Professional Paper https://doi.org/10.24867/GRID-2026-p31

Interactive Packaging Enabled by NFC Technology

ABSTRACT

The convergence of physical and digital media has created new opportunities for developing interactive packaging that enhances product functionality and user experience. This paper explores the potential of Near Field Communication (NFC) technology to integrate physical packaging with digital content through the development of an interactive music album as a case study. The research is based on a review of the evolution of physical and digital music formats, the role of packaging in shaping user experience, and recent applications of NFC technology in interactive products. Based on these findings, an NFC-enabled CD package was developed, providing seamless access to multimedia content, artist information, and exclusive digital materials via embedded NFC tags. The proposed solution demonstrates how NFC technology transforms conventional packaging into an interactive communication interface that connects physical and digital environments while preserving the aesthetic and collectible value of the product. In addition to improving user engagement, the concept enables product authentication, dynamic content updates, and long-term interaction between creators and users. The presented approach highlights the potential of NFC-enabled packaging as an innovative solution for graphic products and demonstrates its broader applicability in the development of functional, interactive, and user-oriented packaging systems.

Alan Nikolić-Šipek
Katarina Itrić Ivanda
Marina Vukoje Bezjak
Rahela Kulčar

University of Zagreb,
Faculty of Graphic Arts,
Zagreb, Croatia

KEY WORDS
Interactive packaging, NFC technology, smart packaging, user experience, physical–digital integration

1. Introduction

The rapid advancement of digital technologies has significantly transformed the role of packaging, extending its traditional functions of protection, transportation, and information delivery toward interactive communication and enhanced user experience. As interactive technologies become increasingly integrated into graphic products, packaging is expected to provide added value beyond its conventional protective role. Li (2021) argues that interactive packaging design enhances visual communication by establishing a closer relationship between products and users, while Gegeckienė et al. (2022) identify Near Field Communication (NFC) as one of the key technologies driving the development of smart packaging within the graphic industry. Among the available smart technologies, NFC has emerged as a practical solution for connecting physical products with digital content. According to Coskun, Ozdenizci and Ok (2015), NFC enables secure short-range wireless communication that is intuitive for users and compatible with the majority of modern smartphones. The technology has therefore found applications in product authentication, consumer engagement, information exchange, and interactive packaging. Hutson and Hutson (2024) further emphasize the potential of NFC to bridge physical and digital experiences in artistic and cultural contexts, while Tantowibowo and Yau (2024) demonstrate its applicability in authentication systems for physical artworks.

The growing adoption of digital technologies has also influenced the design of music products, where packaging is no longer perceived solely as a protective element but as an important component of the overall user experience. Vad (2021) describes the album cover as an essential medium of visual communication that

contributes to the identity and interpretation of musical works. Likewise, Dorochowicz and Kostek (2019) highlight the close relationship between album cover design and the communication of musical genres, emphasizing the role of graphic design in shaping audience perception. Recent studies further indicate that physical music releases continue to provide experiential value despite the dominance of digital streaming services. Fumihira and Johnston (2025) argue that tangible music products remain relevant when combined with digital interaction, while Scott and Schofield (2025) demonstrate that visual presentation continues to influence user experience even within digital music environments.

Although streaming platforms have become the primary mode of music consumption, physical editions continue to occupy an important niche among collectors and dedicated audiences. This has encouraged artists and publishers to explore new approaches that combine the permanence and collectible value of physical media with the flexibility of digital content. NFC technology provides an opportunity to achieve this integration by enabling immediate access to multimedia materials, artist information, exclusive content, and continuously updated online resources through embedded NFC tags.

Commercial solutions such as NFC-enabled albums, music cards, and collectible vinyl releases demonstrate the practical feasibility of integrating NFC technology into music products (Fumihira & Johnston, 2025). However, these solutions primarily focus on content accessibility, while considerably less attention has been given to packaging as a unified communication interface that simultaneously integrates graphic design, physical interaction, and digital media. This creates an opportunity to develop interactive packaging concepts in which the physical product remains the central element of the user experience while being extended through digital functionality.

Therefore, this paper presents the design and development of an NFC-enabled interactive CD package that integrates physical packaging with digital multimedia content. The proposed concept demonstrates how NFC technology can transform conventional graphic packaging into an interactive communication interface while preserving the visual identity, material qualities, and collectible value of physical music products. Furthermore, the presented solution illustrates the broader potential of NFC-enabled packaging in the development of functional, user-oriented, and digitally connected graphic products.

