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ANTI-COUNTERFEITING TECHNOLOGIES IN ALBANIAN FOOD INDUSTRY

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ABSTRACT

European Parliament has taken several actions related to the authenticity of food, including the establishment of laws and standards. Albania, as a country that aspires to join the European Union, has implemented the legal framework to meet these standards. However, there is a lack of traceability in systems that will help food companies and the government fulfill these requirements. This paper shows a prototype where food authenticity is an integral part of a traceability system. The objective is to provide a combination of Quick Response (QR) coding with anti-counterfeiting technology. This is accomplished using encryption algorithms over mobile platforms. The prototype implementation in this way implies easy data access of for business operators, government authorities as well as the ultimate customer.

JEL: M15, L66

KEYWORDS: Brand Protection, Safe Food, Traceability Systems, Encrypted 2D Barcodes, Pedigree Process

INTRODUCTION

Being able to trace food back to its origins and to prove its authenticity can be crucial to government and industry during a food-related recall or outbreak. Food companies might benefit from traceability and government may eventually demand it. But, in a large part traceability and authenticity is about building relationships with consumers and giving them what they really want, the ability to trust that they know what they are eating. In this context, consumers should be confident with their choice of foods and be able to buy according to their particular requirements. Knowing what is in their food and where it comes from sounds simple enough, but food chain traceability and food authenticity are complex worldwide issues. It requires consistent standards and adequate technology in an ever changing world. In EU countries, US and Japan, the authenticity of products is widely controlled and regulated by laws and standards. Three schemes regulate the geographical indications and traditional specialties for agricultural products. EU Regulation 1151 (2012) and EU commission guidelines (2014) define the Protected Designation of Origin (PDO), the Protected Geographical Indication (PGI) and the Traditional Specialty Guaranteed (TSG), to ensure the authenticity of dishes and regional specialties. PDO is the legal protection for product brands, which characteristics depend primarily or exclusively on the territory of production. PGI indicates a mark of origin on agricultural products and foods of a certain quality, either from the geographical origin of the product or the area of processing, preparation, manufacture. Finally, the TSG is designed to regulate products with traditional composition, or produced according to local traditions. The laws associated with these schemes ensure the authenticity of products originated within the EU, eliminating unfair competition and non-regulated products of lower quality or with substitutes that do not comply with the original product requirements.

Based on the objective outlined previously, the paper first provides a review of the literature about existing technologies used by counterfeiting systems for labeling. Legal issues, directives and standards concerning brand protection and food quality will also be addressed. Second, the idea of using encrypted QR codes in mobile systems will be explored, as part of food traceability systems. The paper will conclude with remarks and an outlook on future research.

LITERATURE REVIEW

In the EU, the protection of a product's brand is regulated and controlled by three standards (PDO, PGI, and TSG) which also ensure a safe and quality food product. One component of a "safe" food product is its' traceability. The European Commission Regulation (2002) defines the principles and legal obligations that each entity, that delivers or manufactures food product, should comply with, including the traceability system. All entities in the food industry, that have implemented the traceability system, should be able to identify the life cycle of their product from one point in the supply chain to another (including raw material, ingredients identification, premises identification and product movement). Nevertheless, traceability requirements are not applicable to entities selling the final product to consumers.

In Albania, the National Food Authority (NFA) was initially formed in 2007. Assisted by foreign expertise and EU funds, the authority was officially introduced on 20 May 2010, supported by a decision of the Council of Ministers, DCM 1081 (2009). Today the institution covers 12 regions in Albania, with nationwide coverage. The goal of this institution is to oversee the food safety in Albania and meet the requirements of the Stabilization and Association Agreement (2006) signed between the EU and Albanian government. In social terms, the creation of the NFA, entitles the Albanian citizens to consume products as safe as those consumed by the citizens of the European Union member states. European Commission (EC) assists through the CARDS project (Community Assistance for Reconstruction, Development, and Stabilization), the establishment and functioning of NFA. This is done in accordance with the best models of EU member states that match administrative features, legal, demographic and food security issues in Albania. EU supports the further consolidation of NFA, within the IPA program (Instrument for Pre-Accession Assistance) for the years 2010-2013. This program has envisioned a number of projects, which support components for food safety, safety products with non-animal origin etc.

