A REVIEW OF THE DNA DECISION SUPPORT SYSTEM FOR CRIMINAL INVESTIGATION

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ABSTRACT

This paper focuses on dealing with DNA profiles and DNA databases, as well as the most comparable instances that may be connected, software engineers are building more high-speed and more systematic tools that will be used to anticipate the next criminal attempt (Crouse, et al. 2019). On the other hand, limitations and the scope of work are also crucial factors to consider because, even if the necessary information is readily available, there is no absolute assurance that the problem at hand will be handled on the spot. Of course, tactics and instruments must be enhanced, but the reality scenario that criminal investigators encounter, which includes a variety of limits and security concerns, must also be taken into consideration

Keywords: DNA extraction techniques, computing systems, Forensic DNA testing

I. Introduction

The employment of biological DNA extraction techniques and computing systems to analyse this DNA data has already advanced crime investigation in this period. Using a real-life case study to show the strength of DNA evidence is the most effective way to explain and demonstrate its effectiveness. (Toom, Granja, & Ludwig, 2019) noted that forensic science has a significant role to play in criminal investigation and data processing (Mapes, *et al.* 2019). It aims to give a framework within which existing viewpoints on patterns and linkages may be integrated. Among other things, their research aims to demonstrate that the study of criminal investigators' assumptions and decision-making processes is a useful approach for analysing how DNA evidence and forensic details might be integrated into crime investigations.

II. Crime investigation

Evidence collecting and handling mistakes are especially common during forensic DNA analysis and the gathering of DNA data during a criminal investigation. Corrupt scientists and cops may be able to alter evidence at any point during the examination of a crime scene. In some cases, evidence may be planted prior to or during the investigation of the crime (Ahmad, 2018). Due to their own rationale, lawyers and judges who have been assigned to manage this case may be willing to compromise the evidence even if it is clear that DNA evidence directly or cannot exonerate them from being criminal and convicted offender.

(Toom, Granja, & Ludwig, 2019) believes that despite the widespread use of forensics, crime pattern analysis, and other investigative techniques, tackling serial crimes remains a difficult task, despite the advances made recently in technology. It is my opinion that the major reason for this predicament is the fact that DNA data, profile, and information are owned by different research firms that work independently with little information and assessment input from police and criminal investigators. Additionally, the applications focus on evidence rather than suspicions, as outlined by (Toom, Granja, & Ludwig, 2019), should be taken into account as a success factor. In a criminal investigation, forensic testing is critical.

III. Court

(Machado, & Silva, 2019) learned that the court is examining the likelihood that the suspect left the crime stain compared to the likelihood that the suspect did not leave the crime stain. 'The court's attention to numerical DNA evidence was also brought up, more clearly than (Machado, & Silva, 2019), in the discussion. It is up to forensic scientists to determine the strength of DNA evidence from these pieces of evidence. Any processing of DNA data outside of a specific area of information security must be explicitly banned by law (Machado, & Silva, 2019).

Only a few people have talked about how we may convince the courts to adopt particular methods of charging. One of the problems with this explanation and study is that there is no universally applicable international standard approach for handling DNA data analysis for use in courts (Bowman, *et al.* 2022). It is not uncommon for the circumstances and likelihood of evidence being moved between victims and suspects to be overlooked during a criminal investigation or court trial. Evidence gathering procedures could also have to be compromised, which could lead to a mistaken conviction or interpretation of the evidence.

IV. Forensic science

Forensic DNA testing is the evaluation of a DNA strand at 13 specified places in a laboratory environment (loci). From the biological evidence and a suspect's DNA profile, the DNA profiles are compared. Whatever the case may be, the availability of increasingly more discriminating technical testing (Machado, & Silva, 2019) raises ethical questions. As indicated, scientists are expected to report if the profile presented has extra alleles or missing alleles that will exonerate from the list of suspects, while some scientists could be excessively cautious by leaving inconclusive results (neither include nor exclude) of suspects as said (Alotaibi, *et al.* 2022). Low copy number (LCN) DNA profiling is the study of a little quantity of DNA from a few cells. They also noted that LCN profiles, which include characteristics such as peak height, may be used to assist the selection of genotype combinations that are viable. Aside from that, explain that the LCN definition has been inextricably connected to rising PCR cycle numbers, even though this is no longer suitable. The term "elevated cycle number" (ECN) has been asserted to describe a technique that could potentially increase injection time, but they disagree with this definition because the stochastic effects associated with the analysis of LT-DNA, including the analysis by LCN, are undeniably observed with all DNA profiling technologies, including LCN.

