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THE EVOLUTION OF FACIAL IDENTIFICATION IN THE JUDICIAL SYSTEM

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Abstract

Facial identification has had a crucial role in forensics, helping to modernize justice investigation and administration methods. Starting with Alphonse Bertillon's anthropometry in the 19th century and implementing complex biometric systems such as the facial identification and recognition System (NBIS), this technology has evolved significantly. We propose to examine the transition from manual methods to automated identification systems, pointing out both their advantages and their limitations, as well as the international collaborations that have eased the global use of biometric data.

Key words: *Facial identification, Forensics, Imagetrak, NBIS, biometric recognition.*

INTRODUCTION

In the forensic identification process, activities are carried out both in the laboratory and on the field. Actions and/or inactions are in a certain sequence, in a concrete context and in different environments where factors contributing to the formation, preservation, fixation, lifting, transportation and valorisation of traces and/or dynamic characteristics of persons intervene (*Mihuț E.A., 2004, p. 35).*

Since ancient times, the idea of uniqueness of the face features has been established, thus Aristotle was convinced that each person has a unique face, a belief that increased the interest in physiognomy, the study of the features of the face and implicitly their association with a certain type of character of the person (*Leunissen, M. Physiognomy, 2012, p.508*).

Modern systems used in forensic identification have changed over the years through additions in working variants, so as to be as effective as possible in the context of information society, computerization and digitalization.

Considering the process of trace formation, modern means of search and trace detection, the limits of trace preservation, knowing that the environment is in constant change, the possibilities of exploiting traces within the limits of existing technique, and the various possibilities to change facial features (*Iancu E.A., 2019, p. 458*), cutting-edge facial recognition systems still present shortcomings when used in forensic procedures.

Used for the purpose of securing, identifying, preventing and/or combating fluctuations in facial morphology attributable to variables such as position, illumination, circumstances, facial expressions and image fidelity may make it difficult to establish the identity, to verify or recognize the identity *(Poorvi Ujjainia and all., 2024, p. 3129).*

At the same time, communities have legitimate expectations of the state to have at its disposal effective means of deterrence and/or of discovering and identifying the perpetrators of crimes. The issue of Facial recognition technology (FRT) compliance with indisputable standards for the protection of fundamental human rights and freedoms still raises controversy or/and is being challenged by others, which can lead to delaying criminal investigation processes and make it difficult to establish the truth in criminal proceedings *(Novokmet, A., Tomičić, Z., & Vidaković, I., 2023, p.527).*

Facial recognition technology could provide "legal certainty" that represents citizens' sense of trust in the correct application and unitary interpretation of legal norms *(Lorincz A.L., 2025*).

Considered an essential element of the rule of law, the principle of security of legal relationships is explicitly enshrined in the case-law of the and Fundamental Freedoms, i.e. the right to a fair trial, including the requirement to European Court of Human Rights[1] in relation to one of the fundamental rights stipulated by the Convention for the Protection of Human Rights ensure access to justice (*Lorincz A.L., 2025*).

Moreover, it has also been held in Community case-law that the reasoning must be appropriate to the act issued and must present in a clear and unequivocal manner the algorithm followed by the institution which adopted the contested measure, so as to enable the concerned persons to determine the motivation of the measures and also to allow Community courts to have jurisdiction to review the act (case C-367/1995).

As decided by the European Court of Justice, the extent and detail of the reasons depend on the nature of the adopted act and the requirements to be met by

[1] For example, the judgment of the ECHR of 31 August 2000 in *Brumărescu v. Romania*, published in the Official Journal of Romania no. 414 of 31 August 2000

such reasons depend on the circumstances of each case, an insufficient or incorrect reasoning being considered equivalent to a lack of reasons for the acts, as in this case. Moreover, the lack of reasons or failure to state reasons entails the nullity or invalidity of Community acts (case C – 41/1969). A detailed statement of reasons is also necessary where the issuing institution has a wide discretion, as the reasoning gives transparency to the act, enabling individuals to verify that the act is properly substantiated and, at the same time, allows the court to exercise judicial review (case C – 509/1993) (*Iovănaș E., 2024, p.217).*

There are pros and cons of using Facial recognition technology (FRT) in a criminal trial in respect of human rights, but in essence, one must consider the contribution brought by such evidence in the identification and investigation of suspects based on FRT.I believe that the acceptance or rejection of the implementation of such evidence in a criminal trial must be decided after analysing the benefits and possible breaches of fundamental rights generated by the implementation of this technology in countries that already use the FRT, respectively how the magistrates reacted to such evidence, meaning if they accepted or rejected them. Of course, certain restrictions in the use of this technology must be considered, but there must be a balance between security and respect for the rights of the person. Possible errors in the interpretation of technological systems must also be accepted if they fall within the margin of error.

