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Design of a Smart Coupon System

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Abstract

Most customers of shopping malls get a discount or a rebate with coupons. In order to promote merchandise consumption, businesses issue and distribute coupons. With the coupons, they increase sales by encouraging repeat purchases, by increasing product awareness, by attracting customers with a new product, or by encouraging customers to purchase a large quantity of an over-stocked product. As electronic devices evolved, electronic coupons appeared. Mobile coupons have been widely used and are replacing traditional paper coupons. Nowadays, smartphones with powerful computing capabilities, huge memory capacities, and various sensors are carried by almost everybody. Smart coupons are distributed via short message service, multimedia messaging services, peer-to-peer communications, and so on. Customers can save money with coupons while merchants maximize profits with them. Therefore, this paper reviews existing coupon systems and discusses the design of a smart coupon system.

Keywords*: Coupon, Electronic Coupon, Mobile Coupon, Online Shopping*

1. Introduction

It is widely believed that coupons attract more consumers to buy goods, leading to higher profits. There are many kinds of coupons, such as direct mail coupons, newspaper coupons, and package coupons [1]. Electronic coupons can be downloaded from websites or received from other end users via peer-to-peer coupon pushing services, and can be stored on mobile devices [2].

This paper reviews existing coupon systems and introduces a design for a coupon system. Server components of the system include a coupon management system and a distribution management system [3]. The coupon management system manages merchants, coupons, and subscribers. The distribution management system records information on orders and sales. Client components include a coupon collector system and a shopping mall system. Coupon collectors can collect them via the coupon collector system. The shopping mall system displays coupons for distribution on the user interface, and takes orders placed by customers.

2. Related Work

A scenario for peer-to-peer distribution is described in Figure 1. A customer purchasing something from a store gets an electronic coupon. From that moment, a copy of this coupon can be pushed to anybody through WiFi connections. A receiver can also forward a copy of the coupon to others. If a receiver redeems a coupon at the store, then a certain amount of credit or bonus is given to the forwarder [2].

WingBonus, a web and mobile system devoted to the management of partners who offer virtual coupons, was introduced by Sanchez-Silos *et al.* [4]. Using near field communication (NFC) or quick response (QR) codes and wireless and Internet technologies, users can select, download, exchange and transfer M-coupons with full, personalized and safe management of the information.

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The architecture of WingBonus is illustrated in Figure 2. A smart poster is a combination of the visual impact of a traditional poster with near field communication, and a user can purchase vouchers through smart posters or obtain ones from another user who wants to transfer vouchers (step 1). When the user sends a piece of information obtained from the smart poster to the server (step 2), the server retrieves detailed information about the voucher by referring to the database (steps 3 and 4), and sends it back to the user (step 5). There are two ways to obtain vouchers. One is direct access to the server (step 6), and the other is to access it through a partner establishment (steps 7 - 10) [4].

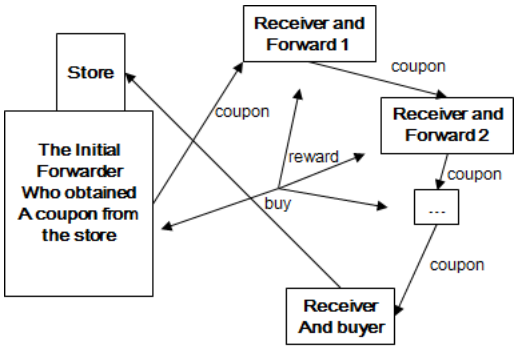

Figure 1. Typical Scenario of Peer-to-Peer d\Distribution [2]

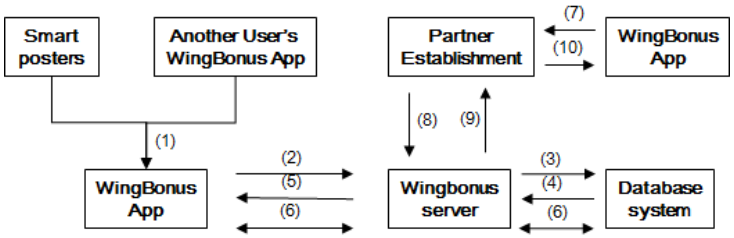

Figure 2. The Architecture of WingBonus [4]

Groupon is an American online group-coupon sale company. Groupon helps local businesses to sell discounted coupons. Groupon salesmen talk directly with local businesses to persuade merchants to offer deals. Merchants publish the deals on a website. The deal is 50-90% off the regular price. But the deal can vanish if the number of people who sign up is not greater than a predetermined number. Customers buy the deals and redeem their coupons. Finally, Groupon pays merchants their share [5].

