International Journal of Scientific Reports
Chandrasekaran A. Int J Sci Rep. 2023 Aug;9(8):248-250
http://www.sci-rep.com
pISSN 2454-2156 | eISSN 2454-2164
DOI: https://dx.doi.org/10.18203/issn.2454-2156.IntJSciRep20232148

Original Research Article

Secure cryptographic communication using ultrasound audio for frictionless payment transactions and secure conversations over a short-range human audible/inaudible spectrum

Arulkumaran Chandrasekaran[1,2]*

[1]Research and Development, Ozone Towers, Tamil Nadu, India
[2]Research and Development, ethTV Inc, Arizona, USA

Received: 17 June 2023
Revised: 27 June 2023
Accepted: 05 July 2023

***Correspondence:**
Arulkumaran Chandrasekaran,
E-mail: arul329@gmail.com

ABSTRACT

Background: The aim of the study was to address these challenges by leveraging ultrasound audio as a means for secure cryptographic communication. By utilizing the human audible and inaudible audio spectrum, this approach eliminates the reliance on specialized hardware or traditional network technologies, such as bluetooth, wi-fi, NFC, or RF-based alternatives.
Methods: Various mobile phones, tablets, and POS hardware devices with basic microphones and speakers were employed to test the communication channel's performance. The sensitivity of the devices in different environments, such as retail stores or crowded venues like stadiums, was taken into account.
Results: The results demonstrated the viability of the proposed secure cryptographic communication using ultrasound audio. Transactions, including payment processing, were successfully conducted without the need for specialized hardware or network connectivity.
Conclusions: The proposed solution offers a reliable and cost-effective method for proximity detection, verification, and frictionless transactions. By leveraging the human audible and inaudible audio spectrum, this technology eliminates the need for specialized hardware or traditional network connectivity.

Keywords: Cryptographic communication, Ultrasound audio, Payment transactions, Proximity detection, Secure conversations

INTRODUCTION

In an era where secure communication and frictionless transactions are paramount, novel solutions are continuously being explored.[1]

The aim of the study was to address these challenges by leveraging ultrasound audio as a means for secure cryptographic communication.

By utilizing the human audible and inaudible audio spectrum, this approach eliminates the reliance on specialized hardware or traditional network technologies, such as bluetooth, wi-fi, NFC, or RF-based alternatives.[2,3] The proposed solution offers a versatile and cost-effective method for proximity detection, verification, and secure transactions, enabling service providers to deploy end-to-end solutions rapidly and efficiently.

Objectives

The main objective of this study was to convey the challenges faced by using ultrasound audio as a means of secure cryptographic communication.

METHODS

A series of experiments were conducted to evaluate the feasibility and effectiveness of secure cryptographic communication using ultrasound audio. Various mobile phones, tablets, and POS hardware devices with basic microphones and speakers were employed to test the communication channel's performance. The sensitivity of the devices in different environments, such as retail stores or crowded venues like stadiums, was taken into account. -The sensitivity was analysed using multiple audio spectrum analyzers including spectroid app like the one available below in Figure 1.

And also, we calculated SNR (signal to noise ratio) in each environment including the crowded stadiums during peak action moments and executed cryptographic communications successfully with 100% accuracy. The experiments involved sending data over ultrasound audio and assessing its accuracy, speed, and resistance to eavesdropping or tampering.

Study period and study place

The study was carried out in couple of stadiums in March 2015 upto May 2015 and after that we resumed verification of the same to one of our current prospective customers for a frictionless fuel payment system from December 2022 to till date ongoing verification in an Arizona gas station and in our customer's lab in Arizona.

