An NFC-Based Solution for Discount and Loyalty Mobile Coupons

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***Abstract*— Today, the success of the business model "deal-of-the-day" it's not a secret; in fact, it is manifested by the large amount of economically stable companies that operate nowadays, always trying to bypass the traditional media through promoting the use of smartphones. In this paper, we describe a complete ecosystem with similar purposes that makes completely expendable the paper support. The system is called WingBonus and it is responsible for dissemination, distribution, supply, validation, and managing of vouchers, loyalty point card and all kind of coupons using NFC. WingBonus is also a platform for advertising all kind of products and a great system for making market research. The system is accessible through its Website and a mobile application for managing coupons. The mobile application uses NFC technology to supply and exchange m-coupons. The Website allows the user to manage his/her account movements, providing a complete way of system data maintenance.**

Keywords: marketing; mobile devices; coupons; Near Field Communication; vouchers

I. BACKGROUND

Times we live are especially difficult because of the global crisis that affects practically the entire population since 2008. This crisis is pushing regular citizens to save money and to seek cheaper prices when they purchase products and services. Obviously, the financial crisis also affects companies, both large multinationals and small and medium companies, therefore marketing strategies become more necessary than ever.

Because of this economical factor and considering the extending of the smartphone over traditional mobile phones, there has been an adaptation of marketing and loyalty techniques at these times, creating the concept of m-coupons or mobile coupons [1].

Today, many companies often use coupons with different purposes. Some companies use these coupons as a way to provide additional services to their employees for different shops or business.

For example, there are food tickets that employees can use in restaurants where companies have agreements, sometimes in order to pay in kind. Another widespread example of using coupons is in malls and manufacturers.

These coupons (in paper) provide general discount at one or several products, in order to increase customer loyalty to a company or product.

Near Field Communications (NFC) [2] is a suitable technology to replace traditional disadvantages of using classical vouchers or coupons and replace them by m-coupons.

This paper presents an ecosystem responsible of dissemination, distribution, supply, validation and managing m-coupons, reducing costs to the businesses and generating valuable knowledge to the companies about users and trends. Besides, it may help to customer loyalty, performing an increase of sales.

The proposed system, called WingBonus, is based on NFC technology, and thereby, it uses mobile, wireless, and RFID [3] technologies.

M-coupons can be provisioned through a web connection, Bluetooth server, Smart Poster or any NFC-reader located at partner establishments, being safely stored in the mobile phone. Thus, m-coupons are always carried out by the user, without number limit, and ready to be used.

Hsueh and Chen [4] propose an m-coupon sharing scheme that uses mobile devices to distribute coupons among existing social networks increasing m-coupons exchange. In this scheme, the company first selects targeted members and then sends a virtual coupon book and a virtual sharable coupon book to each of these targeted members. The targeted member is encouraged to forward the sharable coupons to his/her peers. The m-coupons contain simple hash chains for security.

Aigner et al. [5] propose a system of virtual coupons (so-called mCoupons) that are protected against illicit use. NFC in combination with inexpensive passive tags is used to prevent attacks in a decentralized approach. Moreover, they give a short list of possible attacks.

On the other hand, Hsiang et al. [6] propose a secure and efficient scheme for only use a few hash functions. There is a secret key that the issuer and the cashier know. Only authorized issuers can produce valid mCoupons because they know the secret key. The cashier can verify mCoupons with the secret key. The proposed scheme might satisfy all the security requirements needed in the mCoupons system using NFC technology.

Within the mobile application market, there are applications like Groupon [7] that daily provides discounts and offers localized in most international markets through agreements with partner commerce. The Groupon offers are called "*deals of the day*" because they only are available for a day.

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One difference between WingBonus and the existing applications is that the former does not only uses NFC to obtain and to exchange coupons, it also uses QR [8] codes, so that people that do not have a NFC enabled phone also can use the application until all smart phones support this technology. Besides, the user can filter the offers that he/she wants to see based on his/her preferences.

Another difference lies in the safety of the coupons. Coupons information is encrypted through a symmetric-key algorithm called BlowFish [9] when the information is saved in the mobile database. Moreover, when the coupon is exchanged, the partner establishment checks the accuracy of the coupon information against the WingBonus server.

WingBonus is a web and mobile system devoted to the management of partners that offer virtual coupons. Using NFC or QR and wireless and Internet technologies, users can select, download, exchange and transfer m-coupons with a full, personalized and safe management of the information.

II. System Architecture

Current offerings are usually limited to discounts and vouchers for partners companies. There are more types of coupons supported by WingBonus, like a type similar to the "season tickets". Users can get packages of products or services with a reduced cost.

