

The Value of Fingerprint Science in Crime Detection as Evidence in the Police Criminal Investigation Process in the Society

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Abstract

The comparison of Security Systems in advanced countries with that of Nigeria prompted this study, which describes the contribution on how criminals or culprits can easily be detected in the criminal investigation process. This study was conducted in Lagos state. The research assumed a qualitative research method using a survey design, the department of the Central Criminal Registry (CCR) Alagbon Close Force CID Annex Ikoyi, Lagos as the population with the Fingerprint Experts as sample size. The study discovered the uniqueness of Fingerprint Science and adopting it in crime detection during the Police Criminal Investigation Process will bring an awesome change in the entire society. It was discovered that Fingerprint science has a fundamental verification mechanism that identifies individuals on the basis of their physiological features. The effectiveness of Fingerprint Science lies in different recognition processes which include feature-extraction, feature-robustness and feature-matching.

The emergence of Fingerprint Science covers a wide range of applications for physical and cybercrime detection. This method also overcomes the loopholes of traditional identification system that were based on probabilities. It is considered as a fundamental shift in the way criminals are detected. Hence, the researcher recommends that this concept should be adopted here and across the entire West African society and government should ensure that the law enforcement agencies understand and apply this concept to justify their criminal investigative

results by ensuring that every member of law enforcement agencies undergo training in Fingerprint Science to put them at an edge to use this concept effectively.

Key words: Fingerprint science; Minutiae; Ridge; Pattern Matching; Fingerprint-Recognition Technique

INTRODUCTION

Fingerprint Databases are highly essential in the criminal justice realm of advanced countries of the world. Investigators and analysts will compare unknown fingerprints collected from a crime scene to the known fingerprints in the Fingerprint-databases of victims, witnesses and potential suspects to assist in criminal investigations. For instance, (i) A murderer may leave his or her fingerprints on the suspected murder weapon, (ii) A bank robber's fingerprints may be found on a robbery note, (iii) In an assault case, the perpetrator may have left fingerprints on the victim's skin, (iv) A burglar may leave fingerprints on a broken window pane, (v) A thief's fingerprints may be found on a safe. In addition, fingerprints can link a perpetrator to other unsolved crimes if investigators have reason to compare them, or if prints from an unsolved crime turn up as a match during a database search. Sometimes these unknown prints linking multiple crimes can help investigators piece together enough information to zero in on the culprit.

Fingerprint examination involves looking at the quality and quantity of information in order to find agreement or disagreement between the unknown print (from the crime scene) and known prints on file to conduct the examination, fingerprint examiners use a small magnifier called a Loupe to view minute details (minutiae) of a print, to analyze, make comparison, evaluate and finally verify to produce Fingerprint evidence (Nwokolo, 2018: p. 5). Fingerprint evidences are valuable elements in crime detection, and its importance and role in criminal investigation process cannot be overemphasized. In the event of a murder, robbery, kidnapping, or any other forms of crime, investigators often rely on Fingerprint evidence in crime suspects' detections. In addition to DNA profiling,

Fingerprints are used by the criminal justice system to verify a convicted offender's identity and track through previous arrests and convictions, criminal tendencies, known associates and other useful information. Officers of the court can also use these records to help make decisions regarding a criminal's sentence, probation, parole or pardon. In the light of these efficacies of Fingerprint evidences, the researcher wishes to investigate the value of fingerprint science in crime detection as evidence in the Police Criminal Investigation Process in the society, using Lagos state as unit of measurement.

Statement of Problem

Crime in human societies is as old as humanity itself. It is one of those social vices that human beings have learnt to live with since existence. Globally, no society is immune from crime. But however, some countries have learnt to manage crimes better than others with the aid of more effective crime control strategies. Most of the developed countries of the world have come up with more sophisticated and scientific approaches to crime prevention and criminal investigation through the application of almost all Forensic Science Techniques in checkmating crimes (Nwokolo, 2013: p. 4).

While many of the developing countries, Nigeria inclusive, are still laden with the burden of crimes without a clue on how to get emancipated from the situation (Falaye, 2013: p. 5) and this has agitated the call for revolutionary change of these countries' criminal investigation process, hence, embracing the modern techniques in fighting crimes. Human beings have always been on the lookout for better strategies through which they can prevent crimes and curb insecurities. Thus, in a bid to maintain peace and orderliness in the society, humans, generations after generations, have continued to devise new means of detecting crimes and bringing offenders to justice. One of the most effective and valuable crime detecting techniques that have been found in history is Forensic Fingerprint Analysis (Bond, 2009).