Advance selling of coupons features deep discounts, long coupon durations, but some of them are not redeemed. Wang [6] built the advance-selling model, investigated the effect of it, and found optimal advance-selling strategies. Near field communication is a radio frequency communication link between closely located devices. An NFC mobile coupon (M-coupon) is a cryptographically secured electronic message with some value. Users obtain an M-coupon by reading an M-coupon from an issuer (for example, a smart poster or newspaper) with an NFC mobile. Later, they can redeem the M-coupon at the store. A formal definition of the NFC M-coupon requirements was presented by Alshehri and Schneider [7].

By analyzing sample deals from Groupon, Huang [8] found that people repeatedly purchase coupons that belong to certain categories. Based on this fact, Huang concluded that keyword matching is a viable technique in personalized recommendation systems for these categories. M-Coupons are coupons that can be collected and stored on a mobile device and can be redeemed at the store. Most

mCoupon systems use NFC technology because users can conveniently obtain and use mCoupons through NFC. However, mCoupon systems are vulnerable to attackers and illegal users. Hsiang [9] proposed a secure and efficient mCoupon scheme that may satisfy all the security requirements.

A location-based mobile coupon service pushes coupons that are issued by stores immediately nearby users. This service might reveal the user's location to malicious entities. A privacy protection mechanism for location-based coupons using an anonymous authentication method was proposed by Kazeminia and Ghahfarokhi [10]; factors affecting personal information disclosure were studied by Wang and Liu [11]; and a secure mCoupon authentication scheme was proposed by Park and Lee [12].

3. Proposed System Design

Considering these existing coupon systems aided the design of this coupon system. Requirements are as follows.

1) When an order is placed, let the merchant know the order in detail.
- Whenever an order for purchase is made, the details of the order, such as the item ordered, quantity, total price, and so on, should be immediately sent to the merchant via email or smartphone message service.
- If the merchant does not read the message with details of the order, then the system should retransmit the message.
- This service should be made as an EXE, so it can be registered in the Windows Scheduler.
- Merchants should be allowed to specify a convenient time to receive messages. They should also be allowed to choose a preferred message type (short message service, email, or both).

2) When an order is placed, let the customer know the order details.
- Send order information in detail to the customer when an order is completed.
- If the customer registers for delivery, inform the customer once a day as to where the merchandise is.

3) Mobile web for ticket collector
- Through this mobile web, ticket collectors should be able to check on purchased coupons conveniently. In other words, this web should be able to verify coupons with not only coupon numbers but also the customer’s name and cellphone number. If the collector enters a coupon number, a username, or a cellphone number, then it should display a list with the merchandise name, the customer’s name and telephone number, the date of purchase, and the number of sold coupons associated with the entered data. For example, if a customer name is entered, a list of coupons purchased by him/her is displayed. For each order, the number of coupons purchased and the “checking multi-coupons” button is also displayed.
- The number of coupons purchased and the “checking multi-coupons” button should be linked to a page where coupons can be checked.
- In the check-coupons page, many coupons can be checked at the same time, if one person bought many coupons.

4) Coupon supply chain management
- This management system allows the manager to check coupons on behalf of ticket collectors, so the system manager checks coupons when the collector asks to do so. A user interface to conveniently retrieve coupons with customers’ names and telephone numbers should also be provided.
- This management system should allow users to retrieve coupons and to extend the expiration dates of selected coupons.

- Extension of expiration dates and discarding expired coupons should only be done in this management system.

