Since 2017, the format of the UNT (Unified National Testing) has changed. The new format of UNT includes a compulsory subject - mathematical literacy, which consist of 20 tasks.The new format of the unified national testing presents qualitatively new requirements to the functional literacylevel of the future enrollee. The content of the test includes tasks from simple calculations to more complex ones. The second ones check the application of mathematics in various situations, students ability to analyze and summarize information.Here are some examples:

I have three sons. The age of the first is equal to the first digit of my age, the second son's age is the second digit of my age and the age of the third is the sum of the digits of my age. The age of each of us is different and their sum is 60. My age is equal to:

A) 29 B) 37 C) 28 D) 38 E) 39

As we know, we do not have a definite algorithm or formula for solving this mathematical problem. That is why we try to solve with the help of options.

Option A) 29 Hence the age of the first child is 2, the second child is 9, the third child is the sum 2+9=11. The sum of our 4 ages $2+9+11+29=51\neq60$ The answer is not correct.

Option B) 37 Hence the age of the first child is 3, the second child is 7, the third is the sum 3+7=10. The sum of our 4 ages $3+7+10+37=57\neq60$ The answer is not correct.

Option C) 28 Hence the age of the first child is 2, the second child is 8, the third is the sum 2+8=10. The sum of our 4 ages $2+8+10+28=48\neq60$ The answer is not correct.

Option D) 38 Hence the age of the first child is 3, the second child is 8, the third is the sum 3+8=11. The sum of our 4ages $3+8+11+38=60=60$ The answer is correct.

OptionE) 39 Hence the age of the first child is 3, the secondis 9,the third is the sum 3+9=12. The sum of our 4th age $3+9+12+39=63\neq60$. Wrong answer.

In this way, the answer to this mathematical problem is 38, option D.

It should be noted that students like the tasks that requirethe processes of comparison, monitoring, refining and compiling.And this leads them to stabilize qualities, such as attention, imagination, perception, memory, thinking.Some inspiredstudents find non-standard taskshemselves, solve them and share with other students during classes or breaks.

Conclusion

As a result, students increased their interest in mathematics solving non-standard problems.This is due to the fact that non-standard tasks are aimed at the fulfillment of a number of tasks, such as correctional development and upbringing.They allow teachers to organize the repetition systematically, consolidatestudents mathematical knowledge and skills, develop creative thinking.

The result of the work provides an opportunity to see a number of positive recommendations:

1) Non-standard problems should be used at different stages of mathematics lessons to study various mathematical materials.

2) Non-standard problems are useful in classes, where there are many students who believe that mathematics is a boring science and they are less interested in it.

3) The use of logical tasks of a creative nature for the development of the imagination of students also gives good results at the lessons of mathematics, technology and visual arts.

Teaching mathematics the teacher must adhere to the creative approach. Non-standard reports and assignments have many opportunities for teaching, developing and correcting students.

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ANALYSIS OF METHODS FOR EXTRACTING CHARACTERISTICS FROM A DIGITAL IMAGE FOR SEARCH AND FACE RECOGNITION TASKS

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Nowadays, personal identification systems are of great interest to various law enforcement agencies and security agencies to establish transboundary control and to combat various types of crime. Individual recognition systems, as well as word recognition systems, refer to indirect observation systems, that is, the ability to identify and control the object at a distance, without direct interaction. Within this article was carried out a comparative analysis of the methods of sparse representation and image transformation, for searching and recognizing faces. The considered methods: Discrete Cosine Conversion (DCT), Fast Conversion (FFT), Discrete Wavelet Transform (DWT), Karunen-Loew (KLT), Nearest Neighbor Discriminant Analysis (NNDA). DCT is a homomorphism of the vector space DFT, and their difference is that Fourier works with more general complex numbers, cosine transform with real numbers. Algortm fiberboard, as already noted above, is a very close type of transformation to DCT, of course, here it should be noted that because of the partitioning into blocks in DCT, the quality of the reconstructed image decreases with large compression ratios.