In Nigeria, insecurity has left an indelible but dangerous trend and mark that will require years of consistent use of Forensic Science tools to get rid of the menace of insecurity. Since the last two decades, there has been a need for an effective policing system to curb the social menace that cannot be overemphasized. Criminal activities like armed robbery, kidnapping, militancy, piracy, insurgency, banditry, cattle-rustling, rape, ritual killings, terrorism, and ethno-religious clashes, among other forms of insecurities, have gradually become the order of the day in the Nigeria of today (Ikuteyijo, 2009: p. 3; Ordu & Nnam, 2017: p. 6).

Expectedly, the situation has thrown up new challenges in the country, thereby giving the government, citizens, and stakeholders some sleepless nights. Hence, there is a need to devise means of handling the insecurity situation, as the researcher proposes to conduct a study on 'the value of Fingerprint Science in crime detection as evidence in the Police Criminal Investigation Process in the society,' while, believing that if adopted by nation's security system will be a step in the right direction in saving the future of the national image.

Objective of the Study

The aim of this study is to seek the investigation of the value of fingerprint science in crime detection as evidence in the Police Criminal Investigation Process in Nigeria, using Lagos State as a case study. Other objectives are:

- Describe the science behind human beings not possessing the same Fingerprints.
- Demonstrate that every Finger of every person bears a unique friction ridge formation, NOT duplicated in any other finger.
- Ascertain that the identity of an imprint is determined by the co-incident sequence of the ridge characteristics in the impression under view.

Relevant Research Questions:

1. Is there science behind humans possessing different Fingerprints which made it possible for the development of Fingerprint databases?
2. Is there Science behind the human Finger bearing unique friction ridge formation that is not duplicated by any other finger?
3. How do Fingerprint Experts ascertain the identity of an imprint derived from the co-incident sequence of the ridge characteristics?

The Significance of the Study:

The findings presented in this research paper will be of immense benefits to the promotion of the Forensic Science practice in Nigeria if allowed as the researcher will suggest. They will help in promoting the use of Fingerprint Science in Police Criminal Investigation to advance the level of crime investigation process and as well as enriching the literature. The findings will also expose the role and importance of keeping Fingerprint Databases through the use of the digital matching process that will serve as a tool for curbing crimes and improving the Police Services and Court Judgement System Proceedings in demonstrating that Fingerprints are the most powerful tool for personal identification in society.

Literature Review

Criminal Pattern Theory and Police Criminal Investigation Process

Crime pattern theory suggests that rational criminals carry out their routine and patterned activities anywhere there are no robust and functional crime prevention and control measures in place. Other Scholarly descriptions of this theory are as follows; Brantingham and Brantingham (2003: p. 7) opine that Crime Pattern Theory is a combination of rational choice and routine activity theories, which focuses on how crime, locations, and offenders influence the distribution of criminal events over time and space. According to Adewale and Oluwasanmi (2007: p. 9), people employ various methods of stealing and committing crimes owing to a lack of security and crime control mechanisms.

Examples of these techniques include various forms of physical concealment and deceit. Hence, criminal acts are required to be curbed with techniques and shreds of evidence that have a high probability of controlling and checkmating concealed and deceptive crimes out of society. The importance of crime pattern theory to its theorists is that the contact and interactions transpire between offenders and their physical and social environments (Ikoh, 2011: p. 14), including their potential targets. This theory in this context suggests that the ripple effect of the distribution of criminal events by fraudsters, criminals, and perpetrators over time and space will continue to deepen when there is a flow control mechanism.

Crime Pattern Theory and Its Implication to Police Criminal Investigation Process

This study vehemently advocates for the adoption of Fingerprint Science as evidence for improving the criminal investigation process because the traditional mechanism adopted to checkmate crimes across society is poor and has failed in the entire system. The researcher makes this suggestion of applying the fingerprint databases in the tracing and matching processes during crime investigations because of the experience had while working in the system for about two score years. This emphasis is made on the basis that fingerprints and other tracing shreds of evidence left on a crime scene during a criminal investigation and if all these are collected, and documented; developing databases of fingerprints and other shreds of evidence for crimes committed at one time will lead to the tracing of crime that may be occurring in future and from there apprehension of culprits will be fastened up.

