LTS5 - Image analysis and pattern recognition
lts5www.epfl.ch
EPFL, Lausanne, Switzerland

Special project - description

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1 Introduction

In this special project, your task is to use your image analysis skills to save the bees by detecting and quantifying the presence of varroa in beehives! Varroa destructors are recognized as the biggest pest to honey bees worldwide, and are believed to be the single largest contributing factor in the modern-day decline of honey bees due to their ability to transmit diseases, resulting in death or severe deformity of the pupae.

The presence of varroa in a beehive can be detected by localizing and counting the number of dead mites that fell on a flat plate positioned under the beehive. Therefore, in this project, we use top-view images taken from plates of approximately 40 by 60 centimeters, containing different elements such as wastes, dirts, ants, varroas, and etc.

Figure 1. Environment

Different steps are defined in the following section, each of them allowing you to try methods that you have seen during the course and collect a given number of points. We also organised a final challenge for you, where you can submit your best method and compare your results to other groups and potentially win a 0.5 points bonus (only top 5 groups!). During the last session, Friday, May 31, You will also present your approach to the problem and explain briefly how you implemented your solution.

2 Task: Let's find them!

Your main task is to localize and classify varroa destructors within RGB images. The detailed required steps are defined according to the three following parts:

2.1 Finding varroas by segmentation

Rearrange your code of lab 1 to create a function which takes an RGB image at the input and returns a array containing the coordinates of varroas within that image. Test your function and report the Precision, Recall and F1-score, by using all 50 images of the test-set (presented in section 4.3), and considering **0.3** as the IoU threshold.

Please refer to our Jupyter notebook, dedicated to this project, for more details about the input/output formats of this function.

2.2 Implement your first detector

Object detection is a different problem to classification as we equally need to localize the object within an image. One very common approach that has been in use for a long time is to do object detection by using sliding windows. The idea is to slide a window of fixed size across the input image. What is inside the window at each location is then sent to a classifier that will tell us if the window contains an object of interest or not.

Rearrange your codes of lab 2 and 3, and try few methods that you saw during the course to implement your detector in a sliding window fashion. The choice of the algorithms is up to you; try to choose the ones which make more sense to you/ or gave you the best results during previous labs. The input/output format of these functions should be exactly the same as the one you used for in section 2.1.

Test your functions and report the Precision, Recall and F1-score for each one, by using all 50 images of the test-set, and considering **0.3** as the IoU threshold.

2.3 Using MLP and CNNs

Use Tensorflow and train a Neural Network to classify and detect varroas in a supervised manner. You are free to design your own architecture; as the baseline, you can benefit from your code for MNIST classification in lab 3. You can still benefit from sliding window approach to apply your classifier.

Test your function(s) and report the Precision, Recall and F1-score, by using all 50 images of the test-set, and considering **0.3** as the IoU threshold.

3 Challenge (bonus)

The challenge will be the last part of the project and will be hosted on EvalAI. You can register online (https://evalai.cloudcv.org/) with your **EPFL** email address. Please follow the step on the website to setup your account, sign up your team and join the **Apizoom iapr 2019** competition (https://evalai.cloudcv.org/web/challenges/challenge-page/321/overview). You can only have one registred team per group.

The 259 images for the competition will be released only 1 weeks before the final presentation. Please note that no ground-truth will be provided for these images. You can use the *generate_pred_json* function that we provided in jupyter notebook to generate a submission file and upload it to EvalAI portal. Additional information regarding the evaluation metric and the submission file can be found on the same portal.

In the meantime, you can still use the "test phase" in the online portal to evaluate your model, by uploading your results of the 50 test images that you already have. Doing so, you will be ready for the competition.

Your final ranking in the challenge does not have a negative affect on your final mark, but a bonus of **0.5 points** is allocated for all members of the **top 5 groups**.

4 Organization

4.1 Sessions

Three sessions are dedicated to the special project, organized similarly to exercise sessions. During the last session on May 31, you will present your work. The detailed schedule for the final presentation will be provided later.

May 10	Lecture (8h15 - 10h00)	ELA1
May 10	Session 1 (10h15 - 12h00)	CO023
May 17	Session 2 (9h15 - 12h00)	CO023
May 24	Session 3 (9h15 - 12h00)	CO023
May 31	Presentations (TBD)	CO023

Table 1: Calendar and organization of the special project sessions

4.2 Teams

You will work in teams of three. You will need to register these teams on the course Moodle before the second session dedicated to this special project (on Friday, May 17).

4.3 Data

In our Moodle page, we provide you the link to the dataset, containing images taken in real conditions by real beekeepers: “project_data.tar.gz”. In this folder, we divided the dataset into 1000 images for the training images, 250 images for the validation and, 50 images for the test. Same as lab 1, for each image, you have an .xml file containing the ground-truth and the actual position of the varroas within that image.

The images to be used for for the final challenge will be available only from May 24 and without any ground-truth. These images have the same format as the current test-set that you have at your disposal.

5 Deliverables

During the last session, Friday, May 31, each team presents their approach in 10 minutes. You should focus on your solution and provide a clear overview of the choices you made and the steps you implemented. No report is needed.

Finally, you need to provide an archive containing your jupyter notebook file + a text file of the list of the packages used in your code + the PDF file of your presentation, by **May 30, 11:59 PM**. Name the archive file with the name of your team (e.g. TeamA.zip).