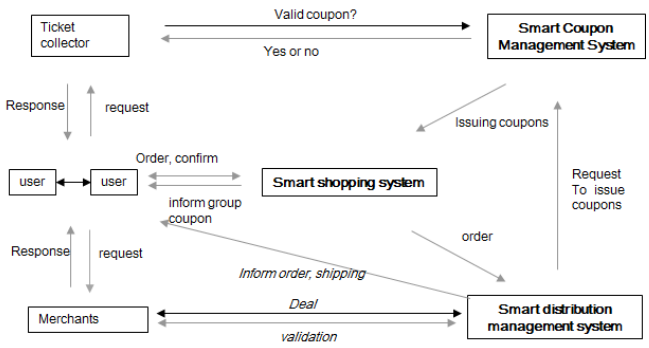

Figure 3. The Structure of the Coupon System

The structure of the system is shown in Figure 3. Merchants make a deal to sell coupons, including group coupons, with the system, and then the contract is recorded through the smart distribution management system (SDMS). Then the SDMS asks the Smart Coupon Management System (SCMS) to issue coupons. The coupon will appear on the Smart Shopping System (SSS), which pushes information about the coupon to users, as well. Users can purchase coupons from the SSS and redeem them at the stores (merchants) and tourist attractions (ticket collectors). Users can also transfer coupons to others.

Users of the coupon system obtain points if they subscribe to the system. They also get extra points if they purchase certain merchandise. The design of the user interface for subscriptions is shown in Figure 4. As soon as an identifier is entered, the system checks to determine if it was already used by another subscriber. This system provides a zip code search service. If the user clicks the search button, the zip code search window pops up. When the user enters part of a postal address, a list of full postal addresses in which the entered string is included is listed with their zip codes. When the user selects one postal address in the list, the address is entered in the form. This interface asks users whether they want to receive promotional emails and short message service (SMS).

SCM System

Subscription Page

Merchant's Information	
Name	
Identifier	Available? No special characters allowed
Password	At least 8 characters. At least one special character and a digit must be included
Postal Address	Zip code Search
Office Phone	
Cell Phone	
E-Mail	
Receive promotional e-mails	
Receive SMS	

Figure 4. The Design of the User Interface for Subscriptions

SCM System

Supplier Page

Supplier's Information

SCM Login ID		Company Name	
SCM password		Password confirm	
Description			

Contract Information

Company chair's name		Company registration number	
Company Address	Zip code Search		
Company delegate		Telephone number	
Fax		Mobile phone	
Company's Bank account	Bank name	Bank account	holder
Distribution type		Sales commission	
Company Accountant		Mobile Phone	
Settlement type	Daily/Weekly/Monthly/Quarter/Half-yearly		

Partnership Information

Partner company name		Partner company ID	
Partnership type		Partnership period	
Memo			

Figure 5. Layout of the Supplier Information Page

SCM System

Merchandise Registration

Merchandise Information

Merchandise Name			
Classification	Scroll and search	Model name	search
Supplier		Manufacture	
Country of manufacturer		Brand	
Distribution type	scroll	Tax rate	scroll
On sale	scroll	Status	scroll
On display	scroll	Expiration Date	
Coordinate			
	Example: Coordinate of Gyeongju National Museum is 35.829856, 129.227281		
Memo			

Video Information

Video URL	
	(Example) rtmp://vod.opensmartplatform.com/vod/test.mp4

Price and Promotion Information

Supplier's price		Normal Price	
Sale price			

Figure 6. The Design of the User Interface for Merchandise Registration

SCM System

Merchandise Information | Merchandise Retrieval

Merchandise Retrieval

Condition for retrieval			
Merchandise	Name	Classification	search
Supplier		Brand	
Status		Type and tax	
Registration Date		Update date	

retrieval | registration

result

Number of lines												
☐	code	image	name	classification	brand	supplier	Sale price	Supplier's price	On display?	On sale?	Registration date	Update date
☐	1230											
☐	9346											
☐	5432											

Change display status

Figure 7. The User Interface to Specify the Display of Merchandise

Only authorized merchants can register their merchandise in the smart coupon system. They have to make a contract for selling merchandise with a representative for the system and subscribe to the system. The design of the supplier registration page is shown in Figure 5. Sometimes, it is necessary to obtain refunds from a company if customers return purchased coupons. So, it is necessary to have the merchant's bank account information. Most companies have a partnership with other companies. For example, banners that are linked to the Korean Traditional Tea Café coupon page can be displayed on a Korean restaurant coupon page. If users click the banner and purchase café coupons in order to have tea after meal, then the café pays a small part of its sale to the restaurant.

