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Biometric Characteristics in the Management System of Information Technology Processes

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Biometric object.

Abstract

The article presents the research results on the organization of the authentication procedure for access to technological information systems. A rational sequence of user identification for access to information based on the selection of biometric characteristics of a person is proposed. The selection of biometric characteristics and their processing is carried out in two-dimensional and three-dimensional coordinate systems with the calculation and subsequent coding of information. Reliability of information protection is ensured by using operational coordination of parametric and biometric characteristics of a person. The developed decision-making algorithms could develop software platforms to implement effective economic and technological processes.

Disciplinary: Management Information System.

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1 Introduction

The scientific literature presents the characteristics of a fairly large number of methods for synthesizing models of economic, physical, biological nature. With the help of computer graphics tools, some can accurately reflect both objects of the real world and their virtual images.

In the case of representing an object through the description of its essential features, such as, for example, a form, the main characteristics of the content, including qualitative and

quantitative, a description of its positioning in the socio-economic system, this object can already be considered as something whole with its name, designation, formalized representation, and semantic meaning.

When considering the structural-logical model of an object in a socio-economic system, a flat or spatial image of it, the topology of elements and characteristic features are used; the presence of benchmarks is considered very important [1, 10]. Such a model can be called frame-structured and defining two types of information: first, geometric parameters; secondly, individual or characteristic features that can be identified.

The study aims to substantiate the structure and content of a model for identifying biometric characteristics of a person, which are best adapted to the control processes of the functioning of information technological systems. Achieving this goal involves solving the following tasks:

- determination of a rational sequence for identifying the coordinates of the research object - a potential user of information technological systems;
- substantiation of the sequence of implementation of procedures for the selection of biometric characteristics of a person to gain access to the information system;
- development of a biometric operational coordination model for recognition, coding, storage of geometric images of selected information features;
- an algorithm for solving the problem of optimizing access control to information resources.

2 Materials and Methods

The set of biometric characteristics of a person claiming to gain access to technological information systems is taken as the initial array of research materials. Its capabilities must be consistent with the requirements for ensuring effective interaction with the information system and rational management decisions [2, 5]. In this case, it will be acceptable to obtain the appropriate user permission certificate.

The construction of geometric and graphic-analytical images of a person's biometric characteristics and mathematical modeling of the processes of his interaction with information systems constitute a set of accepted research methods. In three-dimensional representation, models are characterized by dimensions, angles between sides, precisely defined spatial arrangement of characteristic features. They lend themselves to two types of descriptions that are quite common in research processes: using graphs and a frame representation of characteristics or parameters. Moreover, the identification of coordinates can be carried out in real-time at local areas described using data stored in the corresponding database [4, 6].

Modern object-oriented programming (OOP) technologies make it possible to design software of the appropriate level rather quickly and at low cost, which in the future can be certified. Implementing the topological approach to the design of the object model allows you to fix the relationship between the established spatial parameters.

The analysis of well-known scientific developments on the subject of research allows us to distinguish the following functional stages of the synthesis of the object model:

- appeal to methods and means of solving applied problems;
- creation of standard scenarios or procedures for modeling objects;
- implementation of design in changing environmental conditions or conditions of objects.

3 Result and Discussion

As an example of implementing the provisions mentioned above, one can cite the procedure of coordinate synthesis of code structures that describe the user's biometric system [8]. According to the data of a person's anthropometry, this can be done, called his biometric characteristics (BCP). To do this, from the set of BCP, you should select the parameters according to the certificate-permission of the user to access the information system (Figure 1).

According to the algorithm shown in Figure 1, the BCP space can be set $\vec{W}$. Each component of the BCP collection is directly related to the authorization certificate presented by the user. All BCP $(\vec{W}_{1\text{-}N})$ identify the constant and variable qualities of a potential user involved in the selection procedure. Management is carried out based on a certificate assigned to the user. The result of the BCP comparison is access to the information resource (IR). Monitoring of work is carried out through the control system. Correction can be done if necessary.

