

DEVELOPMENT OF A CONCEPTUAL SOLUTION FOR INTERACTIVE PACKAGING FOR OLIVE OIL

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Abstract: *Interactive packaging is associated with data transmission methods such as 2D barcodes, radio frequency identification (RFI), near field communication (NFC), electroluminescent displays (ELD), and augmented reality (AR) for packaging. Data on storage, distribution, and characteristics of packaged food are most often stored. Some of the important data on storage conditions that can be stored are temperature and relative humidity, and data on food quality from microbiological points of view are also important. All collected data is easily accessible and enables an efficient flow of information to the supplier or end-user or customer.*

The manuscript will present the development of a conceptual solution for functional interactive packaging for olive oil with radio frequency identification. The conceptual solution is designed with full functionality in terms of packaging materials because certain packaging materials such as glass can interfere with wireless contactless technology that uses radiofrequency to transmit information. In addition to all the above, sustainable design settings were considered during the development of the conceptual design, so that the product follows a combination of the latest trends in the process of designing packaging products.

Key words: conceptual design, packaging, RFID, sustainability

1. INTRODUCTION

One of the functions of the primary packaging products is the attractiveness of the design. When creating the design of the packaging product, the function of interactivity can be incorporated, to further attract customers and inform them about the product. In a survey conducted by the Austrian manufacturer of packaging products Constantia Flexibles, it can be noted that 69% of respondents would rather buy or take off the shelves a product with interactive packaging than a similar product with a traditional design, which confirms the attractiveness of such products (Constantia Flexibles, 2017).

Near-field communication (NFC) is a short-range data exchange technology based on radio-frequency identification technology and was designed by Sony and Philips in 2002. NFC communication protocols and data exchange formats are based on FeliCa Card RF Performance standards Certification Specification and ISO/IEC 14443 (Part 1-4) standards (Dantuma et al., 2018; FeliCa Card, 2021; ISO/IEC 14443, 2018; Motlagh, 2012). Information from NFC is transferred to another device (mobile phone or tablet) by electromagnetic induction, and the efficiency of connecting the device depends on the design, configuration, and settings of both antennas (Motlagh, 2012; Pretty, Prabakaran & Balamurugan, 2014). Data transmission is carried out at a distance from 2 to 5 centimeters, which ensures security against information theft during eavesdropping (Chang, 2014). It should be emphasized that the NFC function on mobile phones is not active unless the user activates it himself, which gives the user additional security. In addition to everything mentioned, the NFC tag is sensitive to the direction of action, which further prevents hackers. The NFC tag can be locked after encoding the data, which makes it impossible to change or add data. Most tags can no longer be unlocked. The mentioned security features contribute to the increase in the use of tags in packaging products.

That's how the English producer of the alcoholic drink Bombay Sapphire added augmented reality (AR) elements to the label. In this way, users, by scanning special labels, can enjoy sound, images, and videos with detailed recipes and other information related to the product (Gilliland, 2018).

In addition to augmented reality, solutions with built-in NFC (Near-field communication) technology, described in detail in the next chapter, are receiving more and more attention. American wine producer Böen, in collaboration with SharpEnd and Guala Closures, has created the first aluminum wine closure with integrated NFC. To invite consumers to interact, they came up with the simple text "Tap our Cap" which normally appears on the ribbon around the bottle. In literal translation, it calls the user to action. This type of marketing tool is called CTA or call to action. By holding their smartphones up to the bottle cap, consumers instantly access wine information. In doing so, they verify their product and are then

transported to a virtual California farmhouse to unlock information about the wine they purchase, create, and share content, and build their own virtual wine cellar (We Are SharpEnd, 2021).

Through the cooperation of OTACA Tequila and Identiv, an NFC tag was installed on the bottle so that customers can authenticate and re-order the product using a smartphone. Customers could also find out information about the history of the brand. The first version of the packaging contained an NFC tag on the lid of the bottle itself along with the text because consumers sometimes did not notice the possibility of using it. To further emphasize the possibility of using interactive technology, the cap had a white layer and black printing above and below the place where the antennas were located (Cole, 2022).

Malibu's 'Because Summer' series packaging incorporates NFC technology to enhance the shopping experience for consumers. To notify consumers, they include an educational hanger for the neck of the bottle that informs that the bottle has NFC technology on the front of the bottle. Customers could be able to use three digital experiences, an interactive prize game, new recipes, and exclusive media to continue the summer feeling. In past campaigns, they collected data related to purchases and demographic data. Technological innovation from Malibu 'Coco-nect' - coconut serving cup for Malibu cocktails eliminates the need to wait in line at music events. NFC technology is included in packaging products and serves as part of a good marketing strategy (Newsroom, 2017).