2. Materials and methods

The research was conducted using a design-oriented approach that combined theoretical analysis with the development of an original interactive packaging concept. The methodological framework consisted of two complementary stages. The first stage involved a review of the historical development of physical and digital music releases, the evolution of album packaging, and the application of NFC technology in contemporary music products. Attention was given to the role of album packaging in shaping user experience (Vad, 2021) and to recent applications of NFC technology in interactive packaging systems (Gegeckienė et al., 2022). The findings of this analysis served as the basis for defining the functional requirements of the proposed interactive packaging concept.

Based on the theoretical findings, an original concept of an interactive music album was developed in the form of a compact disc (CD) package with integrated NFC technology. The project included the design of the visual identity, the structural design of the package, the definition of user interaction scenarios, and the integration of digital content accessible through embedded NFC tags. The concept was designed to establish a seamless connection between the physical product and its digital extension while preserving the aesthetic and collectible characteristics of the music release.

The proposed packaging incorporates multiple NFC interaction points that provide access to different categories of digital content. The embedded NFC tags were programmed using NDEF URI records, allowing users to access predefined online resources simply by bringing an NFC-enabled smartphone close to the designated interaction point. The implementation follows the principles of NFC communication described by Coskun, Ozdenizci and Ok (2015), ensuring compatibility with standard NFC-enabled mobile devices without requiring dedicated applications.

The outcome of the research is a functional design concept demonstrating how NFC technology can be integrated into graphic packaging to create a unified physical–digital user experience. Rather than evaluating user behaviour experimentally, the study focuses on the design process and the implementation of an interactive packaging prototype as a proof of concept.

3. Results and discussion

The outcome of this research is the development of an interactive music album package that combines the tangible qualities of a conventional CD release with the functionality of NFC-enabled digital interaction. Rather than replacing the physical product, the proposed concept extends its communicative role by transforming the package into an interface between physical and digital media. The design preserves the visual identity and collectible value of the album while providing immediate access to additional digital content through embedded NFC tags. The final prototype of the developed NFC-enabled CD



(a) (b) (c)

» **Figure 1:** *Final prototype of the interactive CD package (a) front cover, (b) back cover, and (c) opened package*

package is presented in Figure 1, illustrating the front cover, back cover, and internal layout of the package.

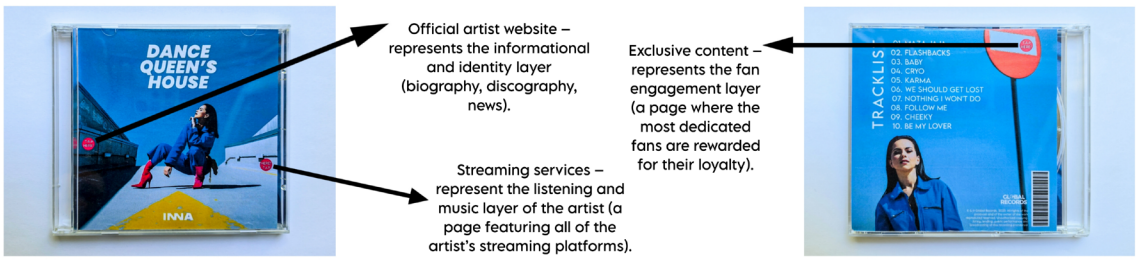
The prototype preserves the visual characteristics of a conventional CD package while incorporating interactive functionality through embedded NFC technology. The developed package was designed around the principle that each NFC interaction should correspond to a clearly defined user intention. Instead of directing all interactions to a single destination, the package incorporates multiple NFC touchpoints, each providing access to a different category of digital content. This interaction model establishes a logical separation between promotional information, music distribution services, and exclusive artist-related content, allowing users to navigate the digital layer intuitively while preserving the simplicity of the physical interface.

The visual design of the package was developed simultaneously with the interaction concept to ensure that the digital functionality remains integrated into the graphic product rather than appearing as an additional technological feature. Attention was paid to the placement of NFC interaction points, which were incorporated into the visual composition using subtle "Tap Here" markers. This approach follows current recommendations for NFC-enabled packaging, where the interaction area should be easily recognizable without compromising the overall aesthetic quality of the product. References to NFC interaction were therefore treated as graphic elements that support usability while maintaining visual consistency. The placement and function of the embedded NFC interaction points are illustrated in Figure 2.

