one feedback will be given through discussions (scheduled one week after submission). Phase two feedback will be provided in written format two weeks after submission.
8. Along with the submitted assignment, you need to submit: a fully completed and signed *Coursework submission form* *and* a *Statement of Academic Honesty Form*. You can only submit your own work. Any student suspected of plagiarism will be subject to the procedures set out in the GAR.

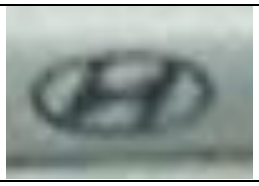
1- Vehicle Logo Recognition

Description

Main Idea

Vehicle identification and tracking are very important for several potential applications in security, including parking and speed control, and offender trailing. Automatic systems exist to aid law enforcement in the process mainly through license plates. However, sometimes when the plate is missing, covered, or forged, the system may use vehicle manufacturer recognition to classify the vehicle by the *brand logo* on the front or back of the car. In this case, the system takes as input an arbitrary scene (stream or snapshot) and automatically outputs information associated with vehicles in that scene.

Assume that the camera takes a shot of the front or rear side of the vehicle in daylight and good weather conditions, and that the vehicle is the main object in the scene. The algorithm should be able to find the region containing the logo, and produce a sub-image of that region. This is normally fed to a recognition system to identify the brand.

Input		
Output		
	Hyundai	Opel

Minimum Requirements

Identify the car logo from color input images with:

1- Possibly other objects in the background.
2- Frontal/rear view of a vehicle.

Possible Add-ons (Bonuses)

1- Identify the car logo from color input images with:
   a. Complex scenes (e.g. many vehicles).
   b. Varying illumination conditions and noise.
   c. Arbitrary perspectives (i.e. different camera angles).

Suggested Search Tracks and Keywords

You may use some/all of the following keywords as a guide (not restricted to them):

1- Segmentation
2- Morphological operations
3- Region properties
4- Representation, feature extraction, matching, and classification

Test Images for Minimum Requirements

Case1: Frontal/rear scene of a vehicle with no other objects.
Case2: Frontal/rear scene of vehicle with other objects (e.g. blocks, signs, other vehicle(s) – partially appear).

Test Images for Bonuses

Case3: Simple scene of a vehicle from arbitrary perspectives.
Case4: Scene of heavy traffic.
Case5: Non-uniformly illuminated versions of cases 1-4.

References

1- Textbook Ch. 9: Morphological Image Processing
2- Textbook Ch.10: Image Segmentation
3- Textbook Ch. 11: Representation and Description
4- Textbook Ch. 12: Object Recognition

2- Action Sequence and Motion Recognition

Description

Main Idea

Many sports enthusiasts, from novice photographers to professional publications, rely on manual image segmentation with tools like Photoshop to combine multiple images of a bike trick or basketball dunk into a single image by cutting out the foreground of each image and overlaying it onto the background of one image.

Assume a fixed camera that shoots a short video of some motion. A first step is determining a number of key frames (burst shots) that mainly construct the motion sequence. The goal of this project is to develop an algorithm that can automatically combine multiple images generated from burst shots of an action into a single image that clearly shows the full action, as shown in Figure 1. It also recognizes the moving object motion (walk, wave, bend, etc.).