The aim of the work is to design a packaging prototype for extra virgin oil according to the results of the survey so that the designed packaging would be attractive to consumers. The packaging would meet the standards of sustainable design with modern NFC tag technology.

2. METHODS

The scientific research shows the creation of a conceptual solution for the primary eco-packaging for olive oil, which combines the premise of sustainability and the features of smart packaging. NFC tag type 2, i.e., NTAG216 read-write model manufactured by the company NXP, is used to create the prototype of the packaging product. The NFC tag is applied to a transparent PET label (Figure 1). In Figure 1, the parts of the NFC tag are clearly visible, such as the antenna and the chip.

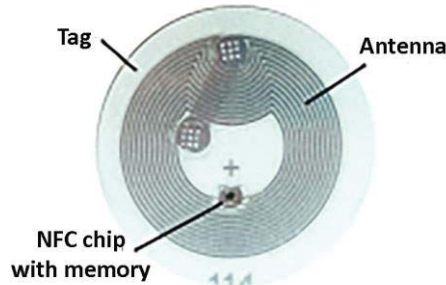


Figure 1: Photo of a sticker with an applied NTAG216

Table 1: Properties and characteristics of NTAG216

| | | |
|----------------------------------|----------------------------|--------------|
| Properties | water resistance | incompletely |
| | transparency | completely |
| Technical characteristics | diameter | 25 mm |
| | thickness | 0,18 mm |
| | frequency | 13.56 MHz |
| | data transfer speed | 106 kbit/s |
| | read/write memory capacity | 888 bytes |
| | password security | 32-bit |

The NFC tag is resistant to a certain amount of moisture from the surrounding atmosphere and, due to its small dimensions, is almost imperceptible to the eye (Table 1).

Saved records have a durability of up to 10 years, with the possibility of deleting about 100,000 times. The password ensures the preservation of old records and the correspondence of new records of the

owner. It should be emphasized that successive writing and deletion of records affect the consumption of memory (Web Cambridge, 2018).

NFC encoding was performed using the manufacturer's official application (NXP TagWriter). The application on the menu offers various functions that can be coded on the tag. In scientific research, a web address (link) is coded into the prototype, which points to an interactive personalized product page.

3. RESULTS

For the desired function to be saved and transferred to the NFC tag in the NXP TagWriter application, default records are stored and printed in Records. Open authentication on the mobile device and then encodes the NFC tag (Figure 2).

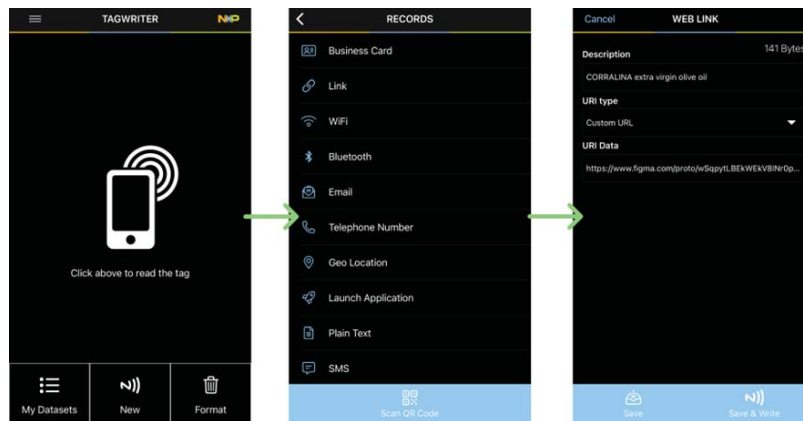


Figure 2: Encoding process through the NXP TagWriter application, part I

Considering the topic of the research, the desired link related to olive oils is being prepared, it occupied only 95 bytes. The mentioned enables the encoding of the NFC tag with other functions (Figure 3). As it was not possible at this time to write information about the conditions for product delivery such as temperature, humidity, light, and others (which can be added later), only the link was coded. Figma was used to create the prototype of the application (interactive web). The application was created to satisfy the informational and promotional needs of the customer while emphasizing the sustainability of the product through design solutions. The created application contains various information that normally appears on traditionally designed packaging (such as general information about the product, such as date and place of production, expiration date, and nutrient table), but in addition, it contains much more information about the manufacturer (brand story, contact form, social networks, gallery), a timeline showing of the maturation of oil over a certain period, tips for storing and using extra virgin oil, and ecological signs with additional explanations to the possibility of misinterpretation is eliminated.

