

Personal Identification by Eyes

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ABSTRACT

Identification of persons through the eyes is in the field of biometrical science. Many security systems are based on biometric methods of personal identification, to determine whether a person is presenting itself truly. The human eye contains an extremely large number of individual characteristics that make it particularly suitable for the process of identifying a person. Today, the eye is considered to be one of the most reliable body parts for human identification. Systems using iris recognition are among the most secure biometric systems.

Key words: *identification, eye, iris, biometry*

Introduction

An old saying claims that the eyes are the mirror of the soul. Today, in the information age, this adage is more accurate than ever. Recognition of people through the iris is one of the most accurate methods of biometric identification. Anthropologists have identified over time, around 400 different features in the iris stroma and iris pigment epithelium. Modern mathematical methods for identification through the iris, a pioneer of which is professor John Daugman, are indicating nearly 250 degrees of freedom in the iris characteristics. The idea to use the features of the iris to identify a person was first proposed by ophthalmologist Frank Burchin the 1936. In the 1986 two other ophthalmologists Aran Safir and Leonard Flom patented that idea. These ophthalmologists in the 1989t addressed the aforementioned John Daugman to develop algorithms that will allow the identification by the iris.

Biometrical Science

Identification of persons through the eyes is in the field of biometrical science. Biometry is the science on procedures and methods for unique identification of humans based on one or more physical qualities or characteristics of human behavior. Biometry is used since ancient times, however, by the development of digital technology biometry is taking a more important place in vari-

ous areas of social life, human work and interests. The achievements of biometrical science are used in the field of medical diagnostics, personal protection, monitoring in certain public areas and to identify a person for forensic purpose.

In the last decades biometry is opening unimagined possibilities of application in the areas of identification. Classical identification methods, which are basically biometrical methods, are achieving a completely new meaning and quality in the digital environment. Modern technologies in the domain of electronics and computing, through modern devices and software tools, reawakens once historically rejected identification methods, which flourish and live a new affirmation. The boom is especially significant in the field of anthropological identification, which was abandoned in the 20th century due to technological limitations. Also, modern technology and scientific advances allow the creation and development of entirely new methods of identification based on physical and behavioral characteristics of the individual person which has not been possible to register, allocate and use. The aim of the identification methods is to establish one's identity or identify the person¹.

The identity represents the whole of immutable characteristics that mark a particular person or object, according to which she/it may be different from all others.

Identification of a person is made by establishing the identity of the unknown with the already well known on the basis of certain identifying characteristics²⁻⁴.

Checking a person's identity is carried out when the person's identity is not questionable and it is only necessary to compare the accuracy of the data. Checking is done by examining the public document or a database to verify identity information from documents or databases, with the appearance of a person. Determining a person's identity is a more complex procedure than the identity verification, it requires the identification of an unknown person or the review of the identity data accuracy when you doubt the accuracy thereof⁵.

Identifying characteristics or parameters can be physical (fingerprint, face, palm, cornea, iris, thermogram of the body or face, the ear) or behavioral (signature, voice, typing dynamics, smell and walk pattern.) A human trait to be used in the process identification must fulfill certain requirements. The decision on the type of features that will be used as a means of identification depends on his universality. Universality implies that every person must possess this characteristic. It is important how this characteristic is unique, and with what degree of confidence it can distinguish one person from another. The characteristic must be constant, which means that it is resistant to change over life time. The possibility to collect and measure the characteristic is the following request, it means that one must be able to collect and measure the characteristic by a generally accepted method⁶.

Many security systems are based on biometric methods of personal identification, to determine whether a person is presenting itself truly. Modern criminal behavior is significantly determined by science and modern technology, as the perpetrators in committing criminal acts are increasingly resorting to sophisticated methods and techniques, using the latest tools.

In today's world, life is permeated on the one hand with the dangers of terrorism and globalism and on the other hand with the need for personal and social security and protection of privacy. High quality protection of persons, objects and systems become an imperative.

The basic requirement for the implementation of biometric identification is the possibility that physical and behavioral characteristics can be used in the process of automatic identification. Each biometric system consists of four main parts. Input unit that is used for measuring and registering biometric features. Then the extractor, this unit is used to extract certain features from the whole. In the system exists the database of identification characteristics. There are units for verification and comparison to certify the quantity and quality of contentious characteristics and then compares them with previously stored.

