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# Application Issues of Biometric Technologies in Electronic Medicine

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**Abstract:** This article aimed to analyze biometric technologies, opportunities and prospects of using those in electronic medicine. The ways of increasing reliability of medical service in health by using biometric technologies are embodied. Identification issues according to the image of skull and head of human corpse shot while he was alive are touched upon. Possibilities of application of biometric technologies in electronic medicine are investigated, and their advantages are mentioned. Biometric technology can revolutionize in electronic medicine, thus human eye, hand, face or fingerprint can be scanned and by using them human can be easily identified. The use of this technology will lead to an increase in the level of security in the medical field.

**Keywords:** Biometric Technologies, E-medicine, Fingerprints, Human Skull

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## 1. Introduction

The application of new information technologies to different areas by people makes the development of some science fields indispensable. One of such science fields is biometrics. The creation and improvement of biometric identification technologies and the use of them strengthen control in passport and visa requirements and in other documents that confirm identity in many areas. Biometric technology is a technology that implements the identity of a person through using subjective human physiological parameters (fingerprints, iris, etc.) [1]. Considering unique individual characteristics of human, the creation of biometric technologies is based on biometrics. Biometric technologies are widely used in human identification issues [2].

Biometric characteristics are divided into two main groups [3]:

- Physiological biometric characteristics;
- Behavioral biometric characteristics.

Some biometric characteristics are unique for a particular person; therefore they can be used in checking of authentication of a person, or personal information. In recent years, one of the areas that biometric technologies are applied is medicine.

Some biometric technologies encompass other fields, as

well as, medicine. Let's show some examples of them:

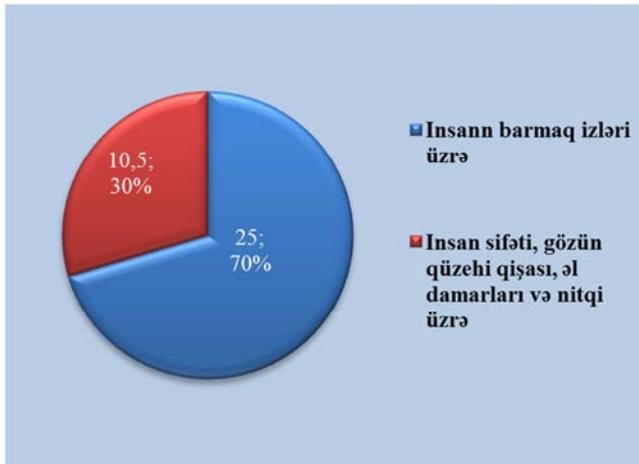
Cross technology is the product of world leading biometric management systems' supplier. Scanned finger, prints of palm and hand, face, iris of eye, etc are used in offered biometric technologies [4];

This technology is used in identification of patients by using biometric characteristics in medicine. MorphoTrack technology is considered as a leading innovator in biometric identification, it carries out human identification according to finger, palm, vein, face, and iris of eye [5].

The volume of biometric technologies market in the health sector in 2012 was approximately 1.2 billion dollars. According to the forecasts of Biometrics Research Group Inc In 2020 the volume of biometric technologies market in the global healthcare sector will be 35.5 billion dollars [6].

In electronic medicine fingerprints-based biometric technologies dominate. This field of biometric technologies will catch more than half of the world marketing 2020, and its volume will be 25 billion dollars. The average annual growth rate of investments in this segment will exceed 20% in a year.

In electronic medicine the volume of biometric technologies that based on identification of human face, iris of eye, hand veins, and speech will be 10.5 billion dollars in 2020 in the world market (figure 1).



**Figure 1.** Biometrics Research Group Inc: for the year 2020 the volume forecast of biometric technologies in the world market (billions of dollars).

Experts of Biometric Research Group predict an increase of interest in biometric technologies in medicine and as a result they expect its intensive development.

## 2. Electronic Medical Information Systems

In recent years, the use of biometric technologies in electronic medical information systems (EMIS) has been widespread. In order to use biometric technologies in medicine, electronic medical information systems are one of the main conditions.

EMIS is intended for automation of management of diagnostic treatment in treatment- and – prophylactic institutions and provides the solution of following issues [7-8]:

- Organizing and registration of electronic medical documents;
- The collection and transmission of data about medical aid;
- Providing the functioning of information provision of medical institutions;
- Ensuring the connection between emergency aid and subsidiary medical diagnostic area;
- The organizing of information exchange of medical institutions with other organizations;
- Accounting for medical services;
- The organizing of statistical and analytical reports.

Below information about some medical institutions has been given.

There are more than ten medical information systems in Russia. The most well-known ones such as “Medialoq”, “Karel TIS”, “TIS TrustMed”, “TIS Samson-Vista”, etc can be shown as examples. Ensuring privacy of personal data of patients in medical institutions as an integral part of EMIS security system provides protection of citizens’ rights. First of all it is related to realizing of social demands according to quick solutions of problems in medicine and also improving the quality of medical services. Because of this the following

works should be done:

- The formation of information system;
- The organizing of working group;
- Obtaining of means of information protection;
- Protection of information resources, etc.