The SDMS allows merchants to register their merchandise in the smart coupon system. The design of the user interface for merchandise registration is shown in Figure 6. Examples of 'merchandise name' include "Red Roof Restaurant." For classification, the system provides a scrollbox and a search service. The merchandise classification system has three levels. Leisure, culture, food, amusement, and others can be found in Level 1. Level 2 under Food has Western style, Korean, Chinese, Italian, and others. Under Food>Korean, one can find seafood, meat, poultry, vegetable, and the "Others" categories.

The SMS allows the system manager to display registered merchandise in the shopping mall. The design of the user interface for displaying merchandise is shown in Figure 7. Before clicking the 'Change display status' button, the manager should retrieve the registered merchandise and designate the merchandise items on which the change will be applied.

Merchandise where the display status is set to "display" can appear in the shopping mall. The layout of the shopping mall's main page is shown in Figure 8. A list of category names is displayed at the top. When one of the categories is selected, a sequence of videos is played in the Video window. When a merchant registers merchandise, a video advertising the item can optionally be registered. All the videos advertising the products belonging to the selected category are played in the sequence specified by the system manager. The main page has three floating image buttons. They represent the most recent popular merchandise. If the customer clicks any button on the main page, the order page pops up.

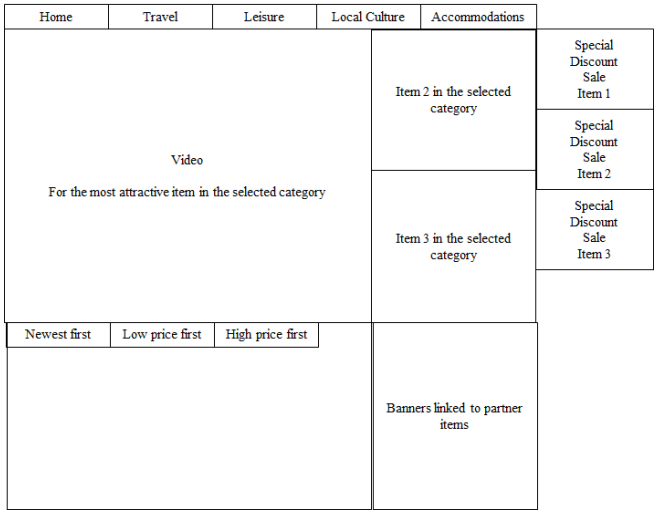

Figure 8. A Schematic Description of the Layout of the Shopping Mall Main Page

The design of the order page is shown in Figure 9. The regular price of the selected item, the manufacturer, and the delivery charge can be found on the page. One of the most important features of this page is the scrollbox where the user can select the type of user and the number of coupons the user wants to purchase. The types of user includes, if the age is the factor, for example, above 19, between 13 and 19, between 6 and 13, between 2 and 6, and "under 2 is free if accompanied by adults" for this box. Users can move forward to purchase the coupons after checking the number of coupons and the total price.