Retina and Iris as Means of Identifying Persons

The first research for identifying a person through the eye began around 1930. A first commercial version

appeared in 1984. The human eye contains an extremely large number of individual characteristics that make it particularly suitable for the process of identifying a person. Today, the eye is considered to be one of the most reliable body parts for human identification. Especially suitable for identification is the iris and the retina of the eye. The retina is a thin layer of cells with an abundance of blood vessels located in the back of the eye. Its structure is individual and unique for each person. What makes retina unique is the complexity of the network of blood vessels and their ramifications. This biometric method still provides the highest recognition accuracy. The detection is performed by scanning the eye. Retinal scan takes 10–15 seconds. The method requires that the eye is at closest to the scanner, so the spectacles must be removed. During the scanning the eye is illuminated with a light beam why this is not one of the most comfortable biometric methods. Therefore, and do to the high cost this method is not the most commonly used, although he has the best results. This is also the most expensive method of identification because the equipment used to scan the retina is very costly.

It has great applications in military facilities and areas of high-level security (police stations, prisons, nuclear plants, laboratories, etc.) where the price of equipment is not the determining factor⁷.

Faster, cheaper and thus more used method is a method of identifying a person through the iris. The iris is the colored part of the eye surrounding the pupil, consists of rings, lines and spots in different colors. It has two hundred characteristics suitable for identification. It is unique, present in every person and unchangeable during lifetime, because its appearance is defined early in the childhood and does not change anymore. The iris is impossible to change without great risk of vision loss. The system for identification based on iris cannot be fooled by lenses, glasses or eyes removed from a dead man. Modern biometric systems have implemented measures to ensure that the subject is alive and that the sample which undergoes testing is not photography or removed eye from the cadaver. There are algorithms that register the changes in a living eye and by the glass eye or the eye of a dead person there are no expansion or contraction of the pupil when the eye is illuminated by light. This method is non-invasive because it requires no physical contact between the eye and the scanner. Recording the iris can be done with a simple camera with a distance of two feet. To search the database takes a few seconds. Iris recognition system first defines the boundary of the iris, sets the coordinate system over the iris, and defines an area for analysis. In the process of recording it does not use the entire surface of the iris such as parts covered with an upper eyelid, the pupil and the reflection of the camera. Identification system using iris scan uses a small high quality camera. With this camera we acquire high resolution black and white images. The technology is based on an infrared scan⁸.

This technique has the potential to become a leading biometric technology of the future.

Numerous practical examples testify that this type of characterization is in wide use. Back in 1996 the U.S. District Lancaster prison in Louisiana introduced the first experimental identification system using iris scanning. The prison counted tens of thousands of prisoners, and they were consequently released from custody or transferred in short periods. Every time it was necessary to perform the identification by fingerprinting. It is proved to be a slow and complex process of identification, so they have decided to use the iris identification system that would enable faster and more reliable circulation of prisoners. This was followed by numerous experiments with employees of airline companies and airports, which are now showing the greatest interest in new identification technologies. In June 2001 iris recognition technology entered in use at the London airport Heathrow. The system was used in regular passengers from Virgin Atlantic Airways and British Airways. This technology made it possible to avoid the passport control, which has shortened the waiting in line for passport control. During system testing, 2,000 passengers from Canada and Great Britain were subject to immigration control office for the registration of biometric characteristics. Passengers, whose data were registered upon arrival in the country, had a special kiosk to compare their biometric data with the data from the database. If the identity was confirmed the passenger received a card with which he could enter the country. Amsterdam Schiphol Airport also uses iris scanning for passenger's identification. The Amsterdam program requires volunteers to pay seven hundred pounds for membership fee, and to lose fifteen minutes of their time, how it takes to do the initial scan of the eye and passport control. After that a volunteer receives a card which contains records of his retina. When it comes to boarding checkpoint, instead of the ticket or boarding pass, the passenger places his card into the scanner, looks into the camera and is on the plane in no time. Also, the passenger does not have to worry that it will lose or misplace his passport or ticket. Schiphol Airport volunteers have reserved parking spaces near the terminal, check-in without waiting by nine selected airlines regardless of the class in which the passenger travels and a separate baggage check. More and more airports, but also banks and other institutions, are considering to use identification by iris as a solution to security problems such as counterfeiting of documents, saving time and increasing safety⁹.

