


Chapter 11

Pattern Recognition in Fingerprint and DNA Analysis

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ABSTRACT

In forensic science, DNA and fingerprint analysis are crucial methods that are frequently used to identify people and solve criminal cases. DNA analysis matches biological samples from crime scenes with suspects or identifies victims by using the distinct genetic code present in each person's cells. Forensic scientists can examine even minute amounts of DNA using methods like mitochondrial DNA analysis, short tandem repeat (STR) profiling, and polymerase chain reaction (PCR) amplification, which yields highly accurate human identification. Analyzing fingerprints also depends on the distinct patterns of ridges, whorls, and loops seen on human fingertips. Automated fingerprint identification systems (AFIS) have advanced in recent years and enhanced the speed and accuracy of matching fingerprints across large databases. In forensic investigations, DNA and fingerprint analysis work well together as complementary methods. Fingerprints are direct proof of physical touch, whereas DNA provides a genetic blueprint.

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FINGERPRINT ANALYSIS

Every person has a unique fingerprint, which is a pattern of curved lines on the end of their finger or thumb (Fingerprint, 2024). Fingerprints have been the standard for human identification by forensic experts for nearly a century. Fingerprints are often used as instruments to help people discover who they are by assisting them in comprehending their uniqueness. Since most crimes cannot be committed without them, a person's hands are their most vital bodily component. No two people can have the same fingerprint since fingerprints are permanent and don't change throughout the course of a person's life because human fingerprints are unique, difficult to forge, and durable over the duration of a person's lifetime, they are perfect for serving as permanent markers of an individual's identity. As a result, they leave indelible imprints on everything they touch. Fingerprints can be readily used by police and other authorities, such as forensic scientists, to identify people who wish to conceal their identities or to identify the deceased or disabled, such as those discovered after a natural disaster. If there were no prints at a crime scene, there would be no evidence that lasted long enough to disappear. (Fingerprints: A Criminal Investigation Forensic Tool, n.d.). Papillary ridges on the fingertips have intricate patterns that differ from one another, which is why fingerprints are important. Not only do the observed patterns change among individuals, but they show distinct characteristics inside each individual. The occurrence of duplicate patterns has never been noted or anticipated.

Since fingerprints are permanent, they don't change over the course of a person's life. The ridges on fingers develop in the third or fourth month of pregnancy, which is before birth. Even after someone passes away, their fingerprints cling to the skin until the epidermal layer is removed by an external force such as fire, insects, rot, or other organisms. Fingerprint impersonation is not possible. Although attempts have been made, no successful fingerprint forgery has been documented to date. Since each person's fingerprints are unique due to differences in ridge pattern, fingerprint classification is a simple process. Millions and millions of people's records can be categorized and accessed as needed.

DNA ANALYSIS

DNA analysis involves the use of scientific techniques to extract, purify, and analyze DNA from biological samples collected from suspects, victims, and crime scenes. (Albujja, 2024). (Saad R, 2005) said in his research that the ABO blood group system was analyzed first in the history of identity testing in the forensic industry. Subsequently, different red blood cell enzymes and serum protein variants

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