Also, with an association of similar offences via compare and contrast regarding the nature of property crimes, kidnapping, killing, assination, etc., there will be additional insight

during Police criminal investigation, criminals may track and trace within a given time frame. Fingerprinting is one form of biometrics, a science that uses people's physical or biological characteristics to identify them. One of the earliest explanations put forward by scholars was the one of O'Neill (1940: p. 2), who explained Fingerprint and Footprint to be the skins covering the palms of the hands and the soles of the feet, unlike the skin on other parts of the body, is elevated into minute ridges which tend to follow patterns of definite design. Such skin is called 'friction skin' and the ridges are commonly referred to as papillary ridges.

Scholarly identification revealed that on the tips of the fingers, the papillary ridges form a definite pattern which may seem to be of the same general form on all of the fingers of the two hands or may differ from one finger to the next, with several or all of the recognized patterns represented in the same individual. According to Fingerprint Scholars such as Cherril Fedrick R., Sir Francis Galton, Jan Evangelista Purkynje, in their respective articles described different patterns classifications and identifications depending on the system used for recording and filing of inked impressions which today has been digitalized in advanced countries. For instance, the Henry system of fingerprint classification is used in the United Kingdom and Nigeria where all fingerprint patterns are divisible into three main types that is Arches, Loops, and Whorls.

According to Nwokolo (2018: p. 5), Fingerprint is defined as the impression of the finger (friction ridges of the hand) whether roll or plain. The fingerprint is a print or impression of the fingers and is either roll or plain, when a print is made by a simple contact between the finger and

a receptive surface it is called a plain impression and when it is rolled from one side (left to right) it is called roll impression. A fingerprint is the impression of the fingers with ridges, depressions, or furrows. Fingerprint in its narrow sense is an impression left by the friction ridges of a human finger. Meanwhile, Champod and Chamberlain (2009: p.4) added that the term Fingerprint Science is an impression left by a friction ridge-skin area of a finger and also a palm print as an impression from the palm. By convention, a print is then a reference from a known sample taken with cooperation and under controlled conditions either using an inking process or an optical device, essentially a digital scanner commonly referred to as 'live-scan', (Maltoni, 2003: p. 5), to buttress more that Fingerprint Science has advanced owing to the advancement in technology which made it easy for fingerprint to be taken either with an electronic scanning device or manually.

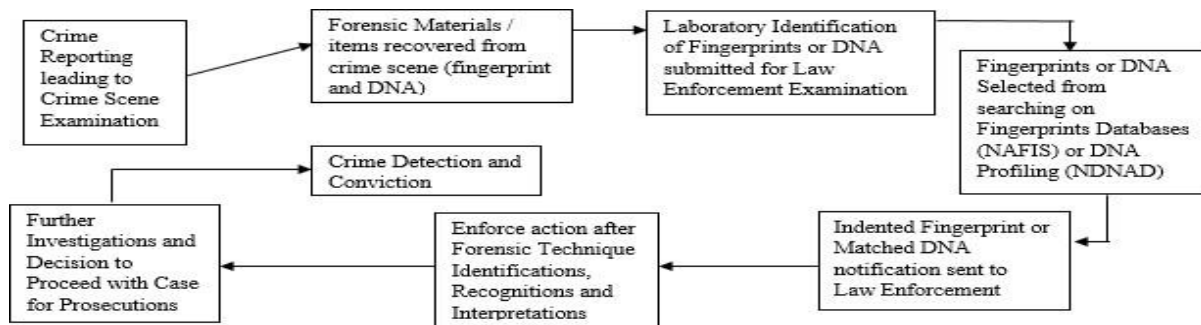
However, in electronic cases, a biometric fingerprint scanner is used to pick up directly Fingerprints, while in manual cases is done through the use of ink and paper and later can be scanned into the biometric machine, a scanner is then used to save the data electronically in the appropriate format, which can be used to build a Fingerprint Database of any country (Kaushal & Kaushal, 2011: p. 11). This database can be a powerful tool in intelligence-led criminal investigation owing to its possibility aid in tracking and tracing criminals in the society. And because of their pristine acquisition conditions, prints (fingerprints or footprints) are a near perfect representation of the friction ridge skin. Forensic experts who specialize in Fingerprint analysis also known as Forensic Fingerprint Experts, know that no two individuals have the same fingerprints, not even identical twins and neither do fingerprints change, even as we get older, unless the deep or 'basal' layer is destroyed or intentionally changed by plastic surgery. If not an accident that removes the basal layer of the skin, nothing can wipe off or alter human fingerprints not even hand sanitizers or chemicals. This is one of the main reasons behind the conception of

this article that Fingerprint Science in crime detection can serve as evidence in the Police

Criminal Investigation Process.

