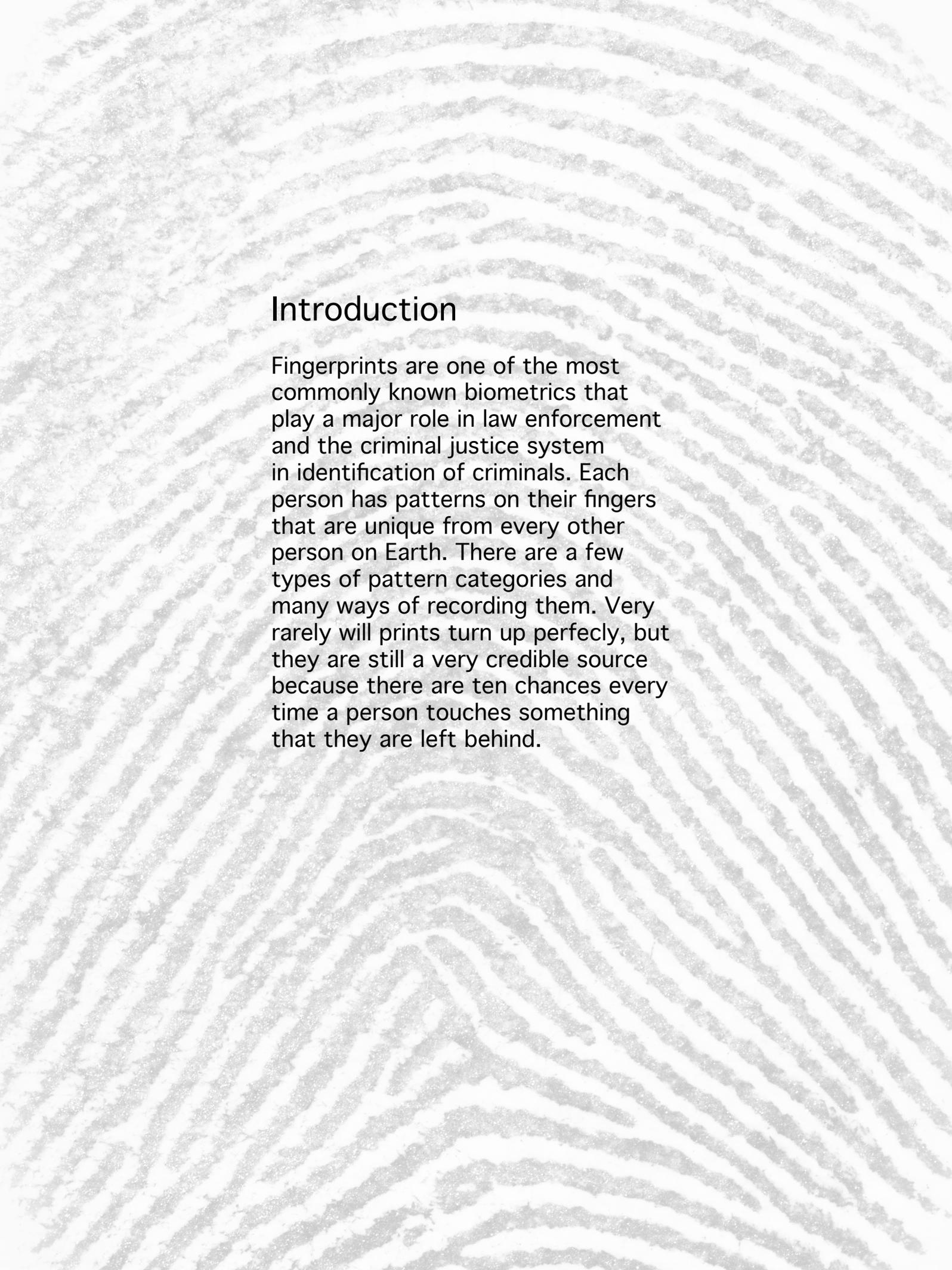




Fingerprints

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Introduction

Fingerprints are one of the most commonly known biometrics that play a major role in law enforcement and the criminal justice system in identification of criminals. Each person has patterns on their fingers that are unique from every other person on Earth. There are a few types of pattern categories and many ways of recording them. Very rarely will prints turn up perfectly, but they are still a very credible source because there are ten chances every time a person touches something that they are left behind.

History

Fingerprints were known to be recorded as far back as 200 BC in China, however Sir Francis Galton was the first person that discovered that fingerprints could be used to identify every human apart in the early 1890's. In 1882 Argentina's Juan Vucetich was the first police official to implement Galton's discovery in law enforcement. In 1903 the US introduced the first systematic use of fingerprints to catch criminals in the New York State Prison. In 1921 there was an Act of Congress because of the increasing demand for a national repository and three years later the FBI established an Identification Division. As of 2014 IAFIS (Integrated Automated Fingerprint Identification System) is now the largest database to store prints. It is a computerized system operated by FBI Criminal Justice Information Services and there are over 100 million prints that are stored and can match up to anyone in America in less than two hours after a submission.