Keywords: sparse representation, recognition system, computational complexity, transformation.

БЕТТІ ТАНУ МЕН ІЗДЕУ ТАПСЫРМАЛАРЫ ҮШІН САНДЫҚ СУРЕТТЕРДІҢ ҚАСИЕТТЕР ТӘСІЛІНІҢ ТАЛДАУЫ

Берік С.Б. – А.Байтұрсынов атындағы Қостанай мемлекеттік университетінің ақпараттық технологиялар кафедрасының оқытушысы, Қостанай қ-сы.

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Қазіргі таңда трансшекаралық бақылау орнатуға және қылмыстың әртүрлі түрлерімен күресу мақсатында тұлғаны тану жүйелері түрлі құқық қорғау органдары мен күзет мекемелеріне үлкен қызығушылық тудырады. Өйткені тұлғаларды тану жүйесі, сондай-ақ сөзді тану жүйелері жанама байқау жүйелеріне жатады, яғни объектіні қашықтықта, тікелей өзара әрекеттесусіз сәйкестендіру және бақылау мүмкіндігі бар. Мақалада беттің тануы мен іздеу үшін суреттің сирек көрсету арқылы және түрлендіру әдісіне салыстырмалы анализ жүзеге асырылды. Дискреттік косинус түрлендіруі (DCT), Тез Фурье түрлендіруі (FFT), Дискреттік вейвлет-түрлендіру (DWT), Карунен-Лоэв түрлендіруі (KLT), Жақын көрші нүктелердің талдауы (Nearest Neighbor Discriminant Analysis, NNDA) әдістері толықтай қарастырылды. DCT векторлық кеңістіктің DFT гомоморфизмі және олардың айырмашылығы - Фурьенің күрделі сандармен, нақты сандармен косинус түрлендірумен жұмыс істейтіндігіде. Алгоритм ДWT сонымен қатар ол DCT-ға жақын түрлендіру түрі болып табылады. DCT-да блокқа бөлгеннен үлкен коэфффициентте қысылған қалпына келтірі-

летін суреттің сапасы төмендетіледі. Сол себептен суретті қысу арқылы дискреттік вейвлет-түрлендіру шамамен қызықты, ол толық суретке қолдану тиімді және оларда блоктік бөлудің артефактісі қатыспайды.

Түйінді сөздер: сирек көрініс, тану жүйесі, есептеу қиындықтары, түрлендіру.