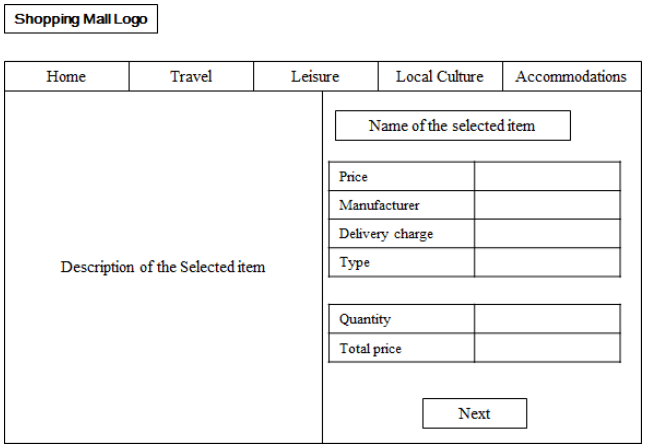

Figure 9. The Design of the Order Page

SMS allows system managers to specify "used" on coupons when coupon collectors ask them to do so. In addition, system managers can extend the expiration date of a coupon. The design of the coupon management page is shown in Figure 10. Managers can specify, at most, six conditions, which can be connected by Boolean 'AND' and 'OR'. System managers can select one or more coupons in the results and change the expiration date and the 'used' status of the selected coupons.

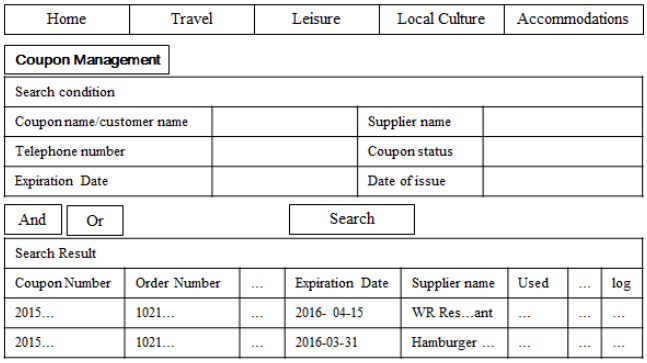

Figure 10. The Design of the Coupon Management Page

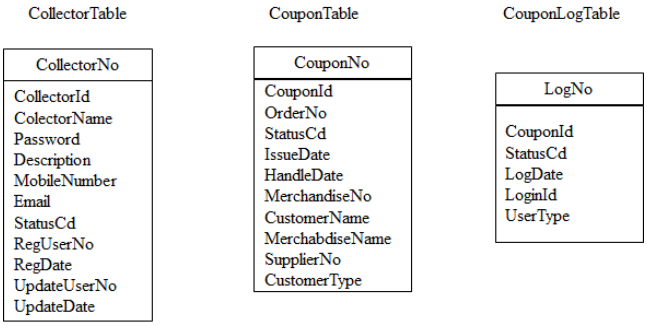

Figure 11. Tables to Record Coupon Information

One of the most important components of the smart coupon system is the database. The database system, in addition to the tables, includes all online shopping systems; for instance, the menu items, users, groups, roles, merchandise, categories, baskets, and so on, as shown in Figure 11. The CollectorTable is where information about coupon collectors is recorded. In the CouponTable, information about the coupons is recorded. Referring to this table, one finds which coupon is for what merchandise. Log data is recorded in the CouponLogTable.

4. Implementation Considerations

The coupon system should be integrated into shopping systems so that customers can purchase the coupons. Therefore, the coupon system provides the application programming interfaces (APIs) shown in Table 1. Given a merchandise name, a supplier's identification (ID) number, a customer name, a status code, an issue date, and/or an expiration date, the getCoupons method retrieves all coupons that meet the input conditions. Given a coupon ID number or supplier ID, the getDetailOfCoupon method retrieves all coupons that meet the input conditions. Given a coupon ID number, the getCouponLogs method retrieves all information about the coupon from its inception to expiration. Given a coupon ID, a status (on sale or used), a user ID, and a user type (manager or collector), the modifyCouponWithStatus method updates the status of the coupon. Given a login ID and a password, the authenticateCollector method checks if the user is registered. Given a collector's ID, the getDetailOfCollector method retrieves detailed information on the collector.

