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Challenge Title

Grand Challenges on Vehicle ReIdentification.

Call for Participation

Vehicle Re-identification (ReID) is of great significance for the intelligent transportation and public security. With recent deep learning technology development, Vehicle ReID algorithm efficiency is significantly improved. However, several challenging issues of Vehicle ReID in real-world surveillance scenarios have not been fully investigated e.g., the high viewpoint variations, extreme illumination conditions, complex backgrounds, and different camera sources. These limitations may oversimplify the practical challenges of the ReID task, the ReID models being developed and evaluated on most existing datasets could be problematic regarding the generalization capability in the wild. A new vehicle ReID dataset in the Wild (VERI-Wild) [1] is released to address the aforementioned issues, researchers and developers from academia and industry are welcome to participate in this competition and further exploration on relevant technical and application issues is encouraged.

Challenge Description

Vehicle Re-Identification (ReID) aims to retrieve images of a query vehicle from a large-scale vehicle database, which is of great significance to the urban security and city management. However, to the best of our knowledge, all of the existing vehicle ReID datasets are captured under constrained conditions, and generally have limitations in the following aspects:

(1) The number of vehicle identities and images are not large enough to the needs of practical application.

(2) The limited camera numbers and covering areas do not involve complex and variant backgrounds in a variety of real-world scenarios.

(3) The camera views are highly restricted as shown in Figure 1. For most vehicle datasets, the samples are collected from checkpoint cameras that only capture the front and rear views, and the severe occlusion is also not taken into consideration.

(4) Most of current datasets are constructed from short-time surveillance videos without significant illumination and weather changes. The purpose of this competition is to promote research and development on unconstrained wild vehicle ReID, especially in complex situations, *e.g.* high viewpoint variations, extreme illumination conditions, complex backgrounds, and different camera sources.

Figure 1. The extensively collected VERI-Wild dataset poses practical challenges for vehicle ReID, e.g., significant viewpoint, illumination, and background variations, and severe occlusion. Another challenge of our dataset is that one vehicle may appear across numerous cameras, e.g., in an extreme case, a vehicle appears in 46 surveillance cameras.

Potential Participants

- Institute of Computing Technology, Chinese Academy of Sciences
- Tsinghua University
- Beihang University
- Beijing Institute of Technology
- National University of Singapore
- University of Toronto
- The University of Melbourne
- Imperial College London
- University of Surrey
- University of Technology Sydney
- etc.

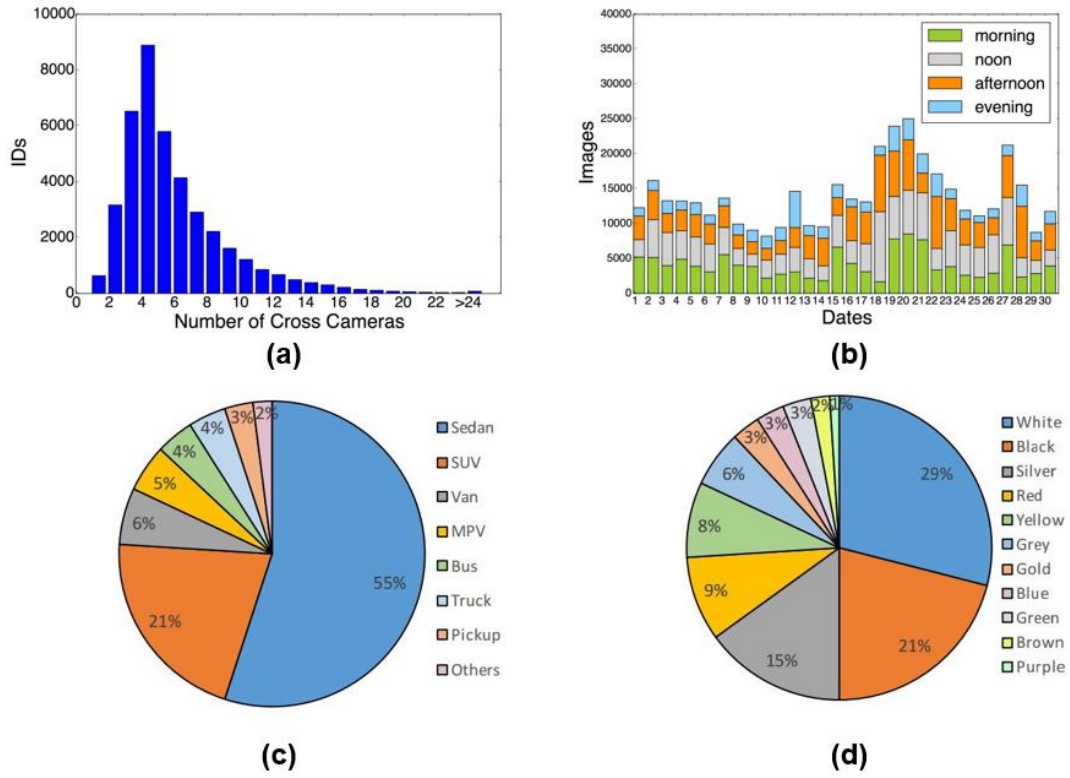

Figure 2. The statistics of VERI-Wild dataset. (a) The number of identities across different cameras, i.e., 1-174 cameras; (b) The number of IDs captured in each day; (c) The distribution of vehicle types; (d) The distribution of vehicle colors.