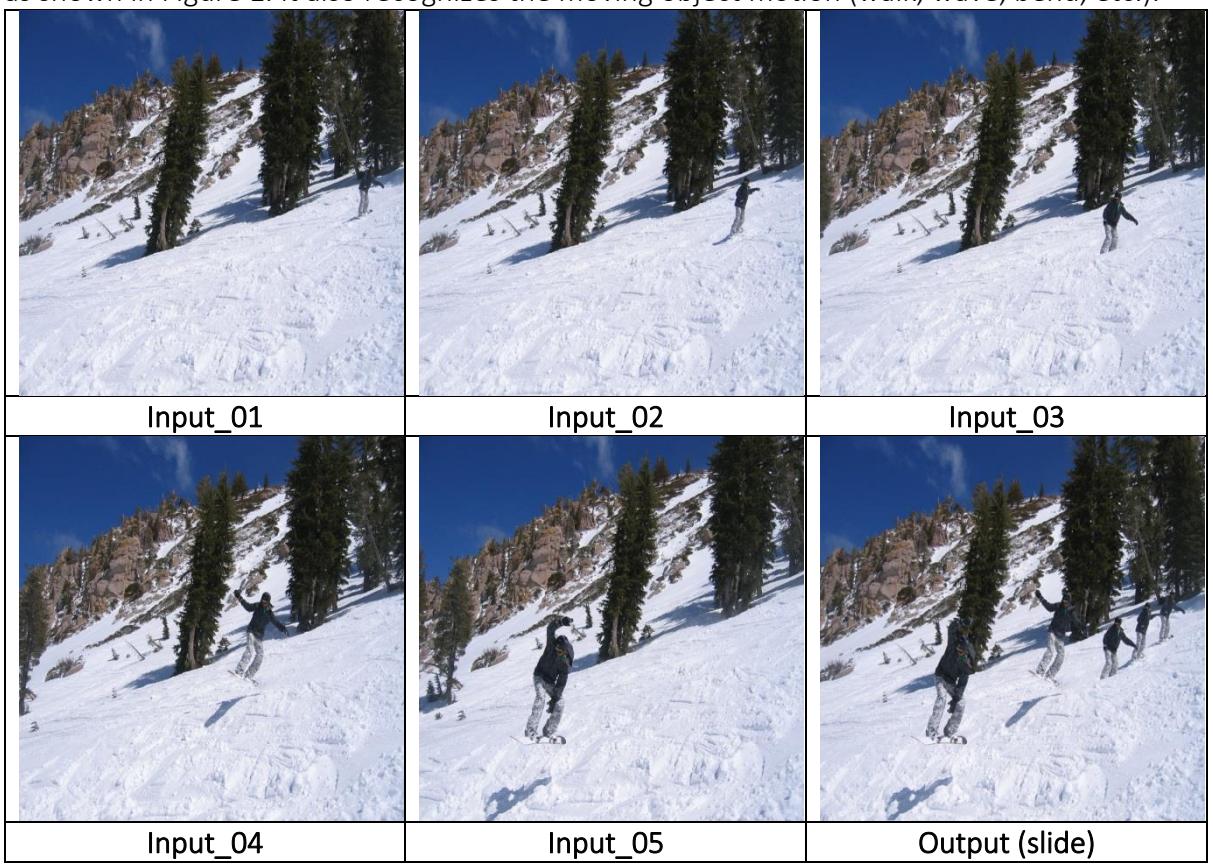


Figure 1: Sequence of input images and the final output image

	
a. Full body motion (catch)	b. Body part motion (wave)

Figure 2: two types of a moving object

Minimum Requirements

Construct an action sequence image and identify the motion from a set of burst shots with

1- Fixed camera position and uniform illumination.
2- Only one moving object with
    a. Full body motion,
    b. Body part motion, as shown in Figure 2.
3- Scenes with dynamic backgrounds (e.g. trees/water).

Possible Add-ons (Bonuses)

Construct an action sequence image and identify the motion from a set of burst shots with

1- Moving camera.
2- Multiple moving objects.
3- Non-uniform illumination.

Suggested Search Tracks and Keywords

You may use some/all of the following keywords as a guide (not restricted to them):

1- Motion segmentation
2- Morphological operations
3- Region properties
4- Tracking
5- Matching and classification

Test Images for Minimum Requirements

Case1: single object, 2D whole body motion, static background, fixed camera, uniform illumination.
Case2: single object, 2D body part motion, static background, fixed camera, uniform illumination.
Case3: single object, 2D whole body motion, dynamic background, fixed camera, uniform illumination.

Case4: single object, 2D body part motion, dynamic background, fixed camera, uniform illumination.

Test Images for Bonuses

Case4: (case1 and case 2) but with moving camera.
Case5: several moving objects.
Case6: non-uniformly illuminated versions of cases 1-5.

References

1- Textbook Ch. 9: Morphological Image Processing
2- Textbook Ch.10: Image Segmentation
3- Textbook Ch.11: Representation and Description

3- Music Score Reader

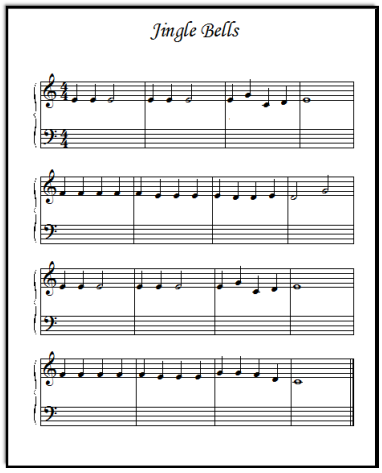
Description

Main Idea

Optical music recognition (OMR) has been the subject of research for decades. An accessible and easy-to-use OMR application could provide an amazing tool for improving the musical education experience. For example, a novice musician could use such a tool to hear what a selected piece of music should sound like.

Ideally, an OMR, given an image of a simple or complex music sheet, automatically identifies the notes, and plays the musical piece. For this project, our goal is to develop an algorithm to parse music sheet images, produce the associated annotation, and implement a playback mechanism for the parsed musical notes.

Input



Demo for expected output

Minimum Requirements

4- Parsing horizontally aligned music sheets.
5- Generating ABC annotation.
6- Music playback.

Possible Add-ons (Bonuses)

4- Parsing tilted music sheets (staff lines are not lined with the horizontal).
5- Parsing complex music sheets.

Suggested Search Tracks and Keywords

You may use some/all of the following keywords as a guide (not restricted to them):

6- Optical music recognition (OMR).
7- Segmentation.
8- Morphological operations.
9- Region properties.
10- Matching and classification.
11- ABC annotation.

Test Images for Minimum Requirements

Case1: Twinkle Twinkle sheet music.
Case2: Jingle Bells sheet music.

Test Images for Bonuses

Case3: Bach sheet music.
Case4: Slightly rotated versions of cases 1-3.

References

4- Textbook Ch. 9: Morphological Image Processing
5- Textbook Ch.10: Image Segmentation
6- Textbook Ch. 11: Representation and Description