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Data Article

UrOAC: Urban objects in any-light conditions

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ABSTRACT

In the past years, several works on urban object detection from the point of view of a person have been made. These works are intended to provide an enhanced understanding of the environment for blind and visually challenged people. The mentioned approaches mostly rely in deep learning and machine learning methods. Nonetheless, these approaches only work with direct and bright light, namely, they will only perform correctly on daylight conditions. This is because deep learning algorithms require large amounts of data and the currently available datasets do not address this matter.

In this work, we propose UrOAC, a dataset of urban objects captured in a range of different lightning conditions, from bright daylight to low and poor night-time lighting conditions. In the latter, the objects are only lit by low ambient light, street lamps and headlights of passing-by vehicles. The dataset depicts the following objects: pedestrian crosswalks, green traffic lights and red traffic lights. The annotations include the category and the bounding-box of each object.

This dataset could be used for improve the performance at night-time and under low-light conditions of any vision-based method that involves urban objects. For instance, guidance and object detection devices for the visually challenged or self-driving and intelligent vehicles.

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Specifications Table

Subject	Computer Vision and Pattern Recognition
Specific subject area	Urban Object Recognition
Type of data	Images, Bounding-boxes
How data were acquired	Data was captured with the following smartphones: Aquaris X Pro, Samsung Galaxy S7 and iPhone X
Data format	Raw
Description of data collection	The images were captured so the following considered objects are depicted: pedestrian crosswalk, red traffic light, green traffic light
Data source location	City/Town/Region: San Vicente, Alicante, San Juan, Jumilla, Valencia, Elche, Albacete, Murcia and Blanca Country: Spain
Data accessibility	Repository name: UrOAC: Urban Objects in Any-light Conditions (Mendeley Data) Data identification number: DOI:10.17632/fcrmp92ckn.1 Direct URL to data: https://data.mendeley.com/datasets/fcrmp92ckn

Value of the Data

- This dataset is important as it addresses a range of lighting conditions. Vision-based algorithms usually struggle when it comes to detect objects in the brightest and darkest images as the features are worn away. Thus, this dataset could be used for testing these extreme cases and to train learning algorithms to be robust to them as well.
- The proposal is aimed to vision-based researchers focused in urban object recognition tasks that want to test or to strengthen their algorithms to any lighting condition.
- The dataset is comprised of images with the bounding boxes and their corresponding category among pedestrian crosswalk, green traffic light and red traffic light. In order to use this dataset, just download and extract the content. There will be two folders, one containing the images and one containing the labels. The labels are in the PASCAL VOC [1] format, which is a common one, so it can be used straightforwardly with deep learning frameworks such as Darknet [2].

1. Data Description

The Urban Objects in Any-light Conditions dataset is a collection of images that depict urban environments under a range of different lighting conditions. The images include objects typically found in the streets from the point of view of a pedestrian. The objects were manually labeled so that the dataset provides the category and position of each one. As it includes night-time and low-light, and day-light condition, this dataset could be used for testing, training and enhancing vision-based urban object detection algorithms. Ultimately, this dataset could be applied to guidance or urban environment, object detection devices for the visually challenged and self-driving and intelligent vehicles.

The UrOAC dataset is composed of 1010 images. The images include instances of the following categories: pedestrian crosswalk, green traffic light and red traffic light. Random images of the dataset are shown in Fig. 1. Each instance of the mentioned objects is labeled with their bounding box within the image and the category. A label file is distributed for each image. The instance distribution is as shown in Fig. 2.

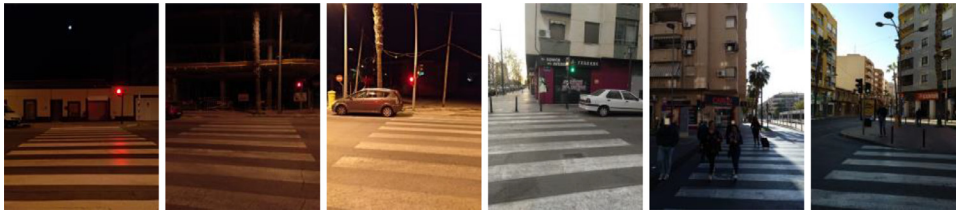

Fig. 1. Random samples of UrOAC dataset showing different lighting conditions.