For example, a user can buy ten vouchers for dinner at a particular restaurant and pay for eight of them. Each time that the user goes to enjoy one dinner, he/she will have to exchange his/her coupon through NFC using WingBonus mobile application until ten exchanges.

WingBonus also includes an implementation of loyalty point card. We call these cards "chits". Using this feature, a user can earn points every time he uses the services of a trade partner. When the user reaches a certain amount of points, he can exchange them for goods and services in the same trade. The desire to score points builds user loyalty.

WingBonus makes completely expendable the paper support for the entire process of using the system, from coupon supply to the exchange, can be done electronically through an Internet connection and NFC technology (see Fig. 1).

The proposed architecture for WingBonus allows supplying of all kind of coupons to users and this action can take several ways. The user can acquire coupons via Smart Poster using NFC technology, through a Bluetooth server or being transferred from another user (Fig. 1, Step 1).

The Smart Poster might contain all necessary information of the coupon, as well as the Bluetooth server might send it, otherwise the information gathered from the Tag or Bluetooth server will be sent to the server (Step 2), and once it is validated (Step 3), the server will retrieve the coupon information from the database (Step 4) and send back to the mobile application (Step 5).

In a similar way, users can transfer or recommend coupons between them through NFC. Like using the Smart Poster, this transferring can correspond to the whole information of the coupon or just a mark to get it later from the server.

Alternatively, coupons can be downloaded straight from WingBonus mobile application using a synchronizing procedure and selecting the desired coupons (Fig.1, Step 6).

Moreover, WingBonus provides a safe way to exchange the coupons at partner establishments using NFC. The communication is peer-to-peer. Thus, coupon information is first sent to the NFC reader (Fig. 1, Step 7) and then the PC connected with the reader verifies this information against WingBonus server (Fig. 1, Steps 8 and 9). Finally, the PC at the establishment returns a result through NFC to the user's smartphone, showing if the operation was successfully completed (Step 10).

A. Objectives

WingBonus is positioned as a complete ecosystem capable of encompassing all marketing variables that use means saving for users. In fact, the most powerful feature consists on supplying users all types of coupons, providing its safe use and management with NFC and mobile application.

The system allows two types of users: registered and anonymous. The coupons available for each user type show different characteristics. For example, there will be coupons which companies will be interested of knowing who kind of people (age, job, status, etc.) downloaded and used these coupons. If the company does not care about this information, everybody can download coupons as anonymous.

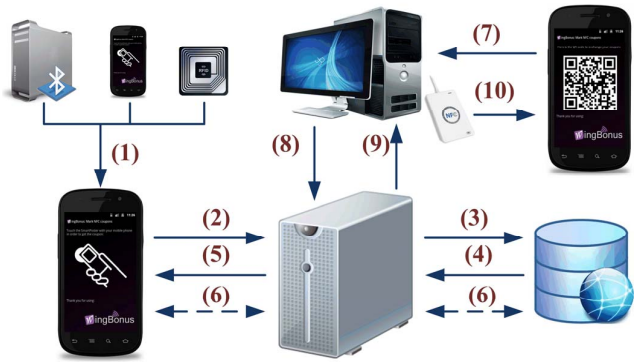

Figure 1. WingBonus architecture

The system provides to the registered users a total control over the actions they can perform with all types of coupons through an access to WingBonus website. This feature allows the user to view all his/her history in the system: coupon movements, selected, provisioned, exchanged and cancelled, and so on.

Furthermore, WingBonus stores preferences of registered users about wished coupon characteristics. The preferences control of website and mobile applications, generate tailored web page interfaces as well as procedures for capturing of bonus information and its later provisioning in the mobile database.

By using and NFC-based peer-to-peer communication for the coupon exchanging process, the software used for

validating coupons or exchanging points at partner establishments can transfer useful data of such process. An example is the location of the establishment determined by GPS. The fact of having all these information in addition the data related of supplying coupons, allows the production of value-added information of great interest to contracting companies. With all those data WingBonus can make market research that could help companies to grow their businesses.

Figure 2. Some snapshots of WingBonus Mobile Application

The simple and wide diffusion of the coupons is an advantage for clients as well as for users. Usually, when companies use a coupon as a marketing tool, brands want to have the maximum diffusion as possible. WingBonus provides great diffusion thanks to various distribution channels: Smart Posters with Tag and QR codes, WingBonus website, mobile application and Bluetooth server.