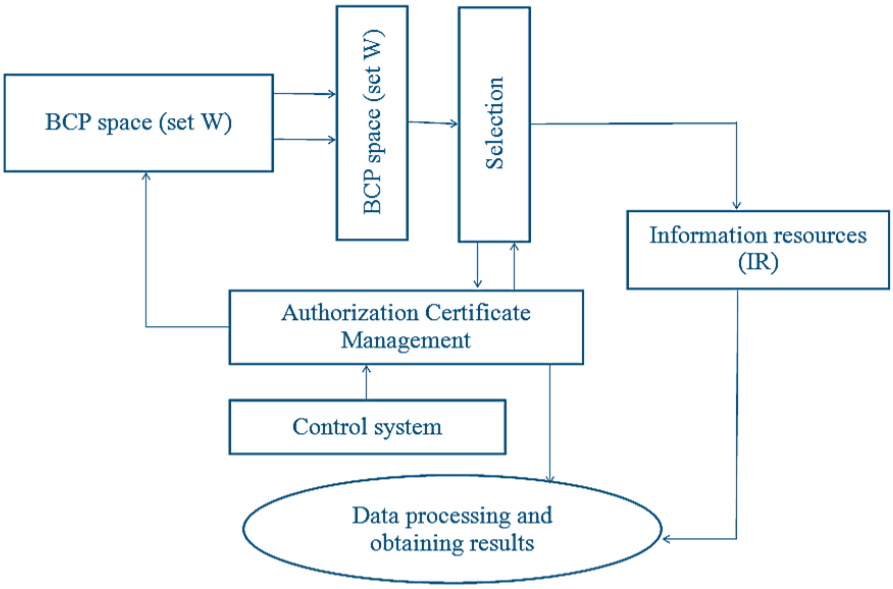


Figure 1: Sequence of BCP Selection.

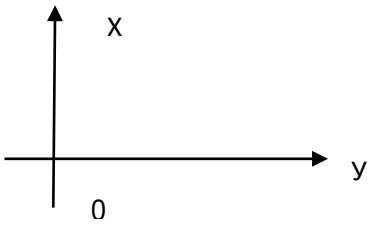
In BCP space $(\vec{W})$ all parameters are stored encoded in the binary system. For coding, it is advisable to synthesize BCP in the adopted coordinate system. For this purpose, the topology of the object (biometrics) is selected, which can be planar or three-dimensional, depending on the applied secrecy label of information resources.

The sequence of operations includes the following:

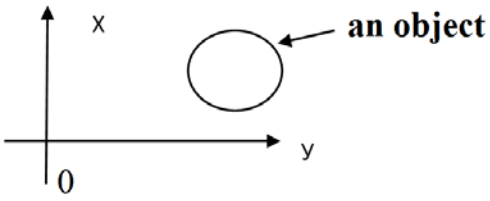
- diagnostics of the content of the certificate-permission of a potential user;
- choice of topology in the "two-dimensional-three-dimensional" system;
- control of access to information resource;
- substantiation of rational scenarios and procedures for their implementation.

Coordinate synthesis of coding in 2D, topology involves the following sequence of operations:

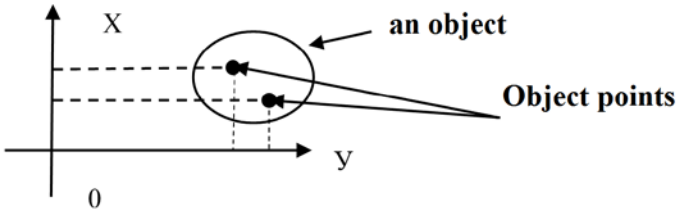
1. Selecting the coordinate system and scale.