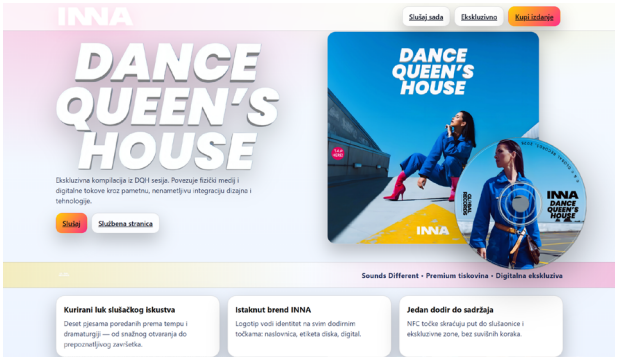
The digital component of the project was implemented through NFC tags programmed with NDEF URI records that redirect users to predefined online resources. Using any NFC-enabled smartphone, users can access the associated content without manually entering web addresses or scanning QR codes. The proposed interaction reduces the number of required user actions and creates a seamless transition from the physical package to the digital environment. This implementation demonstrates how NFC technology can simplify access to multimedia resources while maintaining compatibility with standard mobile devices and NFC communication protocols. Figure 3 presents the landing page that serves as the primary digital interface accessed through the embedded NFC tags.

The use of NFC technology offers several advantages over conventional approaches to linking physical and digital content. Unlike QR codes, which require users to open a camera application and visually scan a printed code, NFC interaction is initiated through a simple tap, resulting in a more intuitive and seamless user experience. Furthermore, NFC tags can be discreetly integrated into the graphic design of the package without affecting its visual appearance, allowing interactive functionality to remain virtually invisible until activated. This approach enhances both the aesthetic quality of the packaging and the overall user experience (Coskun, Ozdenizci & Ok, 2015; Gegeckienė et al., 2022).

Compared with conventional CD packaging, the proposed concept extends the role of the package beyond storage and visual presentation. It becomes an active communication medium capable of delivering con-



» **Figure 2:** *Location of the NFC interaction points integrated into the CD package and their corresponding digital functions*



» **Figure 3:** *Digital content and user interface accessed by interacting with the NFC-enabled CD package*

tinuously accessible digital content while preserving the permanence and material qualities of physical media. Unlike QR-code-based solutions, NFC interaction requires only a simple tap, reducing visual clutter and allowing the interactive functionality to remain discreetly integrated into the package design. These characteristics support a more natural user experience and reinforce the perception of the package as a unified graphic product rather than a printed object supplemented with external digital services.

The proposed concept also demonstrates broader opportunities for applying NFC technology within graphic products. Although developed as a music album, the same design principles can be adapted to other forms of packaging where interaction with digital content adds value to the physical product. Examples include limited-edition publications, exhibition catalogues, promotional packaging, premium product packaging, and collector's editions, where digital content can complement rather than replace the physical experience. Existing commercial implementations, including NFC-enabled albums and music cards, primarily use NFC technology as a gateway to streaming platforms or promotional content. In contrast, the concept presented in this study considers NFC as an integral component of the packaging design process. Rather than functioning solely as a digital shortcut, the embedded NFC tags contribute to a coherent communication system in which graphic design, physical interaction, and digital media are intentionally integrated into a single user experience. This approach extends the communicative role of packaging while preserving the authenticity and collectible value of physical music releases (Fumihira & Johnston, 2025).

From the perspective of graphic product design, the presented prototype illustrates that NFC technology should not be considered merely as an additional technological component but as an integral element of the communication strategy. By integrating visual design, physical interaction, and digital content into a coherent user experience, the developed package demonstrates how traditional graphic products can evolve into interactive communication interfaces while maintaining their aesthetic, cultural, and collectible value.

Overall, the developed prototype demonstrates that NFC technology can be successfully incorporated into graphic packaging without compromising its visual identity or usability. The proposed concept illustrates that interactive functionality can be achieved through careful integration of graphic design, packaging structure, and digital media, creating a unified physical–digital communication environment. Although developed as a music album, the design principles presented in this study are transferable to a wide range of graphic products where interactive communication can enhance product functionality and user engagement.

