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# **OBJECT IDENTIFICATION METHOD BASED ON IMAGE KEYPOINT DESCRIPTORS**

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A person receives the bulk of information about the environment with the help of the visual channel and then effectively processes the information received using the apparatus for analyzing and interpreting visual information. Technologies do not stand still and today many processes are being automated [1-6], this is no exception for computer vision.

Computer vision is one of the most developed branches of artificial intelligence [7-11], which makes it possible for computer systems to read and process visual data and obtain the calculations as conclusions. Systems that use computer vision can solve tasks that are often perceived as purely human. While modern systems may not always do a better job than humans, they have already made significant headway in the industry.

Today, we can see computer vision techniques that use the identification of objects in the image in use in almost all spheres of everyday life [12, 13]. First, these are systems for recognizing human faces, searching for cars, security systems, creating and managing unmanned vehicles, searching, as well as counting the number of pedestrians. Object detection is the most profound and complex aspect of computer vision and has a huge number of practical cases [14].

Researched used these technologies in the fields of science and technology, such as process automation, increased productivity, improved quality of manufactured products, control of production equipment, intelligent robotic systems, control systems for mobile vehicles, biomedical research, and many others [15-18]. In addition, we can say that it is based mainly on the success of modern business on the quality of the manufactured products, which requires proper visual control.

Consequently, because of the increasing complexity of scientific and technical problems being solved, automatic processing and analysis of visual information are becoming more and more urgent issues and have great development potential.

The object of the work is a data set of different-angle images of the object.

The work aims to develop a method for identifying objects based on descriptors of key points of the image.

We based modern structural methods on the identification of key points of images and classification models in the space of binary vectors. The key point is a numeric vector (handle) with a fixed coordinate, reflecting the properties of some of its environments. Many cue point descriptors provide the ability to and recognize images.

Modern methods of generating cue points (detectors), for example, ORB or BRISK, also calculate cue point descriptors as binary vectors [7-11, 19].

In recent years, researchers have created many models for identifying and classifying objects, and they are improving in terms of accuracy and efficiency. However, most models are trained and tested in ideal scenarios. Although computer vision already has a long way of development and algorithms for detecting objects using artificial intelligence have surpassed humans in certain tasks, some problems create difficulties for computer systems. The scenario in which we use these models is not always ideal: the background may be cluttered; the object may be deformed, or obscured.

A good detector should be robust enough to detect a different object, while still being sensitive to variations between its classes.

Although computer vision has achieved considerable success in development, many problems impede the correct recognition of objects. This means that it is necessary to look for alternative ways to solve the existing shortcomings.

To create a reliable object detector, it is important to ensure that the training data differs from different points of view, lighting conditions, and objects with different backgrounds. If it is not possible to find real training data with all variations, you can use data augmentation methods to synthesize the desired data [20].

Having studied modern approaches to methods of object identification, we can say that there are many ways to achieve the required solution. Based on this information, we have built a plan, comprising several steps that must be performed to implement the solution to your object identification problem:

- Definition of a dataset. At the first stage, it is necessary to select 10-12 images of the .jpg or .png format containing the object under study. We showed an example of an image from a dataset in Figure 1a;

- Pre-processing of the dataset images. Selected images need additional processing: first, determine the etalon image, remove the background in it and leave only the object on it (Fig. 1b). Based on the finished etalon image, create a data set of changed images for comparison with the etalon image (Fig. 2);

- Definition of detectors that will identify objects. The primary goal of this step is to define the methods that will identify objects in the image. Having analyzed the existing approaches, you need to decide which of them will be applied in solving your problem. SIFT method selected;



Figure 1. An example of a etalon image: a – for processing; b – after processing.