2. Identifying the position of an object in the XOY coordinate system.



3. Determination of projections of points characterizing an object on the X and Y coordinate axes.

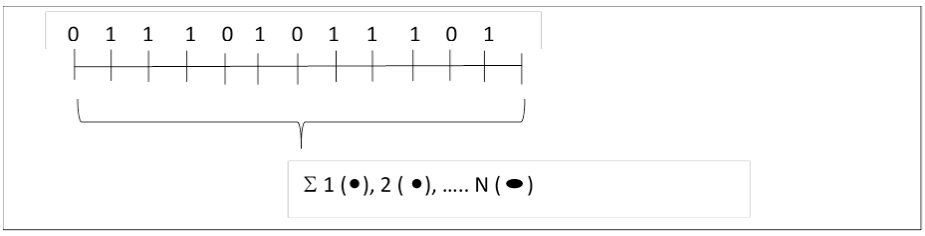


4. Determination of coordinates *x1, x2, y1, y2* points of an object and assigning them numerical values 1, 2, … ,n.

$$\begin{cases} 1\ (\bullet) \rightarrow x_1, y_1 \\ 2\ (\bullet) \rightarrow x_2, y_2 \end{cases}$$

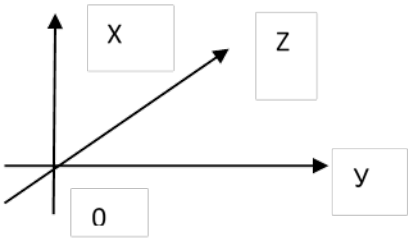
5. Conversion of the obtained numerical values of coordinates (1, 2, ..., n) into a binary number system (0, 1).

6. Lining up the synthesized code.

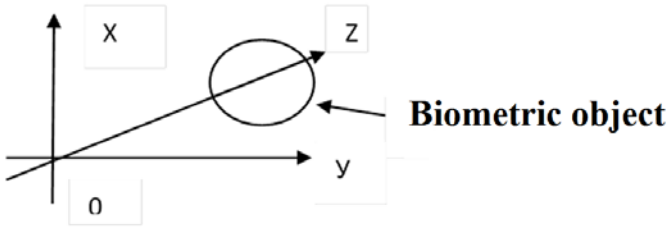


Coordinate synthesis technology for 3D coding, topology is a solution to the problem:

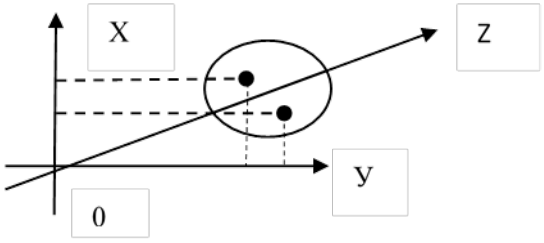
1. The selection of a three-dimensional coordinate system is made.



2. A biometric object is embedded.



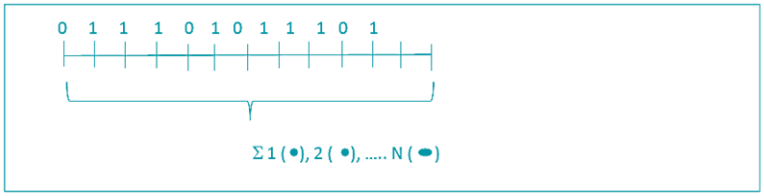
3. Characteristic points are projected on the *X, Y, Z*-axis.



4. A three-dimensional coordinate system is formed with the assignment of digital coordinate values.

$$\begin{cases} 1\ (\bullet) \longrightarrow x_1, y_1, z_1 \\ 2\ (\bullet) \longrightarrow x_2, y_2, z_2 \end{cases}$$

5. The numerical values of the coordinates are converted to a binary number system (0, 1, 0).
6. The synthesized code is built.



