DOI: 10.14529/ctcr180303

DEVELOPMENT OF THE IDENTIFICATION SYSTEM BY FINGERPRINTS

A.N. Alanssari [1, 2], *alaan.azeez@uokufa.edu.iq,*
H.I. Wahhab [1, 3], *hader_wa@yahoo.com*
[1] *South Ural State University, Chelyabinsk, Russian Federation,*
[2] *University of Kufa, Najaf, Republic of Iraq,*
[3] *University of Karbala, Karbala, Republic of Iraq*

Dactyloscopy (fingerprint recognition) is the most developed to the date biometric method of personal identification. The catalyst for the development of the method was its widespread use in criminology of the XX century. As each person has a unique papillary pattern of fingerprints, so identification is possible. Typically, algorithms use characteristic points on fingerprints: the end of the pattern line, branching lines, single points. In addition, information about the morphological structure of the fingerprint is attracted: the relative position of the closed lines of the papillary pattern, "arched" and spiral lines. Peculiarities of papillary patterns are converted to some unique codes, which preserves the information content of the fingerprint image. And it is "fingerprint codes" that are stored in the database used for searching and comparing. Currently, fingerprint recognition systems occupy more than half of the biometric market. A lot of companies are engaged in the production of access control systems based on the method of fingerprinting identification. Due to the fact that this direction is one of the oldest, it has become the most widespread and is currently the most developed. Fingerprint scanners have come a really long way to improve. Modern systems are equipped with various sensors (temperature, pressing force, etc.), which increase the degree of protection against counterfeiting. Every day the systems become more convenient and compact.

Keywords: system of identification, fingerprints, identification, comparison of fingerprints.

Introduction

The targets of structural image analysis have a wide range of applications, ranging from victimization of raster and ending with recognition. Structural analysis of images involves selecting structural elements from them, such as a line, area, compact element (letter), and so on.

Nowadays, reliable data protection is one of the main criteria by which systems intended for storage and processing of important information should be selected. This is due to the existing risk of unauthorized access to such systems, since they have wide information interaction with related control systems via the INTRERNET. Therefore, information security should be an important part of their development.

Security based on the biometric parameters of the human body, in particular fingerprint, has a number of undeniable merits: ease of use, convenience and reliability. The whole process of identification takes little time and requires no effort from those who use the access system.

The aim of this work is to develop and implement such a transformation of the image, in which the data on the location of the unique features are stored most fully and with the lowest content of false information [1].

The article is structured as follows. Section 1 states the purpose of the study the article justifies expediency of development of the system of identification by fingerprints. Section 2 provides an analytical overview. The method of identification by fingerprints, which has been known for a long time and with the advent of electronic computer technology began to appear software products for the analysis and comparison of images, is described [2].

Section 3 sets out the basic system requirements. The creation of an identity recognition system will provide a new opportunity in the field of protection and organization of access to information, as well as the development of new, efficient algorithms for processing raster and converting them to a structural form, to develop a tool that improves the quality of graphical information by reducing distortion and noise. Section 4 describes the main technical solutions of the system project.

1. The foundation for the development of the system of fingerprint identification

1.1. The purpose of the system

The system of personal identification by fingerprints [3, 4] fulfils identification on the basis of biometric parameters of a human body [5], namely a structure of fingerprints. The system is designed for processing graphic images of prints. The system allows you to compare several prints with each other according to the selected local features. Local features are minutes and their relative settings (from one minute in correlation to all the others) [6, 7] which guarantees the independence of the comparison of the parallel transfer and rotation.

The software product could be used in various applications [1], including:

1) civil identification systems;

2) forensic identification systems;

3) large-scale commercial applications.

The system of civil identification includes the following credentials:

– driving license;

– national identity cards of citizens;

– voter's registration;

– registration for social programs;

– immigrants' registrations, visas;

– identification of state officers.

Forensic identification systems require:

– to learn if the person is wanted for some offence;

– about personal legal record;

– prisoner's registration/access control;

– mobile and remote applications;

– processing of fingerprints from crime scenes.