In formation of EMIS the following information is used:

- Patient’s name, surname, father’s name;
- Patient’s address;
- Patient’s medical information.

Participants of medical information system are given below:

- Doctors and other medical staff;
- Patients, etc.

In EMIS architecture cloud technologies can be used too.

Two main groups of biometric characteristics of human are used in EMIS:

- Static (fingerprint, tracks of palm veins, facial geometry, iris of eye, etc.);
- Dynamic (signature, keyboard line, sound and so on.);

Static biometric characteristics are considered as the most accurate one of them, so they can neither be forgotten, nor lost by the owner, nor can be stolen by criminals [9].

Collection and use of electronic medical information about particular patient (the patient who comes to doctor for treatment) or population is one of the main issues of modern medicine, so electronic medical records are being main resources. Based on current condition of appropriate scientific researches and documents in this field, the necessity of using biometric technologies for new paradigms of medicine service can be noted [10].

In treatment and prophylaxis institutions for providing security of patients, quicken the service, improving the quality and reducing the number of errors encountered during the work process, biometric technologies are widely used. Biometric technologies are combined with electronic medical cards and are used for protection of patients’ personal data [11].

The use of biometric technologies by people in electronic disease history causes increasing of reliability of medical information system [12].

For this purpose the following works should be done:

- Research and analysis of existing medical information systems;
- Analysis and research of biometric technologies for identification of person;
- Selection of biometric technologies for MIS;
- Architecture development of biometric medical information system;
- Preparation of hardware and software in MIS through biometric network;
- Providing information security in MIS, etc.

## 3. Patient’s Electronic Medical Card

Patient’s electronic medical card is the totality of information about patient’s health status and treatments assigned to him, which can be stored and processed in

electronic form.

There are following forms of patient's electronic medical card [13, 14]:

- (1) Personal Medical Record (PMR) is a record about concrete human and is carried out by a certain person. These records in compare with R 52636-2006 standard about health have been a little bit expanded, so they are carried out by a patient himself, or a person who patient relies (for instance, parents). There is minimal information about patient's health in PMR.
- (2) Electronic personal health record – EPHR is any record that stored in electronic resource. EPHR has been included in a specific database, it is characterized by placing in the base. EPHR has been designed according to R 52636-2006 standards and encircle several life circles of human being. Patient performs the procedure of signing EPHR and assumes full responsibility.
- (3) Electronic medical document – EMD is a document that signed by an authorized person who is responsible for the maintenance, and is a legal significant electronic medical document that has characteristics of continuity and integrity.
- (4) Electronic medical card – EMC is a combination of personal medical records that belongs to one person, and collected, stored and used in one medical organization.
- (5) Integrated electronic medical records – IEMR is the combination of electronic personal medical records which collected and used by several medical organizations and belongs to one person.
- (6) Electronic medical archive – EMA is created to store information about patients and other things (informational booklets, employee lists, navigation aids, etc) of a medical organization.
- (7) Integrated electronic medical archive – IEMA is an electronic archive that stores electronic medical cards collected and used by several medical organizations.
- (8) Personal electronic medical archive is an electronic warehouse, it stores patient's electronic medical card and as well as other information, and it is used for sending and controlling of information by special programs.
- (9) Electronic medical cards system – EMCS is a system of computer programs, and is intended for technical documentations of organization, their accompaniment and using of necessary information, and it uses electronic medical card while working.

Electronic Medical Record-EMR is an international medical term. In accordance with the type of medical organization about EMR the following information can be noted [15]:

- Doctors who work at ambulatory, outpatient clinics, diagnostic centers, clinics, hospitals or specialized medical centers, outpatient departments and others use patients' electronic medical records;

- Stationary patient's electronic medical card. In this case, it should be noted that electronic medical card for stationary patient means all the electronic medical records about the hospital where patient's placed.
- Patient's medical card can be divided into ambulator and stationary electronic medical card. It should be mentioned that integral medical organization without stationary and ambulator dividing can organize patient's unique electronic medical card based on his electronic medical records.

Collection and storage of information, using rules of EMR, as well as access rights to EMR is carried out by medical organization on the basis of the standard by the state. The document that about history of patient's electronic illness and his general state is prepared in accordance with the requirements of the legislation.

Biometric technologies are used for preventing illegal use of information in patient's electronic card, and providing its security.

#### 4. Application of Biometric Technologies in Electronic Medicine

As it is mentioned biometric technologies are widely used in medicine. Let's inform about some of them.

Saint Vincent medical center in the US state of Indiana has achieved to high-level information security and increasing the speed of service to patients by applying fingerprint scanning for identification of patients.

Medical information system of veterans in medical center attached to the Ministry of Health in Florida identifies patients according to their voices. Urban Health Plan clinic in Bronx for more than two years identifies patients according to iris of their eyes, and it helps to define identity of patients quickly, fast, and accurate.