Police crime detection will be more effective with the use of Fingerprint identification which has the uniqueness that no two individuals have the same Fingerprint and persistence that a person’s fingerprints remain essentially unchanged throughout his / her lifetime, as new skin cells are formed they remain cemented in the existing friction ridge and furrow pattern (Saini & Kapoor, 2016: p. 16). The idea here deals with the fact that many people have conducted research that confirms this persistency by recording the same Fingerprints over decades and observing that the features remain the same. Even attempts to remove or damage one’s fingerprints will be thwarted when the new skin grows, unless the damage is extremely deep, in which case, the new arrangement caused by the damage will now persist and is also unique.

The Integration of Fingerprint Science into Crime Detection Process



The Integrated Crime Detection Process with Fingerprints and DNA Profiling System

Fingerprint science leading to Fingerprint Technology, which is a set of knowledge that has practical application in the creation, designing, and utilization of Fingerprints for human identification in crime detections, has come a long way since its inception more than several decades of years ago. The crime detection process deals with various stages of crime incidents or the crime scene is subjected to a series of examinations till the result is obtained or the culprit is

apprehended to allow justice to prevail. This process may be divided into three main stages namely:

- Crime Incident Reporting leading to Crime Scene Assessment or Investigation.
- Evidence Gathering Management from Victims, Witnesses, and Suspects
- Post Charge Management

In the first stage, Forensic Experts as well as trained Police Officers go into the crime scene to collect Forensic items either Fingerprints or DNA proceed to Laboratories to get actual findings of the identity of Fingerprints and DNA. This process is a part of crime examination. At the second stage, the evidence-gathering management process deals with the collection of samples from victims, witnesses, and suspects found within the crime vicinity to check if the victim is within the location but in the case of suspects not found within, the discovered crime scene fingerprints are compared with what is in the Fingerprint database to identify the criminal.

Methodology:

The research design adopted by the researcher here is qualitative; where primary data were used and generated through the use of survey design, which allows systematic gathering of information via observation. This qualitative case study is a research approach that facilitates the exploration of a phenomenon within its context using a variety of data sources. This ensures that the issue is not explored through one lens, but rather a variety of lenses which allows for multifacets of the phenomenon to be revealed and understood (Baxter and Jack, 2008).

The researcher must describe the context within which the phenomenon is occurring as well as the phenomenon itself. There is no one correct way to report a case study. However, some suggested ways are by telling the reader a story, by providing a chronological report, or by addressing each proposition. Addressing the propositions ensures that the report remains focused and deals with the research questions. Returning to the propositions or issues ensures that the researcher avoids any form of pitfall. To fully understand the findings, they are compared and

contrasted to what can be found in the published literature to situate the new data with preexisting data.

The population of study was mainly experts in fingerprints who are practitioners handling Fingerprint Recording and Identification, at the Central Criminal Registry (CCR) Force CID Annex, Ikoyi, Lagos State. To be specific, the researcher targeted fifty (50) workers of the Fingerprint Unit of the Nigeria Police which was established in 1922. In the process the sample size of thirty (30) Police Officers participated in the interview session conducted by the researcher. The research instruments used were interview sessions aided with semi-structured questionnaires where the researcher highlighted some guiding question items. The method of data collection consists of information generated by the researcher. The interview session helped to give a better and sound understanding of the subject matter which eased responses from respondents.

Data Analysis Techniques

The interview session was conducted in the Police Fingerprint Unit, Alagbon, Ikoyi, Lagos, where thirty (30) respondents known as the sample size were engaged in question and answer sessions in the analysis of this study. The goal of this result is to describe the study in such a comprehensive manner as to enable the reader to feel as if they had been an active participant in the research and the study findings could be applied to their situation.

Respondents' opinions to research question one: Is there Science behind humans possessing different Fingerprints which made it possible for the development of Fingerprint databases?

The majority of the respondents, who are mainly the core staff that handles Fingerprint analysis, gave an affirmation that the Science behind humans possessing different Fingerprints is covered mostly in the study of the science aspect called "ridgeology" which centers around a quantitative and qualitative philosophy of Fingerprint examination. Ridgeology is a holistic

approach that focuses on the biological uniqueness of friction ridges and involves the sequential examination of the features and spatial relationship of ridges, noting the quality and quantity of the assessed information for identification purposes (Kaushal & Kaushal, 2011: p. 11). This examination is conducted using a methodology that incorporates sound scientific protocols and

practices, allowing for accurate and repeatable conclusions that meet rigorous scientific standards. The standard methodology used by Fingerprint Experts to conduct friction ridge examinations is called ACE-V, for analysis, comparison, evaluation, and verification, which are the four fundamental phases utilized in this process.

