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COMBINATION OF AI AND HUMAN EXPERTISE IN ADVANCING AUDIO FORENSIC INVESTIGATION: AI TRANSCRIPTION AND AI SOUND RECOGNITION IN LEGAL PRACTICE.

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Abstract

This study consists of evaluating the power of emerging AI that can be used in audio forensic investigation: these are AI Transcription and AI sound recognition. The combination of these AI Technologies with human expertise will offer a bright future by enhancing the investigation practices, especially audio forensic practice, in order to have better results in terms of efficiency, accuracy and reliability. This research will investigate these instruments effectiveness: Human expertise and AI combination; to give valuable insights that will help practitioners, scholars, and researchers in the field of audio forensic practice. With a legal pragmatic perspective, the study will be in the form of qualitative research, analyzing and reviewing related documents, AI articles, legal articles and concerned international regulations. The objective of this research consists of filling the gap of empirical studies, that assess Human-AI combination effectiveness, in audio forensic field. This empirical studies have not yet been done in previous literatures. The results and discussions highlight the strong power of innovation and AI technologies, such as AI Transcription and AI sound recognition, in accuracy and efficiency. But this AI integration still needs expert intervention, to ensure a fair and just outcomes in the audio forensic investigation, by bringing rigorous critical thinking, contextual analysis, subjective interpretation, emotion understanding and rational judgment. The results and discussions will end with a table, demonstrating the effectiveness of traditional methods, versus AI, versus combined methods. However, the conclusion part requires the Human-AI combination methods in audio forensic, to align with ISO legal standards.

Keywords: Human-AI expertise; Audio Forensic, Legal Practice

INTRODUCTION

The global emergence of AI has impacted many different areas especially the legal field. Innovative AI is starting to transform regulations and shaping the legal practice for professionals.

Some of that rising transformation is brought by AI transcription and AI sound recognition in the field of audio forensic investigation. This transformation presents rather positive impacts such us the improvement of the analysis of audio forensic by using AI power to detect and identify the suspicious speaker in audio forensic in case of crime case investigation, and also by decoding unclear or undetectable signals by human in the audio content [1][2]. Apart from that, AI Transcription has now the capacity to analyze overlapping voices, which is very essential in audio forensic practices [3].

This article will answer these questions: How does the use of AI transcription and AI sound recognition with human expertise, contribute to the advancement of audio forensic investigation in a practical legal lens? How can the combination of AI transcription and AI sound recognition with human expertise, advance audio forensic in enhancing outcomes accuracy and efficiency? As insight, this research will provide enhancement in audio forensic practices through the use of AI transcription and AI sound recognition integrated with human expertise.

After analyzing previous researches, the study of the combination of AI audio forensic technologies with human expertise, its practical effectiveness and practical implications in audio forensic has not yet been done, especially in the legal practice field. Then, this lack of study in the specific field of audio forensic is the study gap.

As a contribution to fill this research gap in the existing knowledge, this research aims to evaluate the effectiveness of AI transcription and AI sound recognition as methods in audio forensic analysis. As the research focus on the utilization of AI and human expertise, this involve an instrumentalism perspective. AI technologies and innovations will be utilized as an instrument in the audio forensic legal practice, to achieve objectives: fairness, accuracy, efficiency and reliability. To do so, along the study, even if the article will exhibit that AI demonstrates algorithms power in providing accurate and in depth analysis in audio forensic legal practice, the necessity of human intervention remains crucial in interpreting emotions, lies and tones that cannot be found by AI. The importance of the rational judgment of human or experts in the field plays big role in adjusting AI outcomes. And this stands to be the best way of achieving these goals: fairness, accuracy, efficiency and reliability. These goals are very important in ensuring justice in legal

proceedings, justice, and right for everyone, that cannot be hindered by the limitation of AI. Not only that but, to also have more in-depth analysis of the topic, a comparison study between the utilization of "Only AI", "Only Human" (considered among traditional methods) and "AI and Human expertise" in audio forensic will be conducted. This comparative study of different types of methods will present each method's efficiency and challenges through a pragmatic perspective. It will reveal some limitations and improvements by placing human as a crucial element in interpretation and decision making phase.

Therefore, the objective of this research is to evaluate the capacity of AI transcription and AI sound recognition working with human expertise, to have fruitful enhanced outcomes in terms of efficiency, accuracy and reliability. And these criteria of accuracy, efficiency and reliability is assured by the Universal Declaration of Human Rights in its Articles 7 and 10 stating the important role of human in discernment during legal proceedings in order to insure justice and fairness. Next, it will assess the limitations of AI technologies and the necessity of human intervention in interpreting emotional and rational matters. It is crucial to note that this research will offer valuable benefits because it consists of enhancing and advancing investigation practices in the framework of collaboration between AI and human expertise methods, specifically in audio forensic analysis. This article allows to give valuable insights to aid practitioners, policymakers in the field of audio forensic investigation, scholars and researchers in their works. It can be used as a foundation research for future researches related to AI integration and human expertise in audio forensic investigation.

