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«ҒЫЛЫМ ЖӘНЕ БІЛІМ - 2018»
XIII Халықаралық ғылыми конференциясы

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«НАУКА И ОБРАЗОВАНИЕ - 2018»

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«SCIENCE AND EDUCATION - 2018»

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The proceedings are the papers of students, undergraduates, doctoral students and young researchers on topical issues of natural and technical sciences and humanities.

В сборник вошли доклады студентов, магистрантов, докторантов и молодых ученых по актуальным вопросам естественно-технических и гуманитарных наук.

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RESEARCH AND DEVELOPMENT OF THE SOFTWARE OF PROCESSING AND ANALYSIS OF MEDICAL IMAGES

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The computer vision and machine learning find the application in many fields of activity of the person. The medicine did not become an exception also. An opportunity to see and distinguish objects – a natural and habitual opportunity for the person. However for the computer meanwhile – it is extraordinary the difficult task. Attempts to teach the computer at least to a shred of what the person uses every day are now made, even without noticing that.

Probably, most often the ordinary person meets computer vision on cash desk in a supermarket. Of course, it is about reading of bar codes. They were developed expressly so that as much as possible to simplify to the computer reading process. But there are also more difficult tasks: reading of numbers of cars, the analysis of medical pictures, a defectoscopy on production, face recognition etc. Actively use of computer vision for creation of systems of augmented reality develops.

Difference between vision of the person and the computer. The child learns to distinguish objects gradually. He begins to realize as the object form depending on its situation and irradiating changes. Further at a discernment of objects of people is guided by the previous experience. For the life the person accumulates a huge number of information, process of tutoring of neuronic network does not stop for a second. For the person does not represent special complexity according to the flat picture to restore prospect and to imagine, kind of all this looked in three dimensions.

All this is given to the computer much more difficult. And first of all because of an experience accumulation problem. It is necessary to collect a huge number of examples that meanwhile not really turns out.

Besides, the person at an object discernment always considers an environment. If to pull out an object from a habitual environment, it will become much more difficult to recognize him. Here too the experience accumulated for life which the computer does not have plays a role.

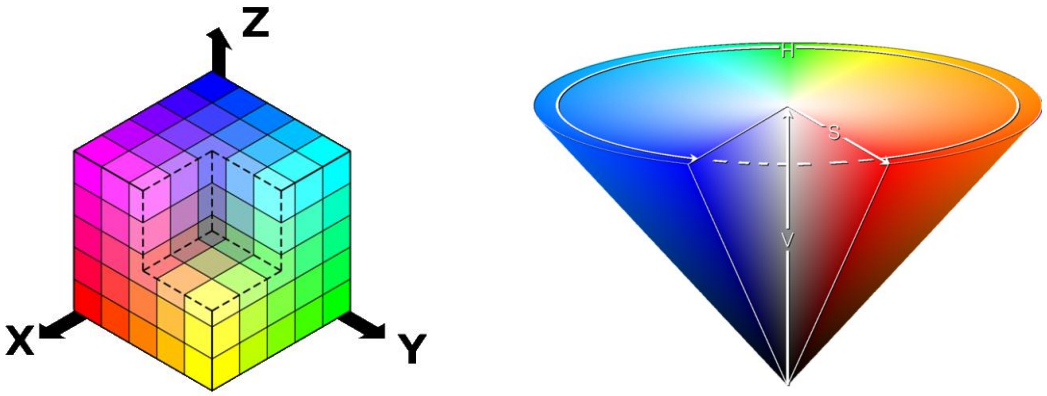
Let's present that we need to learn to define at a single glance a gender of the dressed person according to the photo. For a start it is necessary to define factors which can indicate belonging to object. Besides, it is necessary to collect the training set. It is desirable that it was representative. In our case we will take as the training selection of all attendees in audiences. Also we will try to find distinctive factors on their basis: for example, length of hair, existence of a beard, make-up and clothes (skirt or trousers). Knowing at what percent of same-gender representatives these or those factors met, we will be able to create rather legible rules: existence of these or those combinations of factors with a certain probability will allow us to tell what person of a floor in the photo.