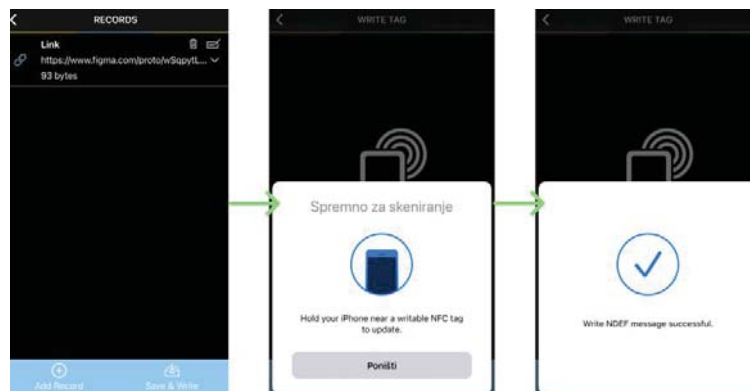


Figure 3: Encoding process through the NXP TagWriter application, part II

The steps of a photo montage of the initial screen of the conceptual solution of the interactive web with the corresponding menu are shown in Figure 4 (Web Behance, 2021). Information stored in the mentioned way is available to the customer, the website is easily updated, there is no need for printing and the consumption of printing materials can affect the environment. Printing inks and adhesives can contribute to air quality with the volatile organic compounds they contain in their composition, which contribute to the formation of L.A.-type smog. Paper production leads to air pollution with sulfur compounds of reducing characteristics, volatile organic compounds, and water oxidizing agents in the bleaching process.



Figure 4: The initial screen of the conceptual solution of the interactive web

After information storage, the NFC tag is applied to the glass packaging of olive oil. Bottles of 0.5 L and 0.75 L were used in this research. The choice of packaging material is related to the product to be contained. In the research, olive oil is studied, the nutritional properties and shelf life of which are best preserved in dark glass packaging. The dark color of the glass was chosen due to the impermeability of ultraviolet rays of light, which have a negative effect on extra-virgin olive oil, which is at the top of the hierarchy in terms of the quality of olive oils (Periyasamy et al., 2018). When ensuring the sustainability of the packaging material, glass has favorable characteristics, it can be recycled an infinite number of times. Attention must be paid to the negative properties of the mentioned packaging material, which is the weight that contributes to greater pollution during the transportation of the product. It contributes to the formation of greenhouse gases and L.A.-type smog, but the benefits of the selected material are more important than those listed. Another alternative for packaging material would be multi-layered materials that have a smaller mass but are difficult to separate or prepare for the recycling process of each individual material.

An NFC tag is applied to the packaging, above which a label with basic information about the product is applied (Figure 5). The enumerated forms the conceptual solution of the primary eco-packaging. The information printed on the label is the name of the brand, description of the product and its volume, statement about the ecological product (Caring for you & the environment), and notification about the possibility of using the NFC tag.



Figure 5. Primary eco-packaging for extra virgin olive oil

The design of the label and the interactive web is linked to two premises. One premise is related to survey research that suggests simplicity of design. The second premise stems from the fact that the minimalist design and colors from nature such as green suggest the naturalness and ecological awareness of both the packaging product and the olive oil. The language of writing on the label is English for the design to be suitable for a wider market, that is, for the conceptual solution to be applicable in a global context. The label was printed using the UV printing technique, to reduce the impact on the environment. There is no need to use printing plates, which contributes to the saving of materials, there is no emission of harmful chemicals that are used in the production of printing forms itself (Periyasamy et al., 2018). The mentioned printing technique was also chosen because of its suitability for smaller editions, and the printing of the label for organic oil production is related to smaller editions. When printing, UV drying inks were used that do not contain volatile organic compounds that have a negative effect on the environment, which was already explained earlier.