Respondents' opinions to research question two: Is there science behind human's Finger-bearing unique friction ridge formation which is not duplicated by any other finger?

Opinions pool from Nigerian Fingerprint Experts reveals a proposition similar to Symposium (1995), which stated that analysis of ridges focuses on the examination of the quantity and quality of information present in a print, which according to Kaushal and Kaushal (2011: 11), can be broken down into three levels of detail. First-level details refer to the overall ridge flow and pattern type of a print. Second-level details refer to ridge path, which corresponds to the spatial relationship of ridges and their characteristics in a print. Finally, third level detail refers to individual ridge attributes, which involve ridge shapes and pores structure/location in a print. During fingerprint identity analysis, analysts use codes to indicate the features of each fingerprint before subjecting it to the Standard methodological process that determines the exact proofing.

Respondents' opinions to research question three: How do Fingerprint Experts ascertain the identity of an imprint is derived from the co-incident sequence of the ridge characteristics?

Responses from Nigerian Experts were that the Fingerprint Examiner must consider various quality factors, such as distortion, that could alter the reliability of the observed information when determining the suitability of a print for comparison purposes. The information present in the latent or poorest quality print is always examined first, followed by an examination of the known or best quality print. To compare two friction-ridge or minutiae prints, an effort should be made to identify these four basic elements

- The General Likeness of Patterns in terms of arches, whorls, loops, and composites.
- The Qualitative Likeness of the Friction-ridge or minutiae characteristics in terms of the bifurcations, endings, the islands and enclosures.
- The Quantitative Likeness of the Friction-ridge or minutiae characteristics in terms of imprints disclosing the 16 coded ridge characteristics or minutiae which are code 1 representing ridge ending, code 2 representing islands, code 3 representing lakes, code 4 representing spurs, code 5 representing cross-over, code 6 representing forks, code 7 representing abrupt ending, code 8 representing abrupt beginning, code 9 representing angles of the forks, code 10 representing length of the ridges forming forks, code 11 representing types of cores, code 12 representing pores, etc.

Fingerprint Science is one unique form of biometrics that uses human physical and biological characteristics to identify them; hence making Fingerprint evidence to be crucial evidence that plays a vital role in criminal investigations as it can confirm or disprove a person's identity. To make criminal investigation faster and easier, there should be an existence of Fingerprint database of any nation's citizens and foreigners living in every part of that country which crime scene investigation officers can use to make comparisons to identify culprits and criminals. When a Fingerprint is found at a crime scene it could be referred to 'finger mark' or 'latent print'. As soon as crime scene investigation officers get to the scene, they collect, cross-checking the latent print against the Fingerprints of suspects and other fingerprints in Police

databases has the potential to link a series of crimes together, or to place a suspect at the scene of a crime in their office.

The Science Behind Adoption of Fingerprint Identity as Evidence in Police Criminal Investigation:

At every moment of each day, we come in contact with our environments and in the process engage in touching one object or the other. Objects that we could likely come in contact with are a coffee cup, a car door, or a computer keyboard. Each time we do, it is likely that we leave behind our unique signature, which is our Fingerprint. Thus, Fingerprints can be found on practically any solid surface, including the human body. Fingerprint recognition is one of the most popular biometric techniques used in automated personal identification and verification.

Therefore, Fingerprint evidence is the print of a finger, especially a thumb, collected from a crime scene. Analysts use the general group pattern type loop, whorl or arch, which is further classified into nine major patterns of Fingerprints (Arches, Tented Arches, Loops, Whorls-plain, Central Pocket Loop Whorls, Lateral Pocket Loop Whorls, Twin or Double Loop Whorls, Composite Whorls, and Accidental Whorls), to make initial comparisons and include or exclude a known Fingerprint from further analysis. To match a print, the analyst uses the minutiae, or ridge characteristics, to identify specific points on a suspect fingerprint with the same information in a known Fingerprint. For example, an analyst comparing a Crime Scene print to a print on file would first gather known prints with the same general pattern type, then using a Loupe, compare the prints side by side to identify specific information within the minutiae that match. If enough details correlate, the Fingerprints are determined to be from the same person.