One more medical institution- Simply Healthcare Plans in Florida in order to struggle with illegal use of medical insurance uses iris of eye. Biometric characteristics are unique for each person, therefore it is impossible to benefit other person from medical service, and in this case information is immediately sent to police.

Researches show that in recent years in medicine biometric technologies are mostly used in USA, national patents of the state in this field allow us to say that. For instance, in El Camino hospital in Silicon Valley of California in the USA medical and biometric information systems have been combined, and because of that patients are being identified according to their tracks of palm veins in all stages of the process of diagnosis [16]. In Indiana State donors are identified by fingerprints. Donors who give blood for the first time in the hospital, presents his identification documents. After determining the identity of the donor system is scanned for traces of his forefinger on both hands and gives him unique identification number. And it will be enough to present his personal identification number to the system when donor comes again to give blood.

Recently, the hospital in the city of Akron, Ohio State the use of new biometric technologies has been implemented, as a result it is possible to use patients' electronic medical records by helping of scanned fingerprints. Healthcare software of CrossChx firm has been developed for the hospital in the city of Akron [17].

Applied biometric technologies have several advantages:

- The use of this technology helps to improve the treatment of patients;
- Reduce the incidence of fraud in the medical field and prevents re-recordings through the identification of patients who are in the database;
- By implementing the identifications of patients who are in database, but are not able to go to hospital, causes an increase in the quality of work.

One of biometric technologies used in electronic medical is BIO-key technology. BIO-key technology is used in leading hospitals, clinics and so on. BIO-key biometric technologies based on fingerprint are used in ensuring reliability and security, and to improve the regulatory requirements of the State Board of Pharmacy. Doctors, nurses and administrators use BIO-key for electronic recipe of drugs. In addition, this technology plays a key role in ensuring safe access to the sector of electronic drugs in thousands of hospitals all over the world [18].

## 5. Identification According to Human Skull

Biometric technologies are widely used in forensic medical examination process.

According to the remains of human bones, there are a variety of methods for identification in forensic examination [19].

Transparent description (transparent background, black and white) of a person who is being identified is prepared by using his photography taken when he was alive, adopted diagnostic indicators are noted in the form of units and anatomical fixed points. Then the dead man's head is placed on a pedestal covered with black material, the image of the skull is formed through the dark glass of the camera, the dimensions of the image of person's face are brought to the same scale with the dimensions of the image of skull and the process is controlled by putting transparent in dark glass.

This method is used in expert identification of person through using the image of missing person in forensic examination or the image of dead person's skull, and the image of person when he was alive.

It is known that human bones have several signs, so its important part depends on age, sex, profession, life style, illness, wounds, etc. They mean individual characteristic. Some parts of these signs are reflected in X-ray images [20].

During research the process begins with studying of x-ray images of dead person shot when he was alive: a certain part, projection, right or left side of human body described in x-ray are determined. Afterward the consistent part of unknown

person corpse is being x-rayed. After that comparative research is being implemented through both printed photos taken by x-ray. Scientific theory of used identification method is developed in the framework of criminology. Theory of forensic identification is used during implementing identification in forensic medical examination [21-23].

There are various methods of identification of person according to the image of human skull by computer. One of these methods is POSKID 1.1.

In POSKID 1.1 improved method of identification according to image of human skull by a computer has been suggested. This method differs identification analysis of photograph of purported person that taken when he was alive from others through enlarged scale of image of skull which has 49 anatomical points. Independent determination of recurs of each compared object over X, Y, Z arrows is based on obtained results by comparing, in this case multidimensional discriminant analysis method is used for the skull-portrait.

POSKID 1.1 method is based on multidimensional discriminant analysis and gives 76,13-80,65% reliable results in practice [24].

Individual anatomical features of body structure is associated with congenital anomalies of organism [25-26]:

- Individual structure of each elements of bone system;
- individual age-related changes in skeleton, traumas (correct nonunion fractures, bone corns, changes of wounds in soft muscles, etc.);
- common surgery complications (scars after surgery, seams), defects in bones after plastic surgery, metal structures for strengthening bones, small devices attached to the cardiac stimulation (stands) and others;
- aging or pathological changes in teeth-jaw system;
- the structural changes in the bones associated with profession (professional or habitual), for instance machinist, dental technician, hairdresser, etc;
- structural features of face and skull, non-recurring signs (shape, size, configuration and topography of various elements, congenital spots, tattoos, etc.).

The presence of such anomalies in human cause identification errors of patients' some biometric characteristics in electronic medicine.

## 6. Conclusion

The advantages of using biometric technologies in electronic medicine are followings [27]:

- first of all using biometric technologies in electronic medicine increases the quality of medical service. Thus, it is possible to identify patients quickly and accurately, significantly reduces the risk of medical errors, improves the efficiency of the diagnostic and treatment process, and serves in providing of security;
- Application of such methods minimize the risk of personal information theft and data loss;
- Raises the level of personal security of the confidentiality of patients' personal data.

Biometric technology can revolutionize in electronic

medicine, thus human eye, hand, face or fingerprint can be scanned and by using them human can be easily identified. The use of this technology will lead to an increase in the level of security in the medical field [28].

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