АНАЛИЗ МЕТОДОВ ЭКСТРАКЦИИ ПРИЗНАКОВ ИЗ ЦИФРОВОГО ИЗОБРАЖЕНИИ ДЛЯ ЗАДАЧ ПОИСКА И РАСПОЗНАВАНИЯ ЛИЦ

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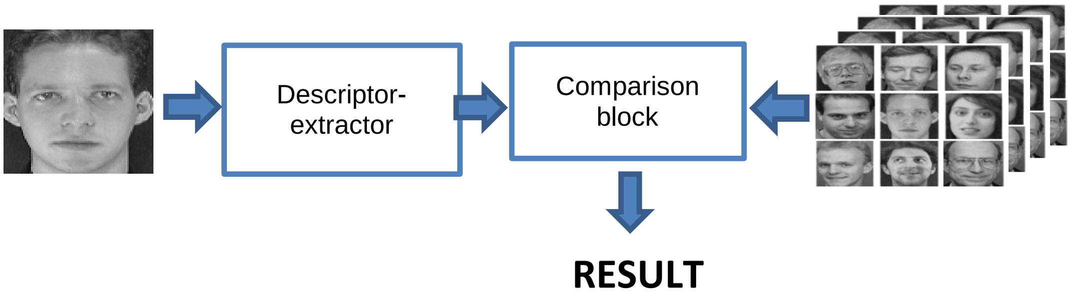
На фоне возрастающего туристического и экономического потока между странами, в целях налаживания трансграничного контроля, и борьбы с различного рода преступностью системы распознавания лиц начинают пользоваться большим интересом у различных правоохранительных структур и органов безопасности, так как системы распознавания лиц, как и к слову голосовые системы относятся к системам неявного наблюдения, то есть возможность идентификации и наблюдения за объектом на расстоянии, без непосредственного взаимодействия. В статье проведен сравнительный анализ методов разреженного представления и преобразования изображении, для поиска и распознавания лиц. Рассмотрены методы: Дискретное косинус преобразование (DCT), Быстрое преобразование (FFT), Дискретное Вейвлет-преобразование (DWT), Преобразование Карунена-Лоэва (KLT), Анализ ближайших соседних точек (Nearest Neighbor Discriminant Analysis, NNDA). ДКП является гомоморфизмом векторного пространства DFT, и их отличие в том что Фурье работает с более общими комплексными числами, косинусное преоброзование с действительными числами. Алгортм ДВП так же как уже отмечалось выше явялется очень близким видом преоброзования к ДКП, конечно здесь необходимо отметить что из за разбиения на блоки у ДКП снижается качество восстанавливаемого изображения при больших коэффициентах сжатия.

Ключевые слова: разреженное представление, система распознавания, вычислительная сложность, преобразование.

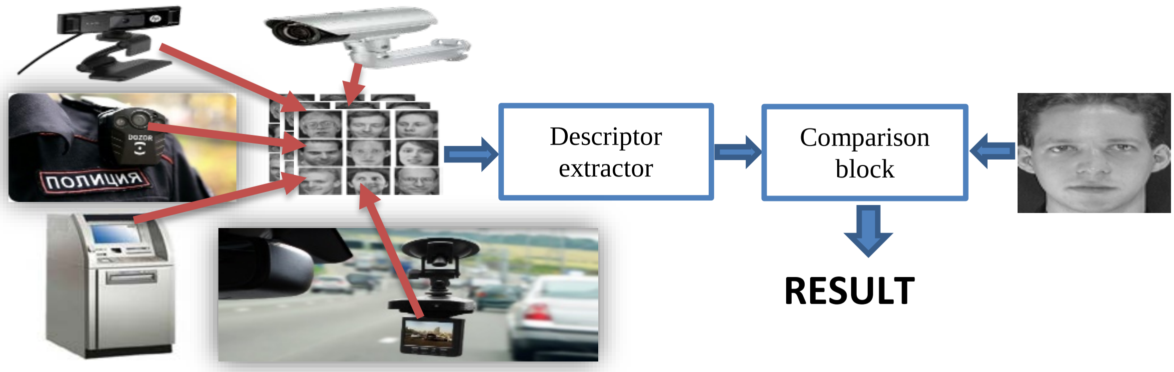
Introduction. Against the backdrop of increasing tourist and economic flows between countries, in order to establish cross-border control, and to combat various types of crime, face recognition systems are beginning to be of great interest. Especially by various law enforcement and security agencies, since face recognition systems, like the voice systems, refer to systems of the implicit observations, that is, the possibility of identifying and monitoring the object at a distance, without direct interaction.

If we consider the standard recognition (identification) scheme on which most of the systems are built, then we have some original image that we want to find and then feed it to the input of the system in the database, a search is performed among the existing images. From the original image, the characteristics are extracted with the help of the characteristic extractor, the necessary characteristics are compared with the characteristics that are available in the database and the most suitable image is displayed (coincidence with the drawing 1).



Picture 1. The standard structure of identification systems

But nowadays the trend of modern recognition methods is changing and moving to a different approach. There is only one image to be found in the database, and an image stream is fed to the input, which is compared with what is found in the database. The wording here already has to talk not about direct recognition, but rather about the search for individuals (in the data stream) **[1, p. 241].**



Picture 2. The structure of search for individuals according to the trends of contemporary recognition methods

The main criterion for constructing a real person search system is speed, so that the system can operate in real time, that is, search the data stream.