In actual tasks which are set for the systems of computer vision it is much more factors. To define them manually and to count dependences – a task, excessive for the person. There fore in such cases not to do without machine learning in any way. For example, it is possible to define several tens of tentative factors and also to set positive and negative examples. And dependences between these factors are more narrow are selected automatically, the formula which allows to make decisions is formed. Rather often and factors are allocated automatically.

THE IMAGE IN FIGURES

Most often for storage of digital images the RGB color space is used. In it the color is appropriated to each of three axes (channels): red, green and blue. About 8 bits of information are

allocated for each canal, respectively, the intensity of color on each axis can accept values in the range from 0 to 255. All colors in digital space of RGB turn out by interfusing of three fundamental colors.



Picture-1-2. RGB colors in three axes and HSV color corner.

RGB not always well is suitable for the analysis of information. Experiments show that the geometrical proximity of colors is rather far from how the person perceives a proximity of belonging to colors to each other.

But there are also other color spaces. Very interestingly in our context HSV space (Hue, Saturation, Value). At it there is Value axis designating amount of light. The certain canal, unlike RGB where this value it is necessary to calculate every time is allocated for it. Actually, it is the black-and-white version of the image with which it is already possible to work. Hue is presented in the form of a corner and is responsible for a fundamental component. The color value depends on Saturation value (distance from the center to edge).

HSV is much closer to how we imagine colors. If to show to the person in the dark a red and green object, he will not be able to distinguish color. In HSV there is the same. The below on axis V we move ahead, the less there is a difference between shades as the range of values of saturation decreases. On the scheme it looks as a cone at which top extremely black point.

In most cases in computer vision color has no value as does not bear any important information. Picture-3: color and black-and-white. It is not much more difficult to learn all objects on the black-and-white version, than on color. For us color in this case does not bear padding loading any, and computing problems creates great variety. When we work with the color version of the image, the volume of data is built in cube degree.

SEGMENTATION OF MEDICAL IMAGES

Weakly and Semi-supervised Semantic Segmentation for Lung Disease Detection

–With very limited strong information of lesion and abundant weak diagnostic information, semantic

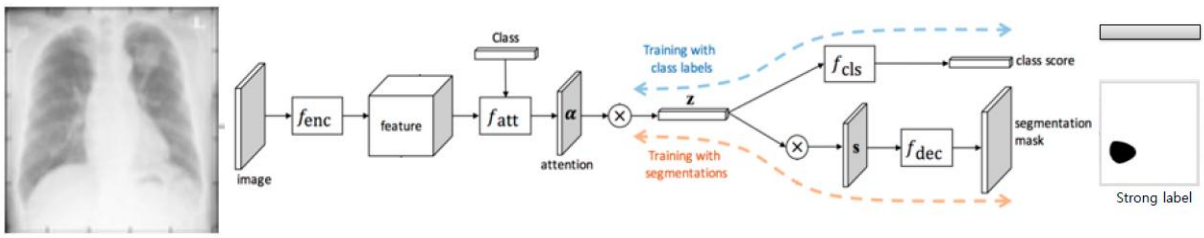
segmentation network is trained.

– By sharing feature extractor for multi-task, classification of disease with localized lesion can be obtained.

– Pre-trained and semantic segmentation with skipped

connected ASPP network.

