Computer Vision 2022 Project

Scene Understanding in Low Lighting Conditions

Scene understanding attempts to analyze objects in context with respect to the structure of the scene, its layout, and the spatial, functional, and semantic relationships between objects. It can be achieved using several tasks among which are Image Classification, Object Detection and Segmentation.

Project Objectives:

1. Apply Image Enhancement on the given images as a preprocessing step to deal with the low lighting conditions (this can be done depending on the type of low light in the image)
2. Apply Image Classification to classify each image whether it was taken indoors or outdoors.
3. Apply object detection on the dataset and then count the number of instances of each class in an image. (Kaggle Competition)
4. Apply segmentation using clustering on the same dataset to separate areas of interest [next lab]

Dataset Descripton

The full dataset can be found [here].

The dataset is also uploaded to the Kaggle competition and can be used directly in Kaggle notebooks [**Make sure the notebooks are private until the competition ends**]

The dataset provided consists of the following folders/files:

1. Train Folder that contains Images folder and Annotations folder (these annotations are to be used in the **object detection task**)
2. Test Folder that contains Images folder only
3. "TrainImageLabels.txt" to be used for **Image Classification and Image Enhancement**
4. "TestImageLabels.txt" to be used for **Image Classification and Image Enhancement**

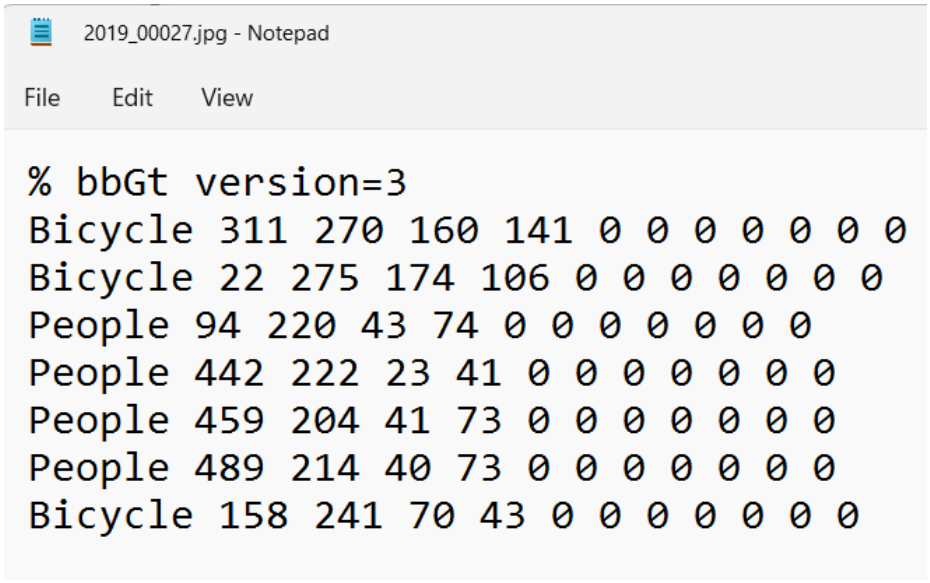
TrainImageLabels.txt

```
ImageName LightType In/Out
2019_00001.png 2 1
2019_00002.png 6 2
2019_00003.png 5 2
2019_00004.jpg 3 2
2019_00005.jpg 6 2
```

LightType has 10 values: Low(1), Ambient(2), Object(3), Single(4), Weak(5), Strong(6), Screen(7), Window(8), Shadow(9), Twilight(10) →Used for Enhancement

In/Out has two values: Indoors(1) and outdoors (2) →Classification Target

Train Folder/Annotations/ 2019_00027.png.txt (used for object detection)



- There are twelve classes in this object detection task: Bicycle(1), Boat(2), Bottle(3), Bus(4), Car(5), Cat(6), Chair(7), Cup(8), Dog(9), Motorbike(10), People(11), Table(12)

- Bounding box coordinates [l t w h]
  ```
  l - pixel number from left of image
  t - pixel number from top of image
  w - width of bounding box
  h - height of bounding box
  ```
- The first row and the columns from 6 – 12 are unused

The goal is to build an object detection model that can detect instances of these classes in each image and their positions.

- Dataset Example:

- The training set folder contains 3000 images.
- The testing set folder contains 1800 images.

Kaggle Competition

Objective:

After applying the object detection model and predicting the bounding boxes for each instance of a class in the image. Use these detections to count the number of occurrences of each class in an image.

Submit a solutions file that looks like this: [You can find a sample.csv file on Kaggle]

where nBicycle should hold the number of instances of this class in image 2019_00251.png and so on.

The submission file should contain exactly 1800 lines (for the 1800 images in the test set)

Important Notes:

1. The classification and segmentation deliverable has no effect on the competition only the object detection models.
2. You will find the competition link [here]
3. The competition metric is MCRMS: Mean Column wise Root Mean Square Error.
4. The team name on Kaggle should be the same Team ID as the one given to you.
5. Competition Deadline: the day before the practical exam.

Practical Exam Project Deliverables:

1. Apply Image Enhancement on the dataset
2. Apply Image classification to classify an image into “indoors” or “outdoors”
3. Apply object detection on the given dataset using deep learning techniques.
4. Apply segmentation on the given dataset using clustering-based algorithms [next lab].
5. A Report that includes description of:
   - Your data preparation process (i.e Image Enhancement + any other techniques you used).
   - Brief description of the models used in each task.
   - Training and Testing times for each model.
   - Image Classification training and testing accuracy.
   - Object detection Training accuracy.
   - Kaggle competition MCRMSE score.
   - Screenshots of the dataset from your object detection trials.
   - Screenshots of the dataset from your segmentation trials.