The main problems of the practical use of the search system for persons with real conditions are associated with working with a very large space of features. For this reason, arises the problem of reducing or representing the original feature space by a smaller, sparse representation.

For example, suppose that a digital image is given at the input of a simple system, the only (or largest) object of which is a human face. Note that this requirement strictly corresponds to the standard for size, quality and content in the original images used in biometric problems **[2, p. 31].** If the size of the original image is M × N pixels, then when using luminance characters for the person's dimension DIM of the characteristic vector is MN (DIM = MN). For example, for M = 112 and N = 92, DIM = 10304. In accordance with, the original image can be 4-5 times larger (for example, M> 500 and N> 400), which corresponds to DIM> 200000, and this is for one image **[3, p. 35].**

Given this circumstance and the fact that the system is designed to work with very large databases (and the rapid dynamics of changes in their composition), it becomes impossible to talk about solving the set task of searching for / recognizing faces in real time.

The main task of sparse data representation is to minimize the input signal, for subsequent processing, with the possibility of reconstructing. Sparse representations are used to store a relatively small amount of data that is located in a large data area.

Main part. Sparse representation methods are widely used not only in image processing, but also in signal processing in general. The methods of sparse representation of the image for the purposes of face recognition have been devoted to a considerable number of works, most of them are based on the following methods and their associations:

- Principal Component Analysis (PCA)
- Discrete cosine transformation (DiscreteCosineTransform, DCT)
- Nearest Neighbor Discriminant Analysis (NNDA)
- Discrete Wavelet Transform (DVR)
- Fourier transform (FT)

Let us consider these methods in more detail, and the algorithms in which they are applied.

Discrete cosine transform (DCT)

Discrete cosine transformation is one of the orthogonal transformations. It is very important in the field of signal processing, from compression of audio signals, to image compression, as well as for spectral representation of information.

The basic idea of an approach is in the representation of image data by the coefficients of their discrete transformations (transformants). The discrete cosine transform is very closely interrelated with the discrete Fourier transform, but in contrast to the Fourier transform it uses only real numbers.

Image pixels have a correlation in two directions, and not just one at a time. Therefore, image compression methods use a two-dimensional DCT, which is given by the (1) formula:

$$G_{ij} = \frac{1}{\sqrt{2n}} C_i C_j \sum_{x=0}^{n-1} \sum_{y=0}^{n-1} p_{xy} \cos\left(\frac{(2y+1)j\pi}{2n}\right) cos\left(\frac{(2x+1)i\pi}{2n}\right) \quad (1)$$

at $0 \leq i,\ j \leq n-1$. The image is divided into blocks of pixels $p_{xy}$of size nxn, and the equations are used to find the coefficients G_{ij} for each pixel block. If a partial loss of information is allowed, then the coefficients are quantized [4, p.359].

The discrete cosine transformation is closely related to the discrete Fourier transform and is a homomorphism of its vector space.

Fast Fourier Transform (FFT)

Fast Fourier Transform (FFT) - is an algorithm for the rapid calculation of a discrete Fourier transform (DFT). The most common algorithm of the FFT is the Cooley-Tukey algorithm, in which the DFT from N = N_1 N_2 is expressed by the sum of the DFT of smaller dimensions N1 and N2. In general form, the Discrete Fourier Transformation (2) formula looks like this:

$$X_k = \frac{1}{N}\sum_{n=0}^{N-1} x_n\, e^{-\frac{2\pi i}{N}kn} \quad (2)$$

When using the Cooley-Tukey transformation algorithm. Taking as a base 2, and expressing the DFT as the sum of 2 parts: the sum of even indices m = 2n and the sum of odd indices m = 2n + 1. As a result of simplifications, denoting the DFT of even indices x_{2m} as E_k and DFT of odd indices x_{2m+1} as O_k, for $0 \le m \le \frac{N}{2}$, we get (3) and (4) formulas:

$$X_m = E_m + e^{-\frac{2\pi}{N}m} O_m \quad (3)$$

$$X_{m+\frac{N}{2}} = E_m - e^{-\frac{2\pi}{N}m} O_m \quad (4)$$

This note is the base of the Cooley-Tukey algorithm with base 2 for calculating the FFT.

