II International Workshop
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Generation of a text description of weakly structured optical coherence tomography images

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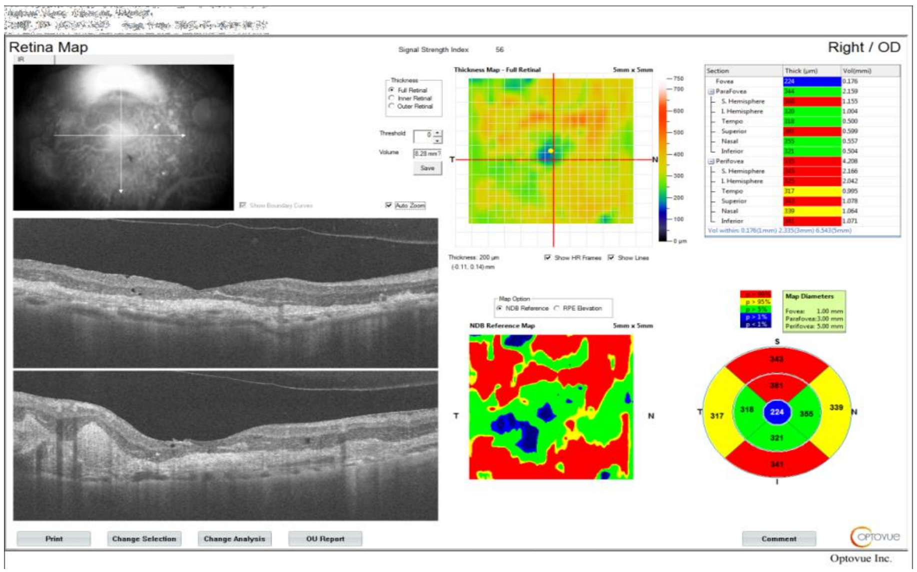
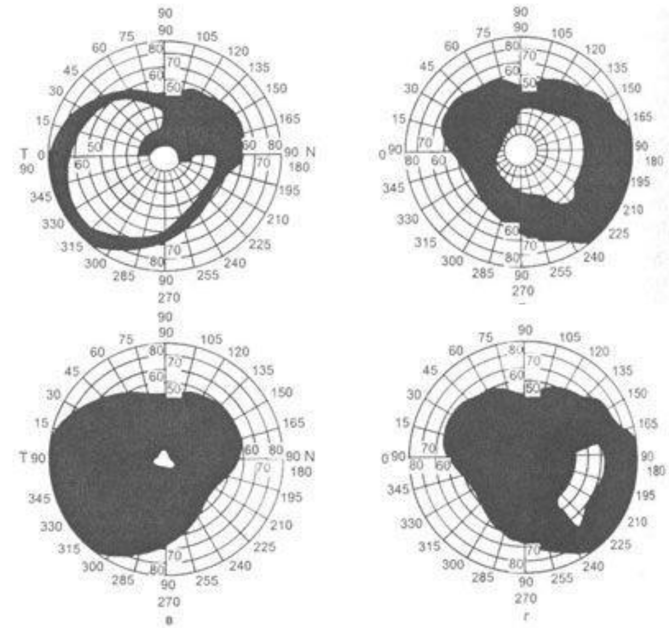
Optical coherence tomography

Optical coherence tomograph (OCT) is a diagnostic device that allows you to obtain layered "slices" of eye structures, providing high-resolution images in real time.