B. Mobile Application

In order to facilitate the user interaction and for the proper functioning of the system, an Android application has been developed.

When users run the application for the first time, a screen as Fig. 2(a) is shown. If the user is registered, he/she should enter his/her credentials on the system preferences window. That window is accessible by an option menu and it also allows defining several viewing options like sorting coupons by date or name, number of coupons shown, favorite categories, etc.

Once the user is identified (as registered or anonymous user), the application shows a main menu. All the options are accessible through this main menu that is shown in Fig. 2(b),

differentiating two separated options to manage coupons and chits.

From coupons menu, users can perform any operation related with those elements. For example, users can download coupons directly as shown at Fig. 2(c). All the management options such as remove coupons, view a single coupon detail (Fig. 2(d)) and to use a coupon are accessible from this menu.

The provisioning of coupons in the mobile application is performed by a secure synchronization procedure. This procedure is in charge of: a) to send to the server side all information stored in the mobile database to be checked, b) to receive all new information (coupons) from the server and store it in the mobile database.

Thus, in this process the server side sends to the mobile application all coupons previously marked or selected by the user as well as other coupons that the user had selected from smart posters, Bluetooth servers or using the mobile application with friends.

Users can access to detailed information of each coupon, as shown in Fig. 2(d). Description, economic data and coupon status about relevant dates is shown previously to the coupon exchanged.

Furthermore, the user can ask a map with information about the place where the coupon can be exchanged, as Fig. 2(e) shows.

For this purpose WingBonus uses the Google Maps API what allows displaying the route from user current position, obtained by GPS if it is available, to the allowed closest establishment where the coupon can be exchanged (Fig. 2(f)).

C. Server Website

Supporting the mobile application WingBonus also has a website developed without using content management systems and powered by languages such as HTML5, CSS3 and Javascript.

WingBonus website is in charge of the advertising and management of m-coupons, companies, users, brands, and so on. Information about the coupons is shown to the user according with his preferences.

Fig. 3(a) shows the main page for access to account management and list last coupons offered.

By clicking over each coupon, the system displays detailed information such as conditions and geolocation through Google Maps as is shown in Fig. 3(b). User can mark the wished coupons from the website to be later provisioning and discharged in the mobile database.

In addition, users can access to a complete history of coupons movement thanks to the data obtained in the synchronization process, as Fig. 3(c) shows. These reports include data about all information related with coupons processing: brands, exchanging points, provisioning, transferring and coupons exchanging, etc.

WingBonus Website is not only a user-oriented portal. There is also a single access gateway for system administrators, allowing the insertion and editing of all types of data present in the system, from corporate clients to coupons issued at any time. An example of a form for introducing new coupons in the system is shown in Fig 3(d).

D. Synchronization process

WingBonus includes a self-built protocol developed with Java using the secure sockets layer (SSL) [10] for the synchronization process between the mobile application and the server side.

Ideally, communication should be direct from the mobile application to the database server. However, Android uses SQLite and it does not has access to an external SQL database. Thus, synchronization must be ad-hoc developed between mobile and server databases.

We choose to use a lower level of implementation instead of other possibilities such as web services. For example, an option for implementing communication is using a protocol such as SOAP [11] or sending XML files that would be parsed later in the mobile application for extracting the requested information.

Although in some synchronizations the transferred information between mobile and server application could be low (few number of coupons), usually the synchronization process will require the exchanged of new preferences, download of new coupons, upload of mobile coupons, etc. In any case, the time required is negligible.

Thus, Java multithreading sockets server communication has been used, allowing a high control over the security and data integrity.

The developed synchronization protocol distinguishes several kinds of messages, one for each data type of information exchange. These messages are “login” to identify the user against the server; “get latest coupons” for downloading the latest coupons which will be shown and chosen from the mobile application by users; “sync marked” to download the marked coupons without consider where they have been selected; “sync exchanged” for upload to WingBonus server the usage information; and “sync downloaded” to send the information of downloaded coupons.

III. Discussion

The combination of NFC with the growing success of mobile technology, will allow in the near future the development of “ideally” smart environments [12], which were conceived decades ago.

The application of NFC to this project offers many advantages over existing systems. There are several and important companies that provide discount and offer services. However, getting and using coupons, is not always easy. The main weak point is the client’s interaction with the coupon and the company or system that serves the product or service.

The use of NFC and its application in mobile devices provides to users an easy way for acquisition, storage, management and use of m-coupons. Besides, these features make the process fast, secure, efficient and transparent.