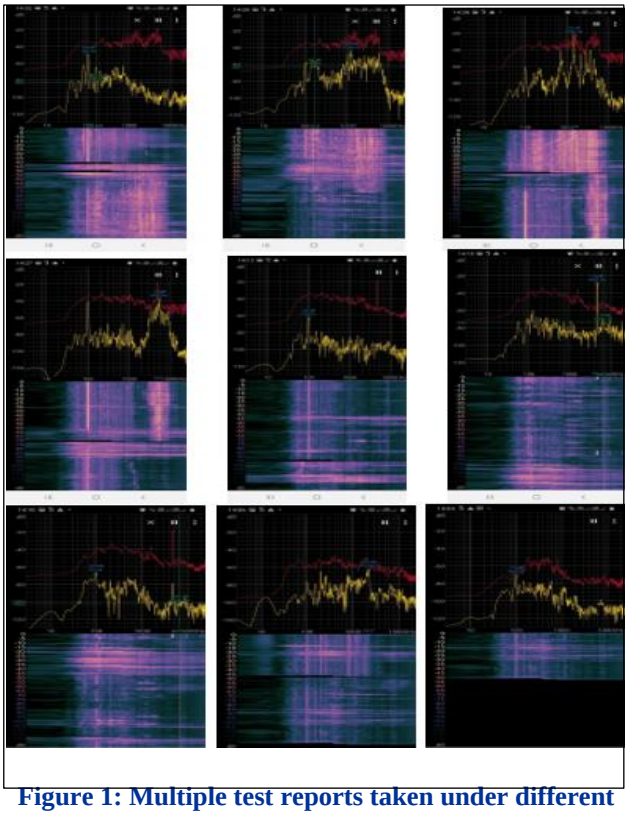

Figure 1: Multiple test reports taken under different environment conditions including crowded environment in audible spectrum as well as inaudible spectrum.

RESULTS

The results demonstrated the viability of the proposed secure cryptographic communication using ultrasound audio. The communication channel proved to be effective in proximity detection and verification, irrespective of the device or environment. Transactions, including payment processing, were successfully conducted without the need for specialized hardware or network connectivity. The communication speed and accuracy were comparable to existing solutions, ensuring a seamless user experience. Multiple test reports taken under different environment conditions including crowded environment in audible spectrum as well as inaudible spectrum are shown in Figure 2.

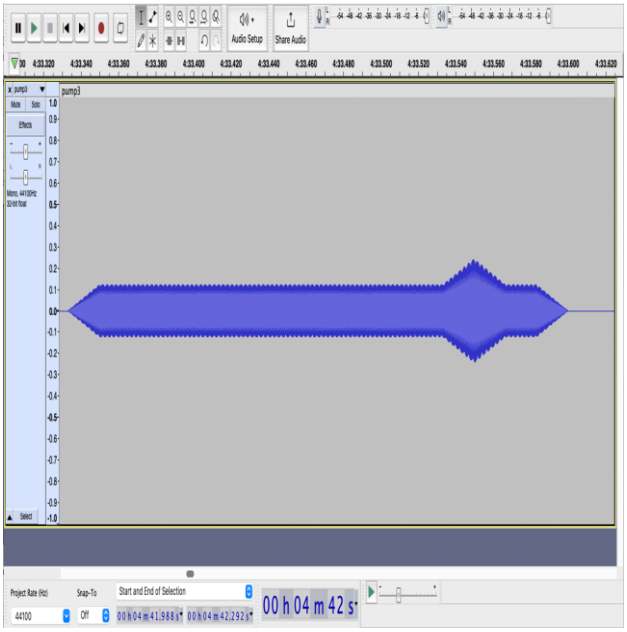

Figure 2: Simple cryptographic identifier embedded into an existing audio content in the inaudible audio spectrum.

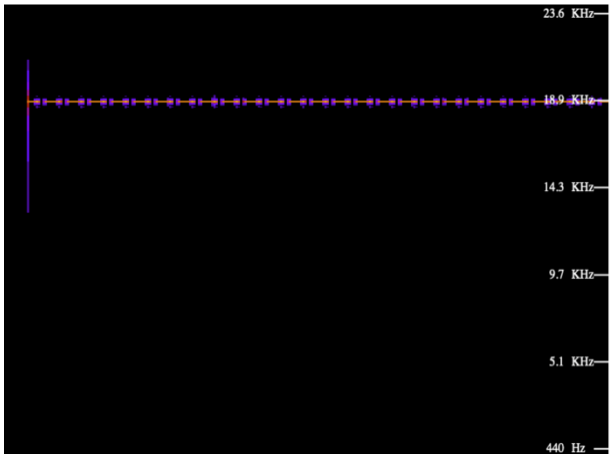

Figure 3: Detailed frequency spectrum analyser output for the same cryptographic embedding alone.