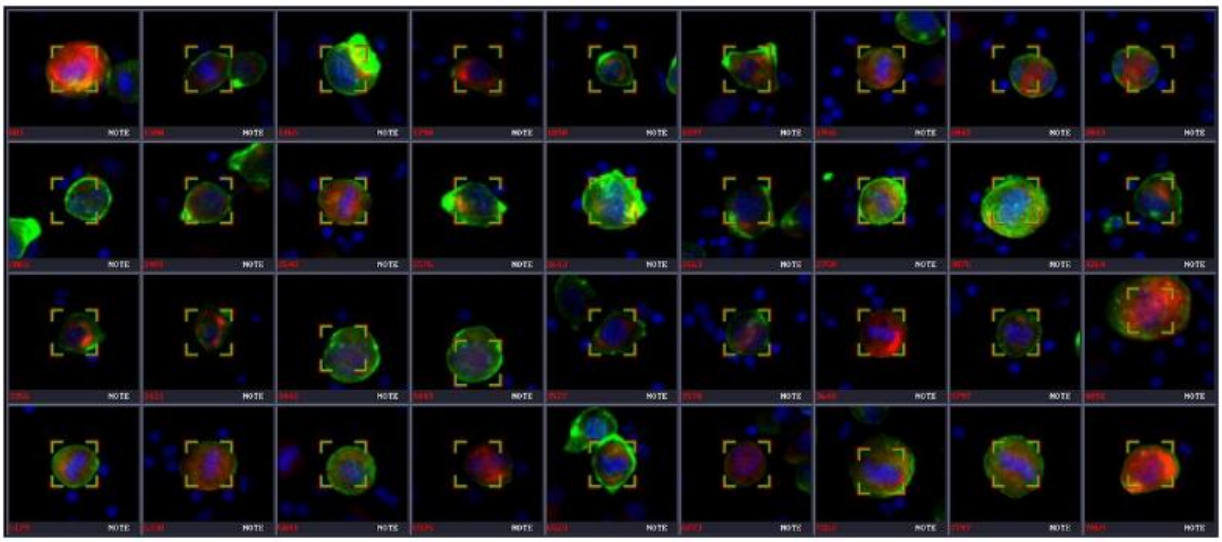
– Slight improvement of segmentation performance by exploiting weak label(Cancer)



Automatic detecting of the circulating tumor cells.

The circulating tumor cells are cells which separate from the place of the main tumor and extend through a blood stream, forming secondary tumors in other organs.

Early detection of such cells and estimation of advance of illness is very important for effective treatment therefore now systems are actively developed for automatic detection of tumor cells. For example, researchers from Germany [1] received accuracy = 99%, recall = 88% and precision = 86% on an experimental data set of the small size.



Picture-3. The circulating tumor cells crossed with to several fluorescent antibodies.

The algorithm is divided into three different parts: image preprocessing, ROI identification, and classification. All code developed for image processing and machine learning was written for Python version 2.7. For the preprocessing and foreground segmentation, we used the libraries pymorph (2) and mahotas (3), whereas for the SVM implementation we used the scikit-learn library (4). Source code and example images are available as Supporting Information. Updated versions of the source code for segmentation, classification, and analysis along with all the image data are available from the corresponding author on request.

The images exhibited a varying overall intensity level both within a single image and between images. To normalize the images, they were passed through a Naka–Rushton filter which enhances foreground objects and suppresses background noise (51). The Naka–Rushton filter is defined as

$$NR(I)=\frac{I^w}{I_c^w+I^w} \qquad (1)$$

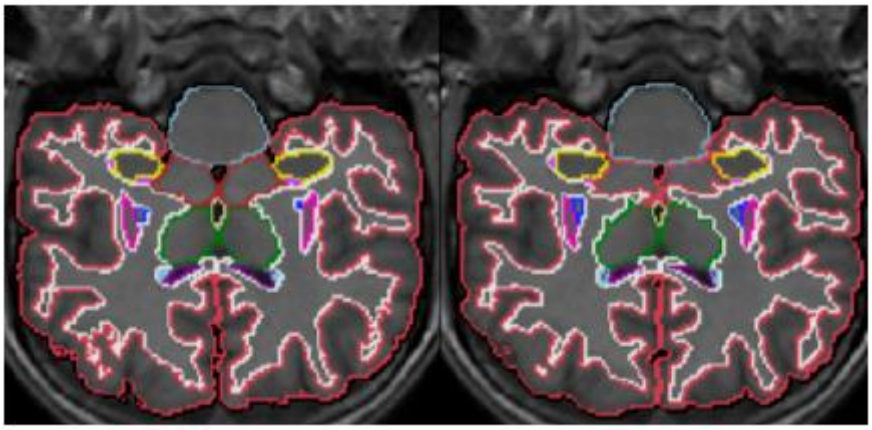
where I is the pixel intensity level and Ic is the semisaturation constant. The latter was chosen individually for each image by computing Otsu's optimal threshold (52), which is calculated based on the image intensity. The images were 8-bit where the pixel values range between 0 and 255, the semisaturation constant varies between 8 Ic 119 across images. The exponent was chosen to be w 5 5 inducing a clear separation between foreground and background. In Figures 1A and 1B,

how the normalization transforms the original images is shown. After normalization, images were smoothed with a Gaussian blurring filter. The width of this filter depends on the magnification at which the image was taken. For magnification with 103 objective, the standard deviation of the Gaussian kernel was chosen to be 1 pixel; for 203 and 403 objectives, the standard deviation was 2 and 4 pixels, respectively. These empirical choices of standard deviations were motivated by the requirement of a balance between making sure that single cells were not.