RESEARCH METHOD

This study has a doctrinal research touch by addressing the International Declaration on Human Rights in terms of justice and fairness. Legal experts in audio forensics are obliged to ensure this right of fairness and justice in outcomes after analysis and investigations. In addition, this study will rather bring more practical insights and theoretical frameworks of audio forensic analysis through AI – Human combination method. This is a qualitative research. Thus, the study will conduct a qualitative data analysis by reviewing some legal literatures, legal documents, relevant rule like the UDHR, and other articles related to the topic.

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RESULTS AND DISCUSSION

Advancements results in Audio Forensic Investigation

The transformation and innovation brought by AI transcription and AI voice recognition has shown important advancements in the legal practice of audio forensic investigation. And those advancements in accuracy and efficiency is not fulfilled without the crucial role of human expertise.

Accuracy and Efficiency of AI technologies

Study has shown that many government organizations, institutions and forensic experts are using AI to improve their methods of analysis. [4] In many countries such as the US, AI is currently employed in investigations [5][6]. This is because not only the innovative technological features of AI demonstrate its advanced capacity in identifying or recognizing speakers, but also, AI audio analysis is now shaped to address many types of environments whether a clear one, an outside or inside environment [7] in water in noises and many other characteristics of area [8]. Moreover, the algorithms of AI Transcription nowadays have the ability to detect unknown (by human) and covered signals. Which will be easy for an AI Transcriptor now to make an analysis of dispute speech or overlapping voice. This is the example of meetings or other action and dramatic scenarios [4][9]. As before, the feature of AI technology to identify a suspect or speaker is still present but rather improve to easily detect the ownership of the voice [10].

AI text decoding has currently the power to recover lost data or complicated data like “black boxes” and telephone calls [4]. And if the audio content is unclear, an Automatic Speech Recognition (ASR) can transcribe and solve unclear audio content, which is crucial in legal settings [11]. Those technological development plays big role in the admissibility of audio evidence in courts or investigations.

Important roles of human intervention

Even if AI is considered to be powerful, it has limitations. It is important to stress that AI processes its analysis through algorithm. It has not heart or brain like human. It may know the significance or even imitate many emotions but this is not genuine, this is fruit of algorithms [12]. AI cannot detect real lies, tones, traits and real emotion cues in audio investigation, which is

however very important in case study like crime scenarios. Let's illustrate it with an example. For example, behind the scene of the audio somebody is threaten to say something against his or her will. Another case stated by Toghuj [13], where the person may be bribed or corrupted or under sort of coercion or influenced by hate or revenge. All those cases examples demonstrate the necessity of identifying the language used and way of communication in the audio, the state of the speaker and any other human complex elements. That is why this article calls for a mixed method of AI's analytical power with human interpretative skills.

Apart from that, it is also important to consider the contextual interpretation by humans, because all contexts are not all in the audio. There are other facts combined with the audio analysis to study together in order to solve a case, not only the audio content. And this contextual background is not in the study area of AI. This is rather expert tasks [14]. But another valuable insight that human will bring in the analysis is the "Benefits of doubt" After deep analysis in audio forensic practice, human has the obligation to assess all elements and give a reliable evidence outcome [11]. Experts use their critical thinking, empathy, rational judgment that AI cannot proceed.

In summary, AI and experts are complementary and their synergy will produce effective and reliable audio forensic analysis.

Comparison of audio forensic investigation methods

To conduct this comparative study of the use of "only AI", "only human" analysis, and a combination of both in audio forensic investigations, scenarios from existing literature will be analyzed:

- "AI Only" method: Baskoro & al. [15], consider the use of AI in audio forensic to analyze modified audio content. AI can detect modification fast but remains limited on technological elements.
- "Human Only" method: Dzulfikar & al., [16] take a case analyzed by an expert using audio forensic traditional methods based on his knowledge and skills. The results of this study indicate that expert is influenced by emotional factors and his subjective understanding and contextual interpretation.

- "Human-AI" method: Krishnan & Hofmann, [17] demonstrated that after using both the AI and human skills in audio forensic analysis, AI algorithms can be effective and experts support it by conducting rigorous human analysis.

By comparing the outcomes of these three approaches, here is the table evaluating the strengths and limitations of each method.

Table 1. Table Comparison of 3 types of methods in audio forensic investigations

Analysis	Description	Strengths	Limitations
AI Only	Use of AI in audio forensic to analyze modified audio content. AI detect modification fast but remains limited on technological elements.	Speed, efficiency	Potential oversight of nuanced aspects
Human Only	Expert using audio forensic traditional methods based on his knowledge and skills. Expert influenced by emotional factors and his subjective understanding and contextual interpretation.	In-depth insights, contextual understanding	Time-consuming, subjective interpretation
Human -AI	Using both AI and human skills in audio forensic analysis, AI algorithms effective and experts support by conducting rigorous human analysis.	Comprehensive assessment, balanced analysis	Complexity in integrating human and AI inputs

CONCLUSION

In conclusion, AI transcription and AI sound recognition has transformed and innovated the legal practice of audio forensic investigation. These AI tools combined with human expertise bring beneficial advancements in the field of audio forensic. However, this study requires that this human-AI combination method must be in harmony with international standards of laboratory. These international standards or protocols are stated by ISO/IEC 17025. ISO/IEC 17025 will empower its recognition and credibility. This international norm provides rigorous criteria for laboratory procedures and outcomes. It will be a valuable research in the future to study the testing of this combination of AI and human expertise in audio forensic, by practitioners in order to get

accreditation and validation from this ISO/IEC 17025. Following this protocol consists of evaluating the adherence of the methods to standards of accuracy, reliability, and quality in audio forensic investigation. And this is always a path towards an enhanced audio forensic investigation.