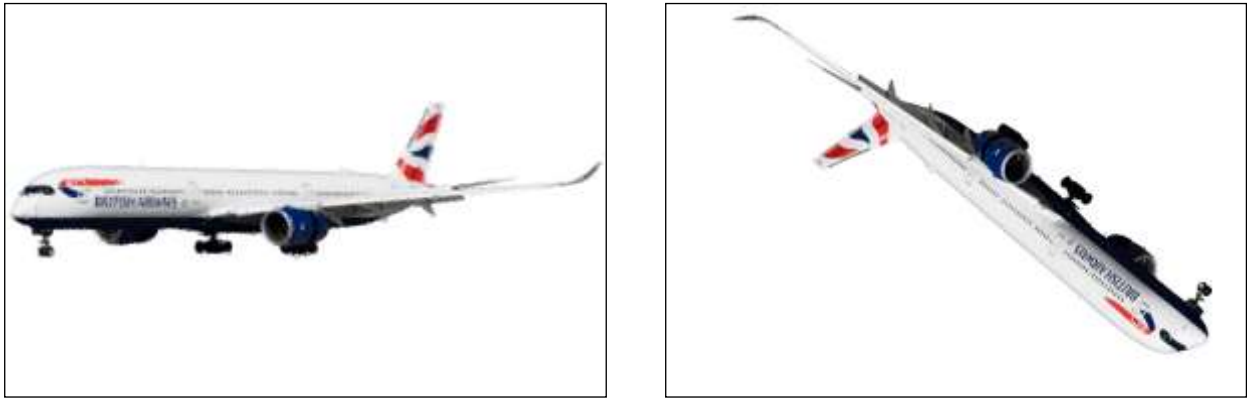


Figure 2. An example of a etalon image with a polygonal effect (left) and an angled image returned (right).

– Definition of the software environment and tools. To implement the technique, you must first select the software environment and tools with which we will perform the task.

– Implementation of identification methods in the software environment. The essence of this stage is in the software implementation of object identification in a pre-selected software environment. We used the Jupyter Notebook development environment, Python programming language, OpenCV library, Anaconda distribution kit;

– Testing. After successful implementation and training, the model must undergo full testing to identify deficiencies in its work. Errors found at this stage should be corrected. We presented the test results in Figures 3 – 7.

The detector is doing the job correctly. Found the number of key points in two images is the same and equal to the number of matches. The SSIM parameter took the value 1; the match is as accurate as possible. Estimation using FLANN parameters – 100% match of images (Fig. 3).

In Figure 4 the SSIM parameter to 0.96, the match is exact. Estimation with FLANN parameters – image match 48.30. The number of key points found in the black-and-white image turned out to be greater than in the etalon image. The number of hits is 539.

SSIM: 1.00  
Keypoints 1ST Image: 1116  
Keypoints 2ND Image: 1116  
matches : 1116  
How good is the match: 100.00

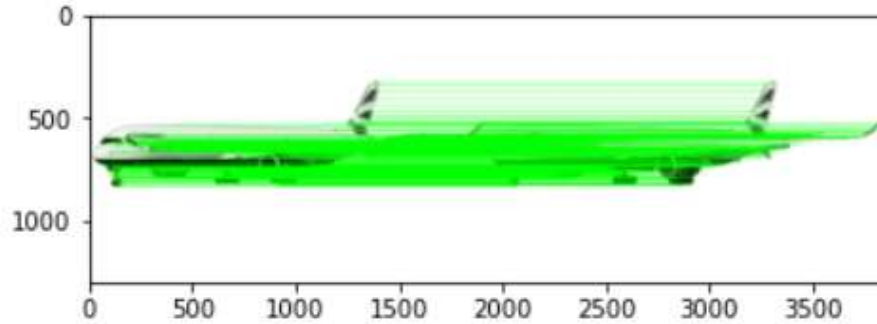


Figure 3. Comparison of the etalon image with the etalon image.

SSIM: 0.96  
Keypoints 1ST Image: 1116  
Keypoints 2ND Image: 1569  
matches : 539  
How good is the match: 48.30

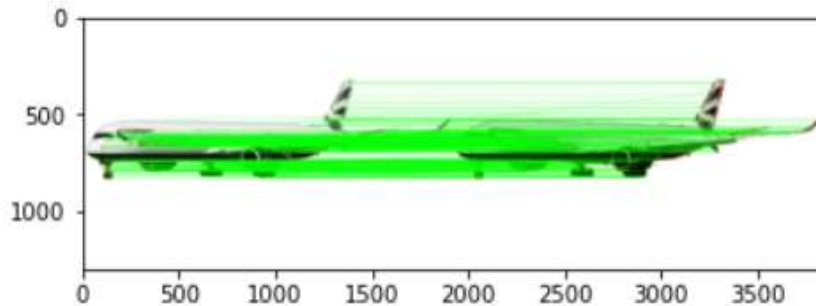


Figure 4. Comparison of the etalon image with a black and white image.