Table 1. List of APIs

Method name	Description
getCoupons	Retrieves all coupons that meet the input conditions
getDetailOfCoupon	Retrieves detailed information of the coupons
getCouponLogs	Retrieves coupon information from the log table
modifyCouponWithStatus	Updates coupon status
authenticateCollector	Authenticates a collector
getDetailOfCollector	Retrieves detail information of a given collector

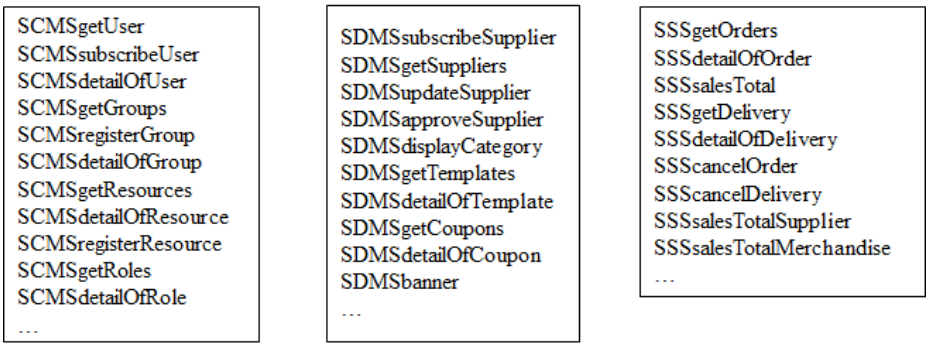

Figure 12. Part of the Classes in the Coupon System

The Smart Coupon Management System will have the methods to subscribe a user, to retrieve users, to retrieve detailed information on a user, and so on, as shown in Figure 12. The smart distribution management system will have the methods to subscribe a supplier, retrieve suppliers, retrieve detailed information of a supplier, and so on. The Smart Shopping System will have methods to retrieve orders, retrieve detailed information on an order, obtain sales totals, and so on.

5. The Prototype

In planning to implement the proposed system, the following screenshots are expected. The coupon registration page is shown in Figure 13. Detailed information on the coupon, and video content that advertises it, can be input through this page.

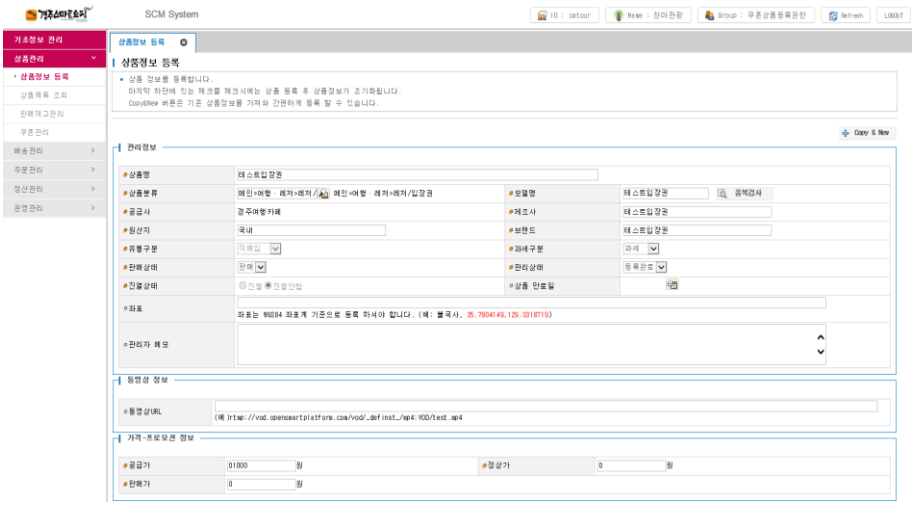

Figure 13. A Screenshot of the Coupon Registration Page

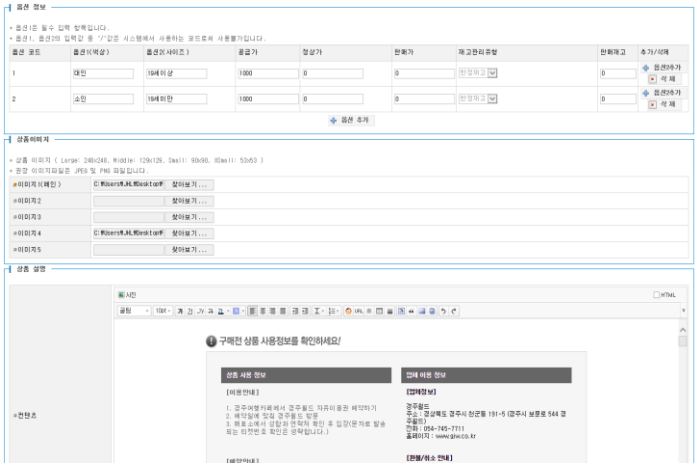

Figure 14. A Screenshot of the Page to Enter Additional Information

Each registered coupon needs an image that visually represents the coupon. These images will appear on the shopping mall page. Also needed is a description of the way to use the coupon, information on the supplier of the coupon, and a description of how to return it and get refund. A screenshot of the page to obtain this information is shown in Figure 14.