The allele length of a DNA genomic sequence may be determined using a scientific approach such as PCR-STR (Polymerase Chain Reaction-Short Tandem Repeat). Numeric values that reflect allele length for a certain locus are known as DNA profiles and are maintained in a DNA database for matching and data analysis purposes. DNA analysis is done by looking at the particular places of the chromosomes (Machado, & Silva, 2019) in forensics and medicine. Loci (Machado, & Silva, 2019) are currently the only places where this process is currently being carried out. After a match was identified, a scientist or technician will do DNA testing and comparisons for a second time, but they won't know which sample was used. Labeling names in reference databases as stopped or arrested by police (Machado, & Silva, 2019) is not uncommon in the United Kingdom, even if it is done purposefully or inadvertently. A counting approach can be used to determine the importance of a match based on how often a given sequence has been spotted in a population database instead of using the average-match probability (0.005-0.025) in some forensic applications that contain analysis that is already damaged or outdated.

In low copy number situations, stochastic events may lead to allele and locus drop-out and drop-in effects, which happens when the number of PCR cycles is increased

The knowledge that may be derived from forensic investigations will be able to assist scientists in making judgments or providing new alternatives for solving problems. Scientists that work in the forensic sector will be able to submit DNA data for examination to investigators. In order to enhance procedures and give additional advice on data management in DNA analysis, researchers have made a slew of suggestions (Schneider, Prainsack, & Kayser, 2019). These include recommendations on DNA extraction and genetic strategies, as well as recommendations on other statistical interpretation or outcomes. Additionally, the question is about how to enhance the present diagnostic tools for DNA data matching in forensics, which are dependent on the type of input and intended outcome (result). In addition, the problem occurred in handling data due to some information diagnostic tools of DNA which are not being researched or implemented yet especially for forensic and crime investigation in Malaysia (Butler, & Willis, 2020). There is intense competition since new research and development is always being conducted and refined for applications in forensics, medicine, and criminal investigation. It is possible to compare the success of the traditional method with the unambiguous DNA profile obtained from the conventional method. Uncertainty can arise as a result of allele drop-out and drop-in, as well. When it comes to DNA parentage testing and forensic identification, DNA profiles that are composed of measurements on highly polymorphic short tandem repeat (STR) genetic markers are commonly employed in many situations.

According to the investigators, even though the government originally looked into these technologies, there are now more private businesses who are working on the creation of this type of DNA database for forensic inquiry as well. When faced with increased caseloads and hundreds of samples, not to mention a big list of data from evidences that need to be processed, forensic lab experts are faced with a number of obstacles. Scientists that work in the forensic sector will be able to submit DNA data for examination to investigators. A forensic investigation is defined by (Toom, Granja, & Ludwig, 2019) as "the gathering and examination of traces, most of which are left by suspects, in order to get material or physical information from the crime scene." The knowledge that may be derived from forensic investigations will be able to assist scientists in making judgments or providing new alternatives for solving problems. The importance of knowing how to properly handle traces is stressed by (Toom, Granja, & Ludwig, 2019), who feels that even if an enhanced model is proposed, how can it genuinely assist to decision-making in a larger security context, particularly when it comes to data processing of traces? (Toom, Granja, & Ludwig, 2019) stated that forensic science plays a significant role in criminal investigation and data analysis through intelligent reasoning. DNA profiles, which are composed of measurements on STR (Short Tandem Repeat) genetic markers, are not only utilised for criminal investigation, but they are also employed for DNA parentage testing.

V. Evidence retrieval

Because it can be difficult to distinguish between innocent people and criminals in some cases, DNA testing has been established since the 1980s as a reliable and accurate means of identifying suspects. DNA samples from forensic scientists will be permitted to be submitted for assessment. Researchers in the field of DNA analysis have

made a number of recommendations on DNA extraction and genetic procedures, as well as other statistical interpretations or results (Mishra, *et al.* 2020). DNA samples will be collected by forensic DNA analysts who work with scientists and submitted for automated analysis through the use of a computer application called tool. An interpretive database can be useful to criminal investigators; however, the judiciary believes that certain information has not been adequately incorporated into the police information system, and as a result, they propose a framework for the introduction of data to an intelligence-based platform. Their major objective is to establish a framework that may be used to unite current ideas that are based on patterns and interactions between things. Researchers in the field of DNA analysis have made a number of recommendations on DNA extraction and genetic procedures, as well as other statistical interpretations or results. When determining the likelihood ratio and probability of a suspect based on DNA analysis data, all evidence will be compared to all STR profiles in order to identify whether or not there are numerous genotypes and/or alleles that are identical. Specifically, it is required to describe how the likelihood ratio was computed, as well as any other criteria that were added, and then give the results in order to establish the validity of an original hypothesis.