SSIM: 0.88  
Keypoints 1ST Image: 1116  
Keypoints 2ND Image: 1580  
matches : 101  
How good is the match: 9.05

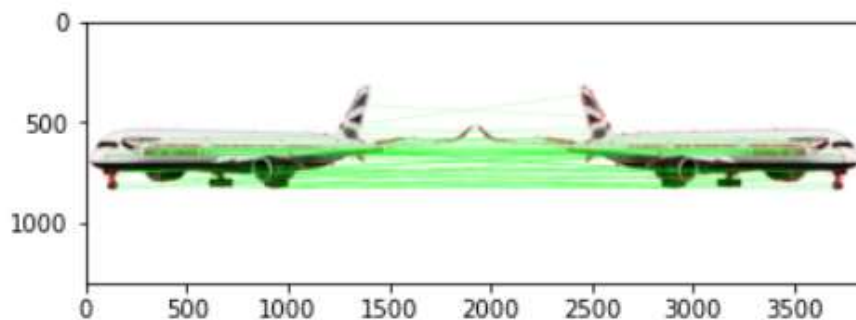


Figure 5. Comparison of the etalon image with the reflected image.

In Figure 5, the detector could not understand that the image was reflected. The SSIM parameter took the value 0.88, the match is quite accurate. Estimation with FLANN parameters – image coincidence 9.05. The number of key points found on the reflected image turned out to be greater than on the etalon image. The number of matches is 101.

```
SSIM: 0.90
Keypoints 1ST Image: 1116
Keypoints 2ND Image: 689
matches : 73
How good is the match: 10.60
```

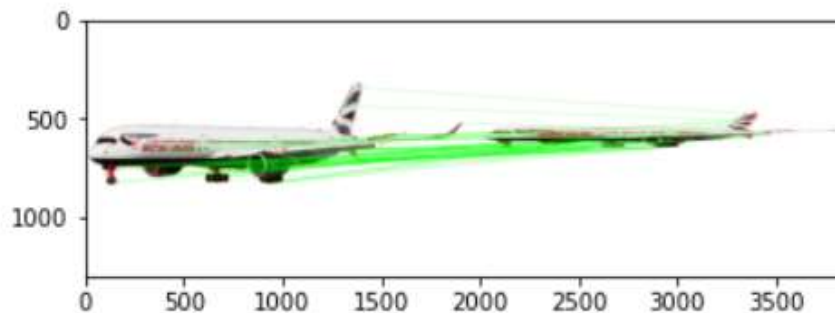


Figure 6. Comparison of the etalon image with the compressed image.

In Figure 6, the detector was unable to understand that the images were compressed. The SSIM parameter was set to 0.90, the match is quite accurate. Estimation with FLANN parameters – image coincidence 10.60. The number of key points found in the compressed image was almost half that in the etalon image. Number of hits 73.

```
SSIM: 0.56
Keypoints 1ST Image: 1116
Keypoints 2ND Image: 10768
matches : 509
How good is the match: 45.61
```

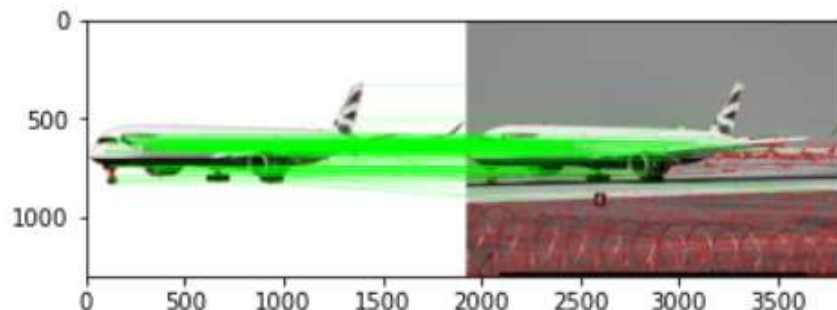


Figure 7. Comparison of the etalon image with the image with the background.

In Figure 7, the background affected the operation of the detector. The SSIM parameter was set to 0.56, the match is not exact. Estimation using FLANN parameters – 45.61 image match.

The number of key points found in the picture with the background, as expected, is much higher, because besides the object there are other details in the photo. The number of hits is 509.

Having analyzed the results of the work done, we can say that the created method works well. It compares objects in the image using the SIFT detector and finds key points. But, in most situations, the person performs the comparison better. Research needs additional refinements of the method and new tests to improve performance. The implemented method can be useful in various spheres of human life, if you improve its work in other systems, for example, iOS or Android.

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