The managers of the system can designate coupons as “on display” if they want to display them in the shopping mall. A screenshot of the process for labeling “on display” is shown in Figure 15.

The coupons that are labeled “on display” appear on the shopping mall page shown in Figure 16. The coupons in the shopping mall can be purchased by customers. The process of placing an order is shown in Figure 17.

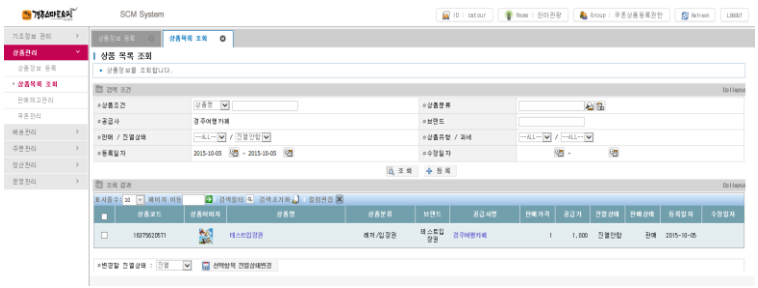

Figure 15. A Screenshot of the Process for Labeling "On Display"

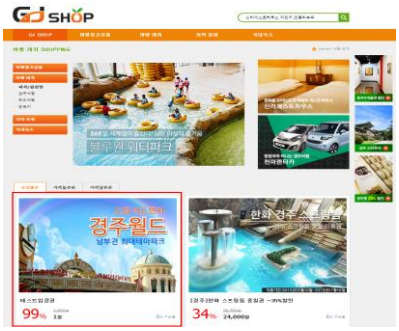

Figure 16. The Gyeongju World Coupon is Displayed

Figure 17. The Process of Placing an Order

Coupon collectors can access the coupon system with their smartphones. Figure 18 shows the collector login page. After login, collectors can retrieve coupons with a customer name, a telephone number, or a coupon number. Then, collectors can select coupons and label them "used". When the collectors retrieve coupons with a telephone number or a customer name, all the coupons purchased by the customer will be retrieved. If the customer wants to consume several coupons at once, then the collector can select those coupons and label all of them "used" by clicking the "check all" button. If the collector clicks the "check all" button, then the system pops up the confirmation page shown in Figure 20. The coupon system allows the user to check sales totals through the order slip page shown in Figure 21.