4. Conclusions

This paper presented the design and development of an interactive music album package that integrates Near Field Communication (NFC) technology with conventional graphic packaging. By combining the physical qualities of a compact disc package with digital content accessible through embedded NFC tags, the proposed concept demonstrates how traditional packaging can be transformed into an interactive communication interface while preserving its aesthetic and collectible value. The proposed concept demonstrates that NFC technology offers a practical solution for connecting physical and digital media in graphic products. Unlike conventional packaging, which primarily serves protective and informational functions, the developed concept extends the role of packaging by enabling immediate access to multimedia content, artist information, and additional digital resources through intuitive user interaction. The integration of NFC technology was achieved without altering the visual identity or usability of the package, illustrating the compatibility of interactive technologies with established principles of graphic design.

Beyond its application in the music industry, the presented concept demonstrates the broader potential of NFC-enabled packaging in the development of innovative

graphic products. The same design approach can be applied to promotional materials, premium packaging, limited-edition publications, museum products, and other applications where physical objects can benefit from an interactive digital extension. In this context, NFC technology represents not only a communication tool but also a means of enhancing user engagement and creating a stronger connection between physical products and digital services. The main contribution of this work lies in the development of a functional design concept that integrates graphic design, packaging design, and NFC technology into a unified user experience. The presented prototype illustrates how interactive packaging can support the ongoing convergence of physical and digital media while opening new possibilities for the design of user-oriented graphic products.

Future research could focus on evaluating user interaction with NFC-enabled packaging through usability studies and user experience assessment, as well as investigating the application of emerging technologies, such as dynamic web content, cloud-based content management, and artificial intelligence, to further expand the functionality and adaptability of interactive packaging systems.

5. Acknowledgments

This work was supported by the Croatian Science Foundation [grant number IP-2022-10-3864].

6. References

Coskun, V., Ozdenizci, B. and Ok, K. (2015) 'The survey on Near Field Communication', *Sensors*, 15(6), pp. 13348–13405. DOI: 10.3390/s150613348

Dorochowicz, A. and Kostek, B. (2019) Relationship between album cover design and music genres. In: *2019 Signal Processing: Algorithms, Architectures, Arrangements, and Applications (SPA 2019), 18–20 September 2019*, Poznań, Poland. Piscataway, NJ: IEEE, pp. 93–98. DOI: 10.23919/SPA.2019.8936738

Fumihira, E. and Johnston, A. (2025) Physical music albums in the digital era: Exploring experiential value through the integration of AR. In: Cavdir, D. and Berthaut, F. (eds.) *Proceedings of the International Conference on New Interfaces for Musical Expression*, 24–27 June 2025, Canberra, Australia. NIME, pp. 582–589. DOI: 10.5281/zenodo.15698968

Gegeckienė, L., Venytė, I., Karpavičė, J., Tambo, T., Vaitasius, K. and Pauliukaitis, D. (2022) Near Field Communication (NFC) technology in the packaging industry. In: Vladić, G. (ed.) *Proceedings of the 11th International Symposium on Graphic Engineering and Design GRID 2022*, 3–5 November 2022, Novi Sad, Serbia. Novi Sad: University of Novi Sad, Faculty of Technical Sciences, Department of Graphic Engineering and Design, pp. 495–501. DOI: 10.24867/GRID-2022-p54

Hutson, P. and Hutson, J. (2024) 'Bridging the digital divide: Innovative uses of QR codes and NFC in the artistic realm', *ISRG Journal of Arts, Humanities and Social Sciences*, 2(2), pp. 338–345. DOI: 10.5281/zenodo.11081838

Li, Y. (2021) 'Analysis of visual communication packaging design based on interactive experience', *Journal of Physics: Conference Series*, 1852(2), 022074. DOI: 10.1088/1742-6596/1852/2/022074

Scott, M. and Schofield, D. (2025) 'The impact of album layout on user experience in smartphone music applications', *International Journal of Multimedia & Its Applications*, 17(1/2), pp. 1–22. DOI: 10.5121/ijma.2025.17201

Tantowibowo, C.H. and Yau, W.-C. (2024) 'ArtProtect: Blockchain and NFC-based anti-counterfeit system for physical art', *IET Blockchain*, 4(4), pp. 423–442. DOI: 10.1049/blc2.12069

Vad, M. (2021) 'The album cover', *Journal of Popular Music Studies*, 33(3), pp. 11–15. DOI: 10.1525/jpms.2021.33.3.11

© 2026 Authors. Published by the University of Novi Sad, Faculty of Technical Sciences, Department of Graphic Engineering and Design. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license 4.0 Serbia (http://creativecommons.org/licenses/by/4.0/rs/).