Segmentation of MRT of images

The method of the magnetic resonance imaging (MRI) is widely applied to diagnosing and tracking of dynamics of diseases of a brain and also to a research of its functioning. The method allows to receive quality three-dimensional images and permissions which are under construction on a set of consecutive two-dimensional "sections". The marking of images of MRT of a brain on anatomical structures is an important step for the further analysis in many tasks in this area.

The full marking of the three-dimensional image assumes splitting (segmentation) volume of a brain into several dozens of regions corresponding to the main anatomical structures. To each point (voxel) it is marked in compliance of anatomical structure. Thus, the manual marking in this case becomes long and labor-intensive process. Therefore the algorithms automating process of an anatomic marking are necessary. [5]



Picture-4. Example of work of an algorithm of segmentation. At the left — a true marking; on the right — the received marking

Authors from [5] managed to receive the following accuracy of segmentation for anatomical structures (DSC indicator — a measure of similarity of Dyce):

Cerebellum — 0,885 ± 0,05
Pallidum — 0,7442 ± 0,009
Ventricle — 0,9 ± 0,02
Blood vessels — 0,2 ± 0,001
Mesencephalon — 0,8474 ± 0,0073

The automated segmentation is a key step which finds application in computer diagnostics, clinical trials and scheduling of treatment. In recent years the most various approaches to segmentation of images of CT and MR having own advantages and restrictions were offered. Bases of approaches to segmentation and their corresponding features are presented in the present review.

The approaches to segmentation of images discussed in this review can be ranged on the basis of applicability, fitness, efficiency and computing expenses. The segmentation methods based on methods of level gray such as threshold value and methods on the basis of regions, are the simplest methods and find restricted application.

Also there is a set of various algorithms on the basis of neuronic networks for segmentation and classification of the textures having good accuracy. However the majority of these algorithms on the basis of neuronic network demand careful supervision and tutoring, and their efficiency

depends on a method of tutoring and data used in tutoring. At last, it is desirable that segmentation of medical images and algorithms of classification demanded that they had the following characteristics: a) accuracy, b) reliability, c) repeatability, d) reliability and e) the least dependence on the operator.

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FEATURES OF HARDWARE-SOFTWARE ACCELERATION OF SIGNAL PROCESSING IN MICROCONTROLLER SYSTEMS

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Arduino is a complete system that allows you to manage various systems and read data from different sources. The main advantage of Arduino is the standardized distribution of the outputs, which allows the use of ready-to-use solutions that extend the capabilities of the system.

Using special cards called Shields, you can expand the capabilities of Arduino by connecting, for example, a network card, a driver for controlling a stepper motor or a distance sensor.

Consider the main ways to increase the processing speed of the Arduino board.

- Mechanical replacement of Quartz, by increasing the frequency of the controller and thereby increasing the speed of work. The standard operating frequency is 16 MHz.

- Programmatically change the speed of work, using the method of accessing the line to the port.

At the beginning of the work we will test the actual speed of the digitalWrite function on the Arduino Mega2560 board and consider the possibility to speed up the program several dozen times. At the core of the Arduino Mega2560 debug card is the AT2560 microcontroller, which operates at a clock speed of 16 MHz. If we translate these 16 million oscillations into a time interval, then we get a rather small period equal to 62.5 ns.

The commands, written in Wiring, are converted into simpler commands, the so-called machine code, which the microcontroller is already executing directly. Some commands of the microcontroller are executed in one clock cycle of the microcontroller, some require more cycles, respectively, and runtime. Therefore, one, in our opinion, a simple command or function will be