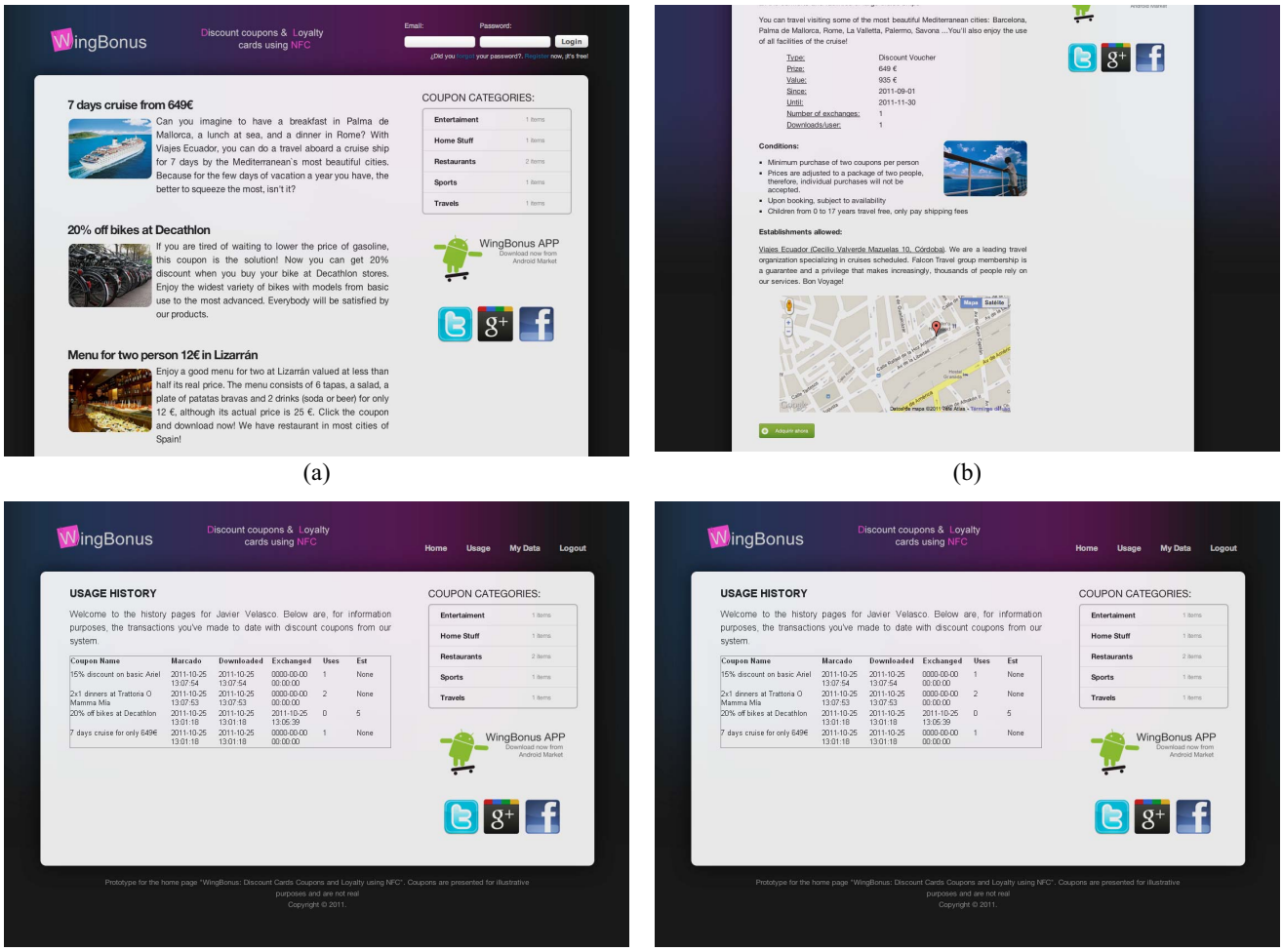

Figure 3. Some snapshots of WingBonus Website

WingBonus allows consumers to take advantage of all offers made by companies. This guarantees a huge saving on the purchase of consumption products. M-coupons are transported in the mobile phone without any possibility of lost or forgotten.

For partner companies, WingBonus offers great advantages: reduction of costs, elimination of paper, to reach more customers, elimination of forgeries, real time tracking, market analysis, study of trends, to build loyal customers, etc. Moreover, the commerce where the m-coupons are adopted benefit from the speed and safety of the process.

Currently, we are working in the improvement of the system described in this paper in order to add new features and also allowing the storage of the m-coupons in the secure element of the NFC phone.

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