Another important step in aligning Albanian legislation with EU laws is the passing of the Law 9863 (2008) on FOOD. This law defines general standards for food quality, food labeling, registration of geographical indications and the labeling of controlled origin. It specifies the definition for "tracking" as the ability to trace and follow a food, feed, animals that produce food, or specified substances that are, or are expected to be, associated with a food or feed, at all stages of production, processing and distribution. This law includes the ability to trace and follow imports and raw materials for food production, storage, transport and sale, or supplying of the final consumer. Food business operators are meant to establish a system for maintaining the data (e.g. a database), to guarantee procedures which enable their identification in every moment. These operators should keep this information for three years. The geographical indication is the name of the region, specific place or, in exceptional cases, the country name used to describe the food that 1.) Comes from this region, specific place or the place of use, or 2.) Has a special quality, reputation or some other features, which are attributes of its geographical origin and the production, processing and preparation are performed in this geographical environment.

The indicator "Traditional food product" is assigned to a food if it is produced with traditional raw materials, has a traditional composition, is produced or manufactured in a traditional way and stands for special features of the foods of the same category. This law defines administrative violations and penalties with fines ranging from hundreds of thousands to one million for actions contrary to the requirements of traceability, defined in Article 25 of this law, and for the use of "Traditional food product" note, contrary to Article 33 of this law.

Considering the known counterfeiting systems for labeling, most are based on data carriers like RFID or bar codes. The Radio Frequency Identification technology is a method of uniquely identifying items using radio waves. Typically, a reader communicates with tags that holds digital information in microchips. For RFID systems we mention "Call-in the Numeric Token" (CNT) technique proposed by Johnston (2005). The idea behind this mechanism is to generate a random, unique and unpredictable identity number, which is a virtual tag or token, assigned to each product. The mechanism relies on difficulties in guessing valid identifying numbers and requires customer participation in authenticating the products they purchase. By setting an appropriate threshold, any item with a high-enough instance of query for validation would be deemed counterfeit. Another mechanism based on RFID is research done for tags performing secure authentication on an EPC Network. The Electronic Product Code (EPC) is a global unique identification service for physical objects described by Brock (2001) in a white paper. A non-profit organization like EPCGlobal developed global standards to increase visibility and efficiency throughout supply chains. Tags respecting their 2-generation standards can reliably authenticate product items if they are unique.

While RFID tags are difficult to counterfeit, the barcodes are not. Due to their structure, they are simple to copy. Different techniques are developed to combine with barcodes as watermarks or holograms. Xie et al. (2013) proposed a kind of graying algorithm for binary images, to make possible domain-watermarking transformation methods. They showed through experiments the proposed watermarking scheme for QR 2D barcode, greatly improves anti-counterfeiting performance without loss of barcode information. Companies like DuPont implemented 3D security holographic technology. They use advanced overt authentication imaging technology for brand protection on the packaging of products.

Our research focuses on the goal of adding security to the data carried by the barcodes without adding considerable cost to existent barcode systems. We explain how to implement this in the latter section, introducing an encryption mechanism of data carried by QR barcodes.

THE USE OF ENCRYPTED QR CODES IN MOBILE SYSTEMS AS AN ANTI-COUNTERFEITING TECHNOLOGY

In our recent article, Vukatana and Hoxha (2014), is proposed an architecture for Albanian products that applies traceability based on smartphones and 2D barcodes. The architecture is compliant with all points discussed in the introduction of this article including both Albanian and EU laws, directives and guidelines. The research is focused on QR code as part of the second generation of barcodes known as 2D barcodes. This type of barcode is chosen for two principal reasons. First, according to US Mobile Marketing (2013), the growing trend of spending on mobile recognition, ought to almost double in the 2014 to reach $164 million, where QR codes are a primary component. This trend continues to grow strongly, reaching $364 million in spending by 2015. That estimate is based on reports of increased scanning levels. ScanLife, a global leading company providing cloud-based mobile solutions and QR Code technologies, stated that it processed 18 million scans via its ScanBuy application in Q1, 2013. That is up from 13 million scans in Q1 2012, which in itself was up 157% over Q1 2011, as shown in Marketing Charts (2013) report. Second, Kato and Tan (2007) show that QR codes are the mostly used through 2D barcodes integrated in camera phone applications. Both, database-based codes (VSCode and Data Matrix) and index-based codes (Visual Code, ShotCode, and ColorCode) are benchmarked in their analysis.