Pattern Types

Fingerprints are found not only on your hands and fingers but also on your toes and feet. They are very small raised ridges and recessed furrows or valleys which create the patterns. There are three major categories of pattern types including loops, whorls and arches.

Loops (right) are the most common of the three types of patterns. About 60% of the population have them. These patterns have a large curve that goes in one direction then continues back toward the start. There are two different types of loops which are named radial loops, known to point toward the radial bone in the thumb, and ulna loops, known to point toward the ulna bone in the pinky. Basically, the pattern will either loop away from your hand or toward the middle of your hand.





Whorls (left) are the second most common pattern. About 35% of the population have whorls. These patterns are swirls and make circles or whirlpool looking shapes. There are four types of whorls. A plain whorl is just a centered pretty circular shaped pattern. There is a central pocket loop which is a loop with a whorl at the end of it. A double whorl is the third in which two loops create a pattern that is in the shape of an "S". The last whorl pattern is the accidental loop which is any other type of irregular, circular shape that does not fit into the other three categories of whorls.



Arches (right) are the last category of the patterns and are the least common. Only about 5% of the population have arches. Arches make a shape of a wave and are just a slight up and down. There are two types of arches, plain arches and tented arches. The only difference between the two is that tented arches are higher and come to more of a point than the plain arches.

Fingerprint Characteristics

Every person on Earth has different finger print patterns, including identical twins, which means that they can be used in identification or dactyloscopy. Dactyloscopy is the examining and identifying of different finger patterns and the impressions they leave. Every time you touch an object you leave a print from the oils created from your body. Along with being unique to each person, fingerprints are always the same. There has not been extensive research done but it is believed that throughout a person's life patterns never change over time when a person grows. The only thing that can change patterns permanently is scars from any type of deep damages to your skin. Even small damages can be reverted back to the old pattern with time when new skin cells develop. There are many characteristics of a fingerprint which include core, bifurcation, ridge ending, island, delta, pore, crossover and more. When comparing and identifying fingerprints, cores, deltas and bifurcations are the first characteristics to narrow it down.



Types of Prints

Patent Print – Patent prints are left behind in a substance and are visible to the unaided eye. They can be seen in different substances like dust, ink, grease, blood and other liquids. When searching for or photographing patent prints, lighting is an important aspect. Ink falls under patent prints and is the easiest way to get a fingerprint from someone and is used for keeping records. Below is an example of a white card used in a police station. Black ink is applied to a person's finger and then rolled from nail to nail where it leaves the ink on the paper. The ridges are seen as black lines and the valleys are the white space.

FBI NO.	STATE IDENTIFICATION NO.	DATE OF BIRTH MM DD YY	SEX	RACE	HEIGHT	WEIGHT	EYES	HAIR
 1. R. THUMB	 2. R. INDEX	 3. R. MIDDLE	 4. R. RING	 5. R. LITTLE				
 6. L. THUMB	 7. L. INDEX	 8. L. MIDDLE	 9. L. RING	 10. L. LITTLE				
 LEFT FOUR FINGERS TAKEN SIMULTANEOUSLY		 L. THUMB	 R. THUMB	 RIGHT FOUR FINGERS TAKEN SIMULTANEOUSLY				

Plastic Impressions – Plastic prints are formed in molds such as clay when physically pushed into the surface. It creates a 3D replica of the patterns and is easily viewable with the naked eye.

Latent Prints – Latent Prints are the ones we cannot see with our unaided eye and must use enhancing methods to be viewable. Latents are left behind from the oils that are excreted from our body and are made of 99% water, therefore, they will evaporate with time.