REFERENCES

1. Peffers K., Tuunanen T., Rothenberger M., & Chatterjee S.. A design science research methodology for information systems research. Journal of Management Information Systems 2007;24(3):45-77. https://doi.org/10.2753/mis0742-1222240302
2. Metcalf J.. Estimating the postmortem interval using microbes: knowledge gaps and a path to technology adoption. Forensic Science International Genetics 2019;38:211-218. https://doi.org/10.1016/j.fsigen.2018.11.004
3. Han R., Lam H., Zhan Y., Wang Y., Dwivedi Y., & Tan K.. Artificial intelligence in business-to-business marketing: a bibliometric analysis of current research status, development and future directions. Industrial Management & Data Systems 2021;121(12):2467-2497. https://doi.org/10.1108/imds-05-2021-0300
4. Rao S. Forensic Aspects of Voice Analysis in India. International Journal for Research in Applied Science and Engineering Technology. 2021 Aug 31;9(8):1990–3. https://doi.org/10.22214/ijraset.2021.37702
5. Jarrett A. and Choo K.. The impact of automation and artificial intelligence on digital forensics. Wiley Interdisciplinary Reviews Forensic Science 2021;3(6). https://doi.org/10.1002/wfs2.1418
6. Singh S.. Forensic and automatic speaker recognition system. International Journal of Electrical and Computer Engineering (Ijece) 2018;8(5):2804. https://doi.org/10.11591/ijece.v8i5.pp2804-2811
7. Zhao H, Malik H. Audio Recording Location Identification Using Acoustic Environment Signature. IEEE Transactions on Information Forensics and Security. 2013 Nov;8(11):1746–59. DOI: 10.1109/TIFS.2013.2278843

8. Wang Z. and Hansen J.. Multi-source domain adaptation for text-independent forensic speaker recognition. Ieee/Acm Transactions on Audio Speech and Language Processing 2022;30:60-75. https://doi.org/10.1109/taslp.2021.3130975
9. Kabir M., Mridha M., Shin J., Jahan I., & Ohi A.. A survey of speaker recognition: fundamental theories, recognition methods and opportunities. Ieee Access 2021;9:79236-79263. https://doi.org/10.1109/access.2021.3084299
10. Smith H., Baguley T., Robson J., Dunn A., & Stacey P.. Forensic voice discrimination by lay listeners: the effect of speech type and background noise on performance. Applied Cognitive Psychology 2018;33(2):272-287. https://doi.org/10.1002/acp.3478
11. Loakes D. Does Automatic Speech Recognition (ASR) Have a Role in the Transcription of Indistinct Covert Recordings for Forensic Purposes? Frontiers in Communication. 2022 Jun 14;7(1). https://doi.org/10.3389/fcomm.2022.803452
12. Benbya H, Pachidi S, Jarvenpaa S. Special Issue Editorial: Artificial Intelligence in Organizations: Implications for Information Systems Research. Journal of the Association for Information Systems [Internet]. 2021 Mar 9 [cited 2021 Aug 3];22(2). Available from: https://aisel.aisnet.org/jais/vol22/iss2/10
13. Raed Toghuj. Forensic Linguistics Function in Evidentiary and Investigative Contexts. SocArXiv (OSF Preprints). 2022 Jan 10; https://doi.org/10.33774/coe-2022-7nnxw
14. Bianchetti RA, MacEachren AM. Cognitive Themes Emerging from Air Photo Interpretation Texts Published to 1960. ISPRS international journal of geo-information. 2015 Apr 10;4(2):551–71. https://doi.org/10.3390/ijgi4020551
15. Baskoro AB, Cahyani N, Putrada AG. Analysis of Voice Changes in Anti Forensic Activities Case Study: Voice Changer with Telephone Effect. International Journal on Information and Communication Technology (IJoICT). 2020 Oct 21;6(2):64–77. https://doi.org/10.21108/ijoict.v6i2.508
16. Dzulfikar H, Adinandra S, Ramadhani E. The Comparison of Audio Analysis Using Audio Forensic Technique and Mel Frequency Cepstral Coefficient Method (MFCC) as the

Requirement of Digital Evidence. Jurnal Online Informatika. 2021 Dec 26;6(2):145. https://doi.org/10.15575/join.v6i2.702

17. Krishnan G, Hofmann H. Hierarchical Decision Ensembles- An inferential framework for uncertain Human-AI collaboration in forensic examinations. arXiv (Cornell University). 2021 Oct 31;1(1):33 https://doi.org/10.48550/arXiv.2111.01131
18. Universal Declaration of Human Rights (UDHR)
19. ISO/IEC 17025 International Accreditation for Laboratories