Fingerprint evidence can be obtained for a wide range of offenses, and it plays a crucial role in criminal investigations as it can help confirm or disprove a person's identity. The interpretation of Forensic Fingerprint evidence relies on the expertise of latent print examiners. The use of Fingerprints in Forensic Science is based on several fundamental principles. The first is that the probability of finding two people with identical Fingerprints is very difficult or zero. No two identical Fingerprints have ever been found the same. Galton calculated that the probability of finding identical prints was 1 in 64 million.

A second principle is that an individual's Fingerprints do not change with time. The pattern of ridges on a person's Fingertips, palms, and soles at birth remains unchanged until death. Consequently, a detective can be certain that a criminal's fingerprints will remain unchanged until death. Finally, there are enough similarities in the patterns of ridges on people's fingers that can be classified. The basic patterns of fingerprints are composites, loops, whorls, and arches that can be found in fingerprints. The arches can be either plain or tented, and the whorls can be classified as the central pocket, lateral pocket, Twins or Double Loop, Composites or Accidentals.

Detailed examination of the friction ridge skin also reveals that the ridge path, in most instances, is not continuous across the entire surface of a finger. Some ridges, called ending ridges, will flow and abruptly come to an end, while other ridges, called dividing ridges or bifurcations, will flow and separate into two separate and distinct ridges. Additionally, some ridges are as long as they are wide and are like dots. These ridge events are commonly referred to as characteristics or minutiae, and their spatial relationship to one another in a friction ridge impression is the basis for Fingerprint comparison and identification. An arch has ridges that enter from one side of the pattern, make a wave in the middle, and pass out the opposite side

from which they entered. In a whorl, the friction ridges tend to have a circular or spiral ridge flow. An examiner needs to note the ridge flow of a print for orientation purposes and the recognition of focal areas that will ultimately assist in the identification process. While pattern configuration alone cannot be used for individualization, it can be used for exclusionary decisions made by an examiner.

Fingerprint Science an Alternative for Police Criminal Investigation Process

Fingerprint Science is one of the most fascinating methods to solve crime issues. It is an automated way to establish the identity of a person based on his or her physical Fingerprint like other behavioral characteristics such as signature or handwriting. Fingerprint Science or fingerprint biometric technology makes a contribution to crime detection by associating the traces to the persons stored in the database, ranking the identity of persons, and selecting a subdivision of persons from which the trace may originate. A Biometric system is a pattern recognition device that acquires physical or behavioral data from an individual, extracts a salient feature set from the data, compares features against the features set stored in the database, and provides the result after the comparison. Fingerprint biometrics is highly very essential for Police criminal investigation and crime detection.

Fingerprint Science in Crime Detection lies in the Minutiae Extraction and Matching Minutiae Extraction:

The minutiae location and the minutiae angles are derived after minutiae extraction. The terminations that lie at the outer boundaries are not considered minutiae points, and the Crossing Number is used to locate the minutiae points in a Fingerprint image. **Minutiae Matching:** To compare the input fingerprint data with the template data Minutiae matching is used. For an efficient matching process, the extracted data is stored in the matrix format.

Conclusion

In this paper, the researcher presented Fingerprint science as the best evidence for crime detection during Police criminal investigation. The process of Fingerprint science detection involves image binarization, ridge thinning, and noise removal. Fingerprint recognition or detection deals minutiae score matching method used for matching the minutiae points. Usually, a technique called minutiae matching is used to be able to handle automated Fingerprint recognition with a Computer System.

The researcher concludes that there will be an effective and efficient Police Criminal Investigation Process if the system allows Fingerprint Science to be fully used during crime detection. Many academic and commercial systems that have regard for fingerprint science recognition have adopted it as a control measure during working hours. The researcher equally deemed it a necessity to present this concept to be adopted in the Police criminal investigation process to improve the reliability and performance of the current systems. Thus, the future of this Society's Security System lies in the ability of law enforcement agencies to have the capacity to use the full knowledge of Fingerprint Science which will enhance crime detection.

Recommendation

These Recommendations are made based on this study's findings and conclusion

- Advocacy of Forensic Science with full knowledge of criminology that fingerprint science will unveil a lot of culprits and easily send them to their appropriate category of sanctions stipulated by law.
- Professionals and experts in this field must be conversant with the nine major patterns of fingerprint group pattern type loop, whorl or arch, which are further classified into nine major patterns of Fingerprints (Arches, Tented Arches, Loops, Whorls-plain, Central Pocket Loop Whorls, Lateral Pocket Loop Whorls, Twin or Double Loop Whorls, Composite Whorls, and Accidental Whorls).

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