In the proposed model for the synthesis of a biometric characteristic or parameter *{B}*, the primary elements are the sets of characterizing points *{R}*, which have topological (spatial) structures *{RT}*. In this case, the topology is determined by the stamp of information resources and the user permission certificate *{G, M}*. The coordinates *{R}* have different numerical values *{K}* depending on the axes of the topological structure. Coordinate synthesis is formalized as follows:

$$\{S\} = \sum_1^N \{K\}_{(n)} \qquad (1).$$

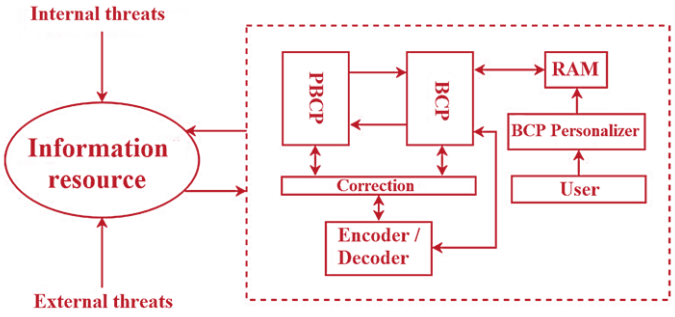


Figure 2: Biometric operational approval model.

Topological relationships of biometric objects can be divided, internal, contiguous, equal, covering, overlapping. An analysis of biometric characteristics for information protection showed that the qualitative parameters of biometrics should be effective and have operational agreements

on recognition, coding and decoding, storage of geometric images of information signs. With this in mind, the following biometric operational approval model can be proposed (Figure 2).

An obligatory element of the implementation of operational coordination is interfacing between devices, elements, communication systems. The practicality of introducing a biometric operational coordination model is argued by the following: information resources are exposed to external and internal threats, which entails the destruction of the integrity of the structural segmentation of the information volume and the loss of the useful phase the information component. For eliminating this, a protection mechanism is needed, which should contain operational reconciliation of parametric and biometric characteristics of a person (PBCP). They are the main elements of user identification/authentication. Therefore, it is necessary to correctly and qualitatively isolate biometric parameters, which are combined in the BCP.

The introduction of the correction block is justified by the expediency of full coordination of the BCP and PBCP values. For ensuring storage and machine-to-machine exchange, biometric information must be converted into a special digital code, which, if necessary, could be deciphered and also reconciled using a correction unit.

The submission of biometric characteristics by the user is made in a personalizer, which selects the necessary components from them and transfers them to the random access memory (RAM), where they are accumulated. The sequence of digital biometric approvals is in Figure 3.

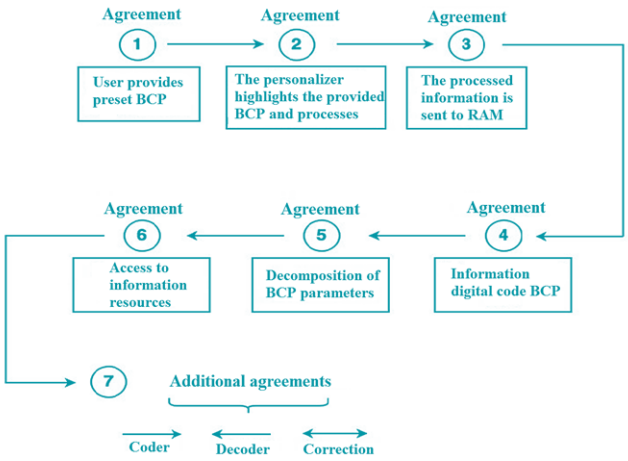


Figure 3: Sequence for the implementation of biometric approvals.

Coordination is a function implemented under the compatibility of algorithmic operations related to information security and based on innovative technologies of technical devices and software, and hardware. In the biometric system, it also takes into account the values of the corresponding characteristics and parameters. For ensuring the security of information in the form of BCP, it can be implemented through three modes:

1. Functional coordination in the mode of operation at the request of a specific BCP with a user authorization certificate.

2. Functional coordination in the mode of continuous operation of BCP presentation, taking into account the choice of neck segments.

