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Biological Databases

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Abstract – Accessing multiple biological databases involves either explicit navigation through multiple databases or expressing a query in the query language of the designer which is a formidable task. In this we propose a graphical user interface to multiple biological databases. The query which consists of the data to be retrieved and the condition, if any, to be satisfied is expressed in an intuitive way. The link information that exists in the databases is used automatically by the system and the relevant data retrieved. The retrieved data can be viewed in more than one format. There is also a provision for refining the query.

Many biometric methods are closely connected with methods of pattern recognition and image analysis. The realization of a number of biometric technologies requires using the last achievements in this area. Some elements of technology based on some methods of image analysis are demonstrated by the example of iris person identification. From a position of organizing the educational process, laboratory works in the area of biometric technologies allow stimulating students' inquisitiveness in studying methods and algorithms for image processing and pattern recognition.

We develop a pattern recognition algorithm and photo-identification method that uses photographs taken in the field to identify individual marbled salamanders, using their dorsal patterns as 'fingerprints.' The algorithm ranks all images in a database against each other in order of visual similarity. We couple this technology with a graphic user interface to visually confirm or reject top-ranked algorithm results.

Synthesis and applications: We develop, test, and apply a pattern recognition algorithm that enables efficient identification of individual marbled salamanders in a database exceeding 1000 images. We expect that this algorithm can be modified to facilitate individual identification in many other organisms because it does not rely on manual coding or discrete geometric pattern features. High performance results suggest that it can be scaled to larger databases, allowing biologists to address critical conservation-based questions regarding demography, reproduction and dispersal of rare and endangered species.

I. INTRODUCTION

Biometric and biomedical informatics are the fast developing scientific direction, studying he processes of creation, transmission, reception, storage, processing, displaying and interpretation of information in all the channels of functional and signal systems of living objects which are known to biological and medical science and practice. Modern natural sciences at present sharply need in the updating of scientific picture of the world, and the essential contribution in this process can be made by the biometric and biomedical methods.

Only some more simple (statistical) forms of biometric and biomedical information have found their application when person identification, and raised interest for these methods of identification can be caused by new possibilities of information technologies.

So, exclusively new and not explored possibilities for verification of living objects can be expected in enology. A concept of electromagnetic is intensively investigated at present. New results have been obtained in fractal analysis, using which an attempt was taken to explain some paradoxical phenomena such as morphogenetic field, distant cells communications, anomalously high sensitivity of organism to near-zero frequency perturbations, regulation processes critical dependence on the fractal features of noisy environment, etc. Perhaps, each of these phenomena can be applied in future to identify a person, and these methods may replace instead the traditional ones such as fingerprinting, handwriting, signature verification etc.

Biometric Technologies (BTs) in modern condition actively applies for an independent place in complex hierarchy of information technologies. The terms to determine the borders of this place have been formed: biometric industry, biometric products, biometric projects, biometric approach and methods, biometric devices (scanners, ID cards, etc). This is, of cause, not very correct from the position of designers of such system; however, on the other hand, it proves intensive commercial applications BTs. It is obviously, that BTs are closely connected with problems of information security, including criminology [Diat].

In this we consider BTs from the position of using the image processing and pattern recognition methods, or high-level vision. Vision is a complex process that includes many interacting components involved, for example, with the analysis of color, depth, shape, motion, texture of

objects, and with the use of visual information for recognition, extraction of shape properties, classification, locomotion, and manipulation. The significant part of modern directions of BTs is implemented based on classical and modern approaches which are very well established for various engineering applications (robot engineering, radiolocation, map drawing, document recognition and understanding, etc.)

At the same time, to realize BTs, it is required to take into account many rather specific requirements, for example, a character of timing stability of attributes; statistical sufficiency of these attributes, increasing the reliability of object identification. That part of these problems can be decided and frequently is decided based on enough simple approaches, say, by a combination of BTs and traditional methods.

The main goals are:

(i) To show close connection BTs with methods of image processing and pattern recognition, to pay attention the experts to it a heavily developing direction, and

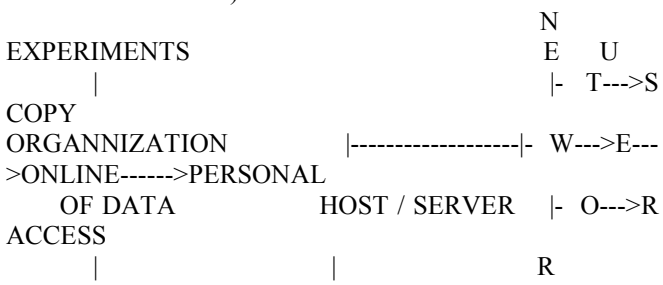
(ii) To analyze BTs from the academic point of view, i.e. as object of study and educational establishments. In the first section we present the main directions of modern BTs which are using in practice. The practical applications are considered in details in the second section of the paper. In the third section we concentrate our attention on methods and algorithms of image processing and pattern recognition which are using in BTs.