Large-scale commercial applications include:

– access to web-resources, e-Commerce;

– access for users and employees;

– financial services, payment verification;

– access to buildings and premises;

– loyalty programs.

1.2. Characteristics of the functional structure of the system

The functional scheme of the system is shown in Fig. 1.

Image processing consists of the following steps:

1) entering the image into the system of identification by fingerprints;

2) in the image analysis subsystem the raster is processed to suppress noise, as well as to eliminate typical image distortions, such as breaks or merges of the arcs of the papillary pattern [8];

3) in the subsystem of image analysis is the selection of local features, such as the end and split for further recognition [9, 10] of the fingerprint;

4) in the image analysis subsystem, the obtained parameters of local features are sorted;

5) the recognition subsystem converts the absolute parameters of special points to relative parameters to prevent the effect of parallel transfer and rotation of the finger when scanning the fingerprint [11];

6) fingerprint recognition with existing fingerprints is based on the relative parameters of each point for each fingerprint stored in the database.

(First column downward: The original image → Correcting typical distortions → Refreshed image Allocation of minutiae → List of local features).

(Second column downward: Saving to database → Database with prints → Converting absolute parameters to relative → List of minutiae in relative parameters).

(Third column downward: Sorting local features → List of minutiae → Converting absolute parameters to relative → List of minutiae in relative parameters → Recognition → Comparison Result).

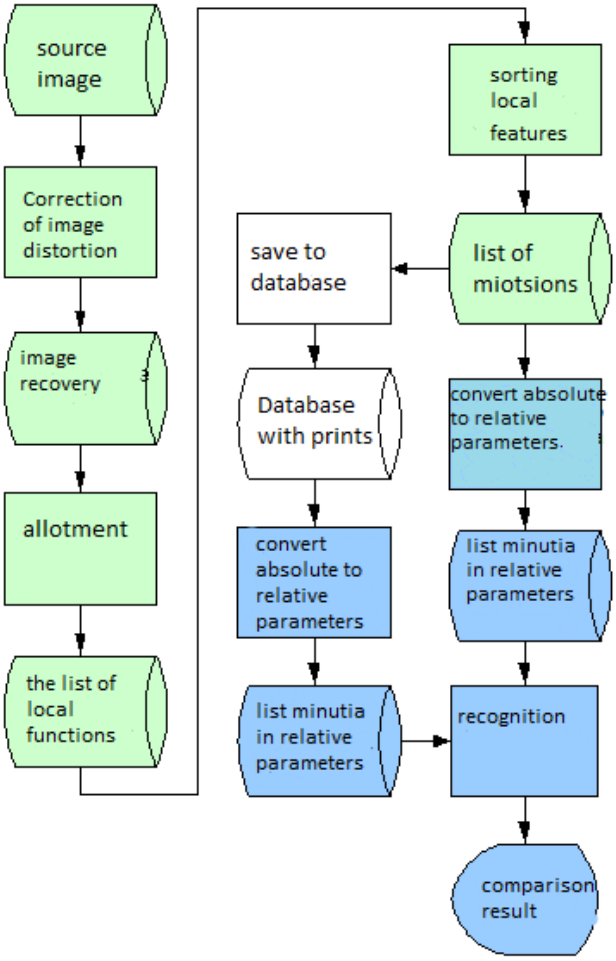

Fig. 1. Functional scheme of the fingerprints identification system

1.3. The reasoning of the automated task

The implementation of the identification system by fingerprints will integrate in a single interface all the stages of processing the image of the fingerprint and compare it with other fingerprints:

1) analysis of image parameters, detection of scanning defects and their elimination;
2) the selection of local features – minute, creating a list minute in absolute parameters [12];
3) sort the list of absolute parameters, with the exception of false and unreliable minute;
4) conversion of absolute parameters to relative, formation of a list of relative parameters [13];
5) installation of a system of tolerances to account for the correlation of images;
6) compare a single print with a variety of other;
7) the method of storing the description of prints allows you to apply the result of the program for different fields of activity.

2. Analytical review

As we have already mentioned in the introduction, the method of identification by fingerprints has been known for a long time, and with the advantages of computer technologies, caused the appearance of software products for the analysis and comparison of images.