The development of software that serves the FRT and the improvement of algorithms have as a challenge the minimization of errors and the establishment with maximum accuracy of the authenticity of persons *(Novokmet, A., Tomičić, Z., & Vidaković, I., 2023, p.528-529).*

The main argument of persons who are reluctant to implement such a system as evidence in criminal proceedings is based on the possible violation of fundamental rights and in particular the procedure determining which categories of persons are subject to databases[2].

It is normal that the databases storing images of people's facial features for automatic comparisons are not identical to national databases, but the better a database is populated, the higher the chance of a HIT (positive identification).Even if there is a fear that an innocent person may be wrongly accused, it should be noted that in a criminal trial, the criminal prosecution is based on a combination of evidence (direct and indirect), not just on a single piece of evidence. The credibility of a person's statement must also be taken into consideration. Even if the judicial bodies, through their experience, can observe certain aspects and concordances, nevertheless supporting or supplementing a statement with the FRT is an additional piece of evidence, taking into

[2] https://theconversation.com/facial-recognition-ten-reasons-you-should-be-worried-about-the-technology-122137 accessed in 04.03.2025

consideration the difficulty and complexity in establishing a person's credibility (*Novokmet, A., Tomičić, Z., & Vidaković, I., 2023, p.550-551).*

I. HISTORY OF FACIAL IDENTIFICATION

The identification of people based on facial features was introduced into the police system in France in the late 19th century, when Paris was facing a large exodus of repeat offenders. Although in 1840, shortly after the appearance of the photo, France decided to photograph the criminals, it was not until 1888 that anthropometry was standardized; until this date, the identification of persons was done only by name or photo[3].

Anthropometry was invented by Alphonse Bertillon (1853-1914) and was the first scientific system used by the police to identify criminals. Bertillon's method is based on the fact that each human being is different from another by the size of different parts of the body (head, upper and lower limbs).The ratio of proportionality remains constant throughout life, even with the waxing and waning of old age, and individualizes each person. The Paris Police Prefecture had more than 60,000 photographs of criminals in its possession, but the disorganization of the file cabinet and the large volume made it almost impossible to identify an offender from the existing photographs. With the Bertillon method, following the measurements established by it as relevant, the encoding of the file cabinet was successful, which made it much easier to search for recidivist criminals. Even though this method was viewed with scepticism and was considered controversial because it was prejudicial to privacy, because subjects had to be stripped of their clothes, it proved to be a real success. Between 1883 and 1884 Bertillon was able to measure and code 19771 individuals, and based on the encoding process, 290 were identified. Bertillon concluded that only 11 measurements are analysed, and the chance of finding them in another person would be 1 in 4,191, 304[4].

Also in 1888, Bertillon perfected the system by introducing the "Spoken-portrait" method, which combines, on a single sheet, the characteristics of the head, photographed from the front and profile, with body measurements and other particularities (for example, scars and tattoos), these elements still being used today in the Romanian Police databases.

In Romania, anthropometry was introduced by the forensic pathologist Mina Minovici who translated Bertillon's work on anthropometry into Romanian and who, through insistence, succeeded in introducing the anthropometric method developed by Bertillon in the Romanian judicial system by publishing the "Catalogului cu condamnați în toată țara în cursul anului 1892" (Catalogue of convicted persons in the country in 1892). By this method, Mina Minovici proves

[3] https://inec.ro/scurt-istoric/ accessed in 04.03.2025
[4] https://inec.ro/scurt-istoric/ accessed in 04.03.2025

the efficiency of identifying recidivists, a method already used in other European countries, and which has had the expected effects in Romania, as well, because criminals were afraid to commit another offence for fear of being identified as recidivists, which would lead to a more severe sentence.

