AC41002 Computer Vision Assignment 2015

Aim

The book cover in Figure 1 is a composite image of the Mona Lisa; it consists of many tiles each of which is a painting. The aim of this assignment is to develop, evaluate and report on image processing software to automatically create composite images of various types, using images automatically selected as being of certain classes of scene.

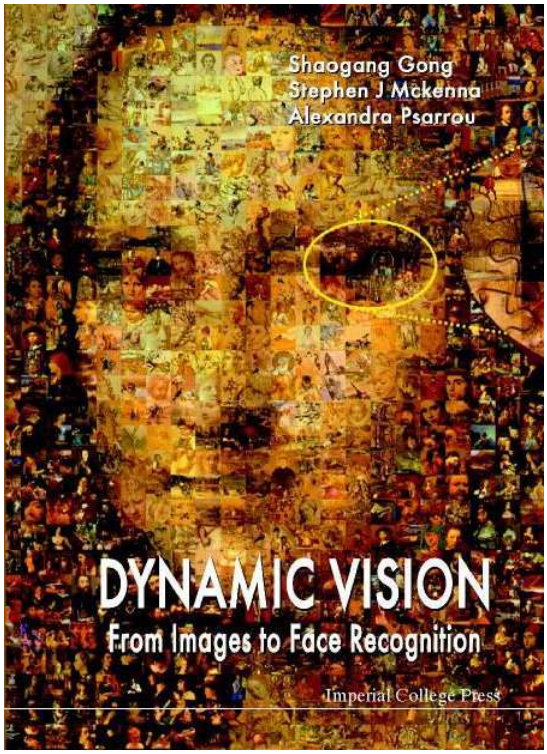

Figure 1

Terminology

The image to be approximated is called the *target image*. The images used to create the tiles are called *source images.* In Figure 1, for example, the Mona Lisa is the target image, and the source images are various paintings.

Image Data

You will be provided with sets of images of several hundred outdoor scenes. Each image has been labelled as either *natural* or *manmade*. The *natural* images are of scenes dominated by mountains, hills, desert, or sky, for example. The *manmade* images are of scenes dominated by commercial buildings, shops, markets, cities, and towns. You should use these image sets for each Part of this assignment. The images sets are divided into disjoint subsets for *training* and *testing.*

Training set:	500 *natural* images & 500 *manmade* images
Test set:	250 *natural* images & 250 *manmade* images

PART A: Composite image generation

The first part of your assignment is to develop software capable of creating composite images.

The user should be able to select the number of pixels and the number of tiles in the output composite image. You should use the training set of 1000 images to obtain source images. *Optionally, you might want to source other image sets to create your own composite images. If you do so, make sure that their use is not prevented by regulations (e.g., specific stipulations on some websites limiting the use of published material) or decency considerations.*

Source images should be cropped and have their sizes adjusted appropriately prior to inserting them into the composite image (e.g. by Gaussian smoothing and resampling).

Which source image to use for a given tile should be determined by computing a *measure of similarity* between the tile in the target image and each source image. You should design and implement an appropriate similarity measure. A good starting point is to compute image histograms and use a measure of histogram similarity. However, obtaining satisfying result might require taking into account other characteristics of the images such as their texture and structure. You might even consider taking into account neighboring tiles when deciding which source image to use.

Towards the end of the module, you will be provided with two target images and asked to produce composite images of them for inclusion in your presentation. There might even be a small prize for the team that produces the most pleasing composite images!

PART B: Binary image classification

The second part of your assignment is to develop and quantitatively evaluate software to classify images as belonging to one of two classes: *natural* or *manmade*. You should implement a K-nearest neighbor classifier based on an image-image similarity measure.

Start by using the similarity measure you developed in PART A. Subsequently, you might want to design a different similarity measure better suited to this classification task. (Think about what differentiates these two classes of image and about methods you have learned about in this course.)

You should evaluate the performance of your classification system on the test set. Test results should be given in terms of computation time, misclassification rates for each class, and overall accuracy. Of course, the system must not make use of images from the test set when making classification decisions.

PART C: Class-specific composite images

In this part, you should combine what you have done in Parts A and B to produce class-specific composite images. Given a target image, your system should first classify it, and then build a composite of it using only images from the same class (as determined using your classifier from Part B).

Teamwork and Assessment

This assignment will be assessed based on written reports and presentations. This will include an element of moderated self/peer assessment.

The class will split into ***teams***. Each team should produce its own ***integrated*** solution. Every team member should contribute to some aspect of all three of the following: (i) software development (ii) report preparation (iii) presentation/competition.

Team Report ***(due Thursday of week 11)***

Each team should submit a technical report (10-15 pages including images) both electronically and as a hardcopy. The report should describe the algorithm design, implementation, testing and evaluation of the software developed. Code produced should be submitted in electronic form. Your team might want to appoint an editor for the report but every member of the team should contribute material to the report. You should submit the electronic version of the team report and code to VLE.

Individual Report ***(due Thursday of week 11)***

Each student should also submit a short individual report. Half a page is all that is required; it should certainly be no longer than a page. This individual report should be emailed directly to both stephen@computing.dundee.ac.uk and jgzhang@computing.dundee.ac.uk. It need not be seen by any other students. It should contain:
1. An assessment of the extent to which you contributed to the outcome of your team, including the three ways in which you personally contributed most to the project.
2. A brief assessment of the contribution of each member of your team.
3. A suggested overall mark (%) for this assignment for each member of your team, including yourself.

Presentations ***(Week 12)***

Each team will give a short presentation summarizing its system design and results, to which each team member should contribute (either in preparation or delivery or both). Each team will be allocated around 10 minutes plus 5 minutes for questions and discussion. The presentation should begin by introducing the team members and stating briefly their contributions.

Marking Scheme

This assignment counts for 30% of the total module mark

For the purposes of marking, the relative weighting of Parts A, B and C is 45:45:10
The relative weighting of the team report and the presentation is 80:20.

The individual reports will be used to assist the markers in the relative marking of team members, in combination with the markers' own observations of performance.

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