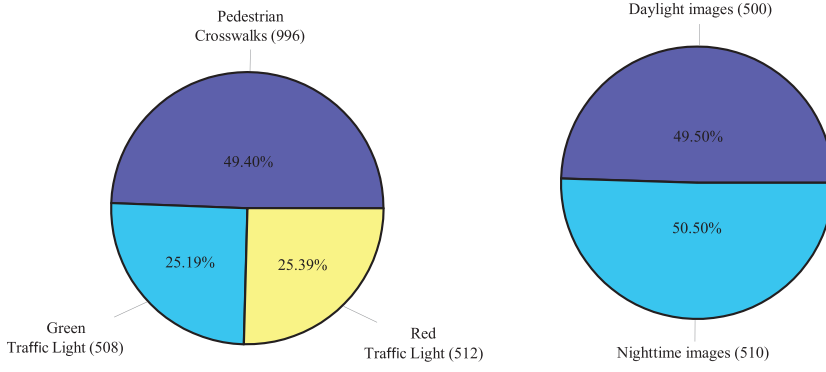

Fig. 2. Amount of instances per category and distribution of images by lighting condition.

The images were captured at any time of the day, from dawn until nighttime, so it includes a range of different lighting conditions, including low-light ones. From the total 1010 images that compose UrOAC, 500 of them were taken on daylight, and 510 were captured at nighttime, as shown in Fig. 2. The point of view of a pedestrian was used to capture the images.

The dataset includes images of different locations of Spain: San Vicente, Alicante, San Juan, Jumilla, Valencia, Elche, Albacete, Murcia and Blanca in order to ensure variability of context and scenarios.

For each image, a label file in the format of PASCAL VOC/YOLO [3] is distributed. In the mentioned label file, there is a line for each instance depicted. Namely, if an image shows a pedestrian crosswalk and a green traffic light, the corresponding label file will include two lines: one for the crosswalk and one for the traffic light. Each line has 5 different values separated by spaces. These values mean: the category, center X position, center Y position, width and height. The category is an integer that corresponds to a semantic category. The mapping is 0 = pedestrian crosswalk, 1 = green traffic light and 2 = red traffic light. The center X position and the center Y position are the X and Y coordinates within the image of the center of the bounding box. Finally, the width and height define the size of the bounding box. It is worth noting that both coordinates of the bounding box and dimensions are normalized so the values are in the 0-1 range.

2. Experimental Design, Materials and Methods

As mentioned before, the images were acquired from the point of view of a pedestrian, with no particular setup. The settings were all configured to auto, as this is the default setup for most of users. We involved a range of different smartphones to capture the images in order to provide variability on the sensor of choice, which is particularly critic in low-light scenarios. Specifically, a BQ Aquaris X Pro, a Samsung Galaxy s7 and and iPhone X were used, as shown in Table 1.

Table 1
Details about the acquisition requirements and technical data of the acquisition devices.

Data acquisition requirements	The images should depict any of the following objects: pedestrian crosswalk, red traffic light, green traffic light. They should be made from the point of view of a pedestrian. The should be taken at any time and with camera auto settings.
Specification of image acquisition system	Aquaris X Pro (12 megapixel, f/1.8, auto settings), Samsung Galaxy S7 (12 megapixel, f/1.7, auto settings) iPhone X (12 megapixel, f/1.8)
Specification of images	Resolution: 3024 × 4032 pixels Format: PNG Colorspace: sRGB

The images were manually labeled by a single person so the criteria is always the same. We leveraged LabelIMG[1], which is a wide-spread and commonly used tool for labeling images for the annotation process. Finally, a peer review process was carried out to confirm the accuracy and correctness of the labels.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have, or could be perceived to have, influenced the work reported in this article.

Data Availability

UrOAC: Urban Objects in Any-light Conditions (Original data) (Mendeley Data).

CRediT Author Statement

Francisco Gomez-Donoso: Methodology, Writing – original draft; **Marcos Moreno-Martinez:** Investigation, Software, Data curation; **Miguel Cazorla:** Supervision, Validation, Writing – review & editing.

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