Enhancing Latent Prints

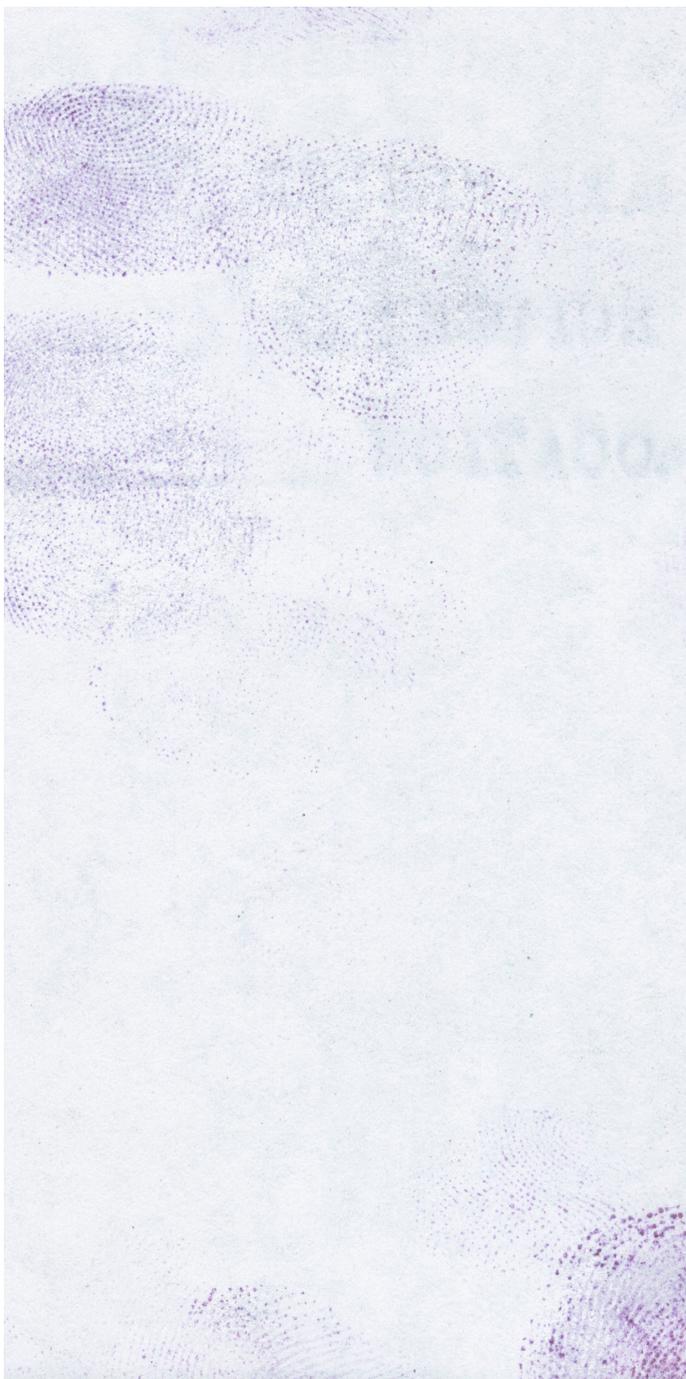
Fingerprints are very difficult to see with the naked eye unless positioned in light at a very specific angle. Therefore, there are many ways to enhance the print left behind to make it more visible. There are three commonly used processes. Dusting powder, Ninhydrin and other chemical reactions and Cyanoacrylate Fuming, that are used in many crime labs around the world.

Additional light sources are always useful in boosting contrast and making prints more easily visible. Most of the enhancement processes become very destructive on any evidence that is being examined, so in crime labs they are most often the last bit of testing to be done. There are a few other process that can be done to enhance latent fingerprints, but only major labs such as the FBI have the resources to demonstrate them.

Dusting—This is one of the most common ways to detect a hidden fingerprint. The powder is adhesive to the oil and water left behind after being touched, which creates contrast. Black powder is the most common, but it is made in other colors. There are also different types of powders that serve different purposes for surfaces and textures. Carbon black is basic and can be made of many different materials, flaked or nonflaked. Another type is magna powder, which is also known as magnetic. Magna powder uses a combination of ferromagnetic properties with powder. There is a magnetic stick that the powder clings to and creates its own brush. Lastly, fluorescent powder can be used to show more contrast when lit with special lighting sources. Lifting prints is done commonly with clean clear tape pressed down on the surface, scrapping in one direction to remove as many bubbles as possible. Then after lifting the tape it is placed on a white card.



Ninhydrin and Chemical Reactions– Ninhydrin is a liquid chemical made of a combination of ninhydrin crystals and acetone in most police stations, but to be perfect it is 25 grams ninhydrin dissolved in 225 milliliters absolute ethanol, 10 milliliters ethyl acetate, 25 milliliters glacial acetic acid. Processing is used when you have paper or porous like material. When you have a material that is being checked for prints you usually dip the paper into the liquid or paint the liquid on to the paper. Multiple coats will help the print become more visible. After the paper dries the reaction that happens with the amino acids left on the print show up as a purple color. Different wavelengths of ultraviolet and visible light sources can increase the contrast making the print easier to see. There are many other types of chemicals that cause colors to pop from the reactions that take place. A few more of these chemicals are Diazafluoren-9-one, indanedione and Methylthioninhydrin. These processes are dangerous if they come in contact with skin or eyes so precautions are needed.



Cyanoacrylate Fuming-This is more simply the super glue process. Using a heater in an enclosed container the glue is vaporized and the fumes stick to the left over residue from a print. Once it dries the print is white and visible. Water may need to be added to the container if the print is older and has evaporated.

Contact the Author

I am a fourth year biomedical photography major at Rochester Institute of Technology. My main interest is in the forensic field and my goal for the future is to pursue a career in law enforcement.

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Sources

<https://www.ncjrs.gov/pdffiles1/nij/225327.pdf>

http://www.fbi.gov/about-us/cjis/fingerprints_biometrics/biometric-center-of-excellence/files/fingerprint-recognition.pdf

<http://onin.com/fp/fphistory.html>

http://www.fbi.gov/about-us/cjis/fingerprints_biometrics/fingerprint-overview

<http://www.crime-scene-investigator.net/SimplifiedGuideFingerprints.pdf>

<http://sites.bergen.org/forensic/fingerprint.htm>

<http://en.wikipedia.org/wiki/Fingerprint>

<http://www.bcps.org/offices/science/secondary/forensic/fingerprints.pdf>