2.1. BioLink Company

The leading provider of security technologies designs, manufactures and sells advanced biometric products based on the principle of fingerprinting. The proposed solutions form the basis for user authentication in computer networks, e-Commerce platforms and security systems physical access.

BioLink offers a range of products based on proprietary fingerprint scanning and image processing technologies, as well as a one-to-many identification algorithm that address many of today's security challenges.

2.2. Control system BioLink BioTime 2006

The time management system, which is the latest development of BioLink. The BioTime 2006 system simplifies the usual tasks of accounting and time management and provides simplicity, ease and convenience of registering the arrival and departure of employees. In addition, the BioTime 2006 system provides various types of reports on delays, delays and processing of employees, their arrival and departure times, as well as automates the creation of a timesheet.

2.3. Program server BioLink

Program server BioLink Authenteon Software Appliance (ASA) is a software for comparison of fingerprint templates BioLink. ASA combines password protection and client-server authentication when you logon to Windows, Novell and NFS in solving one of the most urgent problems of today, which is secure users' identification in corporate network. The server supports up to 300 users.

2.4. Microsoft IntelliMouse Explorer with Fingerprint Reader

Announced by Microsoft in autumn of 2004, a new line of products using biometric technologies are a fingerprint scanner, a keyboard with integrated scanner and wireless optical mouse with scanner has the capabilities:

1) Taking a fingerprint while applying a short finger to the scanner;

2) Maintaining a password Manager for web interfaces;

3) Ability to identify the identity to login with one finger attachment.

The product is suitable for use over a personal PC. The software has very limited functionality. There is no way to get the settings of the scanned fingerprint, set additional actions from which finger was attached.

2.5. Cell phone GI100

GI100 is the first phone with fingerprint recognition function. Fingerprints are used for both dialing and gaming. Each of the fingers of the owner of the phone used to speed dial one of ten stored phone numbers. The same way and during games can be used instead of pressing the fingerprint buttons.

Access restriction-when the phone is turned on, the fingerprint of the person who turned it on is scanned. The great disadvantage of the product is that in the case of a triple failure in fingerprint recognition, it is suggested to enter a password. Thus, access to the phone can not get the owner, but simply knowing the password of the person.

2.6. Adobe Photoshop Editor

Professional image editor. Its basic possibilities include:

1) Control the colour or tone of an image: the ability to match the palette you change the colours, supports 32-bit colour (transparency), the ability to build histograms of colour distribution;

2) Intelligent image editing: context-sensitive raster correction tools to achieve photorealism;

3) A wide range of filters to modify and enhance the image;

4) Ability to create many independent layers in one image.

The product is designed for professional editing of photographic images, has a powerful set of tools to improve their quality. To a lesser extent suitable for processing artificial images. The interface has some cognitive function, but it is limited to the raster model.

2.7. Text recognition program Fine Reader

It is a professional program for recognition of printed text [14, 15]. The possibilities it gives are as follows:

1) to download the page image from the file, obtaining a page image from the scanner;

2) to position lines and symbols in the text, recognize symbols when they are inaccurate due to scanning or noise;

3) is able to correct incorrectly recognized characters;

4) is able to save recognized text as a word or PDF document.

The product is designed for recognition of printed text of varying complexity after scanning, has a powerful set of tools to improve the quality of recognition and correction of inaccurate characters. Does not give the possibility to add symbols to the set of recognized characters, so the use is limited only to the recognition of printed text.

2.8. Analytical review conclusion

The list of software products, of course, can be expanded, but still the most characteristic and popular developments are included in it.

Among the software products designed for identification by papillary pattern, it is possible to distinguish the main features:

1) programs can give access the prints;

2) can be processed by standard functions (brightness, contrast, resizing);

3) recognize symbols;

4) no program allows you to adjust the image based on the typical characteristics of the imprint, give an object description of the imprint, as well as the ability to apply processing algorithms individually for their own tasks.

Due to the named above features of the existing software and due to the fact that the use of biometric methods can increase the security and ease of use of systems for most developers will be convenient to use the finished module with fingerprints. Therefore, it is important to develop a system that has an open source and allows a structural description of the papillary pattern. The opportunity to obtain his object description and comparison. The algorithm application is not only for the description of fingerprint images, but also for object description other bitmap images, such as character information, fonts, and signatures.