VI. Conclusion

Every day, scientists all around the world work to better the advancements in DNA analysis in order to aid crime investigators and law enforcement officials in their investigations. To deal with DNA profiles and DNA databases, as well as the most comparable instances that may be connected, software engineers are building more high-speed and more systematic tools that will be used to anticipate the next criminal attempt (Crouse, *et al.* 2019). On the other hand, limitations and the scope of work are also crucial factors to consider because, even if the necessary information is readily available, there is no absolute assurance that the problem at hand will be handled on the spot. Of course, tactics and instruments must be enhanced, but the reality scenario that criminal investigators encounter, which includes a variety of limits and security concerns, must also be taken into consideration.

References

Ahmad, A. A. A. (2018). DNA Fingerprints Facial Prints and Other Digital Forensics as Evidence in Criminal Investigation and Court Proceedings. *IJECI*, *2*(1), 9-9. http://ojs.lgu.edu.pk/index.php/ijeci/article/view/255

Alotaibi, H., Alsolami, F., Abozinadah, E., & Mehmood, R. (2022). TAWSEEM: A Deep-Learning-Based Tool for Estimating the Number of Unknown Contributors in DNA Profiling. *Electronics*, *11*(4), 548. https://www.mdpi.com/2079-9292/11/4/548

Bowman, Z., Daniel, R., Gerostamoulos, D., Woodford, N., & Hartman, D. (2022). Rapid DNA from a Disaster Victim Identification Perspective: is it a game changer?. *Forensic Science International: Genetics*, 102684. https://www.sciencedirect.com/science/article/pii/S1872497322000254?casa_token=AqZE7sqMPuQAAAAA:I4dAACXnBYqDcvb7oCC9cC6XkSA790xTAvJ0sE3jQwoFpnvZKp_PdZ29zDllx1LQkHU61t4VdU6q

Butler, J. M., & Willis, S. (2020). Interpol review of forensic biology and forensic DNA typing 2016-2019. *Forensic Science International: Synergy*, *2*, 352-367. https://www.sciencedirect.com/science/article/pii/S2589871X19301639

Crouse, C. A., Bauer, L., Sessa, T., Looper, A., Sikorsky, J., & Yeatman, D. T. (2019). Combined DNA Index System (CODIS)-based analysis of untested sexual assault evidence in Palm Beach County Florida. *Forensic science international: Synergy*, *1*, 253-270. https://www.sciencedirect.com/science/article/pii/S2589871X19301500

Machado, H., & Silva, S. (2019). What influences public views on forensic DNA testing in the criminal field? A scoping review of quantitative evidence. *Human genomics*, *13*(1), 1-13. https://humgenomics.biomedcentral.com/articles/10.1186/s40246-019-0207-5

Mapes, A. A., Stoel, R. D., de Poot, C. J., Vergeer, P., & Huyck, M. (2019). Decision support for using mobile Rapid DNA analysis at the crime scene. *Science & Justice*, *59*(1), 29-45. https://www.sciencedirect.com/science/article/pii/S1355030618301412?casa_token=2GoIb9jFRE0AAAAA:xZoo91G096TkWthLcRS6v10C1jVkqvY0j4KbMXcjkOawhU5tvojU3CZxI7IY6ZpBVXhRUhvKz4vQ

Mishra, I. K., Singh, B., Mishra, A., Mohapatra, B. K., Kaushik, R., & Behera, C. (2020). Touch Dna as Forensic Aid: A Review. *Indian Journal of Forensic Medicine & Toxicology*, *14*(2). http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09739122&AN=148369450&h=FQGmLauXuw8JkWTxQePolB82oGPOwt0tREegpfNavmfpd6mas1kZ7sgi25W4UZ5cPiEZzhaxdlAjMgqC967h7Q%3D%3D&crl=c

Schneider, P. M., Prainsack, B., & Kayser, M. (2019). The use of forensic DNA phenotyping in predicting appearance and biogeographic ancestry. *Deutsches Ärzteblatt International*, *116*(51-52), 873. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6976916/

Toom, V., Granja, R., & Ludwig, A. (2019). The Prüm decisions as an aspirational regime: Reviewing a decade of cross-border exchange and comparison of forensic DNA data. *Forensic Science International: Genetics*, *41*, 50-57. https://www.sciencedirect.com/science/article/pii/S1872497319300687