4. DISCUSSION

After naming the product and creating a prototype of the primary packaging proposal for olive oil from the described conceptual solution, it was presented to the respondents in the age group of 25 to 35 years. The group consists of equally represented persons of the female and male gender. Respondents' opinions about the experience while handling the prototype were recorded, as well as their attitudes and opinions about this type of packaging after the interaction. Based on their experience with eco-packaging, it is possible to see the advantages and disadvantages of the prototype. Part of the respondents asked for help with reading the NFC tag with a mobile phone. Not knowing how to handle the mentioned label should not be a problem if consumers become familiar with it and if packages with interactive features be more common in use. The inclusion of instructions for reading the NFC tag in the instructions for iPhone and Android users could contribute to more frequent use of the NFC tag. It is recommended to create such instructions on websites to avoid printing instructions with an increased number of pages compared to the previous ones, which would increase the unsustainability of mobile devices. It can be assumed that with more frequent use of the label, users will transmit the instructions orally, which is the most sustainable way of educating users about product packaging. Literature research showed possible implications of cultural differences on the adoption of NFC technologies that are operating in peer-to-peer mode (Özdenizci et al., 2010).

Half of the respondents with Android devices recognized the implemented technology and did not need help in interacting, i.e., reading the NFC tag. The good result could be explained by the young age group of the respondents. Once loaded, the used type of tag (NTAG216) worked well on all common NFC-enabled smartphones.

The functionality of the prototype was tested, and all the information stored on the tag could be read by the respondents. The described test is important because, in addition to the transparency of the tag, the aim is to reduce the size of the tag so that it is as little notice as possible on the packaging. Because of this, the impact point for the transmission of signals or information is smaller. The testing of the prototype showed the full functionality of the packaging product. The advantage of the used technology can be found in the fact that there is no need to install additional applications on mobile devices because

most mobile devices could read NFC tags. It is evident from the above that the technology significantly contributes to the reduction in the utilization of the device's memory space.

Most respondents, 90% of them, positively evaluated the use of the prototype, and the same percentage of respondents expressed interest and desire to use the presented type of primary packaging. From the above, it can be concluded that training on the use of NFC is easy to master if it is needed at all, and respondents about the prototype point out good features such as the simplicity and speed of available information, transparency of content, and a different interesting experience. The advantage of the prototype, which was seen by all respondents, is the contribution of the design to the sustainability of the packaging product. Ignorance of NFC as a technology and the principle of its functioning led one respondent to doubt the theft of data from a mobile device, which is not a possible scenario.

For the information stored on the NFC tag to be complete, suppliers and representatives should have the knowledge and ability to supplement information about the environmental conditions in which the product was located at the time of purchase. In this way, all relevant information affecting the durability and quality of the high-quality product, which in this case is extra virgin oil, would be presented to the customer. To make the use of the NFC tag more complete, it can be combined with sensors or NFC that record temperatures, in which case it is not necessary to add data from the supplier or dealer, which makes it easier to use the product for packaging. In addition, tag data can be integrated with real-time location reading or fingerprint reading, and facial recognition can be integrated, which helps with transaction execution. A special contribution of the NFC tag is the development of interactive packaging adapted to people with disabilities such as the visually impaired. On the website, it is possible to display text and images in a larger font or larger dimensions, and it is also possible to program text readers.

5. CONCLUSIONS

In the packaging industry, a lot of attention is paid to the sustainability of packaging products, which is additionally emphasized when packaging organic products. Buyers of organic products are especially concerned about the sustainability of the entire product. Interactive packaging is interesting for customers because it contributes to customer information. By combining both trends, a product is obtained that can be maintained on the market for many years. The NFC tag can contribute progress to the production of packaging products, due to the possibility of storing information that speaks about the quality of food products such as extra-virgin olive oil. When applying an NFC tag to a packaging product, the amount of text on the label can be significantly reduced, which contributes to reducing the consumption of printing inks. In the mentioned way, the amount of materials used and the emission of pollutants into the air that contribute to the formation of L.A.-type smog are reduced.

In this research, was made the design of the prototype packaging for olive oil based on the survey data. Wanted to design a solution that has a design desirable to customers in addition to ecological aspects. For the NFC tag to be functional, it was necessary to create a website whose link will be stored on the tag. The dominant color in the design of the label and the page is green to emphasize the ecological suitability of the product as well as the connection with the green leaves of healthy olive wood and olive fruit. The color was supported by the surveyed participants in the survey.

Prototyping consisted of applying a transparent tag with stored information on the bottle and applying the label. After creation, the prototype was tested by the user, where uncertainties in the use of the NFC tag were noticed in places. The paper contains suggestions on how to eliminate the mentioned problem. The surveyed users like the prototype and would use it in their everyday life, by which it can be concluded that the prototype was successfully created. In addition to the desired functions tested by users, the prototype contains technical and design solutions that were fully functional. Which makes another reason why the proposed solution could be considered a successful proposal. In the future, it is planned to improve the stored functions on the tag and to test the durability of the prototype.

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