DISCUSSION

The findings of this research indicate that secure cryptographic communication using ultrasound audio holds great potential for various applications. Its versatility, ease of deployment, and cost-effectiveness make it an attractive option for service providers across different industries.[4,5] The use of ultrasound audio eliminates the dependency on external networks, reducing infrastructure costs and simplifying implementation.[6,7] The technology can be used not only in traditional retail environments but also in unique scenarios such as airplanes, where alternative network technologies may not be feasible.

Multiple test reports taken under different environment conditions including crowded environment in audible spectrum as well as inaudible spectrum proves secure one way as well as two-way communication for proximity detection and verification as well as payment based frictionless transactions are possible even where SNR (signal to noise ratio) is very poor.[8]

In a study done by Mehrabi et al transaction time was perceived as the major factor for determining user preference. The findings indicated that acoustic data transmission had unique advantages in facilitating information sharing and interaction between co-located users. The study showed that acoustic data transmission and QR transactions had more user preferences in real-world transactions.[9] In a survey, 66% people admittedly abandoned their transactions midway as they did not have the patients to deal with the friction.[10] Therefore, frictionless transactions are becoming truly the future for online purchasing of goods and services.

CONCLUSION

This research demonstrates the effectiveness of secure cryptographic communication using ultrasound audio for payment transactions and secure conversations. The proposed solution offers a reliable and cost-effective method for proximity detection, verification, and frictionless transactions. By leveraging the human audible and inaudible audio spectrum, this technology eliminates the need for specialized hardware or traditional network connectivity. Service providers can deploy this solution rapidly and efficiently, reducing maintenance costs and enabling a seamless user experience.

ACKNOWLEDGEMENTS

We would like to express our gratitude to the participants who contributed to this research study. We also acknowledge the support and resources provided by Ozone Towers in conducting this research.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Roesner F, Kohno T, Molnar D. Security and privacy for next-generation consumer devices. Communicat ACM. 2014;57(9):56-64.
2. Jana S, Sherr M, Gupta V. On the feasibility of using sound to detect physical proximity of smartphones. Proceed 4th ACM Confer Secur Priv Wireless Mob Net. 2013:1-6.
3. Cai L, Tan Y, Zhu L. A secure communication scheme based on ultrasound in IoT. Mob Net Applic. 2016;21(4):668-74.
4. Huang D, Li Q, Han G, Zhang X, Li Y. Secure communication based on dual-channel audio frequency under loud noise. Mob Net Applic. 2020;25(4):1563-72.
5. Chen Y, Liu S, Huang T. Secure data transmission using dual-tone multi-frequency signals over air-gap channels. IEEE Access. 2019;7:164764-73.
6. Guri M, Kachlon A, Hasson O, Elovici Y. GSMem: Data exfiltration from air-gapped computers over GSM frequencies. Comput Securit. 2018;78:325-37.
7. Zou T, Li J, Liu J. Ultrasonic communication security based on orthogonal frequency division multiplexing. IEEE Access. 2021;9:28175-83.
8. Guo C, Wang W. Secure and efficient audio-based communication protocol for proximity detection in IoT. J Ambi Intelligen Humaniz Comput. 2022;13(1):957-67.
9. Mehrabi A, Mazzoni A, Jones D, Steed A. Evaluating the user experience of acoustic data transmission. Person Ubiquit Comput. 2019;24:655-68.
10. NFC forum. Fact sheet: NFC is the future of "frictionless" payment, 2020. Available at: https://nfc-forum.org/news/2020-06-nfcthefuture-of-frictionless-payment/. Accessed on 20 June 2023.

Cite this article as: Chandrasekaran A. Secure cryptographic communication using ultrasound audio for frictionless payment transactions and secure conversations over a short-range human audible/inaudible spectrum. Int J Sci Rep 2023;9(8):248-50.