This task is to be solved by the fingerprints identification system of by.

3. Basic system requirements

3.1. The main objectives of the system and criteria of its efficiency

The development of an identity recognition system will provide a new opportunity in the field of data protection and organization of access to personal information [16], as well as the development of new, efficient algorithms for processing raster and converting them to a structural form, to develop a tool that improves the quality of graphical information by reducing distortion and noise [17].

To assess the effectiveness of the system can use the quality of the output images and the completeness of their structural description, as well as the level of correctness in fingerprint recognition, which the number of failures for the correct fingerprint, and the number of inputs for the wrong fingerprint can judge [18, 19].

The developed system has an open source code, which allows obtaining a structural description of the papillary pattern and its comparison with other papillary patterns. The algorithm is suitable for working not only with fingerprint images, but also for other bitmap images such as symbolic information, fonts, and signatures [20, 21].

3.2. The functionality of the system

The implementation of the system of fingerprint identification will integrate in a single interface all the stages of processing the image of the fingerprint and compare [22] it with other fingerprints [23]:

1) Modification of images, correction of distortions;

2) Selection of local features – minutes. Creating a list minute in absolute parameters;

3) Sort the list of absolute parameters, with the exception of false and unreliable minute;

4) Conversion of absolute parameters to relative, formation of a list of relative parameters;

5) Installation of a system of tolerances to account for the correlation of images;

6) Comparison of a definite print with a number of others.

3.3. Characteristics of the system and its operating conditions

The system of identification by fingerprints is designed to work with digital images obtained by scanning.

Getting an electronic representation of fingerprints with a well-distinguished papillary pattern is quite a difficult task. Since the fingerprint is too small, you have to use rather complicated methods to get a high-quality image [24].

To the date, one can choose among the following fingerprint scanners based on their physical principles:

– Optical;

– Silicon;

– Ultrasonic.

The oldest known fingerprint scanning technology is optical. Scanning with micro-cameras on the CCD or CMOS chips could significantly reduce the cost of identification systems [25]. But this method of recognition implies some intractable problems: the resulting image depends on the ambient

light, on the boundaries of the image distortion is possible, the sensor can be relatively easily “deceived” (some cheap sensors can be “fooled” by a printed copy made on a conventional copier). There are still problems with the size of the scanner. The sensor cannot be smaller than the camera's focal length. Among the main advantages of optical systems can again mention the relatively low price and practical immunity to electrostatic discharge.

The technology of using electromagnetic field is absolutely new. The sensor emits a weak electromagnetic signal, which follows the ridges and valleys of fingerprint and considers the change of this signal for making the image of the print. This principle of scanning allows you to view the pattern of the skin under a layer of dead cells, which leads to good results in the detection of pale or erased prints. The problem remains the lack of an acceptable ratio between the size of the sensor and its resolution

Another promising technology that should be mentioned is an ultrasonic one. A three-dimensional ultrasound scanner measures the crossed surface of a finger with a kind of radar. This method of scanning may be particularly useful, for example, in health care. It does not require touching any sensor readers with sterile hands, and the fingerprint is easy to read even through the surgeon's rubber or plastic gloves. The main disadvantage of ultrasonic technology is its high cost and long scanning time.

There are other methods, either used in the past or only under development.

3.4. Requirements to the functional structure

The development of the fingerprint identification system involves a modular structure. The common interface and the ability to access all modules in the system must provide a shell. From the shell calls the following modules: the subsystem of the image analysis engine to compare a single fingerprint with a lot of others. The data exchange between subsystems takes place through the project within the overall shell.

The image analysis subsystem should provide with the ability to obtain the main statistical characteristics of the papillary pattern for key areas. The subsystem assumes availability of means for reception of a qualitative image of a fingerprint.

The fingerprint image comparison subsystem is used to recognize automatically the similarity of different images in papillary patterns.