Global trends towards the integration of biometrics in multiple domains have led to the elimination of manual verifications, with the technology helping to optimize certain administrative processes, reducing fraud risks and increasing efficiency in digital identity management. India is one of the countries with such innovative approach, which has introduced an automated authentication system using the FRT technology to give students in both private and public schools secure access to digital information *(Poorvi Ujjainia and all., 2024, p. 3135).*

II. TECHNOLOGICAL ADVANCES IN FORENSICS

In the first half of the ninth century, Forensics had a significant evolution, photography being introduced to case research, facial recognition methods evolving by analysing photos, and yet the progress was not remarkable.

Since the 1950s, European countries have started to set up specialized institutions such as forensic institutes or forensic laboratories dedicated to research and the application of forensic science in the field of crime. In Romania, for example, the National Institute of Criminology was established in 1970, aiming to centralize and apply forensic research in an organized framework, using scientific methods for investigating criminal cases. With the establishment of the National Institute of Criminology, techniques such as facial identification were developed through photo analysis and new methods such as blood or hair analysis were developed.

The lack of standardization of working methods and the lack of common regulations for the use of forensic technologies, their application varied significantly from one country to another.

The period 1900-1990 was crucial in the development of methods of evidence exploitation, from anthropometric studies, to the analysis of judicial photographs, to facial reconstruction based on the skull. Although the development was systematically limited by the technology existing during this period, the studies and research carried out during this time period laid the foundations for the development that followed.

Folders were set up with photographs of the offenders to have a clearer record of them, templates were created with face shapes printed on transparent plastic foil which, by overlapping several templates (eyes, mouth, nose, etc.) led to obtaining a facial image based on the descriptions made by witnesses. Later, with the technology being developed, these printed templates were replaced by computers that had a template base and could be merged until a facial image was obtained based on the descriptions of witnesses.

Recent studies focus on various aspects of facial recognition, including the aging process of the face, identification of distinctive features, correlation of sketches with photographers, analysis based on video recordings, and comparison of near-infrared *(NIR)* images with conventional photographs *(Poorvi Ujjainia and all., 2024, p. 3133).*

III. MODERN IDENTIFICATION SYSTEMS

After the 2000s, there was a boom in the field of facial recognition, a boom favoured by technological evolution, the development of software systems and the automation of search systems. In Romania, starting with 2004, an automated search system "Imagetrak" was implemented at national level, which included a database of persons subject to implementation in the databases of the Romanian Police, implementation regulated by Law no. 218/2002[5] as well as by the Code of Criminal Procedure.

With the implementation of the Imagetrak database, the former file cabinets and folders were replaced, and persons were implemented in this database with their anthropometric data, of interest being also those developed by Bertillon. The advantage of the electronic database was that it could be searched by selecting filters from the search fields, resulting in a list of candidates from the national base. Persons could be searched by several identifying features (eye colour, hair, beard, build, age, race, ethnicity, etc), in addition to these physical features, the database also included photographs of the particular features of the persons entered, such as tattoos, scars, missing fingers, visible surgical operations, etc.

The CDN Corpse-Missing-Unknown base was also part of Imagetrak, a database that had been developed before the advent of Imagetrak, and which includes interest data of bodies with unknown identity (BUI), missing persons (MP) and persons with unknown identity (PUI), with the possibility of identifying persons by cross-searching and based on facial matching and subsequently, through a tracing expertise. Most of the identifications in these three categories were made among the implemented BUIs that were identified among the missing persons.

The old file cabinets and other existing databases that met the quality conditions were taken over and integrated into the new Imagetrak base.

A plus brought by the Imagetrak system is the fact that it offered the possibility of creating a robot portrait with the help of the software application installed on the work program; once the portrait was created, it offered the possibility of searching the created image in the database. If the portrait was as

[5] Law 218 of 2002, published in the Official Journal no. 305 of 9 May 2002; Code of Criminal Procedure published in the Official Journal, no. 486 of 15 July 2010

close as possible to reality, the program would bring in the search list several candidates with similar features to those of the person of interest.

At the same time, the development of surveillance systems installed both in private areas and by public institutions was able to capture people committing illegal acts, images that could be exploited by the Imagetrak system.

After to the implementation of the system, to have the activities carried out recognized at European level, the working stages with the Imagetrak system were processed, thus the ENFIS group (working group comprising forensic institutes at the European level) appreciated the working procedures, the accuracy of the results and the minimization of the risks that may arise, which is why the National Institute of Forensic Science obtained RENAR accreditation in several areas, which led to the work carried out in the forensic training under the aegis of RENAR being recognized and used in the European judicial system.