3. Functional convention in the combined query mode of multifactor BCP.

Risk reduction factor RRF_{BCP} can be represented in terms of the ratio of the number of possible threats of receiving errors (excluding the influence of BCP) to the allowable number of errors as follows:

$$RRF_{BCP} = \frac{F_{incidents\ (without\ BCP)}}{F_{tolerance\ for\ incidents}} \quad (2).$$

Indicators indicated in expression (2) with the letter F are probabilistic. They determined the level of security of access to information accumulated in the BCP personalizer and diagnosed, in turn, by a similar *SFF* ratio *(Safery Failure Fraction)*:

$$SFF = \frac{\sum P_{PDNR} + \sum P_{PFP} + \sum P_{PCP}}{\sum P_{PADI} + \sum P_{PAP}} \quad (3),$$

where P_{PDNR} – the probability of danger of not recognizing BCP;

P_{PFP} – the probability of false perception of BCP;

P_{PCP} – the probability of correct perception of the BCP;

P_{PADI} – the probability of accepting duplicate BCP information;

P_{PAP} – the probability of accidental perception of BCP.

The obtained numerical SFF values can be further used for analysis and conclusions. The speed of calculations required in this case can be achieved through the use of a special software platform. Thus, biometric reconciliation will help keep the information segment intact.

For the effective use of biometric authentication devices, error-free functioning of the decision-making system is required. Simultaneously, an important condition for ensuring its stable and reliable functioning is compliance with basic principles such as complexity and flexibility, security, and reasonable sufficiency. Their main content is in Figure 4.

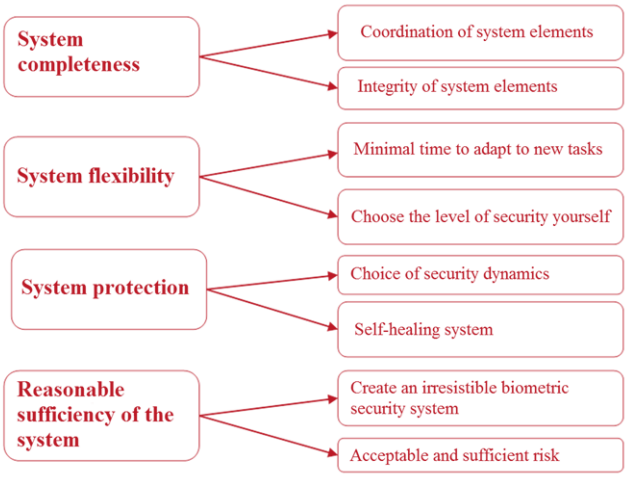


Figure 4: Content of Biometric Authentication Principles.

International standards do not regulate the noted provisions of biometric authentication. Therefore there are no strict functional requirements. However, the existing conditions of the International Biometric Community must be respected. To make error-free management decisions,

it is necessary to have general and specialized software and, secondly, implement systems of admission of general and high levels (Figure 5).

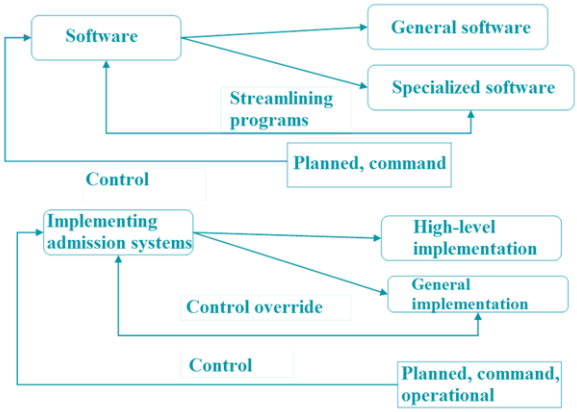


Figure 5: Components of a decision-making system.

A systematic approach to correct management decisions includes some basic elements: data, knowledge, and processes [7, 9]. Various instructions and user manuals form the required database. The base of accumulated knowledge is determined by the ratio of needs and opportunities for their acquisition. Making rational management decisions is always accompanied by the functioning of a rather complex mechanism for acquiring, accumulating and implementing special knowledge (Figure 6).

The knowledge acquisition mechanism operates using the well-known principles of systems analysis and synthesis. Concerning the problem of biometric approvals under consideration, one should consider the modern realities of machine support for the acquisition of special competencies. To find a rational solution to a problem, it is always necessary to expand existing knowledge, modify it, correct it, conduct a test analysis and protect the results obtained.