Methods of VCT and FFT can have a large information redundancy due to the fact that the images in these methods are divided into blocks between which a correlation appears. The approach that allows reducing inter-block redundancy and fragmentation of the conversion, recursive block coding. Also, the discrete wavelet transform (DVT) and its various types become popular.

Discrete Wavelet Transform (DWT)

DWT is a close type of transformation to DCT, but its advantage is that the signal nonstationarity is localized in a small number of wavelet coefficients. This leads to the possibility of better recovery of the non-stationary signal by incomplete data and solves the problems encountered in the FFT and DCT.

A conventional DWT for the input signal, which is represented by an array of 2n numbers, the wavelet transformation groups the elements into 2 and forms a sum and a difference from them. The grouping of the sums is carried out recursively to form the next level of decomposition. The result is a difference of $2^{n-1}$and 1 total sum.

A common and useful feature of wavelets is that they not only decompose the signal into some kind of frequency bands, but also represent a time domain, that is, the moments of occurrence of certain frequencies in the signal **[5, p. 543].**

The Karunen-Loeve transformation (KLT)

The Karunen-Loeve transformation also has a great comparative affinity for the cosine transform. The KLT transformation calculates the most optimal basis for several vectors, in contrast to all other kinds of transformation, which are transformations with a constant basis.

The basis vectors for KLT are calculated using the pixels of the original image, that is, they depend on the original data. In a particular compression method, these vectors are written to a compressed file for use by the decoder. In addition, there is no known fast method for calculating these vectors. All these factors make the KLT method exceptionally theoretical without real applications.

Analysis of the nearest neighboring points (Nearest Neighbor Discriminant Analysis, NNDA)

The problem of finding the nearest neighbor consists in finding among the set of elements located in the metric space elements close to a given one, according to some given proximity function that defines this metric space. Depending on the algorithm used in the application, the complexity of the algorithm can also be different. The most common algorithms for partitioning space are Voronoi Diagrams and various algorithms based on a tree structure.

The Voronoi diagrams of a finite set of points S on the plane represent a partition of the plane for which each region of these partitions form a set of points closer to one of the elements of the set S than to any other element of the set.

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The Voronoi diagrams of a finite set of points S on the plane represent a partition of the plane for which each region of these partitions form a set of points closer to one of the elements of the set S than to any other element of the set **[6,p. 853].**

Conclusion. Thus, it is not difficult to see that most of the methods described, namely DCT, FFT and DVP, take the same approach as the basis, this is the orthogonal data transformation. For example, the DDC is essentially a homomorphism of the vector space DFT, and their difference is that Fourier works with more general complex numbers, cosine transform with real numbers. The DVP algorithm, as already mentioned above, is very close to the type of preprocessing to DCTs, of course, here it is necessary to note that due to the partitioning into blocks in DCT, the quality of the reconstructed image decreases with large compression ratios. For this reason, the compression of an image by means of a discrete wavelet transform is more interesting, since it can be effectively applied to whole images and they do not have artifacts of block decomposition. Also, the cosine transform has a large comparative affinity with the Karunen-Loeve transformation.

The exception is the Nearest Neighbor Point Analysis (NNDA) method, which differs from all others. But it is worth noting that the computational complexity of NNDA in practice is greater than the above approaches, even for the algorithm with modification. For large volumes of data, the decision algorithm must satisfy the specified requirements for the permissible error of search and computational complexity, which, as a rule, are in inverse relationship.

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