3.5. Requirements to technical equipment

The task of system image processing is related to the automatic analysis of large arrays of graphical information. The conversions that are performed on the system must be in the process of interactive interaction with the user, so the processing pauses must not exceed a few seconds. Based on this, the requirements for the technical characteristics of the personal computer on which the system will operate are formulated. The requirements are summarized in Table. 1.

Table 1

Specifications of the personal computer

NAME	VALUE
CPU frequency, MHz	from 900
The amount of RAM in MB	from 64
The screen resolution	not less than 1024×768

3.6. The data requirements

The system is designed to process bitmap images. Due to inaccuracies, noises and approximations made by the equipment (scanner or any other discretizing device graphics), noise of different nature appears in the image. The system allows you to partially avoid these distortions. Therefore, the quality of the input images should be at an acceptable level.

The main type of information processed in the system is graphical information in raster representation and its object representation. This type of data is perceived by a person directly and integrally, so it is necessary to provide visual visualization of images at different stages of processing.

It is advisable to develop the system on Windows operating system, since the OS of this class is the most widespread in the modern world. Platform for the development of a selected environment for application development Microsoft Visual Studio C++ 2012. This environment supports the algorithmic language C++ and has the ability to quickly develop and design visual interfaces, which is especially important when working with graphical data.

4. Essential technical solutions of the system project

4.1. Solution for a set of technical tools

As we have already mentioned, in order to achieve a user-friendly mode of operation of the system, the following minimum configuration of a personal computer is required: processor frequency 900 MHz, the amount of RAM 64 MB, a monitor that supports a resolution of at least 1024×768 pixels. It is also desirable to have the following peripherals: a fingerprint scanner and a colour inkjet printer for printing results.

4.2. Description of the software system

The implementation and operation of the project requires system-wide software OS Windows XP, which is based on the core, characterized by a 32-bit computing architecture and a fully protected memory model that provides a reliable computing environment.

The development of an identity recognition system and its subsystems shall be carried out with the help of Microsoft Visual Studio C++ 2012 application designed environment. The said environment includes a high-performance 32-bit compiler that allows you to optimize the generated code. Microsoft Visual Studio C++ includes an extensive set of tools that improve the productivity of programmers and reduce the duration of the development cycle. The Microsoft Visual Studio C++ 2012 feature-rich IDE includes a compiler that meets the ANSI/ISO standard, a built-in form designer, a rich set of tools for working with components, a Solution Explorer tool, a project Manager, and a debugger. The ease of development and efficiency of programs created in this development environment make Microsoft Visual Studio C++ 2012 the best choice for building a research system that is the identification system.

Conclusion

Researches display that use of a identification fingerprint for is the most convenient biometric identification methods. The probability of an identification error in is much less compared to other biometric methods. In addition, the fingerprint identification device does not require much space on the keyboard or in the mechanism.

In most cases, work with important data implies timely decision-making and ongoing management of progress. In this regard, there is a need for continuous confirmation of identity (if a person for some reason leaves his workplace, then anyone at this time will be able to give instructions to tele- or managing teams). This identity verification method of “the single sign – on” cannot provide security in this case, and entering the password after each command is unnecessarily complicated.

Although there are ready-made systems on the market, along with their advantages they have a number of disadvantages, such as the closeness of the source code and the algorithm, as a result of it, limited applications of these systems, as well as high price. As a result, it makes sense to develop a system that would provide an opportunity for all developers to have a ready base for developing their own projects based on biometric technologies. As well as to provide an object description of variety, not only of papillary pattern images.

We are designing a system of both search and research nature, and aim at facilitating the development of image processing algorithms, simplifying the analysis of experimental data and revealing common patterns.

References

1. Khushboo Khurana R.A. Techniques for Object Recognition in Images and Multi-Object Detection. *Int. J. Adv. Res. Comput. Eng. Technol.*, 2013. vol. 2, no. 4. pp. 2278–1323.