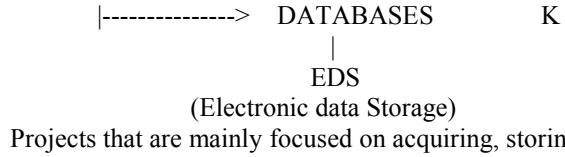
II. BIOLOGICAL DATABASE

Bioinformatics is the application of Information technology to store, organize and analyze the vast amount of biological data which is available in the form of sequences and structures of proteins (the building blocks of organisms) and nucleic acids (the information carrier). The biological information of nucleic acids is available as sequences while the data of proteins is available as sequences and structures. Sequences are represented in single dimension where as the structure contains the three dimensional data of sequences. A biological database is a collection of data that is organized so that its contents can easily be accessed, managed, and updated. The activity of preparing a database can be divided in to:

· Collection of data in a form which can be easily accessed

· Making it available to a multi-user system (always available for the user)





Projects that are mainly focused on acquiring, storing, presenting, and describing data.

Four types of databases:

Large-scale public repositories (e.g. Genbank, PubMed)

User community-specific databases (e.g. TAIR, ChromDB)

Bioinformatics resource databases (e.g. Gene Ontology).

Project-specific databases (e.g. Signal system)

III. MODERN DIRECTION OF BIOMETRIC TECHNOLOGY

Nowadays term BTs means: voice and speech recognition, dynamic signature and writing capture, eyes (iris and retinal) identification, hand geometry, fingerprint (palm print) identification, face recognition and keystroke dynamics (Fig.1)

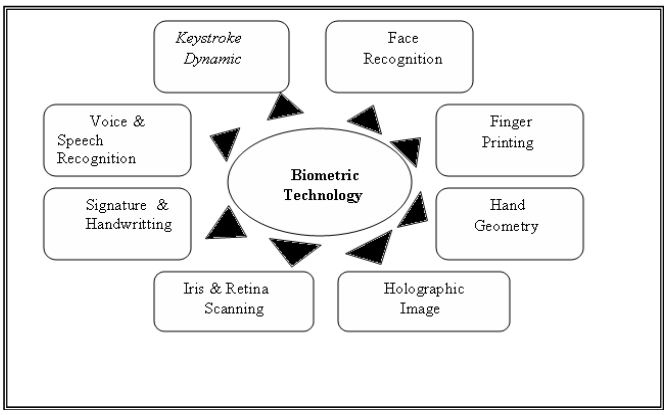


Fig 1 : Main direction of Modern Biometric Technology

In a number of cases, thermal imaging of a living objects is also used. Possibly, it should be classified as a separate direction of BTs. It is quite clear from Fig.1 the modern view of BTs. It is necessary make some remarks only. It is doesn't mean, that BTs includes this direction only. We say about the direction rich are used now in many practical applications. It is well known about many others investigation in biometrics, but these methods can be called as laboratory's BTs methods and approaches. But many experts predict development of not-touch methods BTs, i.e. methods which allow identifying the person on distance. Stability is the main criterion of the BTs. It is mean that we must good understand during what period the biometric attributes of an object will not be changed essentially. For instance, it is known hat the signature and handwriting of a person are changed during a day and strongly depend on psychological factors.

The similar remark can be made on keystroke dynamics identification, for the same time it is necessary to add, that a number of other rather specific factors, for example, increasing of a professional skirling level, are here added. From the position of stability, steady interest to methods of fingerprint and eyes identification is clear. These methods of BTs have a number of unique properties, which allow using them during practically all life of the person. Character of using the BTs methods is another criterion of a choice the BTs.

For example, a number of the financial applications are characterized by short BTs devices life time and high extensively. It imposes a number of other requirements for choice and use of BTs methods:

(i) Whether it meets the requirements of a particular application. For example, for super smart cards, the signature and face identification are considered as good combination.

(ii) Whether it is possible to realize the chosen BTs by using identical mathematical and algorithmic methods. For example, signature and face identification methods have little in common.

IV. METHODS OF IMAGE PROCESSING & PATTERN RECOGNISATION IN BT'S

The analysis shows, that the overwhelming part of BTs is realized by using image processing and pattern recognition methods and algorithms. As the most evident example we consider here the following BTs:

Hand geometry, signature and handwriting, face recognition finger and palm print, iris and retina scanning.

To solve the problem, in this or that form the following main methods were used:

Digitization, compression, enhancement, restoration, reconstruction, segmentation, feature measurement, scene analysis, image representation, models, design methodology, clustering (Fig.3).

Note, that the distance BTs require to use additionally the tomography methods. Typically, a number samples are taken at time (speech, signature) and processed in accordance with a chosen method. An intermediate image is formed as result.

METHODS AND ALGORITHMS OF PATTERNRECOGNITION AND IMAGE ANALYSIS

Fig 3: Implementation of some BTs requires to use practically all modern achievements in image processing and pattern recognition.

V.