Description of VERI-Wild Dataset

A large-scale vehicle ReID dataset in the wild (VERI-Wild) is captured from a large CCTV surveillance system consisting of 174 cameras across one month (30× 24h) under unconstrained scenarios. The cameras are distributed in a large urban district of more than 200km^2. The YOLO-v2 [2] is used to detect the bounding box of vehicles. The raw vehicle image set contains 12 million vehicle images, and 11 volunteers are invited to clean the dataset for 1 month. After data cleaning and annotation, 416,314 vehicle images of 40,671 identities are collected. The statistics of VERI-Wild is illustrated in Figure 2. For privacy issues, the license plates are masked in the dataset. The distinctive features of VERI-Wild are summarized into the following aspects:

Unconstrained capture conditions in the wild

The VERI-Wild dataset is collected from a real CCTV camera system consisting of 174 surveillance cameras, in which the unconstrained image capture conditions pose a variety of challenges.

Complex capture conditions

The 174 surveillance cameras are distributed in an urban district over 200km^2, presenting various backgrounds, resolutions, viewpoints, and occlusion in the wild. In extreme cases, one vehicle appears in more than 40 different cameras, which would be challenging for ReID algorithms.

Large time span involving severe illumination and weather changes

The VERI-Wild is collected from a duration of 125, 280 (174x24x30) video hours. Figure 2. (b) gives the vehicle distributions in 4 time slots of 24h, i.e., morning, noon, afternoon, evening across 30 days. VERI-Wild also contains poor weather conditions, such as rainy, foggy, etc, which are not provided in previous datasets.

Evaluation Protocol

The VERI-Wild is randomly divided into two parts for training and testing, as shown in Table 1. To better evaluate ReID methods, the test set is further partitioned into three subsets, as shown in Table 2. Besides the test set mentioned above (referred as Test 1) for validation, a separate test set, Test 2, is to be used for final evaluation. During competition, the ground truth of Test 1 will be released on the website, while the ground truth of Test 2 will not be released before the final evaluation date.

Table 1. The splitting for training and testing sets. (IDs/Images)

Dataset	Train	Probe	Gallery
VeRI-Wild	30,671/277,797	10,000/10,000	10,000/128,517

Table 2. Descriptions of the subset of the test set

Test Size	Small	Medium	Large
Identities	3,000	5,000	10,000
Images	41,816	69,389	138,517

For each given query, a candidate list is returned from the database by sorting the feature distances between the query and reference images. The mean Average Precision (mAP) is used as performance metrics.

Mean Average Precision: The mAP evaluates the overall performance for ReID, and is defined as follows:

$$AP = \frac{\sum_{k=1}^{n} P(k) \times gt(k)}{N_{gt}}, \quad mAP = \frac{\sum_{q=1}^{Q} AP(q)}{Q}$$

Where k is the rank in the recall list of size n, and N_{gt} is the number of relevant vehicles. $P(k)$is the precision at cut-off k and $gt(k)$ indicates whether the k-th recall is correct or not. Q is the number of total query images. Moreover, Top K match rate is also reported in the experiments.

Tentative Timetable

- Registration Open: Jun. 20, 2019
- Validation (on Test 1): from Jun. 20, 2019 to Aug. 10, 2019
- Retrieval results (on Test 2) submission: from Aug. 11, 2019 to Aug. 25, 2019
- Final evaluation results announcement: Aug. 30, 2019
- Camera-ready paper submission: Sep. 15, 2019

Submission Guidelines

- The dataset webpage will be released by Jun. 20, 2019.
- The final evaluation set Test 2 will be released at the beginning of the Retrieval results submission phase (Aug. 11, 2019).
- The retrieval results should be saved as a TXT file. For each line in the file, the name of the query image comes first and it is followed by names of top 100 retrieved images separated by space.
- Participants should submit the retrieval results on Test 2 according to the given format before retrieval results submission deadline.
- Each participant can submit their response no more than 3 times, the organizers select the best performance on Test 2 as the final submission.
- The participants acknowledge that the results might be used by the organizers in any related materials when reporting the model performance of this challenge.

Additional Information

- The dataset is available for non-commercial research purposes only.
- You agree not to reproduce, duplicate, copy, sell, trade, resell or exploit for any commercial purposes, any portion of the images and any portion of derived data.
- You agree not to further copy, publish or distribute any portion of annotations of the dataset. Except, for internal use at a single site within the same organization it is allowed to make copies of the dataset.
- We reserve the right to terminate the access to the dataset at any time.

References

[1] Y. Lou, Y. Bai, J. Liu, S. Wang, L. –Y. Duan. VERI-Wild: A Large Dataset and a New Method for Vehicle Re-Identification in the Wild. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition. 2019.
[2] J. Redmon and A. Farhadi. Yolo9000: better, faster, stronger. arXiv preprint, 2017.