2. Wahhab H.I., Alanssari A.N. *Survey of Primary Methods of Fingerprint Feature Extraction*. DOI: 10.14529/ctcr180117

3. Ramaswamy pp.G., Sreenivasarao V., Ravi pp.R.D. A Novel Approach for Human Identification through Fingerprints. *Int. J.*, 2010, vol. 4, no. 3, pp. 35–42. DOI: 10.5120/808-1148

4. Gajare V., Patil S.V. A Novel Approach for Human Identification – Finger Vein Images. *IJCSN Int. J. Comput. Sci. Netw.*, 2016, vol. 5, no. 1, pp. 2277–5420.

5. Sand M. Fingerprint Identification System Based On Neural Network. *Int. J. Innov. Res. Sci. Eng. Technol.*, 2014, vol. 3, no. 4. pp. 350–355.

6. Yadav N., Kumar V. A Novel Approach Based on Fingerprint Identification and Face Recognition. *Int. J. Adv. Res. Comput. Sci.*, 2016, vol. 7, no. 3, pp. 222–230.

7. Marák P., Hambalík A. Fingerprint Recognition System Using Artificial Neural Network as Feature Extractor: Design and Performance evaluation. *Tatra Mt. Math. Publ.*, 2016, vol. 67, no. 1, pp. 117–134.

8. Basavaprasad B., Ravi M. A Study On The Importance Of Image Processing And Its Applications. *IJRET Int. J. Res. Eng. Technol.*, 2014, vol. 3, no. 3, pp. 155–160.

9. Amzi Giftlin Lydial A., Annapoorani. G. A Novel Approach for Fingerprint Recognition. *International Journal Of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)*, December 2015, vol. 1, iss. 9, pp. 1–4.

10. Venkatramaphanikumar S., Prasad V.K. A Novel Approach for Fingerprint Recognition with Dynamic Time Warping. *J. Theor. Appl. Inf. Technol.*, 2015, vol. 74, no. 2, pp. 200–206.

11. Flusser J. et al. Recognition of Images Degraded by Gaussian Blur. *IEEE Trans. Image Process.*, 2016, vol. 25, no. 2, pp. 790–806. DOI: 10.1109/tip.2015.2512108

12. Ramirez-Cortes J.M. et al. A Biometric System Based on Neural Networks and SVM Using Morphological Feature Extraction from Hand-Shape Images. *Informatica*, 2011, vol. 22, no. 2, pp. 225–240.

13. Kashyap K., Yadav M. Fingerprint Matching Using Neural Network Training. *Int. J. Eng. Comput. Sci.*, 2013, vol. 2, no. 6, pp. 2041–2044.

14. Chen D., Odobez J.M., Bourlard H. Text Detection and Recognition in Images and Video Frames. *Pattern Recognit.*, 2004, vol. 37, no. 3, pp. 595–608. DOI: 10.1016/j.patcog.2003.06.001

15. Jain A.K., Ross A., Prabhakar S. An Introduction to Biometric Recognition. *IEEE Trans. Circuits Syst. Video Technol.*, 2004, vol. 14, no. 1, pp. 4–20. DOI: 10.1109/tcsvt.2003.818349

16. Pirale D., Nirgude M. Biometric Techniques Using Neural Networks. *Int. J. Adv. Res. Comput. Commun. Eng.*, 2016, vol. 5, no. 4.

17. Kalunga J., Tembo S. Development of Fingerprint Biometrics Verification and Vetting Management System. *Am. J. Bioinforma. Res.*, 2016, vol. 6, no. 3, pp. 99–112.

18. Stigler S.M. Galton and Identification by Fingerprints. *Genetics*, 1995, vol. 140, no. 3, pp. 857–860.

19. K M.M., S S.M.B. Object Recognition in Images. *Information Science (ICIS), International Conference on.* Kochi, India: IEEE, 2016. pp. 10–12.

20. Abiyev R.H., Altunkaya K. Neural Network Based Biometric Personal Identification. *Frontiers in the Convergence of Bioscience and Information Technologies, 2007. FBIT 2007*. Jeju City, South Korea: IEEE, 2007, pp. 682–687. DOI: 10.1109/fbit.2007.24

21. Hong L., Jain A. Integrating Faces and Fingerprints for Personal Identification. *IEEE Trans. Pattern Anal. Mach. Intell.*, 1998, vol. 20, no. 12, pp. 1295–1307.