The need to evolve and expand databases has replaced the Imagetrak system with a new, more modern system called NBIS (National Biometric Information System).

NBIS is a more complex system developed to support the collection, storage and comparison of biometric data, including fingerprints, facial images and other biometric data for national security and other government applications.

NBIS focuses on processing and comparing many biometric data in a massive database. It includes modules for database search and identity verification based on a data set, providing a set of advanced algorithms to process and extract biometric features.

The fact that it supports international standards for interoperability, makes it compatible with certain systems used by the FBI or other governmental institutions, being compliant with the FBI's Next Generation Identification (NGI) standards.

At the same time, the complexity of the NBIS system is also applicable to the national security system, immigration, which requires a robust system for biometric authentication.

With the NBIS system, in 2017 an automatic facial recognition system (NeoFace Wach) was implemented, which made it easier and more efficient to search existing databases.This automated system allows the search for similarities between facial images of people deployed in Imagetrak and CDN.

The results were remarkable, the number of persons identified based on this automatic facial recognition system has increased considerably, from a few dozens of identifications per year at national level to about 1000 identifications.

IV. FACIAL RECOGNITION IN A GLOBAL CONTEXT

In the context of the extension of EU borders, five electronic registers have been set up to manage biometric data of persons of interest (SIS[6], EES[7], ETIAS[8], EURODAC[9]and VIS[10]). The advantage of these electronic registers is that by Regulation no. 817/2019 of the European Parliament and of the Council, they became interoperable, offering the possibility to search all the register databases simultaneously, which reduces the search time of a "trace" and of finding concordances with the data stored in these databases.

After a 6-year negotiation period, from 2017 to 2023, the EU signed a data sharing agreement with the US, an agreement given by the European Commission through the EU-US Framework Decision.

On 13 March 2024, Regulation no. 982[11] was approved by the European Parliament and the Council, amending the two JHA decisions 615 and 616 of 2008 establishing the exchange of data between the Member States of the Treaty of Prum (DNA and fingerprints), which increases the importance of identifying persons by biometric data and expands the possibilities of searching Member States' databases for facial images (facial matching).

Of course, the member states of the PCC-SEE (Police Cooperation Convention of South-Eastern European States), which are not necessarily EU Member States, have developed cooperation systems and search possibilities in their databases on the principle of reciprocity, and at the 2023 meeting, the prevention of transnational war-related crime also became a priority.

V. CHALLENGES AND LIMITATIONS

With all the scientific developments that have appeared and have been implemented so far, the identification of a person based on facial features is recognized in the judicial system only through a demonstration in a scientific report of findings or forensic examination by a specialist or expert in the field.

At present, existing database search software can only achieve authenticity between the image entered and the database by establishing similarities between the person sought and the main candidates.

Performing the identification through specialists or experts minimizes the possible errors and risks that a software program could register, which can be caused by several factors.

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[6] The Schengen Information System
[7] European Entry/Exit System
[8] European Travel Information and Authorization System
[9] European system for the comparison of the dactyloscopic records of asylum seekers, Published in the Official Journal under number 135 L of 22 May 2019
[10] Visa Information System, published in the Official Journal of 05.04.2024
[11] Published in the Official Journal under number 135 L of 22 May 2019

Poor image quality, unfavourable angles and algorithm errors can lead to incorrect identifications. Therefore, the final identification is made by forensic experts, who analyse the images in detail to minimize the risks.

Although FRT systems have reached some degree of evolution, their performance is limited to real-world conditions such as partial face occlusion, lighting, certain disguises or facial expressions, and still poses many challenges.These aspects lead us to state that all these technologies are well below the human ability to visualize and analyse (*Isaf Adjabi, 2020*).

In addition to these aspects, the implementation of technology in the field of identification of persons is also limited by the high cost of high-performance software. Another encouraging aspect is the vision of the European Union, which in recent years has been supporting and funding programs aimed at increasing the safety and security of its citizens through the implementation of modern technologies in all aspects of forensic identification.

CONCLUSION

The evolution of facial identification has transformed forensics, from the rudimentary methods of the 19th century to modern biometric systems. Current technologies, such as NBIS and Neoface Watch, facilitate the investigation of complex cases, and their international integration improves cooperation in fighting against and investigating crime.

We must be convinced that facial identification is the future of forensic identification and will have an increasing trend in evolution as the technology is advancing at a rapid pace.

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