Barcodes are data carriers associated with the process of labeling a product and also used in the overall process from the producer to the consumer, for different tasks as storage, producer ID, sales receipts etc. The large use of barcodes in the food products has driven us to choosing QR codes because the implementation of our system through labeling will be the best choice. It will reduce the costs for taging and keep data storage to a minimum as the barcoding technologies are already implemented by labeling operators. As long as we use barcodes for process traceability and the transparency of the product to the

customer, the system remains robust. The problem arises when the label is counterfeit and the control entities (NFA) are not able to differentiate an original product from a counterfeit.

There exist different anti-counterfeiting technologies. We enumerate only two processes from innovative packaging technologies and better business applied in pharmaceutical security field, described in Bansal et al. (2013) article, which can be adopted in our system. First, is the process of track and trace. It consists of assigning a unique identity to each stock unit during manufacture, which then remains with it through the supply chain until its consumption. Information is added through step-by-step, interacting with a secure database that is accessed through the unique identifier given at the initial phase. Second is the pedigree process. The pedigree process is a paper document or electronic file that records the details of distribution of a given product from its manufacture through wholesale transactions, until it is received by the final operator, which is usually a retailer.

In our implementation, these concepts are mixed to fulfill our established goals. In the first step (Figure 1), a serialized number is generated from the system at the request of the producer. It is included in a standard GS1 structure called Serialized Global Trade Item Number. It is a unique number that identifies a particular trade item, created by appending the serial number to the Global Trade Item Number (GTIN) of the product, where GTIN is a 14/13/12/8 digital unique identification number and is assigned by the manufacturer in accordance with GS1 allocation rules, for trade items, products or services. The generated identifier is then encrypted and the result (QR code image) is given to the producer, which includes it on the label of the product. The encryption protects the process of generating serial numbers from third parties that want to know how the system creates them. This process is also protected in the decryption phase at the steps 5, 6 and 7 when food business operators access the system to add traceability data.

Figure 1: Flow of the Data (Pseudo-Code)

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1. serialized number
    2. → (encrypt) → encrypted compressed message
        3. → (QR encode) → QR of encrypted compressed message
            4. … send over secure channel …
        5. encrypted compressed message ← (QR decode) ←
    6. compressed message ← (decrypt) ←
7. serialized number
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The system has two principal security roles for operators (business and authorities) and consumers. The first group can use smartphones and easily access information about the product. Business operators in the food chain like producers, packagers, carriers or retailers can modify traceability data. On the other hand, authorities like NFA inspectors can access the system to verify through traceability and the serial number if a product either is counterfeited or meets the requirements of EU and Albanian laws noted in the literature review section. The second group, the consumers, can access in read-only mode through the software on their smartphones all the information about a food product.

The system's open and modular architecture allows food concerned operators and businesses to easily add or improve existent modules. For this, we simulate the transformation of an existing process from a company that makes natural water, into the proposed system. It begins with assigning a QR barcode and placing it on the label wrapping the bottle. When the user scans this code through a decoder on smartphone, the application redirects to the company webpage. This page shows information about source, place of bottling and the ISO certificates that the product is compliant. In the simulation, adding traceability data from our system enhances "product safety" and brand protection. These data include information like

packaging date, storing days and the last retail of the bottle. Meanwhile for brand protection, information like serial number, expiry date and lot number is used to match against information stored on the label.

CONCLUSIONS

This paper considers the traceability system architecture for food products (Vukatana and Hoxha, 2014), with the focus on secure and anti-counterfeiting labeling. It shows the first phase of setting up this architecture for the "Made in Albania" brand, in terms of security (authorities), traceability (producer, authorities and consumers) and transparency (consumers). It analyzes the principal data carriers like RFID chips and barcodes and the systems based on them. The data carriers choice falls on the 2D barcode, or more concretely on a QR code, for two principal reasons. First, their low cost against the use of RFIDs. Second, statistics show that QR codes are the most used by mobile devices, comparing to other 2D barcodes. All the considerations in this paper comply with EU legal issues, directives and standards, concerning brand protection and food quality, and respect the Albanian laws on regard.

Future work will address the identification of consolidated sectors of food in Albania (e.g. dairy, seafood, wine, etc.), to create the right database modules. The information stored in these modules will conform to standards and laws reflected in this article and will help the business actors to fulfill these obligations. The system will address another important issue, that is managing the data flow in real-time databases.

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