22. Jain A.K. et al. An Identity-Authentication System Using Fingerprints. *Proc. IEEE*, 1997, vol. 85, no. 9, pp. 1365–1388.

23. Ahmad Radzi S., Khalil-Hani M., Bakhteri R. Finger-Vein Biometric Identification Using Convolutional Neural Network. *Turkish J. Electr. Eng. Comput. Sci.*, 2016, vol. 24, pp. 1863–1878. DOI: 10.3906/elk-1311-43

24. Wayman J. et al. An Introduction to Biometric Authentication Systems. *Biometric Syst.*, 2005, pp. 1–20. DOI: 10.1007/1-84628-064-8_1

25. Shih F.Y. *Image Processing and Pattern Recognition*. Institute of Electrical and Electronics Engineers, Inc. Hoboken, New Jersey: John Wiley & Sons, Inc., 2010. 537 p.

Received 7 March 2018

УДК 004.93.1 DOI: 10.14529/ctcr180303

РАЗРАБОТКА СИСТЕМЫ ИДЕНТИФИКАЦИИ ЛИЧНОСТИ ПО ОТПЕЧАТКАМ ПАЛЬЦЕВ

А.Н. Аль-Анссари[1, 2], Х.И. Ваххаб[1, 3]

[1] Южно-Уральский государственный университет, г. Челябинск, Россия
[2] Университет Куфы, г. Наджаф, Республика Ирак,
[3] Университет Кербелы, г. Кербела, Республика Ирак

Дактилоскопия (распознавание отпечатков пальцев) – наиболее разработанный на сегодняшний день биометрический метод идентификации личности. Катализатором развития метода послужило его широкое использование в криминалистике XX века. Каждый человек имеет уникальный папиллярный узор отпечатков пальцев, благодаря чему и возможна идентификация. Обычно алгоритмы используют характерные точки на отпечатках пальцев: окончание линии узора, разветвлении линии, одиночные точки. Дополнительно привлекается информация о морфологической структуре отпечатка пальца: относительное положение замкнутых линий папиллярного узора, «арочных» и спиральных линий. Особенности папиллярного узора преобразовываются в уникальный код, который сохраняет информативность изображения отпечатка. И именно «коды отпечатков пальцев» хранятся в базе данных, используемой для поиска и сравнения. На данный момент системы распознавания по отпечаткам пальцев занимают более половины биометрического рынка. Множество российских и зарубежных компаний занимаются производством систем управления доступом, основанных на методе дактилоскопической идентификации. По причине того, что это направление является одним из самых давнишних, оно получило наибольшее распространение и является на сегодняшний день самым разработанным. Сканеры отпечатков пальцев прошли действительно длинный путь к улучшению. Современные системы оснащены различными датчиками (температуры, силы нажатия и т. п.), которые повышают степень защиты от подделок. С каждым днем системы становятся все более удобными и компактными.

Ключевые слова: система идентификации, отпечатки пальцев, идентификация личности, сравнение отпечатков пальцев.

Аль-Анссари Алаа Неамах, Южно-Уральский государственный университет, г. Челябинск; Университет Куфы, г. Наджаф, Республика Ирак; alaan.azeez@ uokufa.edu.iq.

Ваххаб Хадер Ибас АбдулВаххаб, Южно-Уральский государственный университет, г. Челябинск; Университет Кербелы, г. Кербела, Республика Ирак; hader_wa@yahoo.com.

Поступила в редакцию 7 марта 2018 г.

ОБРАЗЕЦ ЦИТИРОВАНИЯ

Alanssari, A.N. Development of the Identification System by Fingerprints / A.N. Alanssari, H.I. Wahhab // Вестник ЮУрГУ. Серия «Компьютерные технологии, управление, радиоэлектроника». – 2018. – Т. 18, № 3. – С. 22–30. DOI: 10.14529/ctcr180303

FOR CITATION

Alanssari A.N., Wahhab H.I. Development of the Identification System by Fingerprints. *Bulletin of the South Ural State University. Ser. Computer Technologies, Automatic Control, Radio Electronics*, 2018, vol. 18, no. 3, pp. 22–30. DOI: 10.14529/ctcr180303