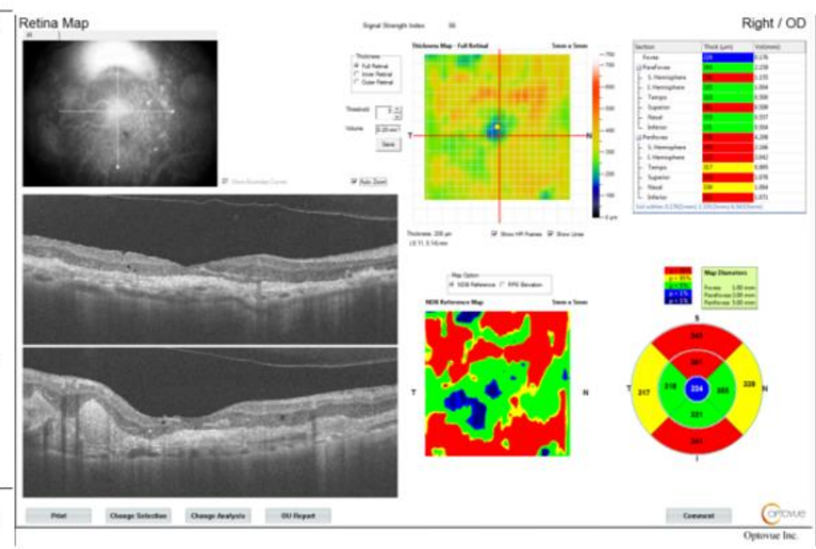




Problem Statement

The heterogeneity of the data structure and templates of the OCT snapshot for building an automated system for generating conclusions requires solving the problem of recognizing the necessary template segments.

In this regard, it is relevant to develop a comprehensive automated system for analyzing OCT images. Within the framework of this work, we propose an approach to building a system for generating a text description of DICOM images using artificial intelligence methods. To build a system of automatic description of the OCT image, the tasks of detecting retinal segments and the task of multi-label classification for the presence of a pathological process and analysis of anatomical properties will be considered.



Dataset

The description of anatomical properties and pathological processes is solved as a multi-level classification problem with **11 non-overlapping classes**. There are a total of **13,000 images** in the dataset

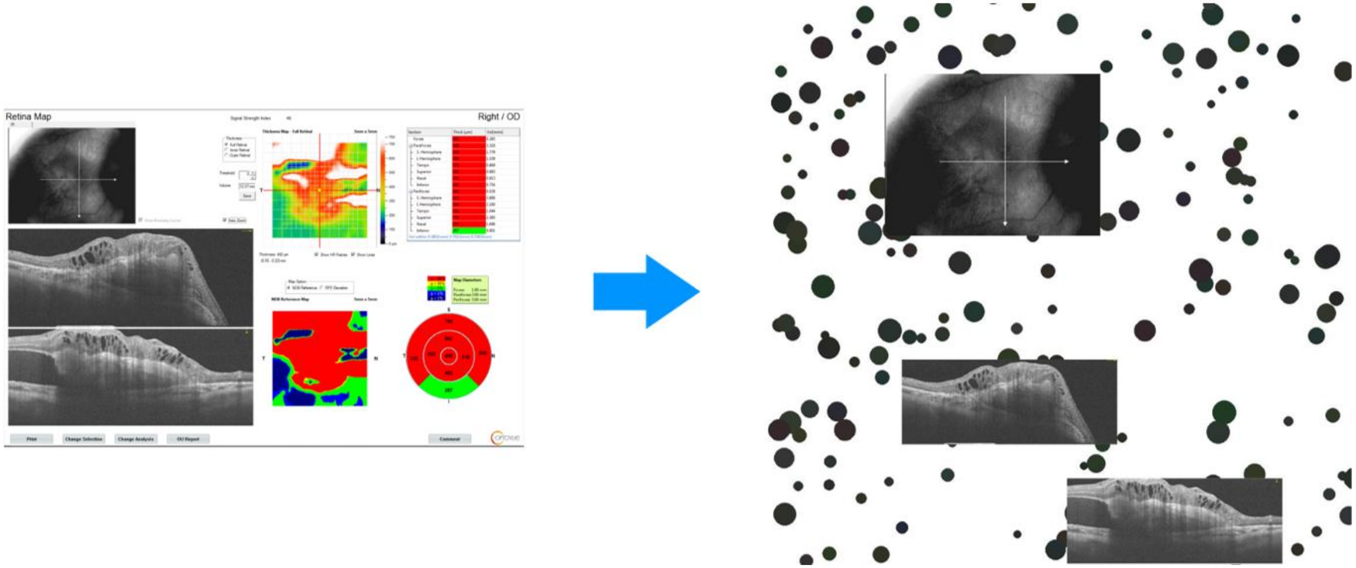
Description and number of classes.