Banks such as the Japanese Suruga Bank uses iris identification for internal security matters, such as opening and access to the vault. Other banks like the United Bank of America are looking for a way that would enable their customers to purchase by iris identification as the only mean of payment. Some supermarkets in the United States have already set up an experimental system, with customers previously registered with the bank, which can pay for purchased merchandise by looking in to the camera for iris scanning. The development of less expensive technology made possible the installation of iris scanning systems on mobile phones and ATMs in order

to confirm on-line payments instead of bank cards and pins. Mexico was the first country who placed a picture of the iris on the identity card. It is proven that a personal document containing images of the iris, fingerprints, photograph and signature, will have a 99% of confidence. Some schools in America introduced in 2003 the identification through the eye for the staff and parents to ensure maximum children safety and to prevent unwanted people from entering and staying in the school. This type of identification is used on land and sea border in 27 checkpoints in the United Arab Emirates. All foreign nationals who have visas to enter the country must look into the camera to scan the eye and the image is compared with the database. The database contains images of the eye of those who for various reasons cannot enter in to the country. Par example felonies, serving a prison sentence, traveling with forged documents or disregard of the duration of work permits.

As biometrics enters the mass market, this technology is produced by large corporations such as Japanese »Matsushita«, which is a leader in the development of biometrics in the Far East, but its devices for the identification through the iris is sold also in Europe and America¹⁰.

Conclusion

After the terrorist attacks on the United States in today's world do to the fear of terrorism more and more institutions have introduced a number of security systems based on biometric characteristics of the human eye. The application of biometrics and biometric identification methods in all areas of human life, including crime-investigation, is a reality. The interest of the society is to continue the research in the field of biometric identification. Systems using iris recognition are among the most secure biometric systems. More frequent use of these systems in everyday life indicates the growing maturity of this technology, both in the accuracy and ergonomics. Compared with some biometric characteristics, the iris is poorly accepted by end users, but more accepted than some others (the cornea, DNA). We can conclude that the iris is a good combination of accuracy and acceptance.

This method does not require physical contact with the scanner and is suitable for identification and authentication of persons. This biometric characteristic does not change throughout life. The technology is so advanced that it has become economically viable and efficient, it is possible to perform the identifications by eye from 9 feet distance, you need 10 seconds to execute a scan, in a minute you can handle 30 people. In 2009 8% of personal biometric identification was based on the eye, in 2017 the fingerprint (as currently the most common method) will decrease from the current 39% ratio to 27%, and identification through the eye will increase from 8% to 19%. Biometric characteristics cannot be stolen as it is possible to steal the keys, credit cards, passwords and other objects that are traditionally used for authentication. Biometric identification is based on something you cannot lose or forget¹¹.

REFERENCES

1. JAIN A, HONG L, PANKANT S, Communications of the ACM, 43 (2000) 2. — 2. BRKIĆ H, VODANOVIĆ M, DUMANČIĆ J, LOVRIĆ Ž, ČUKOVIĆ-BAGIĆ I, PETROVEČKI M, Coll Antropol, 35 (2011) 353. — 3. DJURIĆ MP, MILENKOVIĆ P, DJUKIĆ KM, Coll Antropol, 33 (2009) 1387. — 4. NOVOKMET N, MARJANOVIĆ D, ŠKARO V, PROJIĆ P, LAUC G, GRAHOVAC B, MOHAR B, KAPOVIĆ M, RUDAN P, Coll Antropol, 33 (2009) 1319. — 5. PAVIŠIĆ B, MODLY D, VEIĆ P, Kriminalistika (Golden tehnička knjiga, Zagreb, 2006). — 6. ACLAY M, ZDENEK R, User Authentication through Biometrics (IEE computer society, London, 2003). — 7. SANCHEZ-AVILA C, SANCHEZ-REILLO R, DE MARTIN-ROCHE D, Aerospace and Electronic Systems Magazine, 17 (2002) 3. — 8. WILDES RP, Proceedings of the IEEE, 85 (1997) 1348. — 9. DAUGMAN J, IEEE Trans CSVT, 94 (2006) 11. — 10. BAČA M, SCHATTEN M, KIŠASONDI T, Zaštita, 2 (2006) 135. — 11. JAIN A, BOLLE R, PANKANT S, Biometrics: Personal Identification in Networked Society (Kluwer Academic Publishers, Norwell, 2002).

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IDENTIFIKACIJA OSOBA ORGANOM VIDA

SAŽETAK

Identifikacija osoba putem organa vida spada u biometrijsku znanost. Brojni sigurnosni sustavi temelje se na identifikaciji osoba biometrijskim metodama, da bi se utvrdilo je li neka osoba ta za koju se predstavlja. Ljudsko oko sadrži iznimno veliki broj individualnih karakteristika koje ga čine izuzetno povoljnim za postupak identifikacije osoba. Oko se danas smatra jednim od najpouzdanijih organa za identifikaciju osoba. Sustavi za prepoznavanje putem šarenice oka jedni su od najsigurnijih biometrijskih sustava.