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Near Field Communication (NFC) Technology in the Packaging Industry

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Introduction



In today's complex retail market, brands and retailers must find new and innovative ways to engage with customers. In fact, 90% of smartphone owners use their devices in-store to search for products through search engines and online stores, therefore companies need to recapture customers' attention through new technologies (Ewers, 2018). While millennials and Gen Z spend an average of 3:44 hours a day on their smartphones, 67 percent of them still prefer to shop in-store (Sterling, 2017), so there is a clear need to change the traditional retail marketing to a new approach that builds a bridge between the digital and physical worlds (Ewers, 2018).

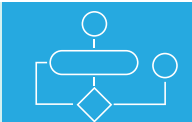
For brand owners and retailers, NFC offers opportunities to develop direct engagement and increase customer loyalty. Such interaction is possible because NFC tags have unique identifiers per item, not just product type, therefore the content can be targeted and dynamic (different before and after purchase). These tags are small and can be integrated into the packaging without affecting the brand identity. NFC technology is also more resistant to cloning because the unique identifier prevents counterfeiting and allows the brand owner or customer to confirm the product's authenticity (Ewers, 2018).

Problem Description



Based on the researchers' insights, the NFC technology is still not widely adopted by the packaging industry. The NFC-enabled interactive communication with the customer might play a major role in accepting the technology, especially for today's Generation Z.

Methods



As a result, it was decided to analyze the existing NFC technologies on the market. It is very important to investigate the speed of scanning and the accuracy of the information, as the Z-generation focuses their attention for a very short time. The performance of the scanning process highly depends on the type and quality of the NFC sticker. The latter can be corrupted during the logistic, warehousing or stocking (retailer) operations due to miscellaneous impacts from the surrounding environment.

Therefore, this research aims to:

1) analyse the existing NFC stickers by summarizing their key characteristics;

2) identify the main mechanical properties of NFC stickers that can be affected by the environment during the supply chain operations;

3) develop a methodology for further experimentation with the selected NFC stickers.

Results



There are several studies conducted in regards to NFC technology and its applicability to the packaging industry (Ma et al., 2018; Escobedo et al., 2020; Nguyen et al., 2019). A study from Mooiman & Andersson (2022) concluded that NFC needs to add value for the customer to enable brands strengthen their relationships with a customer through NFC. The user's experiences with an NFC-enabled product package will reflect the associated brand's image. The results suggest that an enjoyable interaction would benefit the brand's image and vice versa. Therefore, it is vital for a brand to succeed in creating a positive user experience that is highly depended on the technical properties and the performance of the NFC tag.

The technical characteristics of the NFC stickers available on the market have been identified and classified into two groups:

1. The first combination of NFC stickers consists of samples that have the same chip NTAG213 and diameter of 29 mm but are produced on different substrates and/or are composed of different layers.
2. The second combination of NFC stickers consists of samples that have the same chip NTAG213 and are made for on-metal surface applications. However, these NFC stickers are manufactured in different sizes and formats.

The descriptions of each NFC sticker of the first group are provided below in Table 1.

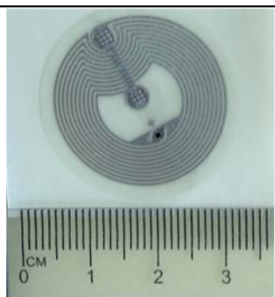
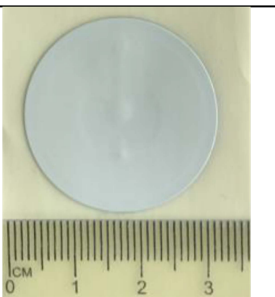
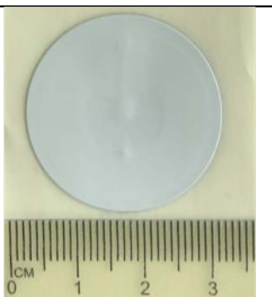
Properties/ Product type	ST710 Clear	ST711 White	ST706 On-metal
Picture			
Purchased from	Seritag	Seritag	Seritag
Diameter	29 mm	29 mm	29 mm
NFC chip	NXP NTAG213	NXP NTAG213	NXP NTAG213
Label form	Circular	Circular	Circular
Standard	ISO 14443A	ISO 14443A	ISO 14443A
Frequency	13.36 MHz	13.36 MHz	13.36 MHz
Data Transfer	106 kbit/s	106 kbit/s	106 kbit/s
Memory (chip)	180 byte	180 byte	180 byte
User memory (chip)	144 byte	144 byte	144 byte
Max URL Length (chip)	136 characters	136 characters	136 characters
Thickness	0.136 mm	0.19 mm	0.47 mm
Antenna Size	25 mm circular	25 mm circular	25 mm circular
Face Material	Clear PET Plastic	White PET Plastic	White PET Plastic
Adhesive	Acrylic, permanent	Acrylic, permanent	Acrylic, permanent
Operating Temperature	-25 to 70	-25 to 70	-15 to 70
Water Rating	Water Resistant	Water Resistant	Water Resistant
Water Resistance	Low	Low	Low

Table 1 Properties of NFC stickers

Discussion / Conclusion



The next step of this study is to conduct experiments on the selected and classified NFC stickers that will be attached onto a particular product packaging. The study will investigate the readability of NFC stickers, when exposed to certain environmental impacts, such as humidity, freeze, and mechanical abrasion. The following mechanical properties are selected to study:

1. Cold/heat resistance;
2. Moisture resistance;
3. Mechanical abrasion resistance.

The parameters are chosen considering the most common problems encountered during the transportation and/or storage of the products. The study will examine how the information in the NFC tag's memory chip is read after being subjected to before-mentioned conditions. The selected information will be further recorded, the readability will be checked against a benchmark and the readability of the information after mechanical impact on the NFC sticker will be checked against the benchmark.

Research shows that interactive and intelligent communication is the main driver for Generation Z. According to researchers, around 90% of smart device owners use them to access product information. Consequently, it is essential to investigate the quality and speed of scanning, as the Z-generation focuses their attention for a very short time. If the information takes a while to scan, the user might lose interest.

Furthermore, the packaging industry is increasingly using NFC technologies (more than 10 times between 2014 and 2024) to provide information about the product being purchased, from the product's composition to information about the product's fitness for use. Therefore the investigation of NFC sticker's mechanical characteristics is essential to determine the technology's potential to be applied and accepted by the packaging industry.

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