Label	Description	Count
fovea_1	Complete posterior vitreous detachment	737
fovea_3	Incomplete detachment of the posterior hyaloid membrane with adhesion in the macula is observed	1107
fovea_4	Incomplete detachment of the posterior hyaloid membrane with adhesion in the fovea is observed	440
fovea_8	Vitreomacular traction syndrome (vertical traction) is observed	228
fovea_9	Epiretinal fibrosis is observed	2612
fovea_11	The retinal profile is deformed due to tangential horizontal traction (fovea is smoothed)	554
fovea_12	The epiretinal membrane partially separated spontaneously	306
fovea_13	The retinal profile has a wave-like deformation after peeling	392
square_1	Retina in the macular region without visible pathology	1283
square_2	Insufficient transparency of optical media for a reliable assessment of changes in the structure of the retina	451
square_4	There is a gross violation of the architectonics of the retina	290

Detection

To solve the problem of detection from the same type of OCT report templates, data augmentation was performed by artificially generating images with annotation files. For different OCT with the same configuration

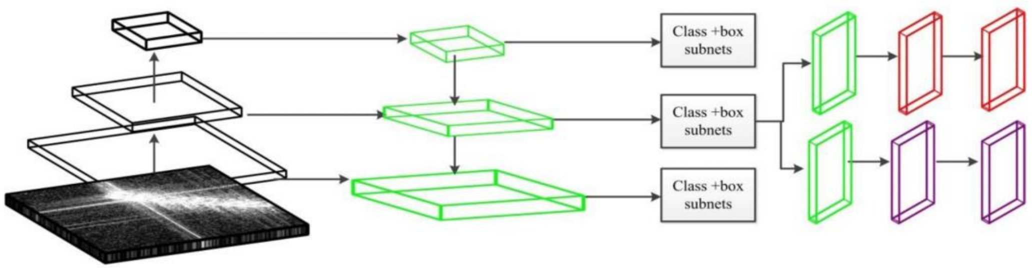
Since OCT images with the same configuration of the arrangement of retinal segments are in constant positions, it is possible to cut out the desired segments pixel by pixel and generate a file with a random location



Detection Results

A data set of 500 samples was generated for the task, consisting of both original templates of OCT images and artificially created ones. The Faster R-CNN model with backbone RetinaNet was used to recognize the bounding-box horizontal sections of the retina. The accuracy indicator for the mAP metric (MS-COCO) was **0.9271**

