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ҚАЗАҚСТАН РЕСПУБЛИКАСЫ ТҰҢҒЫШ ПРЕЗИДЕНТІ - ЕЛБАСЫНЫҢ ҚОРЫ

«ҒЫЛЫМ ЖӘНЕ БІЛІМ – 2017»

студенттер мен жас ғалымдардың
XII Халықаралық ғылыми конференциясының
БАЯНДАМАЛАР ЖИНАҒЫ

СБОРНИК МАТЕРИАЛОВ
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«НАУКА И ОБРАЗОВАНИЕ – 2017»

PROCEEDINGS
of the XII International Scientific Conference
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«SCIENCE AND EDUCATION - 2017»

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Жинаққа студенттердің, магистранттардың, докоранттардың және жас ғалымдардың жаратылыстану-техникалық және гуманитарлық ғылымдардың өзекті мәселелері бойынша баяндамалары енгізілген.

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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SIGN LANGUAGE STATIC GESTURES RECOGNITION TOOL PROTOTYPE

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Sign language consists of 3 main parts:
1) Finger-spelling
2) Static gestures
3) Dynamic gestures

Letters + dacti-lemmas form tracing speech.

Sign language static gestures recognition problem solution is handled within several stages:
1) Data gathering;
2) Data annotation for further machine learning;
3) Features-vectors extraction from gestures by computer vision approaches;
4) Using of machine learning approaches to create a recognition model;
5) Recognition process.

For detection part I have used a part of Polish sign language finger-spelling dataset.

For recognition part has been created the dataset which consists of 1000 images (100 images per gesture average). Images are taken from [1] website videos.

According to competent researchers HOG (Histogram of Oriented Gradients) + SVM (Support Vector Machines) approach is one of the most applicable for real-life tasks. That is why it is decided to use it for current problem.

Histigrams of Oriented Gradients

HOG descriptors are mainly used to describe the structural shape and appearance of an object in an image making them excellent descriptors for object classification. However, since HOG captures local intensity gradients and edge directions, it also makes for a good texture descriptor. The HOG descriptor returns a real-valued feature vector. The dimensionality of this feature vector is dependent on the parameters chosen for the orientations, pixels_per_cell and cells_per_block.

Stages of HOG:

Step 1: Normalizing the image prior to description.

This normalization step is optional, but in some cases this step can improve performance of the HOG descriptor. There are three main normalizing approaches but square-root normalization compresses the input pixel intensities far less than gamma normalization. Dalal and Triggs [2] demonstrated, square-root normalization actually increases accuracy rather than hurts it.

Step 2: Gradient computation.

The first actual step in the HOG descriptor is to compute the image gradient in both the *x* and *y* direction. Convolution operation it is used to obtain the gradient images:

$$G_x = I * D_x \text{ and } G_y = I * D_y$$

where I is the input image, D_x is our filter in the *x*-direction, and D_y is our filter in the *y*-direction. After that the final gradient magnitude representation of the image: $|G| = \sqrt{G_x^2 + G_y^2}$

Finally, the orientation of the gradient for each pixel in the input image can then be computed by:

$$\theta = arctan2(G_y, G_x)$$

Given both $|G|$ and θ, it is possible to compute a histogram of oriented gradients, where the bin of the histogram is based on θ and the *contribution* or *weight* added to a given bin of the histogram is based on $|G|$.

Step 3: Weighted votes in each cell.

Now it is necessary divide our image up into cells and blocks. Here it is used standard parameters: orientations = 18, pixels_per_cell = (8, 8), cells_per_block = (2, 2).

Step 4: Contrast normalization over blocks.

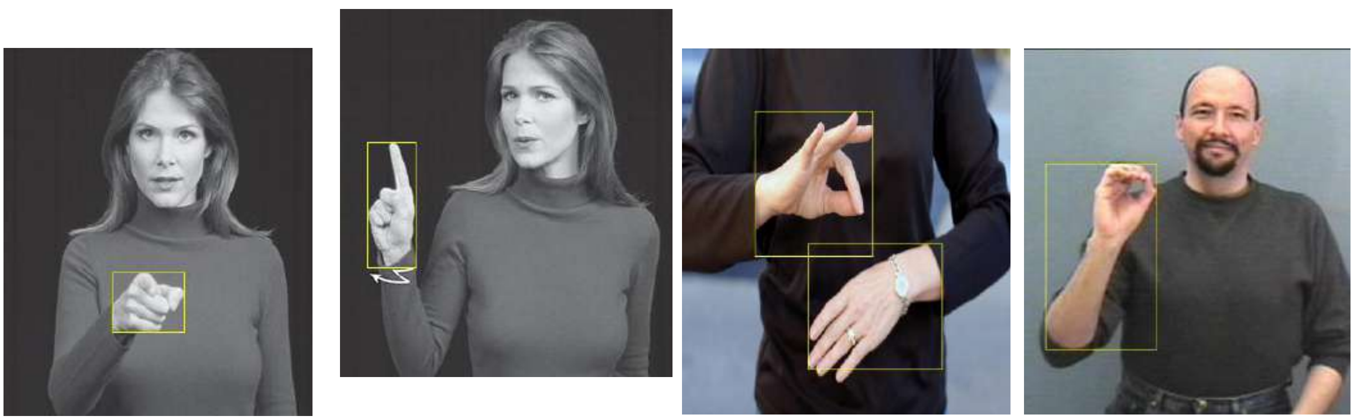
To account for changes in illumination and contrast, the gradient values are normalized *locally*. This requires grouping the “cells” together into larger, connecting “blocks”. It is common for these blocks to *overlap*, meaning that each cell contributes to the final feature vector more than once.

Support Vector Machines

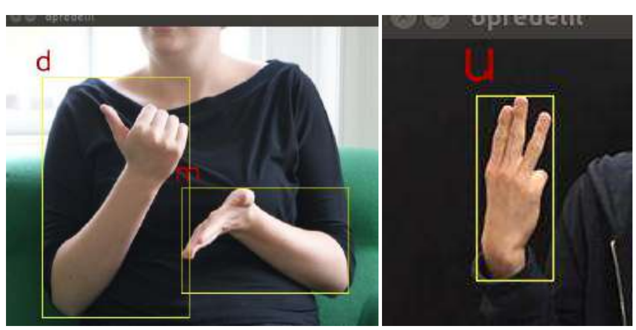
The reason SVMs are so popular is because they have solid theoretical foundations — and they also make for good stock, out-of-the-box classifiers. There are still hyper parameters that you’ll need to tune, but in general, throwing an SVM at a problem is a good way to quickly get reasonable baseline accuracy with minimal parameter tuning. The very basics of the SVM algorithm were introduced way back in 1963 in [3], “kernel trick” introduced to construct non-linear classifiers in [4].

However, the biggest contribution was yet to come. In 1995 Cortes and Vapnik proposed an extension to the SVM algorithm to handle “soft margins” in their paper [5].

Results:



Pic1. Hands detection



Pic2. Finger-spelling recognition

Pic3. Gesture meaning recognition

Literature

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MATHEMATICAL MODEL OF NEURAL NETWORK

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In our talk we discuss how boundary control method can be applied to inverse problem for differential equation on graph-tree. This is a new approach to the analysis of heat equation with memory and a local reconstruction algorithm of source identification.

Differential equations on graphs are used to describe problems which arise in nano-technology,