Final Project: Image Classification System

Universidad Carlos III de Madrid, Multimedia, Year 2018-2019

### Autors

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### Assigned Class

TIE Interceptor

### Chosen Classification Model

K-Nearest Neighbours / Support Vector Machine

### Upgrades Implemented

Upgrade 1 and/or 2 and/or 3

# Development

## Preprocessing

**P1**. Is the segmentation correctly performed in all cases? In case of a negative answer, why do you think Otsu’s method fails to discriminate object from background?

The segmentation is performed correctly in many cases, but not in all of them. That happens since Otsu’s method need the image to have its colours distributed in a bimodal way, having two significant peaks. When that does not happen, this method is not so good for the segmentation.

**P2**. If the current scenario required multiple object identification, ¿which technique could be employed for such a task? Explain briefly that technique.

In order to detect and separate multiple objects the picture (input data) should be divided into smaller regions containing one object each. This technique is called segmentation – it can be achieved i.e. by thresholding, colour-detection or clustering. It differentiates object with the difference between object’s pixels and pixels surrounding the object.

**P3**. What was the main benefit of the opening operation?

*Opening the image allows to decrease the noise by erasing some small objects found in the background (or black part). In our tests, we also found that when the white part of the image is bigger than the black part, applying the opening operation reverses the colours.*

**P4**. If we set the radius of the structural element too large for the opening operation, what risk do we take?

*If we set the radius too big, most likely we will get important parts of the object in the image removed so we will lose the shape.*

**P5**. Why was the closing operation useful?

*The closing operation reduces the noise inside the body of the object (or the white part) by removing the small objects found there. This combined with the opening operation leads us to having an image with two really differentiated parts, background and foreground. This way, the shape of the object is more noticeable.*

## Feature Extraction and Normalization

**P6**. What advantages does the HSV colour space offer with respect to RGB?

Unlike RGB, HSV separates luma, or the image intensity, from chroma or the colour information. This is helpful when extracting only the colours, not caring about the light and colour intensity.

**P7**. What would happen if we tried to extract this feature for the whole image, i.e., without previously applying segmentation and morphology pre-processing?

Extracting features from whole images would mean extracting features and information from parts of the picture that are irrelevant for the algorithm such as background noise, not related extra objects etc. As an effect system of recognition would examine data that is not related to our object of interest thus, it could be less accurate.

**P8**. What measures can be taken so that image size does not affect the shape feature?

One way is to normalize perimeter and check the rectangularity/circularity of the object. That way size will not affect the shape feature because it will be normalized.

**P9**. How would a bad object segmentation affect the extraction of generic features related to shape?

Bad quality of masks (the output of bad object segmentation) could affect in extracting features of areas that are not related to our object of interest, i.e. objects that are overlapping and/or objects in background. From our point of view their features are not relevant and it is crucial to “cut them off” in order to filter “information noise”.

**P10**. In your opinion, what is the most useful feature regarding the discrimination of the spaceship assigned to your group? Justify your answer and use figures to support your claims.

In my opinion texture is the most useful feature. It’s because texture is easy to extract from objects, it’s more objective and it’s mostly better preserved than colour or shape (due to difference in lighting/ perspective). Every object differs in its texture from others and that makes it highly classifiable.

**P11**. Taking into account what was done in Stage 3, mention at least 3 additional features (one of each kind) that could be extracted for this system. Justify your choices.

**Range of colours** – how many colours system can distinguish from an object

This metric could specify “colourfulness” of the objects. Due to significant differences in that metric, I think adding this feature would improve overall system’s score

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## Classification. Training and Evaluation of New Samples

**P12**. Explain the algorithm for classifying new samples followed by the K-NN method.

K-NN method classifies new samples by taking (given) K nearest neighbours and assigning the class that occurs in the majority of them.

**P13**. For this particular case, what would happen if we set a value of *K* equal to the number of samples available for training (*K=56*)? Why?

It would mean that our algorithm, when classifying new sample, takes all the sample’s neighbours into consideration. It would mean that the system would classify unknown objects the same as the majority of objects.

**P14**. Why are we forced to use the same normalization values we used during training?

*Answer*

**P15**. Why can’t we use the same set (e.g. our whole database) for training and testing?

*Answer*

**P16**. ¿What risks do we run by setting a training set too small? And by setting it too large?

*Answer*

**P17** In case K-NN was selected for classification, why do you think the model can only set fixed values of +1 and -1?

*Answer (only one option)*

## Assessment of the System

**P18**. In your own words, describe what each of the presented metrics mean for our case of study (spaceship discrimination system).

*Answer*

**P19**. Taking into account the obtained results (specify them in your answer), do you consider the performance of the system to be acceptable? Why?

Our AUC score was 0.83

Given that we had small amount of training objects and the calculated masks were poor quality, I’d say our score was acceptable – it means our system “guessed” much more accurately than doing so by random.

**P20**. Discuss the relation between the curve displayed in the figure and the values obtained for and .

*Answer*

**P21**. If the AUC gave a value of 0.5, what would this imply?

If the AUC score was 0.5 it would mean that our classification is worthless – system guesses would be purely random.

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# Annex: Preliminary Report

## Introduction

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## Technical Solution

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## Performance

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## Conclusions and lines of work

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