Detection model Faster-RCNN with RetinaNet backbone

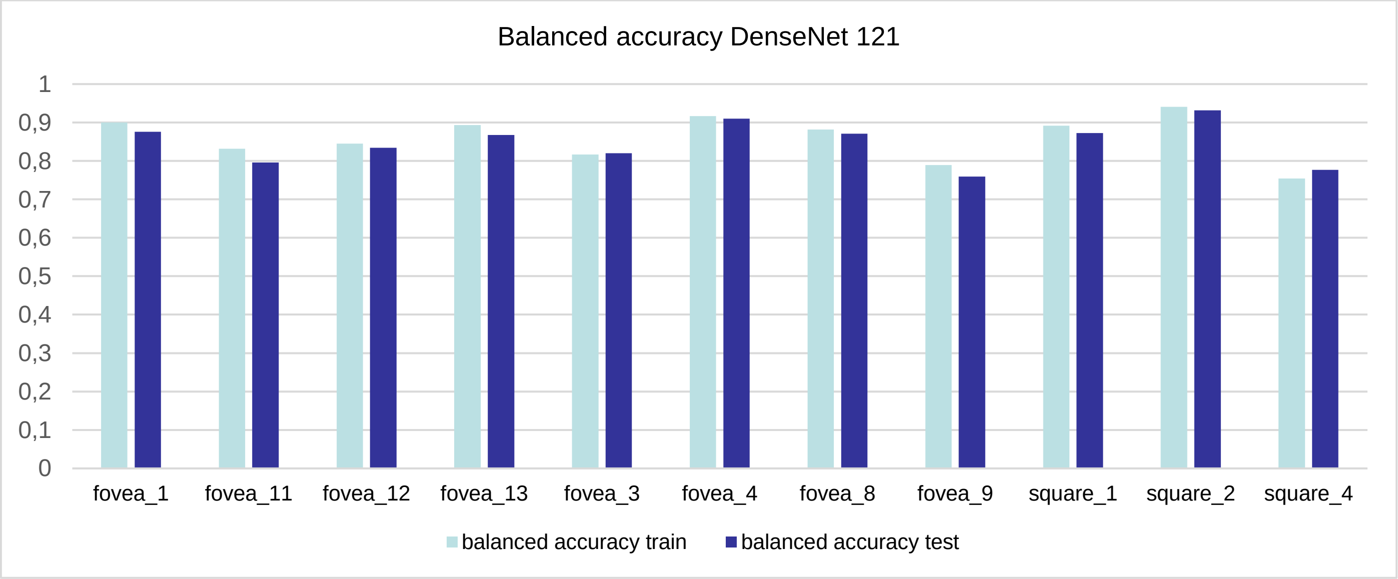


Classification results

Weighted binary cross-entropy is used as a loss function to account for data imbalance. The results of training models using the balanced accuracy metric on training and test datasets.

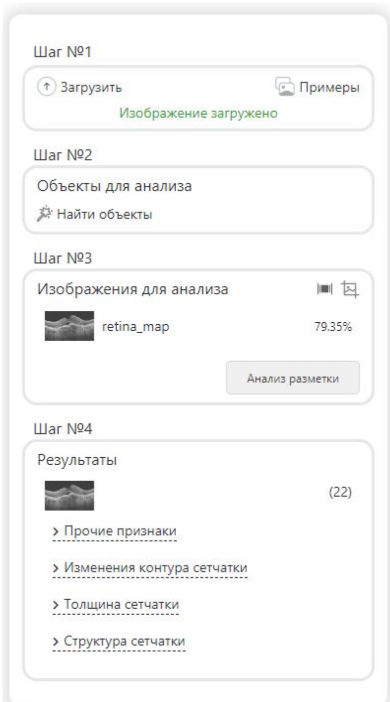
The greatest balanced accuracy is achieved when recognizing the square_2 label, the metric indicator is 0.9317. While for fovea_9 of all classes, the accuracy index is the lowest and is equal to 0.7592.

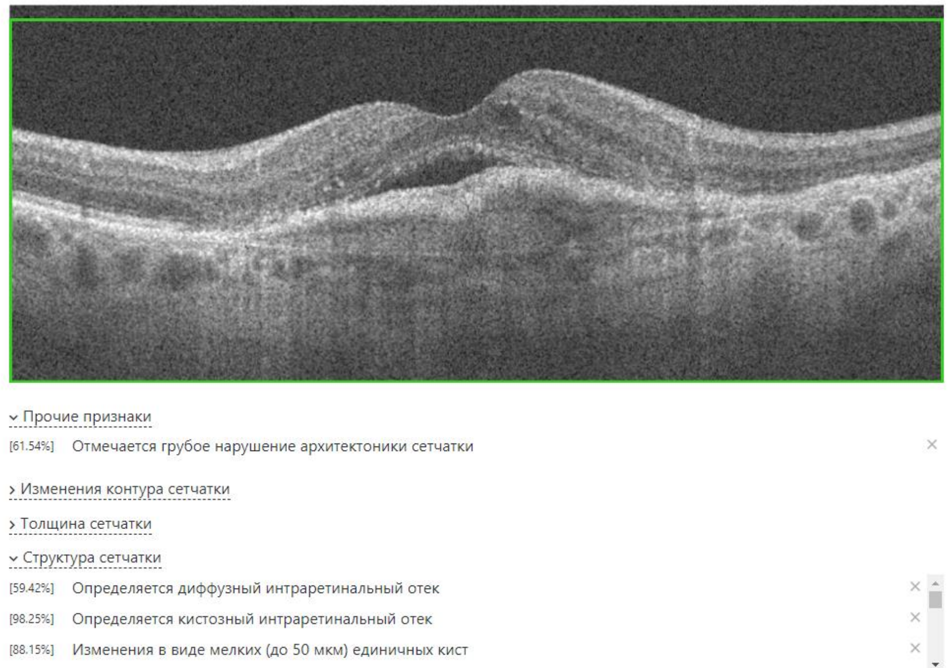
Model results



Demo web-server

Web Application Interface http://retinadeepai.site





Thanks for your attention!

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