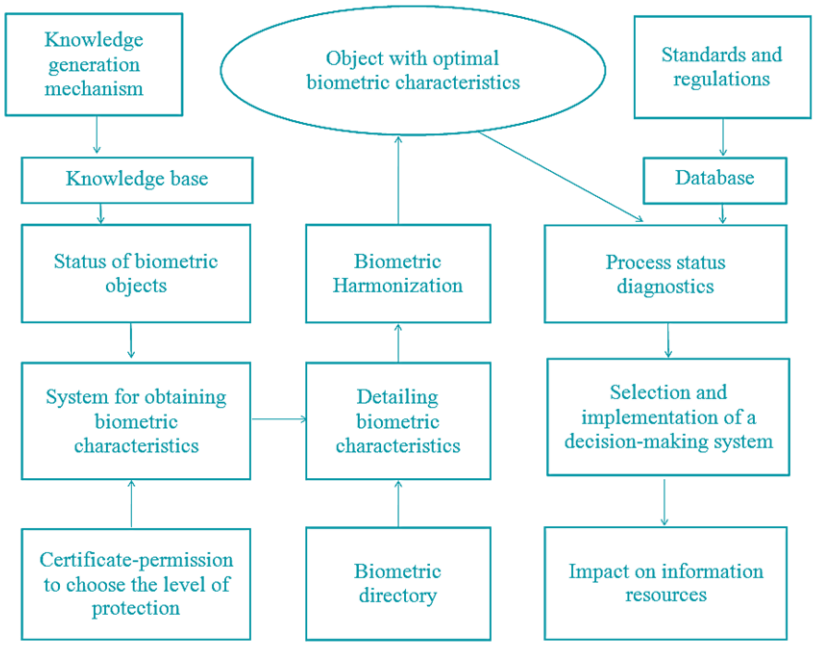


Figure 6: Structure of the mechanism for finding the optimal solution.

The search for the best option involves making an informed decision from interaction with information resources and is carried out in a certain sequence (Figure 6). Initially, a biometric object (BO) is selected, according to which the characteristics are specified and its possible states are checked (SBO). Then, using a refinement system (RS), objects are selected from a set of SBO. Based on the results obtained, biometric characteristics are classified in obtaining biometric characteristics (SOBC). The choice of the required characteristic is carried out from the biometric catalog (BC) on the platform of the submitted certificate-permission, which contains information about the level of protection of the information resource.

At the final stage, according to the selected characteristic (or a set of characteristics), a check is made for BO authentication/identification, and information resources are influenced through a decision support system (DSS).

The data collected as a result of the search can be represented as a function [3]:

$$F(t) = F(\omega_1(t),(\omega_2(t), \dots (\omega_n(t)) \quad (4),$$

where *F(t)* – quality state of search at a point in time *t*, *t* – argument fixing the moment in time of presentation of the biometric characteristics of an object, $\omega_i(t)$ –impact of the permission certificate on the choice of the level of protection of information resources.

4 Conclusion

The aggregate of the acquired knowledge of a biometric nature, together with a database of standards and regulatory documents on information security, makes it possible to model decision-making processes in the field of influence and control access to information resources upon presenting an appropriate certificate of permission. Its intended purpose determines the choice of biometric technology. The technology for mass identification will differ significantly from the technology for protection against unauthorized access. Consequently, its choice must begin with an analysis of a specific information system, the results of which will determine the algorithm for solving the problem of optimizing access control to information resources.

Thus, the coordinate synthesis of the coding of biometric objects makes it possible to carry out the corresponding operations in the n-dimensional topology of the geoinformation system model. It creates the conditions for identifying an object in the BCP space, protecting the structure, and increasing information security. Modern object-oriented programming (OOP) technologies make it possible to quickly and at minimal cost develop software platforms to implement the formulated proposals for the effective management of economic and technological processes.

5 Availability of Data And Material

Data can be made available by contacting the corresponding authors.

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