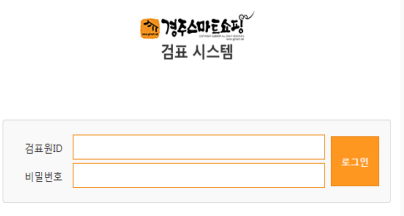

Figure 18. Collector Login Page

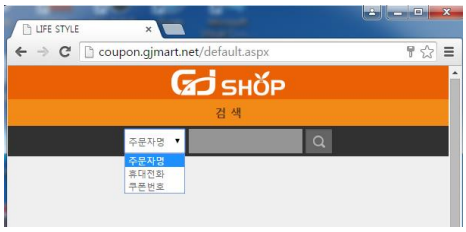

Figure 19. The Page to Retrieve Coupons

Figure 20. The Confirmation Page

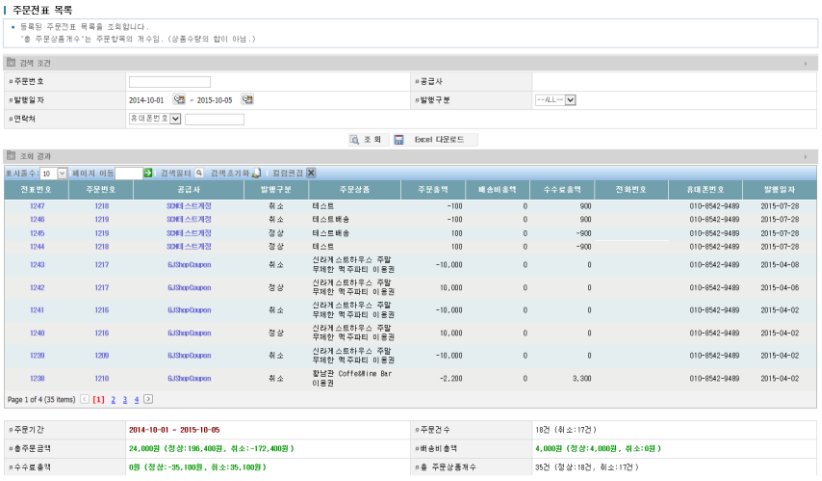

Figure 21. The Order Slip Page

6. Conclusion

The design for a smart coupon system has been discussed. The system allows system managers to access it anytime and anywhere through the Internet. System managers can allow merchants to register coupons for distribution on the system, which provides an environment where customers can conveniently obtain coupons. Future plans include integrating social networks into the coupon system.

Acknowledgement

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References

[1] Z. Jun and Y. Mu, "Joint Decision of Pricing and Package Coupon Value", Proceedings of International Conference on Management and Service Science, Wuhan, China, **(2010)**, pp. 1-4.
[2] B. Zhang, J. Teng, X. Bai, Z. Yang and D. Xuan, "P3-coupon: A probabilistic system for Prompt and Privacy-preserving electronic coupon distribution", Proceedings of IEEE International Conference on Pervasive Computing and Communications, Seattle, USA, **(2011)**, pp. 93-101.
[3] J. Yim, "Review of Coupon Systems", ASTL, vol. 117, **(2015)**, pp. 65-68.
[4] J. S. Silos, F. V. Arjona, I. Ruiz and M. G. Nieto, "An NFC-Based Solution for Discount and Loyalty Mobile Coupons", Proceedings of the 4th International Workshop on Near Field Communication, Helsinki, Finland, **(2012)**, pp.45-50.
[5] F. Xu, "A comparative study of online group-coupon sale in USA and China", Proceedings of the 2nd International Conference on Artificial Intelligence, Management Science and Electronic Commerce, Deng Feng, China, **(2011)**, pp. 1806-1809.
[6] G. Wang, "Optimal advance selling strategies using coupons in a monopoly market", J. Chen, Y. Li and J. Shan Editors. Proceedings of the 8th International Conference on Service Systems and Service Management, Tianjin, China, **(2011)**, pp. 1-6.
[7] A. Alshehri and S. Schneider, "Formally defining NFC M-coupon requirements, with a case study", Proceedings of the 8th International Conference for Internet Technology and Secured Transactions, London, UK, **(2013)**, pp. 52-58.
[8] Y. Huang, "Can keywords help personalized recommendation for coupon deals", Proceedings of International Conference on Progress in Informatics and Computing, Shanghai, China, **(2014)**, pp. 656-659.
[9] H. Hsiang, "A Secure and Efficient Authentication Scheme for M-Coupon Systems", Proceedings of the 8th International Conference on Future Generation Communication and Networking, Hainan, China, **(2014)**, pp. 17-20
[10] A. Kazeminia and B. Ghahfarokhi, "A privacy protection mechanism for location-based mobile coupons", Proceedings of the 3th International Conference on Computer and Knowledge Engineering, Mashhad, Iran, **(2013)**, pp. 202-206.
[11] Z. Wang and Y. Liu, "Identifying Key Factors Affecting Information Disclosure Intention in Online Shopping", IJSH, vol. 8, no. 4, **(2014)**, pp. 47-58.
[12] S. Park and I. Lee, "Efficient Coupon Authentication Scheme for Smart Poster Environments based on Low-cost NFC", IJSIA, vol. 7, no. 5, **(2013)**, pp.131-138.

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